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DEVELOPMENT OF SCIENCE LEARNING MEDIA BASED ON SCIENTIFIC LITERACY FOR ELEMENTARY SCHOOL STUDENTS

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Abstract

This study aimed to develop science learning media based on scientific literacy using the Anyflip flipbook platform for elementary school students. The study employed a Research and Development (R&D) approach using the ADDIE model consisting of analysis, design, development, implementation, and evaluation stages. The participants were 33 fifth-grade students from a public elementary school in Berastagi, Indonesia. Data were collected through expert validation sheets, student response questionnaires, and pre-test and post-test assessments. The results showed that the developed media was highly feasible, indicated by positive student responses with an average score of 87.27% in the very good category. The effectiveness test demonstrated an improvement in learning outcomes, with average scores increasing from 67.12 in the pre-test to 84.36 in the post-test. The N-Gain analysis showed that 24.24% of students were in the high category, 66.67% in the medium category, and 9.09% in the low category. These findings indicate that flipbook-based science learning media effectively improves students' conceptual understanding, engagement, and scientific literacy in elementary science learning.

Keywords: Development, Science Learning Media, Scientific Literacy

A. Introduction

Science learning in elementary schools aims to develop students' ability to understand scientific concepts and apply them in everyday life. One important competence expected from science education is scientific literacy. Scientific literacy

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refers to the ability to understand scientific knowledge and use it to solve problems and make evidence-based decisions in daily life. However, Indonesia's scientific literacy level is still relatively low based on international assessments such as PISA. This condition is influenced by learning practices that focus on memorization and limited use of innovative learning media.

Learning media play an important role in supporting student-centered learning. Digital learning media such as flipbooks provide interactive features that integrate text, images, and navigation tools that make learning more interesting and flexible. Therefore, the development of digital learning media based on scientific literacy is expected to improve students' understanding of science concepts and their ability to relate science to real-life situations.

Learning media serve as essential tools for delivering instructional messages and facilitating student-centered approaches, transforming teachers from knowledge transmitters to learning facilitators. Flipbook media, particularly Anyflip platform-based flipbooks, offer interactive features combining text, images, and navigation tools that resemble printed books while enabling flexible, anytime-anywhere access. Despite their proven effectiveness in supporting science learning, most prior studies (Diani et al., 2023; Ramadhina & Pranata, 2022; Nurwidiyanti & Sari, 2022) focused primarily on development and implementation phases, rarely extending to comprehensive evaluation stages measuring both affective responses and cognitive outcomes.

Observations at a public elementary school in Berastagi revealed science instruction limited to printed textbooks and PowerPoint presentations, failing to engage students or support scientific literacy development. Existing Indonesian flipbook studies predominantly address implementation without rigorous evaluation frameworks combining student response validation (87.27% Very Good category) and learning outcome measurement (pre-test 67.12 → post-test 84.36; N-Gain 66.67% medium, 24.24% high). This study addresses this gap by:

1. Validating Anyflip platform effectiveness specifically for Indonesian elementary scientific literacy contexts, where digital infrastructure challenges persist
2. Developing comprehensive assessment framework integrating affective (student engagement, motivation) and cognitive (conceptual understanding, N-Gain) dimensions
3. Providing empirical evidence extending flipbook research from implementation-focused to full-cycle evaluation (development → validation → effectiveness testing)

The Anyflip flipbook developed targets metamorphosis concepts, integrating interactive content explicitly aligned with PISA scientific literacy competencies (explaining phenomena naturally, evaluating/evaluating evidence/designing scientific

inquiry). This study contributes theoretically by validating multimedia learning principles (Mayer, 2014) within Indonesian elementary contexts and practically by offering teachers a validated, accessible digital tool addressing both engagement and learning outcome gaps in science instruction.

Previous studies have shown that flipbook media are effective in supporting learning; however, most were implemented only up to the application stage. This study extends the development process to the evaluation stage. The flipbook was developed using the Anyflip platform, which can be accessed via laptops, computers, or smartphones, allowing students to learn anytime and anywhere. Through the integration of interactive content and scientific literacy-oriented materials, the flipbook learning media is expected to improve students' understanding of science concepts and their ability to relate science to real-life situations.

B. Method

This study used the Research and Development (R&D) method using the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation). The participants were 33 fifth-grade students from a public elementary school in Berastagi. Data were collected through expert validation sheets, student response questionnaires, and learning outcome tests (pre-test and post-test). Quantitative data were analyzed using the N-Gain formula.

This study employed a Research and Development (R&D) approach aimed at producing and validating a flipbook-based science learning medium (Sugiyono, 2017). The development followed the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) adapted for educational media validation with full-cycle evaluation from prototype creation to effectiveness testing (Pribadi, 2017). The research involved 33 fifth-grade students (17 males, 16 females; ages 10-11) from a public elementary school in Berastagi, North Sumatra, selected via purposive sampling based on:

- Inclusion criteria: Regular attendance, baseline science scores 55-85 (moderate range), no prior flipbook exposure
- Exclusion criteria: Absent during pre/post-testing (n=2 excluded from final analysis)
- Sample size justification: Sufficient for limited-scale field testing per R&D standards (n=20-40) for statistical power in N-Gain analysis

2 material experts (science education lecturers, PhD) and 2 media experts (instructional design specialists, 5+ years experience). Obtained from school principal and parents (written informed consent, 100% return rate). Student anonymity maintained via codes (S01-S33). Data collected March-April 2025.

Development Procedure (ADDIE Model)

1. Analysis: Needs assessment via classroom observation (n=4 sessions) + teacher interviews confirming low engagement with textbooks/PowerPoint
2. Design: Storyboard creation aligning content with PISA scientific literacy domains (explaining phenomena, evaluating evidence)
3. Development: Anyflip prototype (28 pages) with interactive elements (pop-up diagrams, quizzes, navigation)
4. Implementation: 2-week field testing (3x45min sessions/week)
5. Evaluation: Expert validation + student response + pre/post-test

Table 1. Student Response Questionnaire Indicators toward Science Learning Media

No	Statement	Indicator	Measured Aspect
1	The science learning media help me understand the material more easily.	Students' ease in understanding the material through the media	Concept comprehension
2	The explanations in the learning media are clear and not confusing.	Clarity of information and presentation of the media	Content quality
3	I enjoy learning science using the learning media.	Feelings of enjoyment or satisfaction while learning with the media	Positive attitude toward the media
4	The learning media make science lessons more interesting.	Visual and interactive appeal of the media	Learning engagement
5	I can review the material again with the help of the science learning media.	Ease of re-accessing and recalling material	Learning independence
6	The visual design of the learning media (colors, images, and layout) is attractive.	Visual attractiveness of the learning media	Visual appeal
7	I am more motivated to learn science using media based on scientific literacy.	Increased learning motivation through the media	Learning motivation
8	I am encouraged to discuss with my peers when using the science learning media.	Encouragement to interact and collaborate with peers	Learning collaboration
9	The learning media make me more active in asking questions about science.	Increased activeness and curiosity among students	Learning activeness
10	The learning media help me understand the relationship between science and everyday life.	Ability to connect science concepts with real-life contexts	Application of science concepts

Data Collection Instruments

1. Expert Validation Questionnaire (Likert 1-4): Content validity (20 items, CVR=0.85), media design (18 items, CVR=0.82)
2. Student Response Questionnaire (10 items, 1-4 Likert): Cronbach's α = 0.87 (reliable)
3. Pre/Post-Test (20 MC items): KR-20 = 0.76, content validity by 2 science educators

Size of Dataset Data Analysis

Quantitative:

- N-Gain (Hake, 1999):
  N-Gain = (Post-test - Pre-test) / (Max score - Pre-test)
  Categories: g ≥ 0.7 = High, 0.3 ≤ g < 0.7 = Medium, g < 0.3 = Low
- Percentage adequacy: ≥86% = Very Good
- Statistical software: SPSS 26.0

$$\text{N-Gain} = \frac{84{,}36-67{,}12}{100-67{,}12} = \frac{17{,}24}{32{,}88} = \mathbf{0,52}$$

Qualitative: Expert feedback thematically analyzed for design improvements.

Trustworthiness: Triangulation (expert validation + student response + test scores), member checking with teacher, audit trail maintained.

Ethical Consideration

This research followed ethical standards in educational research. Permission to conduct the study was obtained from the school administration before the implementation of the research. Students participated voluntarily, and the data collected were used solely for academic and research purposes. The confidentiality of participants' identities was maintained throughout the study.

Instrument Validity and Reliability

Before being used in the research, the instruments employed in this study—including the student response questionnaire and learning outcome tests—were validated by experts in science education and educational technology. The validation process aimed to ensure that the instruments measured the intended constructs accurately and were appropriate for elementary school students.

Content validity was assessed through expert judgment, where two experts evaluated the relevance, clarity, and suitability of each questionnaire item with respect to the indicators of scientific literacy and learning media evaluation. Suggestions from the experts were used to revise several statements to improve clarity and alignment with the learning objectives.

Furthermore, the reliability of the questionnaire was examined using internal consistency analysis. According to educational research standards, a reliable instrument ensures consistent measurement results when used repeatedly under similar conditions (Sugiyono, 2017). The validation results indicated that the questionnaire items were appropriate for measuring students' perceptions of the developed learning

media, including aspects of comprehension, interest, engagement, scientific literacy, and visual appeal.

Thus, the research instruments used in this study were considered valid and reliable for collecting data on students' responses and learning outcomes related to the implementation of scientific literacy–based science learning media.

C. Finding and Discussion

1. Finding

The student response questionnaire showed an average score of 87.27% in the very good category. The comprehension aspect scored 87.12%, interest 87.88%, engagement 86.36%, scientific literacy 85.61%, and visual appeal 89.39%. These results indicate that the developed learning media was well received by students.

The average pre-test score was 67.12 while the average post-test score increased to 84.36. This improvement indicates that the learning media effectively improved students' understanding of science concepts.

The N-Gain analysis showed that 24.24% of students were in the high category, 66.67% in the medium category, and 9.09% in the low category. These results indicate moderate to high learning improvement.

2. Discussion

The performance of the science learning media based on scientific literacy was analyzed through two main components: (1) the results of the student response questionnaire regarding the use of the learning media, and (2) the effectiveness of the media in improving students' learning outcomes, measured using the N-Gain analysis. These two aspects serve as important indicators in assessing the feasibility and effectiveness of the developed learning media.The student response test was administered to 33 fifth-grade elementary students who had used the science learning media based on scientific literacy. The response questionnaire consisted of five assessment aspects, namely comprehension, interest, engagement, scientific literacy, and visual appeal. The summary of the results is presented in Table 2 below.

Table 2. Results of the Student Response Questionnaire

Aspect	Number of Items	Maximum Score	Score Obtained	Percentage	Category
Comprehension	4	660	575	87,12%	Very Good
Interest	4	660	580	87,88%	Very Good
Engagement	4	660	570	86,36%	Very Good
Scientific Literacy	4	660	565	85,61%	Very Good
Visual Appeal	4	660	590	89,39%	Very Good
Total	**20**	**3300**	**2880**	**87,27%**	Very Good

Based on the results presented in Table 2, the overall student response to the science learning media based on scientific literacy falls into the "Very Good" category, with an average percentage of 87.27%. The comprehension aspect achieved a score of

87.12%, indicating that the developed media helped students understand science concepts more easily and clearly. The interest aspect received a score of 87.88%, showing that the media successfully attracted students' attention and increased their learning motivation. The engagement aspect obtained a score of 86.36%, demonstrating that the media was able to encourage student participation in the learning process, such as asking questions, engaging in discussions, and conducting simple experiments. Meanwhile, the scientific literacy aspect obtained a score of 85.61%, indicating that the media could connect scientific concepts with everyday phenomena and foster students' critical thinking skills. The visual appeal aspect achieved the highest score, 89.39%, indicating that the visual design of the media—in terms of color, illustrations, and layout—was attractive and helped students better understand the material. Thus, the science learning media based on scientific literacy developed through the ADDIE model is considered feasible and effective for use in elementary school science learning. To determine the effectiveness of the science learning media based on scientific literacy, the researcher administered a pre-test and post-test to 33 fifth-grade students. The average score results are presented in Table 3.

Table 3. Average Scores of the Pre-test and Post-test

Type of Test	Average Score	Highest Score	Lowest Score
Pre-test	67,12	78	56
Post-test	84,36	96	72

The table shows an increase in the average learning outcomes from 67.12 to 84.36 after the use of the learning media. This indicates that the developed learning media was able to significantly improve students' understanding of science concepts. Furthermore, an N-Gain analysis was conducted to measure the improvement in learning outcomes using Hake's formula (1999). The distribution of the N-Gain scores is presented in Table 4.

Table 4. Distribution of Students' N-Gain Scores

Category	Number of Students	Percentage
High	8 students	24,24%
Medium	22 students	66,67%
Low	3 students	9,09%
Total	**33** students	**100%**

Based on the results in Table 4, it is known that most students (66.67%) fall into the medium category, 24.24% are in the high category, and only 9.09% are in the low category. According to Hake's (1999) N-Gain category interpretation, these results indicate that the use of science learning media based on scientific literacy provides a fairly significant improvement in learning outcomes. Thus, the developed learning

media is proven to be effective in enhancing students' conceptual understanding, scientific thinking skills, and scientific literacy in elementary school.

The improvement in students' learning outcomes and scientific literacy can be explained through constructivist learning theory, which emphasizes that students actively construct knowledge through interaction with learning materials and experiences. Interactive learning media such as flipbooks support this process by enabling students to explore information independently, visualize scientific concepts, and connect new knowledge with prior experiences.

D. Conclusion

Based on the findings of this study, the flipbook-based science learning media developed using the ADDIE model proved to be both feasible and effective in improving fifth-grade students' scientific literacy. Student responses showed a very positive perception of the media, with an overall score of 87.27% in the "Very Good" category, indicating that the media was attractive, easy to understand, and engaging. The effectiveness test results further demonstrated a significant improvement in learning outcomes, as reflected by the increase in average scores from 67.12 on the pre-test to 84.36 on the post-test. The N-Gain analysis revealed that most students experienced moderate to high learning gains, confirming that the flipbook learning media successfully enhanced students' conceptual understanding, learning motivation, engagement, and ability to relate science concepts to everyday life. Therefore, the flipbook-based learning media is suitable for use as an alternative instructional tool to support scientific literacy-oriented science learning in elementary schools.

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