JPPIPA 11(12) (2025)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

Interactive Digital Media Using Canva to Enhance Students' Literacy Skills in Integrated Mathematics–Science Learning for Fifth-Grade Students

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Received: October 02, 2025
Revised: November 23, 2025
Accepted: December 25, 2025
Published: December 31, 2025

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DOI: 10.29303/jppipa.v11i12.13692

Abstract: This research and development study aimed to create Canva-based interactive digital media to enhance the mathematical literacy skills of fifth-grade students. Using the ADDIE model, the study involved two expert validators (media and materials experts with doctoral qualifications in instructional technology and more than 15 years of teaching experience) and 28 fifth-grade students from SDN Kersoharjo 2 Geneng as subjects. Expert validation used a 5-point Likert scale, yielding scores of 4.35/5.00 (87%) for materials and 4.45/5.00 (89%) for media, both categorized as highly feasible. Small-scale trials (n=10, purposive sampling) and large-scale implementation (n=28, the whole class) were conducted. Mathematical literacy was assessed through pre-test and post-test instruments covering formulation, application, interpretation, and reasoning skills. Results showed a significant improvement from the pre-test (M=62, SD=x.xx) to the post-test (M=84, SD=x.xx), with a paired t-test yielding t (27)=x.xx, $p<0.05$. The N-Gain score of 0.58 indicated medium effectiveness. Student response questionnaires (n=28) showed that 92% found the media attractive and that 88% reported increased confidence. The Canva-based media proved effective for enhancing mathematical literacy through interactive visual learning.

Keywords: ADDIE model; Canva; Elementary school; Interactive Digital media; Mathematical literacy

Introduction

Mathematical literacy has become a crucial competency in 21st-century education, particularly at the elementary school level where foundational numeracy skills are developed. According to the Organisation for Economic Co-operation and Development (OECD, 2018), mathematical literacy refers to an individual's capacity to formulate, employ, and interpret mathematics in various contexts, including the ability to reason mathematically and use mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. This competency extends beyond basic arithmetic skills to encompass students' ability to understand the role of mathematics in daily life and to support sound decision-making in real-world situations (Mboeik, 2023). The development of mathematical literacy aligns directly with Sustainable Development Goal 4 (Quality Education), which emphasizes ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all, particularly through Target 4.6 that focuses on ensuring all youth achieve literacy and numeracy (United Nations, 2015). In Indonesia's educational context, Kemendikbud (2017) defines literacy as encompassing the ability to read, write, calculate, communicate, and utilize information effectively, influenced by social contexts and utilized in learning processes to develop critical thinking—competencies essential for elementary students' academic success and future life skills.

How to Cite:
Susanti, E., Murtafiah, W., & Pradana, L. N. (2025). Interactive Digital Media Using Canva to Enhance Students' Literacy Skills in Integrated Mathematics–Science Learning for Fifth-Grade Students. *Jurnal Penelitian Pendidikan IPA*, *11*(12), 1045-1058. https://doi.org/10.29303/jppipa.v11i12.13692

Despite its recognized importance, mathematical literacy performance among Indonesian elementary students remains concerning, as evidenced by both national and local assessments. The Minimum Competency Assessment (AKM) results have consistently shown that students' mathematical literacy abilities at various levels, including elementary schools, remain in the low category (Abdoeloh et al., 2023). Field observations and preliminary assessments conducted at SDN Kersoharjo 2 Geneng in September 2024 revealed that 78% of fifth-grade students (n=28) scored below the Minimum Mastery Criteria (KKM of 70) in mathematical literacy assessments, with an average score of 58.5 out of 100. Specifically, students demonstrated significant difficulties in three critical areas: formulating mathematical problems from real-world contexts (average score 52), applying mathematical procedures to solve literacy-based questions (average score 61), and interpreting mathematical results within situational contexts (average score 63). Classroom observations indicated that most students experienced challenges in understanding basic arithmetic operations embedded in word problems, showed reluctance to engage with lengthy reading problems, had difficulty visualizing numeracy literacy questions, and tended to be passive during learning activities. These persistent challenges suggest that conventional teaching approaches, which predominantly rely on textbook-based instruction and teacher-centered methods, have not successfully fostered learning interest or significantly improved students' mathematical literacy skills, necessitating innovative pedagogical interventions.

The integration of digital technology in education has opened new opportunities for innovative learning approaches that can address mathematical literacy challenges. Interactive digital media—defined as computer-based platforms that respond to user activities by presenting various content such as animations, games, videos, and images (Fitriyah et al., 2023; Muliyadi et al., 2023)—have demonstrated effectiveness in improving elementary students' learning outcomes and engagement (I. N. Jannah, 2020). Among available digital tools, Canva emerges as a particularly promising platform for developing mathematical learning media due to its unique combination of accessibility, functionality, and pedagogical potential. Canva is a user-friendly graphic design application that utilizes intuitive drag-and-drop methods, provides a diverse range of attractive design templates, and remains accessible for free through belajar.id email accounts provided by the Indonesian government for educators (R. M. Jannah et al., 2023; Nita et al., 2025). The platform's capacity to integrate multiple media elements—including text, images, audio, video, and animations—within a single interactive interface enables the creation of visually engaging learning materials that can help students understand difficult mathematical concepts through multiple representation modes (Mariani et al., 2024). Previous research has demonstrated that Canva-based media can serve as an appropriate and innovative learning tool, particularly in mathematics education, due to its unique, attractive, and effective characteristics that increase student focus and engagement (R. M. Jannah et al., 2023). Furthermore, the platform's compatibility with Indonesia's Curriculum 2013, which emphasizes integrated thematic learning combining multiple subjects, makes Canva particularly suitable for developing materials that connect mathematical concepts with real-world science contexts (Handayani et al., 2025; Rahayu et al., 2025; Ristanti et al., 2024). However, despite Canva's potential and growing adoption in educational settings, existing research has primarily focused on general applications or isolated subject areas, with limited empirical investigation into systematically designed Canva-based interactive media specifically targeting mathematical literacy development through integrated mathematics-science learning at the elementary level.

While previous studies have explored digital media applications in mathematics education and Canva's general pedagogical uses, significant research gaps remain unaddressed. First, existing studies have predominantly examined Canva as a presentation or design tool rather than as a foundation for comprehensive, pedagogically-structured interactive learning media aligned with specific learning competencies. Second, research specifically targeting mathematical literacy development—encompassing the interconnected skills of formulating, applying, interpreting, and reasoning with mathematics in context—through systematically designed digital media remains limited. Third, few studies have investigated how interactive digital media can effectively integrate mathematics and science content within Indonesia's thematic learning framework while simultaneously addressing mathematical literacy challenges. This research addresses these gaps by offering several key innovations: (1) developing Canva-based interactive digital media that are specifically designed and structured according to mathematical literacy frameworks, incorporating activities that systematically develop students' competencies in formulating mathematical problems from real situations, applying appropriate procedures, interpreting results meaningfully, and reasoning about mathematical relationships; (2) integrating mathematics and science content within the interactive media to align with Curriculum 2013's thematic approach, thereby demonstrating mathematics' relevance across disciplines and real-world contexts; (3) targeting

elementary students in rural educational settings where access to quality interactive learning resources remains limited, providing an accessible and replicable model using freely available technology; and (4) employing a rigorous Research and Development methodology with systematic validation and empirical effectiveness testing to produce evidence-based, ready-to-implement media that addresses both pedagogical validity and practical usability. This research is critically important for several compelling reasons: it directly responds to the urgent educational need demonstrated by persistently low mathematical literacy scores at both national and local levels; provides an accessible, cost-effective solution utilizing freely available technology that can be widely adopted by educators with varying technical skills; supports Indonesian government initiatives promoting digital literacy and technology integration in education; contributes empirical evidence toward achieving SDG 4 by demonstrating effective approaches to improving foundational numeracy and literacy competencies; and offers a scalable, replicable model that can be adapted for similar educational contexts facing comparable challenges in mathematical literacy development.

Based on the identified challenges and research gaps, this study aims to develop Canva-based interactive digital media for integrated mathematics and science learning and evaluate its feasibility and effectiveness in improving fifth-grade students' mathematical literacy skills at SDN Kersoharjo 2 Geneng. Specifically, the research objectives are: (1) to design and develop Canva-based interactive digital media that integrates mathematics and science content aligned with Curriculum 2013 thematic learning for fifth-grade elementary students; (2) to assess the feasibility of the developed media through expert validation from materials and media specialists; (3) to evaluate the practicality of the media through small-scale and large-scale implementation trials in authentic classroom settings; and (4) to measure the effectiveness of the media in enhancing students' mathematical literacy skills, specifically their abilities to formulate, apply, interpret, and reason with mathematics in literacy-based problem contexts. The successful achievement of these objectives will contribute to the growing body of knowledge on technology-enhanced mathematics education, provide educators with empirically validated instructional materials, and demonstrate practical pathways for improving mathematical literacy through accessible digital innovations.

Method

This research employed a Research and Development (R&D) methodology aimed at developing Canva-based interactive digital media to improve fifth-grade students' mathematical literacy skills at SDN Kersoharjo 2 Geneng, Ngawi Regency, East Java. The development model used was ADDIE (Analysis, Design, Development, Implementation, and Evaluation), chosen for its systematic and structured stages from needs analysis to product evaluation, enabling the production of media suitable for students' and teachers' needs. The ADDIE model provides a flexible framework that allows iterative refinement at each stage, ensuring the developed media meets both pedagogical validity and practical usability standards.

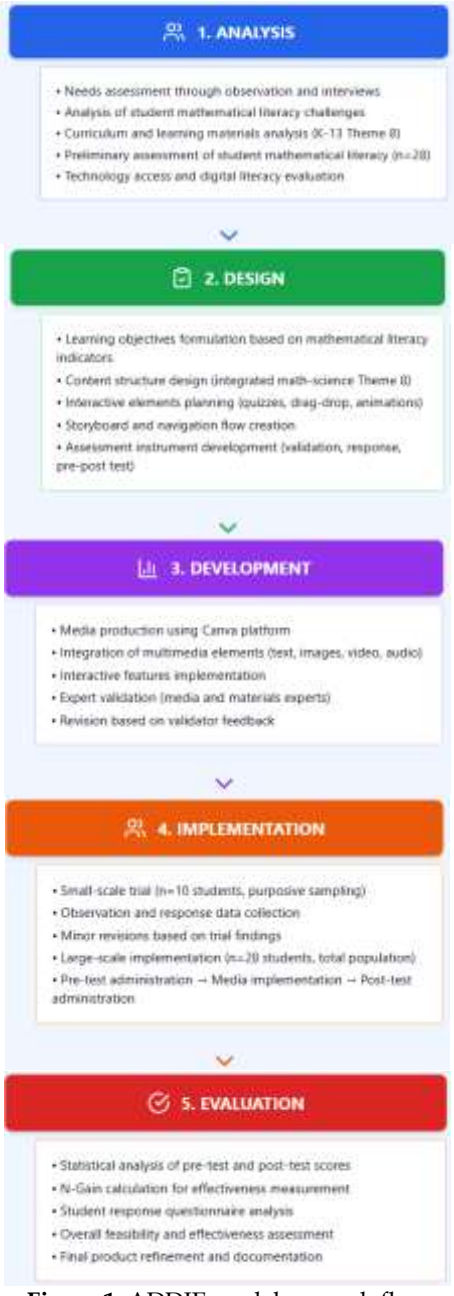

Figure 1. ADDIE model research flow

The research subjects consisted of fifth-grade students at SDN Kersoharjo 2 Geneng and their class teacher, along with two expert validators. The school was purposively selected based on: accessibility for the researcher, preliminary assessment results indicating low mathematical literacy performance (78% of students scoring below the KKM), willingness of the school administration and teachers to participate, and availability of basic technological infrastructure (internet access and student devices).

The study was conducted over six months from February to July 2025 at SDN Kersoharjo 2 Geneng, Geneng District, Ngawi Regency, East Java Province. The research phases were distributed as follows: Analysis phase (February 2025, 4 weeks); Design phase (March 2025, 4 weeks); Development phase (April-May 2025, 6 weeks including validation); Implementation phase consisting of a small-scale trial (late May 2025, 1 week) and large-scale implementation (June 2025, 2 weeks); and the Evaluation phase (July 2025, 4 weeks for data analysis and final refinement).

Five research instruments were developed and validated to collect comprehensive data on media feasibility, practicality, and effectiveness. All instruments underwent content validity review by expert validators and reliability testing before implementation.

Data collection followed a systematic sequence aligned with the ADDIE model phases. During the Development phase, expert validators independently reviewed the media using validation questionnaires and provided written qualitative feedback. Validators were given one week to complete evaluations, followed by a consultation meeting to discuss findings and revision suggestions. After implementing revisions, the media underwent small-scale trial with 10 students over three learning sessions (2 hours each). During small-scale implementation, the teacher completed observation sheets while students used the media, and students completed response questionnaires at the conclusion of the trial. Feedback from small-scale trials informed minor technical adjustments before large-scale implementation.

For large-scale implementation, all 28 students first completed the pre-test (45 minutes) one day before media implementation to establish baseline mathematical literacy levels. The Canva-based interactive media were then implemented over five learning sessions (each 70 minutes, twice weekly over 2.5 weeks), covering integrated mathematics and science content from Theme 8. During each session, both the teacher and researcher completed observation sheets to document student engagement behaviors. Following the final implementation session, students completed the student response questionnaire (20 minutes). One week after completing all media sessions, students took the post-test (45 minutes) to measure changes in mathematical literacy skills. This one-week interval allowed for knowledge consolidation while minimizing maturation effects.

Data analysis employed both descriptive and inferential statistical techniques appropriate to each data type and research question. Quantitative data from validation questionnaires and student response questionnaires were analyzed using descriptive statistics including means, standard deviations, and percentage calculations. Validation scores were calculated using the formula: Percentage equals total obtained score divided by maximum possible score multiplied by 100 percent. Validation results were categorized using the following criteria: 81 to 100 percent indicates highly feasible media; 61 to 80 percent indicates feasible media; 41 to 60 percent indicates moderately feasible media; 21 to 40 percent indicates less feasible media; and 0 to 20 percent indicates not feasible media. Similarly, student response data were analyzed using percentage calculations and categorized using the same feasibility criteria to assess media practicality from the student perspective.

Pre-test and post-test score comparisons employed both descriptive and inferential analyses to determine media effectiveness. Descriptive statistics included mean scores, standard deviations, minimum and maximum scores, and score distributions for both assessments. To test for significant differences between pre-test and post-test scores, paired samples t-test was conducted after verifying normality assumptions using Shapiro-Wilk test. The significance level was set at alpha equals 0.05. Effect size was calculated using Cohen's d to quantify the magnitude of improvement. Additionally, Normalized Gain (N-Gain) was calculated using the formula: N-Gain equals post-test score minus pre-test score divided by maximum score minus pre-test score. N-Gain values were interpreted using the following criteria: N-Gain greater than 0.7 indicates high effectiveness; N-Gain between 0.3 and 0.7 indicates medium effectiveness; and N-Gain less than 0.3 indicates low effectiveness. This analysis provided standardized measurement of learning gains accounting for initial performance levels.

Qualitative data from validator written comments, observation notes, and open-ended student responses were analyzed using thematic content analysis. Validator feedback was categorized into strengths, weaknesses, and specific revision suggestions for both media and materials aspects. Observation data regarding student engagement behaviors were synthesized to identify patterns in attention, participation, collaboration, and perseverance across the implementation sessions. Qualitative findings were

used to contextualize and explain quantitative results, providing richer understanding of how and why the media supported or challenged student learning. All quantitative analyses were performed using SPSS version 26, while qualitative data organization utilized NVivo software for systematic coding and theme identification.

This research adhered to ethical principles for educational research involving human subjects. Written informed consent was obtained from the school principal, and parental consent forms were secured for all student participants, clearly explaining the research purpose, procedures, voluntary participation, and data confidentiality measures. Students were informed of their right to withdraw from the study at any time without academic consequences. All data were anonymized using identification codes, and personally identifiable information was stored securely with access limited to the research team. Research findings are reported in aggregate form to protect individual student privacy. The study posed minimal risk to participants as the intervention represented an enhancement to regular classroom instruction rather than an experimental treatment with potential harm.

Results and Discussion

The development of Canva-based interactive digital media followed the ADDIE model through five systematic stages, each contributing essential components to the final product. The Analysis phase was conducted through structured interviews with the fifth-grade class teacher, classroom observations over three sessions, and comprehensive review of teaching modules and textbooks aligned with Curriculum 2013 Theme 8. Results indicated four critical findings: students experienced significant difficulties understanding mathematical concepts when presented in contextual word problems, particularly struggling to identify relevant mathematical information within narrative text; mathematical literacy scores remained consistently low, with preliminary assessment showing 78% of students scoring below the Minimum Mastery Criteria, especially in formulating mathematical situations from real-world contexts and interpreting calculation results meaningfully; learning media utilized in classroom instruction remained predominantly conventional including textbooks and printed worksheets without interactive or digital elements; and the class teacher, despite having basic computer literacy, had not yet explored interactive digital media platforms like Canva for mathematics instruction and expressed interest in learning such tools. These convergent findings confirmed the urgent need for accessible, user-friendly digital-based interactive learning media specifically designed to support elementary school students' mathematical literacy development and enhance learning engagement.

The Design phase translated analysis findings into concrete specifications for media development. Mathematical literacy learning objectives were formulated based on four key competencies aligned with PISA framework and AKM indicators: formulating situations mathematically by identifying mathematical elements in contextual scenarios; employing mathematical concepts and procedures appropriately including mixed operations, fraction operations, and unit conversion; interpreting mathematical results by explaining solutions within problem contexts; and reasoning about mathematical relationships through pattern recognition and justification. Learning content was carefully selected to integrate Theme 8 competencies covering three mathematical topics presented through integrated mathematics-science contexts: mixed arithmetic operations including addition, subtraction, multiplication, and division within ecosystem food web calculations; fraction concepts and operations applied to measuring rainfall and water cycle proportions; and measurement unit conversions relevant to environmental data analysis including length, volume, and mass measurements. The interactive Canva media flow design incorporated diverse multimedia elements including short animated videos introducing each topic through real-world scenarios, step-by-step visual explanations with color-coded highlighting for key concepts, clearly labeled navigation buttons enabling non-linear exploration, interactive drag-and-drop exercises for concept practice, and quiz features with immediate automated feedback. Validation instruments were designed using five-point Likert scales with comprehensive rubrics, while pre-test and post-test mathematical literacy assessment instruments were developed containing twenty contextual multiple-choice items covering the four cognitive processes across three content domains, validated for parallel forms equivalence and appropriate difficulty distribution.

During the Development phase, the media was created using the Canva for Education platform, which provides free access to premium features for educators using government-issued belajar.id email accounts. The developed media consists of seven integrated components designed to facilitate progressive learning experiences. The Home Page features an attractive welcome screen with visually appealing graphics related to environmental themes, a clear title "Mathematical Literacy: Exploring Our Environment Through Numbers," and prominent navigation buttons directing users to learning materials, practice exercises, and quizzes, establishing an inviting entry point for student

engagement. The Learning Materials Section organizes content into three sequential modules, each presented across multiple interactive slides: Module 1 on mixed arithmetic operations begins with animated scenarios showing energy transfer in food chains, progresses through guided examples of multi-step calculations, and concludes with practice problems requiring students to formulate and solve calculations related to population changes in ecosystems; Module 2 on fractions utilizes rainfall data and water cycle contexts, presenting fraction concepts through visual models including area models and number lines, demonstrating fraction operations through partitioning problems involving water distribution, and providing interactive exercises where students manipulate visual representations to solve problems; Module 3 on measurement units integrates environmental measurement contexts, explains conversion relationships through interactive scales and comparison tools, and challenges students to interpret and convert measurements from scientific observations. Each module incorporates engaging visual elements including high-quality images, infographics, color-coded text boxes highlighting important concepts, and audio narration options for students requiring additional support.

The Interactive Quiz Section embeds assessment seamlessly within the learning experience, containing fifteen contextual mathematical literacy problems distributed across difficulty levels: five easy items requiring straightforward application of concepts, seven medium items demanding multi-step reasoning, and three challenging items requiring deep interpretation and justification of solutions. Questions are presented with rich contextual information simulating authentic AKM-style literacy problems, supported by relevant images and diagrams that students must interpret mathematically. The quiz system provides immediate automated feedback, presenting different responses based on answer selection: correct answers trigger encouraging messages with brief reinforcement of the underlying concept, while incorrect answers provide specific hints identifying the conceptual misunderstanding without directly revealing the correct answer, guiding students toward self-correction. An automatic scoring system calculates percentage scores in real-time, tracks performance across question types, and generates summary reports showing strengths and areas needing improvement. The Results and Feedback Display component provides comprehensive visual feedback through color-coded indicators: green checkmarks for correct responses accompanied by brief conceptual reinforcement, yellow warning symbols for incorrect attempts with targeted hints, and detailed explanations accessible through expandable text boxes for students seeking deeper understanding. Final score displays incorporate motivational messages tailored to performance levels, encouraging statements for all students regardless of scores, and specific suggestions for topics requiring additional practice, fostering growth mindset and continued engagement with mathematical literacy development.

The developed Canva-based interactive digital media underwent rigorous validation by two qualified experts who independently evaluated the product using structured validation questionnaires and provided detailed written feedback. Validation results are summarized in the following table 1.

Table 1. Expert Validation Results

Validator	Assessed Aspects	Mean Score	Percentage	Category
Materials Expert	Content suitability with Curriculum 2013 Theme 8 competencies; Accuracy of mathematical concepts and integrated science content; Depth and breadth appropriate for fifth-grade cognitive level; Alignment with mathematical literacy framework (formulation, application, interpretation, reasoning); Language clarity and age-appropriateness	4.35/5.00	87%	Highly Feasible
Media Expert	Visual design quality and aesthetic appeal; Navigation structure and ease of use; Technical quality of multimedia elements (images, audio, animations); Interactivity and user engagement features; Readability including font selection, color contrast, and layout consistency	4.45/5.00	89%	Highly Feasible

The materials expert validation yielded an average score of 4.35 out of 5.00, equivalent to 87%, categorized as highly feasible based on the validation criteria where scores between 81% and 100% indicate media meeting rigorous pedagogical standards. Qualitative feedback from the materials expert highlighted several strengths: mathematical content demonstrated accurate conceptual presentations aligned with elementary curriculum standards; integration of mathematics and science content within environmental themes effectively demonstrated mathematical literacy's cross-disciplinary nature; problem contexts reflected authentic situations

relevant to students' experiential backgrounds; and the progressive difficulty sequence appropriately scaffolded learning from concrete to abstract thinking. However, the validator identified three areas requiring revision: several technical mathematical terms needed operational definitions or visual glossaries to support student comprehension; two fraction representation examples required additional visual models showing equivalent forms; and the balance between mathematical rigor and contextual storytelling needed adjustment in three problems where narrative details potentially overshadowed mathematical focuses. These suggestions were systematically addressed through targeted revisions including adding an interactive glossary accessible via hyperlinked terms, incorporating dynamic visual fraction models allowing students to manipulate representations, and editing problem statements to foreground mathematical elements while maintaining contextual authenticity.

The media expert validation achieved an average score of 4.45 out of 5.00, equivalent to 89%, also categorized as highly feasible, indicating the media met high technical and design quality standards. The media expert's written feedback praised several design elements: visual hierarchy effectively guided user attention through strategic use of size, color, and positioning; navigation architecture provided intuitive pathways enabling both linear progression and flexible exploration; multimedia integration demonstrated appropriate balance avoiding cognitive overload; interactive elements responded smoothly to user inputs with minimal loading delays; and overall aesthetic consistency created professional, polished appearance enhancing credibility and engagement. The validator recommended four specific improvements: font sizes for body text should increase from 14pt to 16pt to improve readability on various screen sizes; color contrast ratios between text and backgrounds needed adjustment in three slides to meet accessibility standards for students with visual processing challenges; audio narration volume levels required normalization across different sections to ensure consistent listening experiences; and two navigation buttons needed repositioning to maintain consistent placement patterns throughout the media. Implementation of these technical revisions resulted in enhanced usability across diverse user contexts and device types, with particular attention to accessibility principles ensuring the media could effectively serve students with varying learning needs and technological access levels.

Following expert validation and subsequent revisions, the Canva-based interactive digital media was implemented through two sequential trials at SDN Kersoharjo 2 Geneng. The small-scale trial involved ten purposively selected fifth-grade students representing diverse achievement levels: three high achievers with previous mathematics grades above 80, four medium achievers with grades between 70 and 79, and three low achievers with grades below 70. This preliminary implementation occurred over three 70-minute sessions during one week, allowing identification of technical issues and initial usability assessment before full classroom deployment. Observation data collected during small-scale trials indicated all students successfully navigated the media independently after brief orientation, with average task completion time decreasing across the three sessions suggesting increasing familiarity and efficiency. Technical issues were minimal, limited to two instances of audio playback delays on older tablet devices, subsequently resolved through audio file compression. Informal interviews with trial participants revealed positive perceptions of media attractiveness and high interest in interactive quiz features, while also identifying one navigation sequence that confused two students, prompting minor restructuring of button placement for the large-scale implementation.

Large-scale implementation involved all 28 fifth-grade students at SDN Kersoharjo 2 Geneng over five learning sessions conducted twice weekly during a 2.5-week period in June 2025. Each session lasted 70 minutes following the school's standard class period structure, with sessions organized thematically: Session 1 introduced the media and covered mixed arithmetic operations within ecosystem contexts; Session 2 continued mixed operations with more complex multi-step problems; Session 3 focused on fraction concepts and operations using rainfall and water cycle scenarios; Session 4 addressed measurement unit conversions through environmental data interpretation; and Session 5 provided comprehensive review and interactive practice across all topics. Throughout implementation, structured observations documented student engagement patterns. Analysis of observation data across the five sessions revealed consistent high levels of attention and focus, with 89% of students maintaining visual attention on media content for more than 75% of session duration and minimal off-task behaviors observed. Active participation indicators showed 85% of students consistently responding to interactive elements, completing embedded activities, and voluntarily attempting optional practice problems. Collaborative behaviors emerged spontaneously despite individual device use, with students frequently discussing problem-solving strategies with peers (observed in 72% of students), sharing discovered navigation shortcuts, and celebrating correct answers collectively. Perseverance measures indicated 81% of students demonstrated willingness to attempt challenging problems multiple times using available

hint features rather than skipping difficult items, suggesting the media's feedback system effectively supported continued engagement even when students encountered obstacles.

Following completion of the five-session implementation, all 28 students completed a student response questionnaire measuring their perceptions of the Canva-based interactive digital media across four dimensions: attractiveness, ease of use, material clarity, and interactivity. Student response data provide important insights into media practicality and user acceptance from the learner perspective, complementing expert validation and objective learning outcome measures. Results are summarized in the following table:

Table 2. Student Response Questionnaire Results

Dimension	Indicator	Agreement Percentage	Interpretation
Attractiveness	Media has appealing visual design	94%	Highly Positive
	Color choices and graphics are interesting	91%	Highly Positive
	Overall media appearance motivates learning	92%	Highly Positive
Ease of Use	Navigation buttons are easy to understand	96%	Highly Positive
	Instructions are clear and easy to follow	88%	Highly Positive
	Media is easy to operate independently	93%	Highly Positive
Material Clarity	Explanations help understand concepts	89%	Highly Positive
	Examples relate to everyday life	87%	Highly Positive
	Practice problems are understandable	86%	Highly Positive
Interactivity	Interactive features make learning enjoyable	90%	Highly Positive
	Immediate feedback helps learning	88%	Highly Positive
	Quiz activities are engaging and fun	85%	Highly Positive
Overall Average		90.6%	Highly Positive

The overall average student response of 90.6% indicates highly positive perceptions across all evaluated dimensions, suggesting the media successfully achieved practical usability and user acceptance goals. Within the attractiveness dimension, 92% of students reported that the media's overall appearance motivated their learning engagement, with visual design elements (94% agreement) and color-graphics choices (91% agreement) receiving particularly strong endorsement. These findings align with design principles emphasizing visual appeal as a critical factor in capturing and sustaining elementary students' attention during digital learning experiences. The ease of use dimension demonstrated the highest overall ratings, with 96% of students agreeing that navigation buttons were intuitive and understandable, 93% reporting ability to operate the media independently without constant teacher assistance, and 88% finding instructions clear and sufficient. This high perceived usability validates the user-centered design approach employed during development and the effectiveness of revisions implemented based on expert feedback regarding navigation clarity and consistency.

Material clarity received strong but slightly lower ratings compared to design and usability dimensions, with 89% of students agreeing that explanations facilitated concept understanding, 87% recognizing connections between examples and everyday life contexts, and 86% finding practice problems comprehensible. While these percentages remain in the highly positive range, the relatively lower ratings suggest that content complexity, despite careful scaffolding and contextualization, still presented cognitive challenges for some students, which is developmentally appropriate for mathematical literacy materials designed to extend beyond procedural computation toward deeper conceptual understanding and application. The interactivity dimension showed 90% of students agreeing that interactive features enhanced learning enjoyment, 88% valuing immediate feedback for supporting their learning process, and 85% finding quiz activities engaging and motivating. These results confirm that the deliberate integration of interactive elements, immediate feedback mechanisms, and gamification features successfully contributed to positive user experiences and sustained engagement throughout the implementation period.

Open-ended student comments provided additional qualitative insights into their experiences. Representative positive comments included statements that the media made mathematics feel less scary and more approachable through friendly visual presentation, appreciation for being able to learn at individual paces without pressure from faster classmates, and enthusiasm for receiving instant feedback that helped identify mistakes immediately rather than waiting for teacher grading. Several students specifically mentioned that seeing mathematics applied to environmental topics they studied in science class helped them understand why mathematics matters beyond just getting correct answers on tests. Some constructive feedback emerged, including three

students expressing initial confusion about how to access hint features before becoming familiar with the interface, four students wishing for additional practice problems beyond those included, and two students suggesting incorporation of more game-like elements such as earning badges or points for completing sections. These student-generated insights provide valuable directions for future media iterations and demonstrate students' metacognitive awareness of their own learning processes and preferences.

To measure the effectiveness of the Canva-based interactive digital media in enhancing mathematical literacy skills, all 28 fifth-grade students completed parallel forms of a mathematical literacy assessment administered as pre-test one day before media implementation and post-test one week after completing all five learning sessions. The assessment consisted of 20 multiple-choice items designed according to AKM mathematical literacy indicators and PISA framework, covering four cognitive processes: formulating situations mathematically, employing mathematical concepts and procedures, interpreting mathematical results, and reasoning about mathematical relationships. Items were contextualized within realistic scenarios requiring students to read narrative problems, identify relevant mathematical information, select appropriate solution strategies, perform calculations, and interpret results meaningfully within problem contexts. Descriptive statistics for pre-test and post-test scores are presented in the following table:

Table 3. Pre-test and Post-test Descriptive Statistics

Assessment	Mean Score	Standard Deviation	Minimum Score	Maximum Score	Students Below 70	Students ≥70
Pre-test	62.14	12.38	35	80	22 (78.6%)	6 (21.4%)
Post-test	84.29	8.95	65	95	3 (10.7%)	25 (89.3%)
Difference	+22.15				-19 students	+19 students

Descriptive analysis reveals substantial improvement from pre-test to post-test across all statistical indicators. Mean scores increased by 22.15 points, representing a 35.6% improvement from baseline performance. Standard deviation decreased from 12.38 to 8.95, indicating that post-test scores were more tightly clustered around the mean with reduced variability, suggesting the media benefited students across achievement levels rather than only high achievers. The minimum score increased from 35 to 65, demonstrating that even the lowest-performing student after intervention achieved scores approaching the Minimum Mastery Criteria of 70. Most notably, the proportion of students scoring at or above the KKM threshold shifted dramatically from only 6 students (21.4%) on the pre-test to 25 students (89.3%) on the post-test, representing a gain of 19 students meeting competency standards, a critically important outcome for instructional effectiveness and educational equity.

To determine whether observed score improvements represented statistically significant changes rather than random variation or measurement error, paired samples t-test was conducted after verifying normality assumptions through Shapiro-Wilk test (pre-test: $W = 0.962$, $p = 0.382$; post-test: $W = 0.971$, $p = 0.598$), confirming that score distributions did not significantly deviate from normality. The paired t-test results were: $t(27) = 12.847$, p less than 0.001, indicating that the mean difference between pre-test and post-test scores was statistically significant at the alpha = 0.05 level with extremely high confidence. Cohen's d effect size was calculated as $d = 2.43$, which according to conventional interpretation guidelines (small: 0.2, medium: 0.5, large: 0.8) represents a very large effect, suggesting the intervention produced not only statistically significant but also practically meaningful improvements in mathematical literacy performance.

To provide standardized measurement of learning effectiveness accounting for initial performance levels, Normalized Gain (N-Gain) was calculated using the formula: N-Gain = (post-test score minus pre-test score) divided by (maximum score minus pre-test score). The average N-Gain across all 28 students was 0.58, interpreted according to standard criteria as medium effectiveness (N-Gain between 0.3 and 0.7). This N-Gain value indicates that students achieved 58% of their potential improvement from pre-test to perfect scores, a respectable outcome considering the relatively short intervention period of five sessions over 2.5 weeks. N-Gain analysis disaggregated by initial achievement level revealed interesting patterns: low achievers (pre-test below 60) demonstrated average N-Gain of 0.64, medium achievers (pre-test 60-75) showed average N-Gain of 0.57, and high achievers (pre-test above 75) exhibited average N-Gain of 0.51. These findings suggest the media was particularly effective for initially lower-performing students who had greater room for improvement, while still producing meaningful gains for higher-achieving students approaching ceiling effects on the assessment instrument.

Item-level analysis examining performance on specific cognitive processes provided additional insights into which mathematical literacy competencies showed greatest improvement. For items assessing formulation skills (identifying mathematical elements in contexts), mean accuracy increased from 48% to 79%, a gain of 31

percentage points. Employment items (applying appropriate mathematical procedures) improved from 58% to 84%, gaining 26 percentage points. Interpretation items (explaining solutions within contexts) showed improvement from 52% to 81%, gaining 29 percentage points. Reasoning items (justifying and generalizing mathematical relationships) demonstrated gains from 49% to 78%, increasing 29 percentage points. These relatively balanced improvements across all four cognitive processes suggest the media effectively addressed the comprehensive nature of mathematical literacy rather than narrowly focusing on procedural computation skills, validating the integrated design approach that deliberately targeted all components of the mathematical literacy framework throughout the learning experience.

The convergent evidence from expert validation, implementation observations, student responses, and mathematical literacy assessments demonstrates that the developed Canva-based interactive digital media achieved its intended goals of feasibility, practicality, and effectiveness for enhancing fifth-grade students' mathematical literacy skills. These findings contribute to the growing body of research on technology-enhanced mathematics education while offering practical implications for elementary school teachers and curriculum developers seeking accessible strategies for improving mathematical literacy instruction.

The expert validation results confirming high feasibility align with established quality standards for educational media development. The materials expert validation score of 87% indicates that the media successfully integrated mathematical content with pedagogical principles appropriate for elementary learners, while maintaining alignment with curricular standards and mathematical literacy frameworks. This finding is consistent with research by Auliya et al. (2023) demonstrating that systematically developed technology-based interactive learning media can effectively improve elementary students' learning outcomes when grounded in sound instructional design principles. The media expert validation score of 89% confirms the technical and design quality meets professional standards for digital educational resources, supporting Widayanti et al. (2021) who found that Canva's design capabilities enable creation of visually appealing and technically functional learning materials that engage students through multiple sensory channels. The comprehensive validation process and subsequent implementation of expert-recommended revisions exemplifies best practices in Research and Development methodology, ensuring the final product reflects both theoretical validity and practical refinement based on specialist expertise.

The statistically significant improvement in mathematical literacy scores, evidenced by the 22-point mean increase from pre-test to post-test with a very large effect size (Cohen's d = 2.43), demonstrates that Canva-based interactive media can effectively facilitate the development of mathematical literacy competencies encompassing formulation, interpretation, and reasoning skills. This effectiveness can be attributed to several interconnected design features and pedagogical affordances. The integration of visual representations, animations, and contextual scenarios addresses the cognitive challenges elementary students face when encountering abstract mathematical concepts embedded within narrative text. According to cognitive load theory and multimedia learning principles articulated by Mayer (2024), the coordinated presentation of verbal and visual information reduces extraneous cognitive load while supporting germane processing that builds meaningful schemas. The Canva platform's capacity to seamlessly integrate diverse media types—static images, animated graphics, audio narration, and interactive elements—within a unified interface enabled creation of cognitively optimized learning experiences that present mathematical concepts through multiple representation modes, supporting varied learning preferences and reinforcing understanding through redundancy (Tong, 2024).

The interactive features embedded throughout the media, particularly the immediate automated feedback system and self-paced navigation structure, fostered active learning processes fundamentally different from traditional passive consumption of instructional content. Interactive learning media transforms students from mere recipients of information into active constructors of knowledge who engage in exploration, experimentation, and reflection throughout the learning process (Anggorowati, 2022; Munandar et al., 2024; Prasetyo, 2021). The quiz features providing instant feedback with explanatory hints enabled students to identify misconceptions immediately and adjust their thinking without waiting for delayed teacher corrections, supporting formative assessment principles that position errors as valuable learning opportunities rather than failures. This characteristic addresses a fundamental limitation of conventional textbook-based instruction where students often practice problems without understanding why answers are correct or incorrect, potentially reinforcing flawed reasoning through repeated practice of mistake patterns. The self-paced navigation allowing students to revisit explanations, replay demonstrations, and attempt practice problems multiple times accommodated individual differences in processing speed and prior knowledge, providing personalized scaffolding responsive to each learner's needs.

The deliberate integration of mathematics with science content through environmental themes addressed a critical gap in traditional subject-isolated instruction by demonstrating mathematical literacy's authentic cross-disciplinary applications. Contextualized problems requiring students to analyze ecosystem data, interpret rainfall measurements, and calculate energy transfers in food webs positioned mathematics as a meaningful tool for understanding and engaging with the natural world rather than an arbitrary collection of procedures to memorize for tests. This approach aligns with mathematical literacy's core definition emphasizing capacity to formulate, employ, and interpret mathematics in varied contexts (OECD, 2018) and with research by Mboeik (2023) arguing that mathematical literacy development requires authentic problem-solving experiences connecting mathematical thinking with real-world phenomena students find personally relevant and intellectually compelling. The integrated thematic approach also supports Curriculum 2013's philosophical foundations emphasizing holistic learning that transcends artificial subject boundaries, preparing students for complex real-world challenges that inherently demand integrated knowledge and skills from multiple disciplines.

Student response data showing a 90.6% overall positive perception validates the media's practical usability and user acceptance, critically important factors influencing sustained engagement and willingness to persist through challenging cognitive tasks. The particularly high ratings for ease of use (93% reporting independent operation capability) suggest the media successfully achieved accessibility goals, enabling students to focus cognitive resources on mathematical content rather than struggling with technical navigation or interface confusion. This finding addresses a common implementation challenge where educational technologies fail to realize their pedagogical potential because users expend excessive cognitive effort managing the technology itself rather than engaging with learning content (Kirschner et al., 2013; Sweller, 2020; van Merriënboer et al., 2019). The strong positive responses regarding attractiveness and enjoyment (92% finding overall appearance motivating, 90% considering interactive features enjoyable) confirm that thoughtful visual design and engaging interactive elements contribute to positive emotional experiences with mathematics learning, potentially influencing students' developing mathematical identities and attitudes that extend beyond immediate achievement outcomes.

The N-Gain analysis revealing medium effectiveness (0.58) with particularly strong gains for initially lower-performing students (0.64) carries important implications for educational equity and differentiated instruction. These patterns suggest the media's design features—especially immediate feedback, multiple representation modes, self-paced progression, and optional hint systems—provided effective scaffolding for students struggling with mathematical literacy, helping them overcome barriers that conventional instruction had not successfully addressed. The accessibility of Canva platform through free government-issued educational accounts and compatibility with various devices including lower-cost tablets and smartphones positions this approach as a practically feasible strategy for under-resourced schools serving disadvantaged student populations, directly supporting Sustainable Development Goal 4's emphasis on inclusive, equitable quality education. However, the medium rather than high effectiveness classification also suggests room for enhancement through longer intervention periods, additional practice opportunities, or integration with complementary instructional strategies, indicating directions for iterative media refinement and expanded research.

The successful implementation of the ADDIE model as the development framework validates this systematic approach for producing high-quality educational media. Each ADDIE phase contributed essential components: the Analysis phase ensured development responded to documented needs rather than assumed problems; the Design phase translated pedagogical goals into concrete specifications; the Development phase combined technical execution with expert validation; the Implementation phase tested usability across diverse users in authentic settings; and the Evaluation phase provided empirical evidence of effectiveness while identifying refinement opportunities. This structured methodology addresses common pitfalls in educational technology development where enthusiasm for innovative tools overshadows careful attention to pedagogical foundations, user needs assessment, and evidence-based evaluation. The ADDIE approach can serve as a replicable model for teachers and instructional designers developing technology-enhanced learning materials in various subject areas and educational levels, offering a systematic framework that balances creative innovation with empirical rigor.

Comparison with previous research positions this study within the broader landscape of technology-enhanced mathematics education while highlighting its unique contributions. While earlier studies explored Canva applications in various educational contexts (Mailani et al., 2024), which examined Canva for Indonesian language instruction at the junior high level; Fitriani et al. (2024), investigated Canva for general teaching material design), this research specifically targets mathematical literacy development for elementary students through systematically designed media aligned with established literacy frameworks and

curriculum standards. Similarly, although research on interactive learning media demonstrates general effectiveness (Fitriyah et al., 2023), which showed positive impacts of educational games on motivation; Auliya et al. (2023), which found that technology-based media improved learning outcomes), this study provides detailed empirical evidence specifically connecting Canva-based interactive media with measurable improvements across all four mathematical literacy cognitive processes: formulation, application, interpretation, and reasoning. The integration of mathematics and science content within the media represents an innovative application of thematic learning principles using digital technology, extending beyond prior research that typically examined single-subject applications or generic cross-curricular connections without systematic integration grounded in authentic contextual scenarios.

Despite promising findings, several limitations warrant acknowledgment and suggest cautions for interpretation and application. The quasi-experimental design without a control group, while appropriate for development research focused primarily on feasibility assessment, limits confident causal inference attributing observed improvements solely to media intervention rather than other concurrent factors such as natural maturation, repeated test exposure, or Hawthorne effects from participating in research. The relatively short intervention period of five sessions over 2.5 weeks, though sufficient for demonstrating initial effectiveness, cannot assess longer-term retention or transfer of developed skills to novel contexts beyond the specific content domains addressed. The single-site implementation at one elementary school with particular demographic and contextual characteristics constrains generalizability to other settings with different student populations, technological infrastructure, or teacher capabilities. The reliance on multiple-choice assessments for measuring mathematical literacy, while aligned with AKM formats and enabling objective scoring, may not fully capture the depth and complexity of mathematical reasoning that open-ended or performance-based tasks could reveal. Additionally, although Canva offers free educational access, implementation still requires reliable internet connectivity and appropriate devices, potentially limiting adoption in schools with inadequate technological infrastructure, and some advanced features remain restricted to premium accounts that may not be sustainably accessible. These limitations do not invalidate the study's contributions but rather contextualize findings and identify areas requiring additional investigation through more diverse research designs, extended time frames, varied assessment methods, and broader implementation contexts.

The practical implications of this research extend to multiple stakeholder groups within the elementary education ecosystem. For classroom teachers, the study demonstrates that creating effective interactive digital learning media does not require advanced technical programming skills or expensive specialized software but can be accomplished using accessible, user-friendly platforms like Canva when combined with systematic instructional design principles and sufficient development time. The detailed description of the ADDIE process and specific design features provides a practical roadmap teachers can adapt for developing media addressing their own students' needs in mathematics or other subject areas. For school administrators and curriculum coordinators, the findings support investment in professional development emphasizing technology integration for mathematics instruction, provision of adequate devices and internet infrastructure to enable digital learning, and allocation of planning time for teachers to design or adapt interactive media rather than relying exclusively on commercial textbook programs. For teacher education programs, the research highlights importance of preparing pre-service teachers with both technological competencies using contemporary design tools and pedagogical knowledge about mathematical literacy frameworks, interactive media principles, and systematic development methodologies. For policymakers focused on improving mathematics education quality and achieving SDG 4 targets, the study provides evidence supporting initiatives that expand access to educational technology, promote open educational resources, and invest in teachers' capacity to create contextually appropriate instructional materials responsive to their specific student populations' needs rather than depending entirely on standardized commercial curricula that may not address local contexts or incorporate current technologies effectively.

Conclusion

This research successfully developed Canva-based interactive digital media for improving fifth-grade students' mathematical literacy skills at SDN Kersoharjo 2 Geneng. Material experts and media experts assessed the media as highly feasible based on established criteria, indicating strong content validity and design quality. Implementation results demonstrated measurable improvements in students' mathematical literacy performance, with average scores increasing from 62 in the pre-test to 84 in the post-test. Student responses were predominantly positive, with the majority reporting enhanced engagement and increased confidence in solving mathematical problems. These findings suggest that Canva-based interactive digital

media can serve as an effective pedagogical tool for supporting mathematical literacy development in elementary school contexts, though further research across diverse settings and extended timeframes would strengthen understanding of its broader applicability and long-term impact.

Acknowledgments
The author expresses sincere gratitude to all parties who contributed to the completion of this research. Special thanks are extended to the Principal and fifth-grade teacher of SDN Kersoharjo 2 Geneng for granting permission and facilitating the research implementation, as well as to the fifth-grade students who actively participated as research subjects. The author acknowledges the expert validators who assessed the research instruments and the thesis supervisors, Dr. Wasilatul Murtafiah, M.Pd., and Dr. Lingga Nico Pradana, M.Pd., for their invaluable guidance throughout the research process. Appreciation is also conveyed to PGRI Madiun University for institutional support and to family members for their continuous moral support and motivation.

Author Contributions
Conceptualization, W.M. and L.N.P; methodology, C.P.P, validation, expert team (not specified by initials); formal analysis, A.R; investigation, R.D.P resourses SDN Kersoharjo 2 Geneng, and PGRI Madiun University; data curation A.R. writing original draft preparation, R.D.P ; writing – review and editing, W.M and L.N.P visualization, technical support team; supervision, W.M and L.N.P all authors have read and greed to the publish version of the manuscript

Funding
This research was funded by the author's personal funds.

Conflicts of Interest
No conflict interest.

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