Jurnal Cakrawala Pendas
Vol. 10 No. 1, Januari 2024
DOI: http://dx.doi.org/10.31949/jcp.v10i1.7905

p-ISSN: 2442-7470
e-ISSN: 2579-4442

DEVELOPMENT OF SCIENCE-BASED DIGITAL POP-UP BOOKS: A CREATIVE SOLUTION FOR ELEMENTARY SCHOOL STUDENTS' LEARNING

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Abstract

The development of digital technology in the 21st century has encouraged innovation in learning strategies that are more engaging and focused on active student participation. This study aims to design and develop an interactive learning medium in the form of a digital pop-up book focused on the subject of Natural Sciences (IPA) for fifth-grade elementary school students, with the main topic being the water cycle. The development of the medium was based on the ADDIE instructional design model, which includes five stages: needs analysis, concept design, product development, classroom implementation, and evaluation of the medium's effectiveness and practicality. The digital pop-up book was created using Microsoft PowerPoint software by combining various three-dimensional visual elements, dynamic animations, voice narration, and interactive features that facilitate students' understanding of concepts. Validation results from experts showed a very high level of feasibility, namely 88% from subject matter experts and 93.3% from media experts. Meanwhile, the practicality test results by teachers and students each scored 95% and 93%, indicating that this media is very easy to use in daily learning. In addition to feasibility and practicality, the effectiveness of the media was also tested through a comparison of scores before and after using the media, showing a significant improvement in student learning outcomes. The average N-Gain score reached 79.06%, which falls into the high or effective category. Based on these results, this digital pop-up book can be concluded as a learning medium that is not only feasible and practical but also capable of having a positive impact on enhancing students' conceptual understanding and learning interest in elementary schools.

Keywords: *Digital Pop-Up Books, Interactive Learning, Innovative Media, ADDIE Model, Improving Learning Outcomes*

Abstrak

Perkembangan teknologi digital di era abad ke-21 telah mendorong terjadinya inovasi dalam strategi pembelajaran yang lebih menarik dan berorientasi pada keterlibatan siswa secara aktif. Penelitian ini bertujuan untuk merancang dan mengembangkan sebuah media pembelajaran interaktif berupa buku pop-up digital yang berfokus pada mata pelajaran Ilmu Pengetahuan Alam (IPA) untuk siswa kelas V sekolah dasar, dengan topik utama siklus air. Pengembangan media dilakukan berdasarkan model desain pembelajaran ADDIE yang meliputi lima tahap, yaitu analisis kebutuhan, perancangan konsep, pembuatan produk, implementasi di kelas, serta evaluasi efektivitas dan kepraktisan media. Buku pop-up digital ini dibuat menggunakan perangkat lunak microsoft power point dengan menggabungkan berbagai elemen visual tiga dimensi, animasi dinamis, narasi suara, dan fitur interaktif yang mempermudah pemahaman konsep oleh siswa. Hasil validasi dari para ahli menunjukkan tingkat kelayakan yang sangat tinggi, yakni sebesar 88% dari ahli materi dan 93,3% dari ahli media. Sementara itu, hasil uji kepraktisan oleh guru dan siswa masing-masing memperoleh skor 95% dan 93%, yang menandakan bahwa media ini sangat mudah digunakan dalam pembelajaran sehari-hari. Selain dari aspek kelayakan dan kepraktisan, efektivitas media juga diuji melalui perbandingan nilai sebelum dan sesudah penggunaan media, yang menunjukkan peningkatan hasil belajar siswa secara signifikan. Rata-rata nilai N-Gain mencapai 79,06%, yang termasuk dalam kategori tinggi atau efektif. Berdasarkan hasil tersebut, buku pop-up digital ini dapat disimpulkan sebagai media pembelajaran yang tidak hanya layak dan praktis, tetapi juga mampu memberikan dampak positif dalam meningkatkan pemahaman konsep dan minat belajar siswa sekolah dasar

Kata Kunci: Buku Pop-Up Digital, Pembelajaran Interaktif, Media Inovatif, Model ADDIE, Peningkatan Hasil Belajar

Received	: 2023-11-30	Approved	: 2024-01-22
Reviesed	: 2024-01-20	Published	: 2024-01-31

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Introduction

Good and quality education is the hope and goal of a nation, including Indonesia. Education is expected to produce well-rounded Indonesian citizens (Ansori, 2019). To achieve this, learning activities that use interesting teaching methods and encourage students to be more creative are needed. The advent of the 4th Industrial Revolution era has driven significant changes in the world of education, particularly in terms of teaching methods. This transformation demands a shift from traditional teaching methods toward an approach that integrates digital technology. At the elementary school level, teachers are expected to be able to design creative and innovative learning strategies, especially for teaching abstract subjects such as Natural Sciences (IPA). Creativity, as explained by Leen and colleagues (2014), encompasses the ability to generate new ideas, creative solutions, and original concepts that have never existed before. The subject of science itself focuses on understanding natural phenomena through a scientific approach—which includes observation, experimentation, and logical reasoning—and covers various disciplines such as physics, chemistry, biology, and geoscience (Sutrisna & Gusnidar, 2022). Therefore, science should be viewed as a way of thinking for the purpose of understanding nature, as a means of investigation to explain phenomena, and as a body of knowledge produced from inquiry (Collete & Chiappetta, 1994). In the context of learning, educational media play a crucial role in helping students understand concepts while also alleviating the teaching burden on teachers. One innovative media alternative is the digital pop-up book, which not only bridges the gap in conceptual understanding but also fosters motivation, cultivates interest in learning, and supports positive psychological development in students. Therefore, it is important for teachers to select digital media relevant to the characteristics of the material to create an enjoyable and meaningful learning process.

A pop-up book is one type of book-based learning medium characterized by three-dimensional visual displays that appear when the pages are opened, creating an engaging and interactive learning experience (Masturah et al., 2018). This distinctive feature makes pop-up books an effective tool in enhancing students' interest while simplifying their understanding of lesson content. Teachers' skills in designing the appearance and content of pop-up books according to learning needs make them a flexible and adaptable medium. Pop-up books as 3D visual media can be developed with engaging learning content, thereby stimulating students' motivation to learn and reinforcing their understanding of the material (Solichah and Mariana, 2018).

However, findings from interviews with fifth-grade teachers at SDN Babakanjawa II on December 12, 2022, show that the use of innovative learning media is still limited. Teachers more often use lecture methods and conventional media such as blackboards and textbooks. This contributes to a lack of active and critical participation by students during learning. Critical thinking skills are part of higher-order thinking skills (Uswatun & Rohaeti, 2015). Critical thinking is defined as a reflective and reasoned thinking process to decide what to believe or do (Ennis, 1985; Hunter, 2009). Rudd, Baker, & Tracy (Cavus & Uzunboylu, 2009) revealed that critical thinking is a reasonable, purposeful, and introspective approach to problem solving. Observations also show that fifth-grade students have difficulty understanding science material, tend to be passive, and lack confidence in completing practice questions.

To address these challenges, the researcher developed digital learning media. Teachers are required to master digital learning and technology (Moto, 2019), as this can enhance learning success, innovation, particularly in terms of technology and media (MZ et al., 2022). Learning media itself can include anything that conveys messages, stimulates students' thoughts and feelings, and encourages their willingness and motivation to learn (Hartati, 2018). One type of learning media that utilizes digital technology and facilitates access to materials for teachers and students is the Digital Pop-Up Book. This medium provides three-dimensional images, which help students understand the shape of objects, enrich their vocabulary, and enhance overall understanding (Yahzunka & Astuti, 2022). With its decorative design and content that can be customized to the curriculum being taught, the Digital Pop-Up Book is one of the most effective and engaging digital media for learning (Faridha et al., 2023).

Thus, IPAS learning in elementary schools can focus on providing direct knowledge to students to help develop the skills needed to explore and understand the environment scientifically (Handayani et al., 2019; Kharisma et al., 2024; Putri et al., 2024). The development of a Digital Pop-Up Book based on science is expected to present science material in a more engaging, interactive, and dynamic manner to enhance students' understanding and learning outcomes. Previous research supports the effectiveness of this medium. Masturah et al. (2018) showed that pop-up books can improve science learning outcomes in third-grade students at Singaraja Mutiara Elementary School. Musfirah et al. (2021) also found that this medium has a positive impact on students' understanding of the concept of heat in fifth-grade students at SDN 46 Membura. Meanwhile, Samsidar (2022) stated that digital pop-up books are suitable for use in teaching fairy tale material at Lamreung State Elementary School, Aceh Besar. Based on these conditions and support from various studies, the development of Digital Pop-Up Books is considered an appropriate solution to enhance the effectiveness of science education at SDN Babakanjawa II.

Research Methods

This study adopts a Research and Development (R&D) approach using the ADDIE development model, which consists of five main stages: Analysis, Design, Development, Implementation, and Evaluation. The subjects of this study are fifth-grade students at SDN Babakanjawa II. Data in this study were collected using various techniques, including interviews, observations, questionnaires, and tests to measure learning outcomes. The key informants in this study were fifth-grade teachers who were selected purposively, given their active role in classroom learning activities, their deep understanding of student characteristics, and their experience in dealing with the challenges of delivering science material, especially the water cycle theme.

The development stages used the ADDIE model proposed by Yudi and Sugianti (2020), which consists of five systematic steps.

1. Analysis Stage

   In this initial stage, a review was conducted of the curriculum structure, student conditions, and learning media that had been used previously. The analysis revealed the need for more engaging digital learning media that could foster student interaction, leading to the selection of a digital pop-up book as the medium to support students' understanding of science education.
2. Design Phase

The initial design of the media was developed using Microsoft PowerPoint 2019. This process involved creating flowcharts and storyboards to structure the sequence of material presentation and visual design. The selection of content, illustrations, and material presentation strategies was carefully conducted to align with learning objectives and appeal to students.

3. Development Stage

   The designed concept was then realized as a digital pop-up book. After development, the product was validated by subject matter experts and media experts. The evaluation assessed the quality of content, visual presentation, and the product's suitability for classroom learning.

4. Implementation Stage

   The learning media that has undergone the validation process is tested on 26 fifth-grade students at SDN Babakanjawa II. Learning activities are conducted using the media, and its effectiveness is measured using pretest and posttest instruments to determine the extent of improvement in students' understanding after the media intervention is implemented.

5. Evaluation Stage

   Evaluation was conducted in two forms: formative during the development process and summative after field implementation. This evaluation aimed to measure the effectiveness of the media and identify aspects that needed improvement. Revisions were made based on suggestions from validators and field findings to refine the developed media.

Data analysis in this study was conducted using a mixed approach, namely qualitative and quantitative. Qualitative data was obtained through interviews, observations, documentation, and input from experts and respondents. The data was analyzed descriptively to describe the need for media, user responses, and the product improvement process. Meanwhile, quantitative data in the form of questionnaire data and learning outcomes was analyzed based on three main indicators: validity, practicality, and effectiveness. Validity analysis was conducted by calculating the percentage of validation scores using the formula $P = (\sum x / \sum xi) \times 100\%$, with the following interpretation criteria: highly valid (81–100%), valid (61–80%), and needs improvement (<61%). Practicality was analyzed based on teacher and student responses through a Likert scale questionnaire, with categories of highly practical (81–100%), practical (61–80%), and less practical (<60%). To assess effectiveness, a paired t-test was used to determine significant differences between pretest and posttest scores. Additionally, the N-Gain value was calculated with the categories high (≥0.70), moderate (0.30–0.70), and low (≤0.30). Effectiveness was also evaluated through the percentage of learning outcomes achieved, which were classified as highly effective (>76%), moderately effective (56–75%), and ineffective (<40%).

Result and Discussion

To support students' understanding of concepts in science subjects, a digital pop-up book was developed using Microsoft PowerPoint, enriched with various features such as three-dimensional animations, interactive buttons, and audio narration. The combination of these elements is intended to create an immersive learning experience, so that students not only receive information passively, but also actively engage in the learning process. The validation process was conducted by subject matter experts, and the evaluation results in this study include two types of data: quantitative and qualitative. Quantitative data was obtained from assessments using a Likert scale questionnaire, while qualitative data was derived from comments,

suggestions, and open-ended feedback from experts and respondents. The assessments by subject matter experts covered several aspects, including:

Table 1. Results of Expert Validation Data Analysis

No	Aspects assessed	Score
1	Alignment of material with KD	4
2	Alignment of material with Learning Objectives	4
3	Alignment of material with students' knowledge level	4
4	Alignment of material with thematic books	4
5	Alignment of material with evaluation questions	4
6	Readability	5
7	Alignment with Indonesian language rules	5
8	Effective and efficient use of language	4
9	Use of signs and symbols	5
10	Presentation order	4
11	Ease of use	4
12	Ease of understanding the material and presentation	5
13	Clarifying the material and tasks	5
14	Facilitating the learning process	4
15	Facilitating focus	5
Score Total		66
Maximum Score Total		75
Average Assessment Percentage		88%
Category		Highly Recommended

Based on the validation results conducted by subject matter experts, an average percentage of 88% was obtained, which according to the reference falls into the "Highly Suitable" category. This indicates that the developed media has met the overall content suitability standards and can be used effectively in the learning process.

In addition to quantitative data, the validation process also produced qualitative data in the form of feedback and recommendations from validators. In general, subject matter experts gave positive assessments of the developed media. However, there were several constructive suggestions for improving the product, including: the material should be presented more concisely without compromising clarity; additional explanations should be included regarding the impact of disrupted water cycles on living organisms, as well as the scientific reasons why water never runs out; the organization of the material should align with the established learning objectives; and it is recommended that interactive questions be added to enhance student engagement during the learning process.

The validation process for this material was conducted in collaboration with Mr. Mahpudin, M.Pd., who served as the subject matter expert validator. With his expertise and experience in elementary education, he provided valuable input in the refinement of the Digital Pop-Up Book media used in this study.

Table 2. Results of Media Expert Validation Data Analysis

No	Aspects assessed	Score
1	Animation suitability	5
2	Cover design	5
3	Backsound clarity	5

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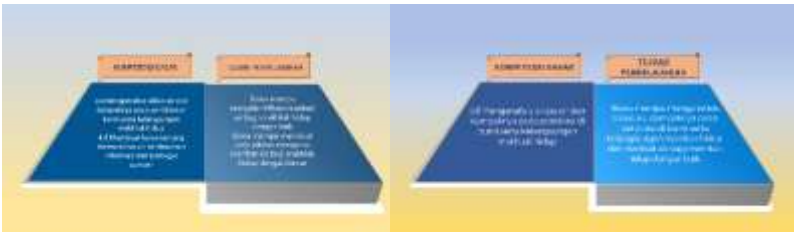
4	Text is easy to read	4
5	Image quality	5
6	Media is easy to operate	5
7	Presentation sequence	5
8	Use of fonts	4
9	Font size	3
10	Media size	5
11	Media color selection	5
12	Background selection	5
Score Total		56
Maximum Score Total		60
Average Assessment Percentage		93,3%
Category		Highly Recommended

Based on the assessment results provided by media expert validators, an average score of 93.3% was obtained, which is classified in the "Very Good" category. This achievement indicates that the developed learning media has met the standards of visual quality, functionality, and usability in the context of learning.

The feedback provided by media experts includes several important notes for improvement, one of which is the need to add reflective features that allow students to confirm their understanding or reflect personally on the information they have obtained during the learning process. This feature is expected to increase student cognitive engagement and strengthen the process of concept internalization. In general, the validation process involving two validators—the subject matter expert and the media expert—contributes significantly to the final quality of the learning media. The comments and recommendations from both parties serve as the basis for revising and refining the Digital Pop-Up Book product before it is tested directly with students in learning activities. A summary of the suggestions and notes from each validator is compiled as an important guideline for further development. The following is a summary of the comments and suggestions from each validator.

Table 3. Product Improvements Based on Suggestions from Material Experts and Media Experts

No	Suggestions for Improvement	Improvements Made
1	Learning objectives are more detailed in accordance with the KD	Learning objectives are revised in accordance with the KD
		

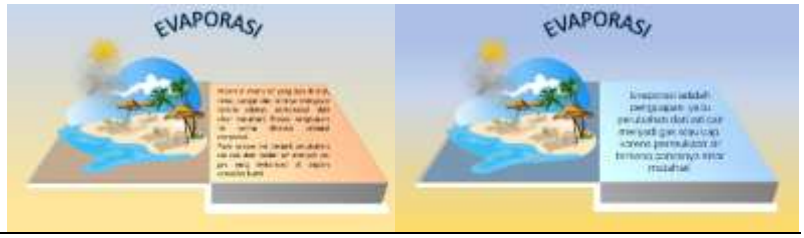
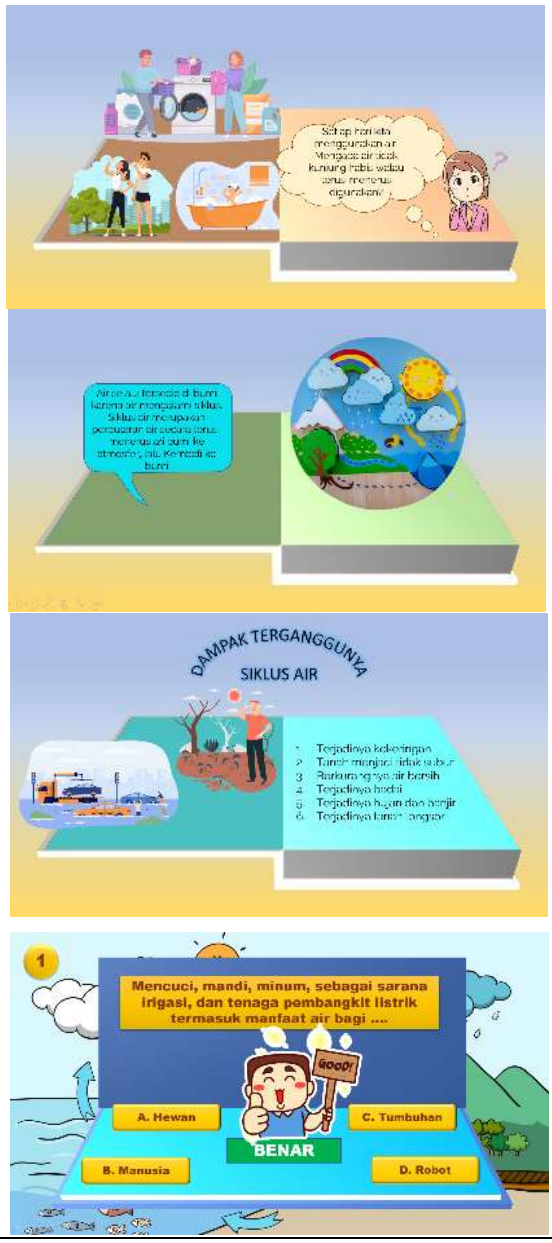
2	Explain the material more concisely but clearly.	The material was revised to be concise yet clear.
		

Table 4. Additional Design

Additional Design


Based on the results obtained from the validation stage, the next step in the media development process is the implementation stage, which is carried out through direct testing in

a real learning environment. This activity was conducted on October 13, 2023, in the fifth-grade class at SDN Babakanjawa II, with a total of 26 students participating. The primary objective of this stage was to evaluate the practicality of the digital pop-up book media and measure its effectiveness in achieving student learning outcomes.

During the implementation process, the researcher distributed evaluation questionnaires to two groups of respondents: students and teachers. The student questionnaire consisted of 15 statements designed to assess the practicality of the media from the students' perspective, covering aspects such as ease of use, visual appeal, and comfort during the learning process. Meanwhile, the teacher questionnaire focused on evaluating the effectiveness of the media, its benefits in learning, and the ease of its implementation.

Teachers' responses were collected after they had directly used the digital pop-up book media in the learning process in the classroom. Some of the assessment areas included the suitability of the content with the learning objectives, visual quality, communicative and easy-to-understand language, and the technical feasibility of using the media. The teacher questionnaire was completed by two respondents: a fifth-grade teacher as Expert I and the principal of SDN Babakanjawa II as Expert II. The evaluations provided by these two experts were used to determine the practicality of the media from an educator's perspective, and the results are presented in the following table.

Table 5. Teacher Response Assessment Results

Practitioners	Score	Percentage	Criteria
Respondent 1	61	94%	Very Practical
Respondent 2	62	95,3%	Very Practical

Table 6. Results of Teacher Response Data Analysis

No	Aspects assessed	Practitioner	
		I	II
1	Alignment of material with KD	5	5
2	Alignment of material with Learning Objectives	5	5
3	Alignment of material with students' knowledge level	5	5
4	Alignment of questions with material	5	5
5	Alignment of media with material	5	5
6	Ease of operating media	4	4
7	Digital pop-up books make it easier for teachers to deliver material	5	5
8	The colors of the text and images on the media are appropriate	4	4
9	Digital pop-up books are easy to understand and use	5	5
10	The design of digital pop-up books is appropriate for the characteristics of students	4	4
11	Digital pop-up books are able to attract students' attention	5	5
12	Digital pop-up books are able to stimulate students' curiosity	5	5
13	The sentence structure used in presenting the material is easy to understand	4	5
Total Score		123	

Maximum Total Score	130
Average Assessment Percentage	95%
Category	Very Practical

Based on the evaluation results from practitioners, the digital pop-up book learning media obtained a total score of 130, which when converted resulted in a practicality percentage of 95%. Based on the assessment guidelines in Table 3.9 in Chapter III, this score falls into the "Very Practical" category, which means that the media is very suitable for use in learning without requiring significant revisions in terms of its use.

In addition to evaluations by practitioners (teachers and school principals), the practicality of the media was also analyzed through student responses as direct users. A total of 26 fifth-grade students participated in a questionnaire aimed at measuring the level of comfort and ease of use of digital pop-up books in learning activities. The questionnaire consisted of several statements reflecting aspects of ease of navigation, interest in the media display, clarity of content, and visual appeal offered by the media.

The results of the questionnaire compilation from the students provide an overall picture of the level of acceptance of the media by the students, as well as how much the media supports their learning process. Detailed information regarding the students' responses to the practicality of using the digital pop-up book media is presented in the table in the following section as a basis for consideration in the overall evaluation of the product.

Table 7. Results of Student Response Data Analysis

Number of Respondents	Score Max	Score Results
26	1.950	1.807
Percentage	93%	
Category	Very Practical	

Based on the results of the evaluation by practitioners on the practicality of use, the digital pop-up book learning media obtained a total score of 130, which is equivalent to a percentage of 95%. This percentage falls into the "Very Practical" category, indicating that this media greatly supports the implementation of learning and can be applied effectively in the classroom. Therefore, it can be concluded that the digital pop-up book media received a very positive response and was deemed suitable for use as an innovative and efficient learning tool.
Before implementing learning using the media, the researcher first administered a pretest to the students to determine their initial abilities related to the material to be taught. Following this, the researcher demonstrated the use of the digital pop-up book medium directly in front of the students, showing how the medium works and presenting the material interactively. After the material presentation session, the students worked on several interactive questions together as a form of practice and reinforcement of the initial concepts. In the final stage, the students were given a post-test aimed at evaluating their learning outcomes after using the learning medium.

The pretest and posttest instruments contained 10 multiple-choice questions and 10 essay questions, which had previously undergone validity and reliability testing. The results of the instrument testing are listed in detail in the appendix of this research document. The purpose of this stage was to measure the effectiveness of digital pop-up books in improving student learning outcomes quantitatively.

To determine the difference in scores between the pretest and posttest, the researcher conducted data analysis using a paired sample t-test in SPSS 26. Before the t-test was conducted, the researcher first performed a normality test to ensure that the data distribution met the

parametric requirements. Given that the sample size in this study was less than 30 people, the Shapiro-Wilk method was used to test the normality of the data distribution, in accordance with statistical analysis standards for small sample sizes.

Table 8. Normality Test Results

	Statistic	Df	Sig,
Pretest	0.936	26	0.107
Postest	0.865	26	0.003

Based on the output table above, it can be seen that the significance values are 0.107 (Pretest) and 0.164 (Posttest), which are > 0.05. Therefore, in accordance with the decision in the Shapiro-Wilk Normality Test, it can be concluded that the data is normally distributed.

The T-test is used to compare student learning outcomes before and after using digital pop-up book learning media.

Table 9. T-test results

	Std. Deviasi	Df	Sig,
Pair Pretest-Postest	-35.692	25	0.000

Based on the Paired Samples Test table, the Sig. (2-tailed) value is 0.000. Since the sig. value of 0.000 is less than 0.05, it can be concluded that Ha is accepted and Ho is rejected. Therefore, the conclusion is that there is effectiveness of the digital pop-up book learning media in the learning process for fifth-grade students at SDN Babakanjawa II.

The N-Gain test was used to measure the improvement in science skills and learning outcomes between before and after learning.

Table 10. N-Gain Test Results

N-Gain Test Results	**Statistic**	**Std. Error**
N_Gain Persen Mean	79.06	2.940
Median	77.30	
Variasi	224.747	
Std. Deviasi	14.992	
Minimum	33	
Maximum	100	
Range	67	
Number of Samples	26	

The N-Gain value in the table above shows that the average increase in student scores reached 79.06%, which is classified as effective because it exceeds the effectiveness threshold of 76%. The N-Gain value ranges from 33% to 100%, indicating a significant improvement in students' understanding of the material taught. Based on these findings, it can be concluded that the digital pop-up book learning media contributes significantly to helping fifth-grade students understand concepts in science subjects more deeply.

In addition, the media validation results show that the product development received an average score of 88% from subject matter experts and 93.3% from media experts, both of which fall into the "Highly Suitable" classification. This validation is further supported by constructive feedback from the validation team, who provided several suggestions for improvements to optimize the media before it is tested in the classroom. These findings align with Samsidar's (2022) view, which emphasizes the importance of using appropriate learning media to support the effectiveness of the teaching-learning process at the elementary level.

Therefore, this media is considered suitable for use and relevant as a learning aid that can significantly improve students' understanding.

Furthermore, the results of the practicality test through a questionnaire distributed to teachers and students also showed very good responses. The practicality level according to teachers reached 95%, while student responses reached 93%, both of which fall into the "Very Practical" category. These results align with previous research conducted by Hanifah (2014) and Siregar & Rahmah (2016), which found that digital learning media based on pop-up books are attractive, easy to use, durable, and accessible anytime as needed. Based on these findings, this media has proven to be practical, beneficial, and effective in promoting student engagement while improving their learning outcomes.

Overall, this study shows that the use of digital pop-up book media in Theme 8 Subtheme 1 Lessons 1 and 2 has a significant positive impact on improving students' learning outcomes. The average pretest score, which was initially 52.92, increased to 80 at the posttest. Analysis using a paired sample t-test yielded a significance value of 0.000 (<0.05), indicating that the alternative hypothesis (H_a) was accepted and the null hypothesis (H_0) was rejected. The average N-Gain value of 79.06% also reinforces that this media is effective in improving student learning outcomes in science subjects. These results are also in line with the findings of Khoirina & Arsanti (2022), who stated that the use of learning media can simplify the learning process, increase motivation, and make the learning process meaningful.

To establish effective communication between teachers as information providers and students as information recipients, media that can bridge messages efficiently and accurately is needed. According to Hamidah (2019), learning media has an important function as an intermediary in the process of knowledge transfer from teachers to students. The selection of appropriate media not only plays a role in increasing motivation and interest in learning but also stimulates critical thinking and helps students achieve learning objectives optimally. Furthermore, Siregar & Rahmah (2016) emphasize that the development of digital pop-up books aims to facilitate students' understanding of the material, with advantages such as ease of access, media durability, and visual appeal. In addition to strengthening students' memory, this medium can also inspire enthusiasm for learning, making the learning experience enjoyable and interactive.

Conclusion

The findings indicate that the Digital Pop-Up Book learning media based on Natural Sciences (IPA) is a valid, practical, and effective tool in supporting the improvement of elementary school students' learning outcomes, particularly in understanding the water cycle material. The validity of the media was obtained from expert assessments that gave high scores for the quality of the content and design of the media. Meanwhile, the practicality and effectiveness of the media are reinforced by positive feedback from teachers and students, who found the media easy to use, engaging, and highly supportive of the learning process in the classroom. Furthermore, the use of the Digital Pop-Up Book not only strengthens students' conceptual understanding in a visual and contextual manner but also enhances learning motivation, encourages active participation, and creates a fun and interactive learning environment. This media presents material with a more dynamic and engaging approach, thereby replacing monotonous and uninteresting lecture methods for elementary school-aged students. With all these advantages, the Digital Pop-Up Book media is recommended as an innovative alternative in thematic learning processes at the elementary school level. This

medium is not only relevant to the characteristics of 21st-century students who are familiar with technology but also serves as a practical solution to address the challenges of conventional learning methods that are less effective in conveying abstract concepts such as the water cycle.

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