Development of E-Book Learning Media Using FlipHTML5 to Enhance Mathematics Learning Outcomes for Fifth Grade Students at Elementary School

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Abstract. The rapid advancement of digital technology has transformed educational practices, necessitating innovative learning media to enhance student engagement and academic performance. This study aims to evaluate the development and effectiveness of FlipHTML5-based e-book learning media in improving mathematics learning outcomes among fifth-grade elementary school students. Employing a Research and Development (R&D) approach with the ADDIE model, this study involved 28 students as research subjects. Data collection was conducted through interviews, validation sheets, response questionnaires, and pre-test and post-test assessments. The findings indicate that the developed learning media achieved a validity score of 90%, classifying it as "very valid." Student response analysis revealed a practicality rating of 96.38%, indicating high usability and engagement. Furthermore, effectiveness testing using the N-Gain Score yielded an 86.44% improvement, categorizing it as "very effective" in enhancing students' mathematics learning outcomes. Despite these successes, challenges related to technical accessibility and digital literacy remain. This study highlights the potential of FlipHTML5-based e-books as an effective digital learning tool and provides insights into their scalability for broader educational applications. Future research should explore long-term implementation strategies and comparative studies across different educational contexts.

Keywords. E-book learning media, FlipHTML5, mathematics education, digital learning, learning outcomes

1 Introduction

Recent advances in digital technologies have reshaped educational landscapes, enabling the creation of innovative learning media that foster greater student engagement and enhance learning outcome [1]. According to Oktiana in Handayani, learning media is a device or means to convey information or messages to help

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individuals learn and obtain material. The learning media can be text, video, audio, visual, and manipulative objects that deliver instructional content [2]. Among these, electronic books (e-books) have gained prominence as dynamic, multimodal platforms featuring embedded multimedia elements, interactive assessments, and intuitive navigation interfaces that cater to diverse learning styles.

The development of e-book learning media has been increasingly influenced by technological advancements and pedagogical approaches that enhance student engagement and comprehension. Imansari, Umamah, and Na'im explored the integration of e-books through the Sigil application for history learning, emphasizing its role in improving accessibility and interactivity[3]. Similarly, Fadillah, Nopitasari, and Bilda developed e-books using Kvisoft Flipbook Maker, highlighting its effectiveness in creating engaging digital content with interactive features[4]. Indrawan et al. further examined emerging e-book trends in schools, noting a shift towards multimedia-enriched digital resources that accommodate various learning styles[5]. Meanwhile, Aristiani and Agung showcased the impact of e-books in elementary social science education, underlining their potential to foster independent learning and critical thinking skills [6].

E-book learning media has showcased its effectiveness in problem-based learning (PBL) environments. Astuti and Santosa designed an e-book for PBL, demonstrating its capability to enhance students' problem-solving skills and learning outcomes[7]. Similarly, Ambarita, Simanullang, and Sirait developed an e-book with a PBL approach, reinforcing its ability to encourage critical thinking and active participation[8]. Anggraini introduced Novelmatika, an e-book designed to improve statistical concept comprehension, showing that narrative-driven digital content can facilitate a better understanding of abstract concepts[9]. Moreover, Sari and Utami conducted a systematic literature review on e-book usage in primary education, concluding that well-designed e-books significantly enhance learning effectiveness by providing structured, multimodal content[10]. These studies indicate that e-books have evolved from simple digital textbooks into dynamic, interactive learning tools tailored to modern educational needs.

An institution in Indonesia has implemented an independent curriculum based on the researcher's initial observation. However, in observing the teaching and learning process in the school environment, researchers saw that the lecture method and image media were still often chosen in the learning process. The results of interviews with the fifth-grade teacher stated that the class had never used interactive e-book media; the media commonly used were pictures, books, and learning videos from YouTube. The media used is not interactive, so learning tends to be classical, and classroom conditions that are less conducive to fiber do not stimulate student participation and communication. As a result, the achievement of student learning outcomes has not reached the Minimum Completeness Criteria (MCC). The Minimum Completeness Criteria in Mathematics is 70, and it is estimated that 46% of students do not reach the standards. The weak mathematics skills of students can be seen from the data above. To overcome this, the researcher took the initiative to develop an Interactive E-Book learning media based on FlipHTML5 for learning Mathematics.

The following summarizes daily test data in mathematics subjects, especially the Least Common Multiple (LCM) and Greatest Common Factor (GCF) material, involving 28 students. The minimum completeness criteria (MCC) for this material is 70. Thus, the assessment is divided into two criteria. Namely, students are considered complete or pass if they score ≥ 70, and vice versa. They are considered incomplete or do not pass if the score is < 70.

Table 1. Daily Mathematics Tests on Least Common Multiple and Greatest Common Factor

Assessment Criteria	Percentage of Students
$x \geq 70$	46%
$x \geq 70$	54%

Source: data on daily test scores on Least Common Multiple and Greatest Common Factor

Referring to these problems, choosing learning methods and media that are not monotonous has benefits in encouraging active participation and student learning outcomes [11]. Improved learning outcomes can be seen from the achievements or accomplishments obtained by someone after following a learning process that includes knowledge, skills, understanding, and abilities that have been obtained and can be applied in real situations. Learning outcomes can be measured and evaluated through tests, assessments, projects, or observations and are used to measure individual progress and achievement in achieving learning goals[12]. Monotonous learning can make students feel bored and less enthusiastic, especially in difficult mathematics lessons. Mathematics studies concepts, structures, patterns, and relationships between numbers, quantities, space, and shapes[13]. Engaging learning media, such as e-books, is needed to overcome the problem so that students are more interested and motivated in learning mathematics[14].

E-book is an electronic book format with features such as images, audio, and video, as well as quizzes or learning activities that allow readers to participate actively in the reading and learning process. E-books are designed to provide a more dynamic, engaging, and effective reading experience, especially in the context of education[15]. In designing this E-Book learning media using the FlipHTML5 website. FlipHTML5 is an application or platform to create interactive digital content such as E-Books, magazines, brochures, and online catalogs. Using Flip HTML5, users can create engaging and easy-to-read content with features such as scrolling pages, page-turning effects, responsive layouts, and text search features [16].

Several studies have explored using FlipHTML5 as an effective digital learning tool across various educational contexts. Jauharati, Hardiansyah, and Halang developed a FlipHTML5-based handout for high school students studying the circulatory system, demonstrating its potential to enhance learning engagement and comprehension[17]. Similarly, Handiar highlighted the role of FlipHTML5-assisted e-books in increasing elementary students' motivation, emphasizing the platform's interactive features[18]. In language education, Sihotang and Pramuniati developed an e-module for elementary-level oral production using FlipHTML5, showing

improvements in students' speaking skills[19]. Furthermore, Kurniawan, Zahrah, and Yuliati integrated FlipHTML5 into madrasah e-magazines to enhance literacy skills, particularly in writing and reading[20]. Fitia, Kholida, and Awardin also found that 3D Page Flip HTML5 in Islamic religious education contributed to better student learning outcomes[21]. These studies collectively indicate that FlipHTML5 can be a versatile and engaging digital platform for enhancing educational experiences across different subjects.

Despite extensive research on e-book learning media in diverse subjects [3]–[6] and the demonstrated affordances of FlipHTML5-based resources in areas such as high-school biology [17], elementary-level motivation studies [18], and religious education [21], there remains a notable gap in the systematic development and rigorous evaluation of interactive e-books tailored for primary mathematics within Indonesian elementary schools. To address this, the present study adopts a Research and Development approach guided by the ADDIE model to (1) design and validate a FlipHTML5-based interactive e-book on Least Common Multiple (LCM) and Greatest Common Factor (GCF) for fifth-grade students; (2) assess its practicality and engagement through expert and student feedback; and (3) measure its effectiveness via pre-test/post-test comparisons and N-Gain analysis. By providing a robust methodological framework and comprehensive empirical evidence, this research contributes to the field of digital learning innovation and offers scalable insights for integrating interactive e-books into primary mathematics curricula in similar educational contexts.

2 Method

This research applies the research and development method using the ADDIE development model. The research and development was used to create new product designs, test the effectiveness of existing products, and develop and create new products [22].

2.1 Research and development procedures

The procedure used is under the procedure developed by Robert Maribe Branch in Tiara Putri Weldami and Relsa Yogica, which consists of five stages, namely Analysis, Design, Development, Implementation, and Evaluation, among others:

2.1.1 Analysis

The analysis stage evaluates the needs for a particular development. It involves identifying problems and assessing student needs, especially related to the product to be developed, by considering student characteristics, subject matter, and desired achievement goals. This stage has several phases, namely needs analysis, curriculum analysis, and learning outcomes analysis.

Design

The design stage is designing the learning media to be developed. This stage includes preparing appropriate teaching materials, presenting the product design, preparing product formats, compiling instruments that will be used for validation, and compiling questionnaires for student responses.

Development

This stage is carried out so that researchers can produce better products based on the assessment and suggestions given by the validator. This validation aims to evaluate the feasibility of the materials and media developed. Media validation was carried out by four experts: media experts, material experts, language experts, and question experts.

Implementation

The implementation stage is the phase in which the product that has been designed and validated is tested on fifth-grade students. This phase ensures that the product developed is truly effective and in accordance with user needs or research objectives.

Evaluation

The evaluation stage is a systematic process of assessing the product to ensure that the set objectives and standards have been achieved. The evaluation results will be the basis for making the final revision so that the media can meet the identified needs, taking into account the input and suggestions given during the implementation process [23].

2.1.2 Trial design

A team of experts will evaluate the trial design stage to produce an assessment of the media that has been made.

Test Subject

The test subjects consisted of two groups. The first group is validators, consisting of material expert lecturers, language experts, media experts, and question experts to evaluate product results. The second group consisted of students from fifth grade, with 28 students.

Data type

The types of data for this research are qualitative and quantitative data. Qualitative data includes comments and input in the research process. At the same time, quantitative data includes values obtained from the evaluation of validity evaluation by experts and student responses.

Data collection instrument

The data collection instruments used include observation sheets, interview guides, validation questionnaires, student response questionnaires, test questions, and documentation[24].

2.2 Data analysis technique

The data analysis technique is an approach to evaluating the data collected to assess the quality of the product being developed.

Validity analysis

The validation process was conducted through a rational analysis involving experts' consideration.

$$P = \frac{f}{n} X\ 100\%$$

Information:
P: Percentage figure for questionnaire data
F: Total score obtained
N: Maximum number of scores

Table 2. Criteria for Validity

Achievement score	Validation category
$81\% \leq p < 100\%$	Very valid
$61\% \leq p < 81\%$	Valid
$41\% \leq p < 61\%$	Enough
$21\% \leq p < 41\%$	Invalid
$0\% \leq p < 21\%$	Very Invalid

Source: Aswardi, 2019

The validation sheets from material, media, and language experts were calculated and analyzed to determine the validity criteria based on the provided table. Additionally, a student response questionnaire in this study utilized a Likert scale ranging from 1 to 5 to evaluate the practicality of Augmented Reality-based teaching modules in the learning process.

Table 3. Likert Scale Interpretation Criteria.

Score	Answers Criteria
5	SS = Strongly agree
4	S = Agree
3	RR = Undecided
2	KS = Disagree
1	TS = Disagree

Practicality analysis

The results of the practicality analysis were obtained from the student response questionnaire.

Table 4. Practicality Criteria

Achievement score	Validation category
80%≤ p <100%	Very practical
60%≤ p <80%	Practical
40%≤ p <60%	Practical enough
20%≤ p <40%	Less practical
0%≤ p <20%	Not practical

Source: Lestari & Yudhanegara, 2017

Effectiveness analysis

The effectiveness process is carried out through the paired sample T-Test and N-Gain Test. The prerequisite test stages that will be used in testing the effectiveness of this FlipHTML5 Interactive E-Book are as follows:

1) Normality test

This evaluation process involves using the Kolmogorov-Smirnov test, which will be run using the SPSS 23 software for the Windows platform. If the significance value of the test exceeds 0.05, then the data is considered to follow a normal distribution.

2) Hypothesis testing

Hypothesis testing is a technique used to make choices from data analysis.

a) Paired sample T-Test

A paired sample t-test will be applied to evaluate whether there is a significant difference in the improvement of student learning outcomes between pre-test and post-test scores. In the context of this study, the analysis can be done using a paired two-sample t-test, which will be run through the SPSS 23 program for Windows. The determination of the level of significance used is 0.05. The null hypothesis (Ho) will be accepted if the significance value is <0.05, while Ho will be rejected if the significance value is> 0.05. The following is an explanation of the research hypothesis:

- Ho (Null Hypothesis): There is no significant difference in learning outcomes between the pre-test and post-test data.
- Ha (Alternative Hypothesis): The pre-test and post-test data significantly differ in students' learning outcomes.

b) N-Gain Test

The N-Gain test was applied to evaluate the difference between the pre-test and post-test scores. By taking into account the difference between the pre-test and post-test scores. The N-Gain improvement score can be found by using the following formula:

$$N - Gain = \frac{score\ posttest - score\ pretest}{score\ ideal - score\ pretest}$$

Description: The ideal score is the maximum score that can be achieved

Classification of results based on the N-Gain score is done according to the N-Gain value or percentage (%) of the N-Gain value. The following is the classification category of the results of the N-Gain score:

Table 5. N-Gain Score Distribution Table

N-Gain Value	Category
$g < 0{,}3$	Low
$0{,}3 \leq g \leq 0{,}7$	Medium
$g > 0{,}7$	High

Source: Setiawan & Aden, 2020

3 Result

This research produces products in the form of Interactive E-Book Learning Media Based on FlipHTML5 in Improving Mathematics Learning Outcomes in Fifth Grade Students. The following are the stages of development to achieve the expected results:

3.1 Step One: Analysis

The analysis stage begins by evaluating the development of Interactive E-Book Learning Media and the suitability and requirements associated with its development. Some aspects that must be investigated include needs analysis: From the results of interviews with Mrs. Siti Asrofah, S.Pd.I. as the fifth-grade teacher, it shows that the class has never used Interactive E-Book media, the media commonly used are only pictures, books, and learning videos from YouTube, curriculum analysis: the curriculum applied for fifth grade refers to the Merdeka Curriculum which uses Learning Modules with Learning Outcomes, Learning Objectives and Flow of Learning Objectives suggested by the government and analysis of student learning outcomes: it was found that the learning outcomes of students who did not reach the MCC score were 46% which had an impact on their learning outcomes.

3.2 Step Two: Design

In the design stage, also known as the product design stage, various steps are taken to produce a product design. This design process involves several stages, including preparing teaching materials, preparing product formats, preparing product content, adding graphic elements, refining designs, and adding interactivity (sound, learning videos).

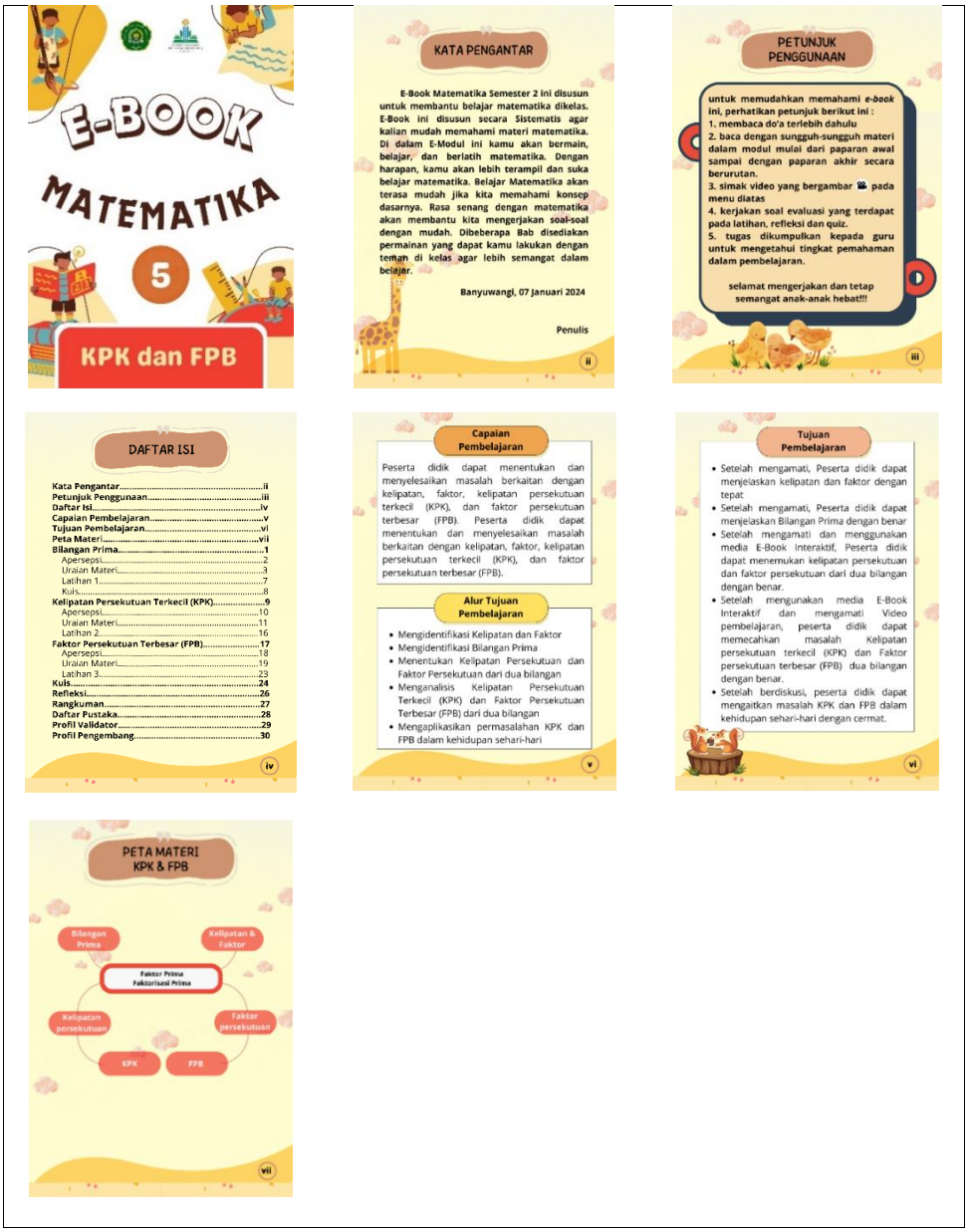

Figure 1 Introduction Page

Figure 2 Content page

Figure 3 Closing Page

3.3 Step Three: Development

The developed media was then assessed by expert validators, namely experts in the fields of material, media, language, and questions. This validation aims to evaluate the feasibility of the materials and media developed and assess how practical the learning media has been.

3.3.1 Media expert validation

The expert validation test was conducted to provide suggestions and assessments of FlipHTML5-based E-Book learning media before it was tested on students.

Table 6. Results of Learning Media Validation by Media Experts

Valid Aspects	Percentage Score	Criteria
View	89%	Very Valid
Audio	87%	Very Valid

Valid Aspects	Percentage Score	Criteria
Video	90%	Very Valid
Animation	89%	Very Valid
Ease of Media Use	95%	Very Valid
Overall Value	90%	Very Valid

Based on the results of the media validity test show that the percentage is 90%, which means it is in the Very Valid category.

3.3.2 Material expert validation

This validation test was conducted to provide suggestions and assessments of FlipHTML5-based E-Book learning media before being tested on students.

Table 7. Results of Learning Media Validation by Material Experts

Valid Aspects	Percentage Score	Criteria
Material	90%	Very Valid
Language	92%	Very Valid
Overall Value	91%	Very Valid

The results of the Material validity test show that the percentage is 91%, which means it is in the Very Valid category.

3.3.3 Language expert validation

This validation test was carried out by a language expert lecturer to provide suggestions and assessments of FlipHTML5-based E-Book learning media before it was tested on students.

Table 8. Results of Learning Media Validation by Linguists

Valid Aspects	Percentage Score	Criteria
Agility	88%	Very Valid
Communicative	93%	Very Valid
Dialogical and Interactive	90%	Very Valid
Overall Value	90%	Very Valid

Based on the results of the Language validity test show that the percentage is 90%, which means it falls into the Very Valid category.

3.3.4 Question expert validation

The fifth-grade teacher conducted this Validation Test to provide suggestions and assessments of the FlipHTML5-based E-Book learning media before it was tested on students.

Table 9. Results of Learning Media Validation by Problem Experts

Valid Aspects	Percentage Score	Criteria

Valid Aspects	Percentage Score	Criteria
Structure	94%	Very Valid
Contents	83%	Very Valid
Language	83%	Very Valid
Overall Value	86%	Very Valid

The results of the validity test of the Pre-test and Post-test questions show that the percentage is 86%, which means it is in a very valid category.

3.4 Step Four: Implementation

At the Implementation stage, a trial was conducted on fifth grade students consisting of 28 participants. This trial was conducted to evaluate the effectiveness of the media. The trial procedure involved giving pre-tests and post-tests directly at school. The following is an analysis of student learning outcomes in the form of pre-test and post-test:

Table 10. Pre-test Result

Criteria	N	P(%)	Description
<70	27	96%	Not complete
>70	1	4%	Completed

The table of pre-test results shows that 27 students are less than the minimum criteria, and one student reaches the minimum standard. So, the math lessons of LCM and GCF material in fifth grade are incomplete.

Table 11. Pre-test Results

Criteria	N	P(%)	Description
<70	0	-	-
>70	28	100%	Completed

The post-test results table shows that no students are less than the minimum standard, and those who reach the MCC are 28. So, the math lessons on LCM and GCF material in fifth grade are still complete. After the pre-test and post-test trials, a questionnaire analysis of students was conducted to find out the students' responses to the FlipHTML5-based E-book learning media. The following is an analysis of the results of students' responses to FlipHTML5-based E-book learning media:

Table 12. Student Response Questionnaire Results

Valid Aspects	Score	P(%)
Content/Material	678	96,8
Language	537	95,8
Interest	810	96,4
Media	404	96,1
Overall Value	2.429	96,38%

Based on the analysis of student responses to learning media, the final percentage of 96.38% suggests that student responses fall into the very practical category.

Based on the data above, the average percentage given by four validators, including material experts, media experts, linguists, and question experts, reached 90%, which indicates that the FlipHTML5-based E-Book learning media meets very valid criteria.

It is necessary to use the T-Test and the N-gain test To determine the effect of interactive E-Book learning media based on FlipHTML5 in improving learning outcomes. Before conducting the *T-test* and N-gain test, the prerequisite test was carried out first, namely the normality test. Prerequisite tests and, *T-Test* and N-gain tests are presented as follows:

Table 13. Normalization Test Results

One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		28
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	3.9602318
Most Extreme Differences	Absolute	.122
	Positive	.094
	Negative	-.122
Test Statistic		.122
Asymp. Sig. (2-tailed)		.065[c]

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

The results of the normality test using SPSS above show that the sig value is 0.065. From these results, it can be concluded that the sig value is> 0.05, which indicates that the data is normally distributed.

Table 14. Paired Sample T-Test Results

Paired Samples Test

	Paired Differences	t	df	Sig. (2-

					95% Confidence Interval of the Difference				tailed)
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Pretest - Posttest	-51.429	14.067	2.658	-56.883	-45.974	-19.345	27	0,000

From the Paired Sample T-test results using SPSS above, it can be concluded that the significance value (sig) is 0.000. That shows that sig has a value less than 0.05, indicating a significant effect after applying *FlipHTML5*-based E-Book learning media.

N-Gain Test Results

$$N - Gain = \frac{2580 - 1140}{1660} = 0{,}86$$

Based on the N-Gain test results, it can be concluded that the average N-Gain score of students' pre-test and post-test scores is 0.86. That indicates that the N-Gain value is in the range of 0.86. $g > 0{,}70$ with a high or effective category, and for the N-Gain percentage of 86.44% with an effective category.

3.5 Last Step: Evaluation

Evaluation is conducted to evaluate the validity, practicality, and effectiveness of the FlipHTML5-based interactive E-Book learning media. That involves analyzing data from validator assessments and student responses through questionnaires to assess the feasibility and success of the teaching materials that have been created.

4 Discussion

4.1 Validity and Design Quality

The study reports exceptionally high expert-validation scores across multiple domains—material, media, language, and assessment items—averaging 90 % and classifying the FlipHTML5 e-book as “very valid”. Such uniformly strong ratings suggest rigorous alignment with curriculum standards and sound instructional design. This is in line with what Sobhi stated in his research on the development of interactive e-books[28].

However, the near-ceiling effect in all validation categories may mask subtle deficiencies in multimedia integration or cognitive load management. For instance, while “ease of media use” scored 95 %, there is limited discussion of how page-turn animations or embedded quizzes scaffold learners’ metacognitive strategies[29].

Another study had only mentioned the relationship between interactive e-books with video feedback and student motivation[30].

4.2 Practicality and Student Engagement

With a student response practicality rating of 96.38 %, the e-book evidently resonated with its primary users. High scores for content clarity (96.8 %), interest (96.4 %), and media appeal (96.1 %) point to strong engagement affordances. That aligns with research by Mifsud et al. who found that e-books offer engagement affordances for parent-child joint reading, including personalized, shared, and interactive experiences[31].

In spite of that, the use of e-books requires both technical and adaptive strategies to align curriculum implementation with standards[32]. While e-books offer benefits such as portability and digital learning opportunities[33], effective use of e-books requires addressing adaptive challenges in teaching practices.

In addition, these aggregate percentages belie variability in individual digital literacy: no disaggregated data are provided to reveal whether less confident users struggled with navigation or multimedia controls. Whereas international standards recommend examining subgroup responses (e.g., based on prior tech experience) to uncover differential engagement patterns [2].

4.3 Effectiveness and Learning Gains

The paired-sample t-test indicated a highly significant improvement from pre- to post-test ($t = –19.345$, $p < 0.001$) , and the N-Gain of 0.86 (86.44 %) is classified as “highly effective.” These results align with meta-analytic evidence supporting interactive digital texts in mathematics[34].

Nonetheless, the absence of a control group limits causal inferences: improvements may partly reflect test–retest effects or maturation over the intervention period. Furthermore, without follow-up assessments, the study cannot ascertain long-term retention or transfer of LCM and GCF concepts.

4.4 Methodological Considerations and Limitations

While the ADDIE-based R&D framework provides a clear developmental pathway, reliance on a single classroom of 28 students constrains external validity. The normality test (Kolmogorov–Smirnov, $p = 0.065$) confirms parametric assumptions, yet small sample sizes reduce statistical power and inflate effect-size estimates. As stated by Peterson and Foley, that effect size, power, and α level are all important in the calculation of sample size needed to conduct a study[35].

Additionally, expert validators were drawn from within the same institution, which may introduce confirmation bias. In alignment with this, Unerman stated that expert validators should be drawn from different institutions to reduce confirmation bias in peer review and avoid self-referential echo chambers[36]. Similarly, Dror says that experts are prone to various biases, which can be reduced by attracting validators from different institutions[37]. Therefore, future studies should incorporate

randomized controlled trials across diverse schools and include inter-rater reliability metrics for validation instruments.

5 Conclusion

This study developed and evaluated the effectiveness of FlipHTML5-based e-book learning media to enhance mathematics learning outcomes for fifth-grade students. Using the ADDIE development model, the research demonstrated that the digital learning media met high validity standards (90% expert validation score), received strong student approval (96.38% practicality score), and significantly improved learning outcomes (N-Gain Score = 86.44%, $p < 0.05$). These findings confirm that well-designed digital learning resources can foster better engagement, comprehension, and academic achievement in primary education.

Despite its effectiveness, the study identified challenges related to digital accessibility, user adaptation, and technological infrastructure, particularly in schools with limited resources. Addressing these issues requires further refinements, such as ensuring device compatibility, enhancing teacher training, and providing offline access options for students with connectivity limitations.

This research contributes to the growing field of digital learning innovation, offering a scalable and interactive approach to mathematics education. Future studies should explore the application of FlipHTML5-based e-books in other subjects and educational levels to maximize their benefits across diverse learning contexts. Additionally, longitudinal research is needed to assess the long-term impact of digital learning media on student performance and retention. By integrating technology into pedagogical practices effectively, educators can create inclusive, engaging, and high-impact learning environments that align with 21st-century education demands.

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