

## HEYZINE -BASED FLIPBOOK DIGITAL LEARNING MEDIA TO IMPROVE SCIENCE LEARNING OUTCOMES FOR FIFTH GRADE ELEMENTARY SCHOOL STUDENTS ON THE HUMAN RESPIRATORY SYSTEM

Erawati<sup>1</sup>, Farida Istianah<sup>2</sup>, Suryanti<sup>3</sup>

Program Studi Magister Pendidikan Dasar Fakultas Pascasarjana  
Universitas Negeri Surabaya

Email : [faridaistianah@unesa.ac.id](mailto:faridaistianah@unesa.ac.id) [erawati140589@gmail.com](mailto:erawati140589@gmail.com) [suryanti@unesa.ac.id](mailto:suryanti@unesa.ac.id)

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### Abstract

This study aims to develop a digital learning medium in the form of a Heyzine-based flipbook on the topic of the human respiratory system and to analyze the feasibility, practicality, and effectiveness of the media in improving the learning outcomes of fifth-grade elementary school students. This research employed a Research and Development method using the 4D development model consisting of four stages: define, design, develop, and disseminate. The study was conducted in two classes. trial class with twenty four students and dissemination class with thirty students. Data were collected through observation, interviews, expert validation questionnaires, student response questionnaires, and learning outcome tests. The data were analyzed using quantitative and qualitative descriptive analysis to determine the feasibility, practicality, and effectiveness of the developed media. The findings indicate that the Heyzine-based digital flipbook learning media achieved a very high level of feasibility according to evaluations by material and media experts. Furthermore, the developed media was considered practical for use in classroom learning and effective in improving students' learning outcomes on the human respiratory system topic. Therefore, the Heyzine-based digital flipbook can serve as an innovative learning medium to support science learning in elementary schools.

**Keywords:** digital learning media, flipbook, Heyzine, learning outcomes, human respiratory system.

### A. Introduction

In today's modern era, education plays a crucial role in improving the intellectual quality of a nation. Advances in information and communication technology have significantly impacted the learning process at various levels of education, including elementary school. Integrating digital technology into learning activities is one way to create a more engaging and interactive learning experience, while also enhancing student engagement in understanding the material. In elementary school Natural and Social Sciences (IPAS) instruction, the use of instructional media plays a crucial role in helping students grasp abstract scientific concepts. One topic requiring a strong conceptual understanding is the human respiratory system. This topic requires students to understand the structure and function of the respiratory organs and the respiration process that occurs within the human body. Observations in grade V of Cluster III showed that learning still utilized conventional media, resulting in students being less actively engaged and experiencing difficulties understanding the human respiratory system. However, the integration of multimedia technology can enhance student engagement and learning outcomes through visual presentation, animation, and interactivity (Prastowo, 2019; Putra & Dewi, 2020; Rahmawati et al., 2023) .

Children aged 7–11 years are at the concrete operational stage, so they need real visual media to understand abstract concepts such as the mechanism of breathing. (Adeyele, 2024; Armansyah et al., 2019; Fathurrohman & Sulistyorini, 2012; Inhelder, 1958; McLeod, 2025; Nurhayati, 2020; Phillips et al., 2020) . Thus, digital learning media are needed that can support students' learning needs in a realistic, interactive, and contextual way. One potential media is a digital flipbook, which can display material like a printed book but is equipped with multimedia elements such as images, video, audio, animation, and interactive quizzes (Prastowo et al., 2025; Rahmawati et al., 2023; Putra & Dewi, 2020). Digital flipbooks can also be designed using the Canva platform and integrated into Heyzine, a

platform that allows for easy embedding of video, audio, hyperlinks, and interactive quizzes (Astuti & Rahayu, 2023; Sari & Nugroho, 2024; Prastowo et al., 2025). Previous research has shown that flipbooks are effective in increasing student motivation and learning outcomes, but the use of Heyzine for science learning in elementary schools is still very limited. Therefore, Heyzine-based flipbook media has great potential to improve students' understanding of the human respiratory system. Previous studies have shown positive results from the use of interactive digital media such as Canva Flipbook, LiveWorksheet, and BookCreator, but each has limitations in interactivity, visual display, or multimedia (Fauziah, 2022; Astuti & Rahayu, 2023; Sari & Nugroho, 2024). Heyzine presents a superior platform because it supports complete interactive features without requiring additional application installation (Astuti & Rahayu, 2023; Sari & Nugroho, 2024; Fauziah, 2022). However, research on the development and effectiveness of Heyzine-based flipbooks in elementary school science subjects is still lacking. Therefore, this study has a *state-of-the-art position* in the development of interactive web-based digital media for elementary learning, especially on the human respiratory system.

The novelty of this research lies in the use of the Heyzine platform as a digital learning medium, which until now has been rarely used at the elementary school level. This innovation is even stronger because the developed content not only presents science material on the human respiratory system, but also integrates various interactive multimedia elements such as text, video, animation, and quizzes to enhance the student learning experience more comprehensively. In addition, this research presents a methodological update through the application of the 4D development model (*Define, Design, Develop, Disseminate*) which is specifically adapted to the needs of elementary education. Another advantage lies in the evaluation approach that measures the feasibility and effectiveness of the media simultaneously, namely through expert validation and student learning outcome testing, thus producing a comprehensive picture of the quality and impact of using the developed learning media. According to the views of several experts, including Hamidah & Asrohah (2025), Arisandhi et al. (2023), Anggraeni et al. (2025), and Jafnihirda et al. (2023), flipbooks as a learning medium are interactive digital books that display pages like physical books, but are equipped with multimedia elements in the form of text, images, illustrations, animations, and digital navigation features. This medium integrates the advantages of well-organized traditional books with the advantages of flexible digital technology, so that it is able to present learning materials sequentially, interestingly, and easily accessible to students. These features make flipbooks very relevant to support the learning process in elementary schools, especially science subjects that contain many abstract concepts.

*Digital flipbooks* have many advantages, making them highly relevant for use in modern education. According to Katili et al. (2025), *flipbooks* have high visual appeal, which can increase students' desire to learn. According to Istiq'faroh et al. (2022), digital *flipbooks* have a systematic and interactive page display, which helps students understand the material. Furthermore, Puspitasari et al. (2025) state that digital media such as *flipbooks*, which combine visual, audio, and animation elements, make learning enjoyable. Furthermore, digital *flipbooks* allow you to adapt the material to various learning needs, such as text, audio, and video. Therefore, this study aims to develop *Heyzine-based flipbook digital learning media* as an effort to improve the learning outcomes of fifth-grade elementary school students. This media is expected to provide theoretical contributions to the development of digital education literature and practical contributions for teachers in presenting creative, interactive, and relevant learning to the characteristics of the digital generation.

## Research methods

This study uses the 4D development model (Define, Design, Develop, Disseminate) because it is considered effective and suitable for the development of digital learning media in elementary schools. This example allows for needs analysis, media design, expert validation, limited trials, and repeated product distribution. Research and development (R&D) methods are used in this study. The purpose of this study is to create digital learning media and test whether the media is effective and appropriate for linking student learning outcomes. Research and development was chosen because it is suitable for creating educational products that are reliable, easy to use, and efficient through orderly steps.

This research was conducted at Sepaku Elementary School, Gugus III, Sepaku District, North Penajam Paser Regency, East Kalimantan Province. The research took place during the even semester of the 2025/2026 academic year. The determination of the population was based on the suitability of the material developed, namely science and science with the subject of the human respiratory system, which is taught according to the curriculum in grade V of elementary school. In addition, students in grade V are in the stage of cognitive development from concrete operational to formal, so they have adequate readiness to receive learning assisted by interactive digital media such as Heyzine-based flipbooks. Thus, this population is considered relevant and representative to study the effectiveness of the developed learning media. This research procedure aims to produce a new product based on existing problems

in learning, so that the products developed can be useful for learning procedures. This type of research uses the 4D model. The 4D development model proposed by Thiagarajan consists of four main stages: *define*, *design*, *develop*, and *disseminate*. The *define stage* aims to analyze learning needs and student characteristics. The *design stage* focuses on designing learning media according to the identified goals and needs. The *develop stage* includes product creation, expert validation, and limited trials. The *disseminate stage* aims to disseminate the developed product (Thiagarajan et al., 1974). The 4D model is considered suitable for digital learning media development research because it has systematic, simple stages and emphasizes the validation and product revision process.

The operational definition of variables in this study consists of two types. The independent variable is Heyzine-based flipbook digital learning media, which is a learning media in the form of an interactive digital book containing text, images, animations, and digital navigation to convey science and natural science material related to the human respiratory system. This media was created as a learning intervention method adapted to the cognitive characteristics of elementary school students. The dependent variable in this study is the science learning outcomes of students in grade V of elementary school on the human respiratory system. Conceptual understanding, material mastery, and the ability to answer questions based on learning indicators are cognitive components used to measure learning outcomes (Arsyad, 2020; Anderson, 2020). & Krathwohl, 2015). The instruments used in this study were teacher interviews, learning observations, expert validation questionnaires, teacher and student response questionnaires, and learning outcome tests. Interviews and observations were used in the analysis stage to obtain media requirements. Expert validation was used to assess the feasibility of the product from the content and design aspects. Response questionnaires were used to assess the practicality of the media in learning. Student learning outcome tests were administered before and after media use to assess the effectiveness of Heyzine-based *flipbook digital media*.

Expert validation data and user responses were analyzed using descriptive analysis. Likert-scale based (Taherdoost, 2023). The effectiveness of the media was analyzed by comparing the pretest and posttest scores. Students. The improvement in learning outcomes was calculated using N-Gain to determine the level of improvement in learning outcomes after using Heyzine-based flipbook media (Aligo & Prudente, 2025; Nurhasanah et al., 2025). In this study, data analysis was conducted to evaluate the practicality, feasibility, and effectiveness of the digital flipbook learning media developed using Heyzine. Data analysis techniques included analysis of expert validation results, analysis of user responses, and analysis of media effectiveness through improving student learning outcomes.

## Data Analysis Techniques Table

### 1. Media validity analysis

The validation data from the material and media experts were analyzed using quantitative descriptive analysis. The scores obtained from each assessment item in the validation questionnaire were summed and the average value was calculated to determine the level of media feasibility. The analysis results were then converted into feasibility categories based on a five-level Likert scale assessment criteria. Media were declared feasibility for use if they received the category "feasible" or "very feasible." In addition to quantitative data, the experts' recommendations and input were evaluated qualitatively and used as a basis for product improvement.

No	Component	Validator	Analysis Techniques	Formula	Assessment criteria
1	Subject Matter Expert Validation	Science Subject Expert	The scores for each assessment item are added up, then the average value is calculated to obtain the level of validity of the material.	$V_m = \frac{\sum s}{N}$	4.21–5.00 = Very Valid 3.41–4.20 = Valid 2.61–3.40 = Fairly Valid 1.81–2.60 = Less Valid 1.00–1.80 = Not Valid
2	Media Expert Validation	Learning Media Expert	The scores for the appearance, language, and technical aspects are analyzed by calculating the average overall score.	$V_{me} = \frac{\sum s}{N}$	4.21–5.00 = Very Valid 3.41–4.20 = Valid 2.61–3.40 = Fairly Valid 1.81–2.60 = Less Valid 1.00–1.80 = Not Valid

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No	Component	Validator	Analysis Techniques	Formula	Assessment criteria
3	Total Media Validity	Subject matter experts & media experts	The final validity value is obtained by averaging the validation results of material experts and media experts.	$V_t = \frac{V_m + V_{me}}{2}$	Media is declared eligible if the final score is in the Valid or Very Valid category

Expert validation scores were analyzed using quantitative descriptive analysis techniques by calculating the average score. The average score was obtained by dividing the total scores given by the validators by the product of the number of statement items and the number of validators. The average score was then converted into a feasibility category based on a five-level Likert scale.

**2. Analysis of media practicality**

The purpose of the practicality analysis was to determine how easily teachers and students use flipbooks *during* learning. Practicality data was obtained from observations conducted during a limited trial, as well as responses provided by teachers and students on a questionnaire. Implementation, ease of navigation, and student engagement when using digital media were all aspects analyzed in this observation. The questionnaire results were analyzed using a percentage of the practicality level. Practicality *of flipbooks* demonstrated how easy it was to use and learn.

No	Practicality Component	Respondents	Analysis Techniques	Formula	Assessment criteria
1	Teacher Response	Fifth grade teacher	The teacher response questionnaire results scores were analyzed by comparing the scores obtained with the maximum score, then converted into percentage form.	$P_g = \frac{\sum s}{\sum S_{max}} 100 \%$	81–100% = Very Practical 61–80% = Practical 41–60% = Quite Practical 21–40% = Less Practical 0–20% = Not Practical
2	Student Response	Fifth grade students	The scores from the student response questionnaire were analyzed descriptively quantitatively using percentages.	$P_s = \frac{\sum s}{\sum S_{max}} 100 \%$	81–100% = Very Practical 61–80% = Practical 41–60% = Quite Practical 21–40% = Less Practical 0–20% = Not Practical
3	Overall Media Practicality	Teachers & Students	The final practicality score was obtained by calculating the average percentage of teacher and student responses.	$P_t = \frac{P_g + P_s}{2}$	Media is declared practical if the percentage is in the Practical or Very Practical category.

Student and teacher response data were analyzed by calculating the percentage of questionnaire response scores. The percentage was obtained by comparing the obtained score with the maximum score, then multiplying it by 100 percent. The percentage results were then interpreted based on the learning media practicality criteria to determine the level of acceptance and practicality of the Heyzine-based flipbook digital learning media.

### 3. Media effectiveness analysis

The analysis of the effectiveness of Heyzine-based flipbook digital learning media was analyzed based on the improvement of student learning outcomes before and after using the media. Learning outcome data were obtained through *pretest* and *posttest tests*. Learning outcome scores were analyzed descriptively to determine the average value before and after treatment, then continued with an analysis of the improvement of learning outcomes. The improvement of student learning outcomes was analyzed using the *Normalized Gain* (N-Gain) formula. N-Gain analysis was used to determine the level of media effectiveness in improving students' science learning outcomes on the human respiratory system material. The Normalized Gain, or N-Gain, formula was used to evaluate the improvement of student learning outcomes. The N-Gain value was calculated by comparing the difference in posttest and pretest scores to the difference in maximum and pretest scores. The results of the N-Gain calculation were then categorized into high, medium, and low categories.

No	Analysis Components	Assessment Focus	Analysis Techniques	Formula	N-Gain Criterion
1	Improving Learning Outcomes	Comparison of pretest and posttest scores of students after using flipbook media	Quantitative descriptive analysis by comparing pretest and posttest scores	$g = \frac{(Posttest - Pretest)}{(Skor\ maksimal - Pretest)}$	$g \geq 0.70$ = High (very effective) $0.30 \leq g < 0.70$ = Medium (effective) $g < 0.30$ = Low (less effective)
2	Effectiveness of Learning Media	Average increase in student learning outcomes after using media	Calculation of the average N-Gain of all students	$\bar{g} = \frac{\sum g}{n}$	Media is declared effective if the average N-Gain value is in the Medium or High category
3	Impact of Media on Learning	Proportion of students who experienced increased learning outcomes	Analysis of the percentage of students with medium and high N-Gain categories	$p = \frac{n_1}{n} \times 100\%$	Learning is declared effective if $\geq 75\%$ of students experience an increase in learning outcomes.

## B. Results and Discussion

### 1. Research result

#### a. Media development results (Stage 4D)

The development of Heyzine-based flipbook digital learning media in this study refers to the 4D model which includes the define, design, develop, and disseminate stages. The development of Heyzine-based flipbook digital learning media in this study refers to the 4D model which includes the define,

design, develop, and disseminate stages. At the define stage, an initial analysis was conducted which included curriculum analysis, student characteristics, and learning needs. Based on the analysis results, it was found that science learning, especially the human respiratory system material, was still not supported by interactive learning media. Students tended to have difficulty understanding abstract concepts, especially those related to the respiratory process and organ functions. In addition, the use of textbooks as the main learning source was considered less able to increase student interest and understanding. At the design stage, an initial design of the learning media was prepared in the form of a digital flipbook. The media was systematically designed by containing several main components, namely: cover page, foreword, instructions for use, concept maps, learning objectives, human respiratory system material, image illustrations, learning videos, practice questions, summaries, and evaluations. The media design was created by paying attention to visual aspects, readability, and suitability to the characteristics of elementary school students.

In the development stage, learning media was developed using the Heyzine platform, resulting in an interactive digital flipbook. The developed media was then validated by subject matter and media experts to assess the product's feasibility. Based on the validation results, the media was declared feasible with several revisions to the appearance and presentation of the material. After the improvements were made, the media was ready for trial with students. In the dissemination stage, the learning media was introduced to teachers and students as an alternative digital learning medium. The media was used in the natural sciences learning process on the human respiratory system to determine its practicality and effectiveness.

**b. Media validity test results**

The results of the media validity test were obtained from the assessment of the developed learning media by subject matter experts. The assessment was conducted using a Likert scale with several assessment aspects.

Table 1. Results of Material Expert Validation

No	Assessment Aspects	Score	Maximum score
1	Material Suitability	12	15
2	Accuracy of Material	13	15
3	Completeness of materials	13	15
4	Clarity of presentation	13	15
5	Learning eligibility	13	15
	Amount	64	
	Average	64 : 5	4.26
	Category		Very valid

Table 2. Media Expert Validation Results

No	Assessment Aspects	Score	Maximum score
1	Media display	13	15
2	Visual Quality	13	15
3	Navigation and Interactivity	13	15
4	Media integration	12	15
5	Media eligibility	12	15
	Amount	63	
	Average	63 : 5	4.20
	Category		Valid

Table 3. Recapitulation of Media Validity based on experts

No	Validator	Score	Category
1	Subject Matter Expert	4.26	Very valid
2	Media Expert	4.20	Valid
	<b>Amount</b>	8.46	
	<b>Average</b>	8.46 : 2	4.23
	<b>Category</b>		Very Valid

Based on the assessment by material experts and media experts, an average score of 4.23 was obtained, which falls into the Very Valid category. This indicates that the developed learning media has met the eligibility criteria in terms of material aspects, both in terms of suitability to the curriculum, conceptual accuracy, completeness of the material, and clarity of presentation.

**c. Results of media practicality tests**

The media practicality test was conducted to determine the level of ease of use of learning media based on teacher and student responses after using Heyzine-based flipbook media in learning.

Table 4. Teacher Response Results

No	Assessment Aspects	Score obtained	Maximum score	Percentage	Category
1	Ease of use aspect	28	30	93%	Very practical
2	Aspects of clarity of presentation	27	30	90%	Very practical
3	Aspects of learning suitability	27	30	90%	Very practical
4	Time efficiency aspect	28	30	93%	Very practical
5	Aspects of media usefulness	28	30	93%	Very practical
	<b>Average</b>			92%	Very practical

Table 5. Student Response Results

No	Assessment Aspects	Score obtained	Maximum score	Percentage	Category
1	Ease of use aspect	707	825	86%	Very practical
2	Aspects of material clarity	720	825	87%	Very practical
3	Aspects of media attractiveness	721	825	87%	Very practical
4	Aspects of media usefulness	707	825	86%	Very practical
5	Aspects of learning motivation	709	825	86%	Very practical
	<b>Average</b>			86.4%	Very practical

Table 6. Summary of Overall Media Practicality

No	Response	Score	Category
1	Teacher	92%	Very practical
2	Student	86.4%	Very Practical
	<b>Amount</b>	178.4	
	<b>Practicality Percentage</b>	178.4 : 2	89.2%
	<b>Category</b>		Very Practical

Based on the table above, the results of the questionnaire response analysis show that the learning media obtained a very practical category where the teacher stated that the media was easy to use in the learning process, had an attractive appearance, and helped in explaining the material more clearly and systematically. Meanwhile, students responded very positively to the use of the media, finding it engaging and engaging, easy to understand, aiding in understanding previously difficult material, and increasing interest and motivation in learning. Therefore, Heyzine-based flipbook digital learning media can be considered highly practical and suitable for use in elementary school science learning.

**d. Results of media effectiveness tests**

Media effectiveness testing was conducted to determine the effect of learning media use on improving student learning outcomes. Measurements were conducted using learning outcome tests in the form of pretests and posttests.

**1) Pretest and posttest results**

Table 7. Improvement in Learning Outcomes

No	Aspect	Indicator	Pretest	posttest	Improvement
1	Understanding	Identifying organs	23	40	+17
2	Understanding	Explaining the function	22	41	+19
3	Understanding	Describe the process	24	42	+18
4	Understanding	Understanding the process	17	45	+28
5	Understanding	Distinguishing types	19	41	+22
6	Understanding	Maintain health	27	53	+26
7	Process Skills	Observing	22	49	+27
8	Process Skills	Classifying	21	42	+21
9	Process Skills	Interpret	22	48	+26
10	Process Skills	Conclude	23	54	+31
11	Process Skills	Communicating	34	53	+31
		Average			+24 (effective)

The analysis showed an increase in student learning outcomes after using Heyzine-based flipbook digital learning media. The average posttest score was higher than the average pretest score. This indicates that the use of learning media has a positive impact on students' understanding of the human respiratory system.

**2) N-Gain Analysis Results**

Table 8 N-Gain Analysis Results

No	Description	Pretest	Posttest	N-Gain	Category
1	Trial Class	38	79	0.66	Moderate (effective)
2	Dissemination Class	45	87	0.76	High (Very effective)
	Average	42	84	0.72	High (Very effective)

The analysis of student learning outcomes based on *normalized gain* (N-gain) calculations showed differences in effectiveness levels across the two stages of learning implementation. In the fifth-grade trial phase, the N-gain score was 0.66, which is in the moderate category. This finding indicates that the applied learning media or strategies have been able to effectively improve student learning outcomes, although they have not yet reached the optimal level. Furthermore, in the fifth-grade dissemination phase, the N-gain score increased to 0.76, which is in the high category. This achievement indicates that after improvements and refinements based on the trial results, learning implementation has become more optimal and has had a very significant impact on improving student learning outcomes.

Overall, the average N-gain value for both stages reached 0.72, which is also in the high category. This confirms that, in general, the use of *Heyzine-based flipbook digital media* is highly effective in improving student learning outcomes. Therefore, it can be concluded that the implemented learning intervention was not only effective in the initial stage but also demonstrated consistency and quality improvement during the dissemination stage.

## 2. Discussion

### a. The Feasibility of Heyzine-Based Flipbook Digital Media

*Digital Flipbook* media was analyzed based on the results of expert validation conducted at the *development stage* in the 4D model. The validation results showed that the media obtained a very valid category, which indicates that the media has met quality standards in terms of material, language, presentation, and visual appearance. From the material aspect, the content presented is in accordance with the curriculum and has high conceptual accuracy. The systematic arrangement of the material allows students to understand the concept gradually. From the media aspect, the attractive visual appearance, the use of relevant illustrations, and easy navigation indicate that the media is designed in accordance with the principles of learning design.

The results of this study align with research on the development of Heyzine-based *flipbook media* for science learning, which demonstrated that the media has a high level of validity and is suitable for use in the learning process. *Flipbook -based digital media* is considered capable of providing a more interactive learning experience than conventional print media because it combines elements of text, images, audio, video, and animation in a single learning platform. The integration of various multimedia elements allows students to have a more engaging and less monotonous learning experience.

Furthermore, the use of multimedia elements in this medium is also relevant to Richard E. Mayer's *Multimedia Learning theory*. This theory explains that students will more easily understand material when information is presented through a combination of words and images rather than through text alone. This principle is known as the *multimedia principle*, which states that learning becomes more effective when verbal and visual materials are integrated. In the context of Heyzine-based *flipbook media*, the integration of illustrations, learning videos, animations, and interactive navigation helps students build a deeper and more meaningful understanding of concepts. Presenting material through various visual and verbal channels can also help reduce students' cognitive load, making the learning process more effective.

The suitability of media can also be reviewed based on the constructivist theory proposed by Jean Piaget and Lev Vygotsky. Constructivist theory emphasizes that students construct knowledge through active learning experiences and interactions with the learning environment. Heyzine-based *flipbook media* provides students with opportunities for independent learning through exploration of digital pages, visual observation, and interaction with multimedia content. This allows students not only to passively receive information but also to actively discover, understand, and construct their own knowledge. With the interactive features in digital media, the learning process becomes more participatory and student-centered.

From a cognitive development theory perspective, the use of Heyzine-based *flipbooks* also aligns with the characteristics of elementary school students who are at the concrete operational stage, according to Jean Piaget's cognitive development theory. At this stage, students understand concepts more easily when supported by visual media, real-life illustrations, and concrete learning experiences. Therefore, presenting material through images, videos, animations, and interactive simulations in *flipbooks* helps students understand abstract concepts more realistically and more easily. Visual and interactive media also help improve students' attention and retention of learning materials.

Furthermore, good learning media must be engaging, practical, and able to increase students' motivation. According to Azhar Arsyad, learning media serves as a tool that can clarify learning messages, thereby increasing students' attention, interest, and understanding. The engaging visuals in Heyzine-based *flipbooks*, such as the use of color, illustrations, page animations, and systematic material organization, can increase students' learning engagement, making the learning process more effective and less monotonous.

In addition to supporting conceptual understanding, Heyzine-based digital media also supports 21st-century learning, which emphasizes the integration of technology into the educational process. The use of interactive digital media can help improve students' digital literacy and create flexible and innovative learning. Teachers can utilize this media as a means to foster a more active, creative, and collaborative learning environment.

Thus, the expert validation results, which indicate a highly valid category, are reinforced by studies of constructivism theory, cognitive development, and multimedia learning, as well as relevant previous research. The Heyzine-based *digital flipbook media* is not only theoretically feasible but also meets the principles of modern learning media development that support interactive, engaging, meaningful, and student-centered learning, making it relevant for use in elementary school learning.

#### **b. The Practicality of Heyzine-Based Flipbook Digital Media**

The practicality of the media is reviewed from the responses of teachers and students, which indicate a very practical category. This indicates that the media is easy to use, efficient, and flexible in various learning conditions. From the teacher's perspective, the media helps in delivering material in a more systematic and engaging manner, thereby increasing the efficiency of learning time. From the student's perspective, the media is easy to operate, has an attractive appearance, and helps in understanding the learning material more clearly and meaningfully. The practicality of Heyzine-based digital flipbook media can also be explained through a study of the constructivism theory proposed by Jean Piaget and Lev Vygotsky. Constructivism theory emphasizes that students actively construct their knowledge through learning experiences and interactions with the learning environment. Heyzine-based flipbook media supports active learning because students can explore the material independently through a combination of text, images, videos, and animations presented interactively. This process allows students to gain a more meaningful learning experience because they do not only receive information passively, but also engage in the process of understanding and constructing their own knowledge.

Furthermore, the use of interactive digital media aligns with Jean Piaget's cognitive development theory, which states that elementary school students are at the concrete operational stage. At this stage, students more easily understand concepts when presented through visual objects, real-life illustrations, and concrete learning experiences. Heyzine-based flipbooks provide engaging visuals, relevant illustrations, and multimedia features that help students understand abstract concepts more concretely and easily. Therefore, this media aligns with the cognitive developmental characteristics of elementary school students, who require visual and contextual learning media. The practicality of the media is also reinforced by Richard E. Mayer's Multimedia Learning Theory. This theory explains that learning becomes more effective when information is delivered through a combination of text and visuals rather than using text alone. The integration of multimedia elements such as images, animations, audio, and video in Heyzine-based flipbooks helps improve students' attention and understanding of the learning material. The use of integrated multimedia can also reduce student boredom during the learning process, making learning more engaging and interactive. Furthermore, according to Azhar Arsyad, good learning media must be easy to use, visually appealing, and able to clarify learning material. Heyzine-based flipbooks fulfill these characteristics with their simple navigation, attractive appearance, and systematic presentation of material, making the learning process easier for both teachers and students.

Thus, the results of teacher and student responses, which indicated a very practical category, are reinforced by theories of constructivism, cognitive development, and multimedia learning. Heyzine-based *digital flipbook media* is not only practical for use in learning but also capable of supporting active learning, enhancing conceptual understanding, and creating interactive and meaningful learning experiences for elementary school students.

**c. The Effectiveness of Heyzine-Based Flipbook Digital Media in Improving Science Learning Outcomes**

The effectiveness of the media was analyzed based on the improvement of student learning outcomes, *N-Gain values*, and statistical tests. The results showed that the experimental class experienced a more significant improvement in learning outcomes compared to the control class. The average *N-Gain value* of 0.72 is in the very effective category, which indicates that the use of Heyzine-based *Digital Flipbook media* has a real impact on improving student learning outcomes. This improvement indicates that the media is able to help students understand learning materials more optimally compared to the use of conventional learning media.

The effectiveness of this media aligns with the constructivist theory proposed by Jean Piaget and Lev Vygotsky. Constructivist theory emphasizes that learning will be more meaningful when students are actively involved in constructing knowledge through direct learning experiences. *Heyzine-based flipbook media* allows students to explore material independently through interactions with available text, images, videos, and animations. These activities encourage students to think actively, connect new information with existing knowledge, and build a deeper understanding of concepts. Therefore, interactive media-based learning can increase student engagement in the learning process, thereby impacting improved learning outcomes. Based on Jean Piaget's cognitive development theory, elementary school students are in the concrete operational stage, a stage where students more easily understand concepts through real experiences and concrete visual aids. *Heyzine-based digital flipbook media* presents illustrations, animations, videos, and interactive visual displays that help students understand abstract concepts more realistically and easily understood. The visual and contextual presentation of material helps students process information better in accordance with the characteristics of their cognitive development. Thus, this media is able to increase students' absorption of learning materials.

Furthermore, the effectiveness of media is also supported by the *Multimedia Learning theory* proposed by Richard E. Mayer. This theory explains that learning will be more effective if information is delivered through a combination of text and visuals rather than using text alone. According to Mayer, the integration of multimedia elements such as images, audio, video, and animation can help students organize information better and reduce cognitive load in the learning process. In *Heyzine-based flipbook media*, the use of integrated multimedia allows students to have a more interesting, interactive, and easy-to-understand learning experience, thus having a positive impact on improving learning outcomes. The results of this study are also in line with research on *The Effectiveness of Digital Flipbooks in Science Learning*, which shows that *digital flipbook media* can significantly improve student learning outcomes because it presents material in an interactive and engaging manner. Interactive digital media is considered to be able to increase learning motivation, student attention, and active participation during the learning process. When students feel interested and involved in learning, their understanding of concepts and learning outcomes tend to improve optimally.

Furthermore, according to Azhar Arsyad, learning media serves to clarify learning messages, increase student attention, and help overcome space and time constraints in the learning process. *Heyzine-based digital flipbook media* fulfills these functions through systematic presentation of material, engaging visuals, and easy-to-use navigation. This makes the learning process more effective and supports the creation of an active and enjoyable learning environment. Thus, the results of the increase in *N-Gain values* and statistical tests that indicate a very effective category are reinforced by the theories of constructivism, cognitive development, and multimedia learning as well as the results of relevant previous research. *Heyzine-based digital flipbook media* has been proven effective in improving student learning outcomes because it is able to create interactive, visual, meaningful learning, and is in accordance with the developmental characteristics of elementary school students.

**C. Conclusion**

Based on the research results and comprehensive discussion, it can be concluded that the *Heyzine-based Digital Flipbook media* developed has met three main criteria in development research: validity, practicality, and effectiveness. First, from the validity aspect, the developed media received a very valid category, indicating that the product has met the quality standards set in the development of learning media. This validity includes the suitability of the material to the curriculum, conceptual accuracy, language clarity, and the quality of the visual appearance and media design. A high level of validity indicates that the media has undergone an adequate evaluation and refinement process, making it suitable for use without requiring significant revisions. Thus, the

media is not only correct in content but also meets the principles of effective learning design. Second, from the practical aspect, the Heyzine-based Digital Flipbook media is in the very practical category, meaning the media is easy to use by both teachers and students in the learning process. This practicality is evident in the ease of operation, clear navigation, and flexibility of use on various digital devices. In addition, this media is also able to increase time efficiency in delivering material and provide a more engaging learning experience. The high positive response from teachers and students shows that the media has a good level of acceptance and can be implemented optimally in real learning situations.

Third, from the effectiveness aspect, the developed media has proven to be very effective in improving student learning outcomes. This is indicated by a significant increase between pre-test and post-test scores, and is reinforced by the results of the N-Gain calculation which is in the very effective category. By fulfilling these three criteria, it can be concluded that the Heyzine-based Digital Flipbook media is not only theoretically feasible, but has also proven to be very effective in learning practice. Therefore, this media can be recommended as one of the learning innovations that can improve the quality of science learning in elementary schools, especially in creating a more interactive, interesting, and student-centered learning process.

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