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Assisted E-Book Media Development Hyzine-Flipbook Food Chain Materials Science Subjects to Increase Students' Interest in Learning in Elementary School

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A B S T R A C T

Modern elementary education struggles with engaging science instruction, particularly for abstract concepts like food chains requiring complex visualization. Traditional media fails to capture student attention, necessitating innovative digital solutions aligned with contemporary learning preferences. This study develops and evaluates Hyzine-Flipbook assisted e-book media effectiveness for teaching food chain concepts to fifth-grade students, measuring impact on learning outcomes and academic interest levels. Research and Development methodology with ADDIE framework was implemented across three elementary schools. Data collection involved pre-test/post-test assessments, questionnaire surveys, and expert validation from material, media, and language specialists. Statistical analysis included normality tests, homogeneity analysis, N-Gain calculations, and independent t-tests. Results: Experimental groups showed superior performance with N-Gain scores of 73-81 versus control groups' 19-20. Statistical analysis revealed highly significant differences ($p < 0.001$) with mean improvements exceeding 30 points. Student responses indicated "Very Feasible" qualifications (81-93%) for experimental groups, while expert validation achieved 88% (material), 80% (media), and 84% (language) scores. Hyzine-Flipbook assisted e-book media significantly enhances food chain comprehension and stimulates learning interest through interactive multimedia integration, representing a scalable solution for transforming elementary science education digitally.

1. Introduction

Modern education faces a major challenge in creating meaningful and relevant learning for students in the digital age. As a transformative process that aims to develop human potential holistically, education must be able to adapt to technological developments and contemporary learning needs (Afifah & Mulyani, 2022). In the context of science learning in elementary schools, especially natural

and social sciences (ipas) subjects, students often have difficulty understanding abstract concepts such as food chains due to the limitations of conventional learning media. Education includes not only knowledge transfer, but also the formation of continuous interest and motivation to learn (Akram et al., 2022). Therefore, the development of interactive learning media based on digital technology is an urgent need to improve the quality of learning, especially in helping students visualize and understand complex science concepts through a more interesting and easy-to-understand approach. Education is seen as a transformation that a person experiences to achieve educational goals (Afifah & Mulyani, 2022). Education serves as an investment in human resources, where individuals play the role of agents and beneficiaries of national development. Education also encourages creativity and innovation to face the changing times (Andes et al., 2024). Learning media plays an important role in improving learning outcomes. Educators today can use a variety of media, including visual, audio, and digital, to facilitate student understanding (Akram et al., 2022)

Although media plays an important role, existing learning media is often not engaging enough to increase students' interest. Therefore, creative and innovative use of media is necessary. Visual media can grab students' attention and direct them to the subject matter. The proper use of media can make learning more enjoyable. The effectiveness of media depends on its ability to support the learning process through various forms of content, such as images, videos, and interactive educational games. The relationship between the media and teaching materials is essential to increase students' interest in learning. Without the right media, students may have difficulty understanding the material presented (Andes et al., 2024) Teaching materials are an important element in the curriculum that students must master to achieve educational goals (Aprianis et al., 2022). Teaching materials can be in the form of written texts or digital resources that support teachers in the learning process. Ariya & Arini (2021) states that teaching materials are systematically arranged to create a positive and focused learning environment. The development of teaching materials must pay attention to the characteristics of students to support effective learning (Ariya & Arini, 2021)

Interest in learning is a psychological factor that encourages individuals to achieve learning goals. When students are interested in a material, they will be more focused and happy (Prabowo et al., 2023) On the other hand, if they are not interested, students will have difficulty learning. Therefore, interest needs to be built so that students can be more focused and accomplished. Teachers act as motivators to create an interesting atmosphere and motivate students (Aswar et al., 2024) must constantly improve their pedagogical skills so that students are interested in learning and actively participating. In the digital era, technology has an increasingly important role in education. Technology offers new ways to engage students and enrich the learning experience. One of the emerging technologies is e-books or digital books that can be accessed using devices such as computers, tablets, or mobile phones. E-books are more affordable and durable than physical books because they do not deteriorate easily over time (Cahyono, 2023). Additionally, e-books allow for the incorporation of multimedia elements, such as images, videos, and audio, which can enhance student interaction with the material (Pinta et al.,

2024). Therefore, e-books are important in modern education because they increase student accessibility and engagement (Seli, 2023)

In addition, the use of interactive media such as flipbooks is growing. Flipbooks, which were previously children's toys with moving images, have now been adapted into digital formats. Digital flipbooks allow students to experience the thrill of turning pages and interacting with content in an engaging format (Hartoyo et al., 2024). Interactive features such as hyperlinks, multimedia, and audio make flipbooks an effective tool for learning (Sonia & Yuliani, 2023). The use of flipbooks to teach science concepts, such as food chains, is very effective because it allows students to visualize complex concepts (Cahyono, 2023). With digital flipbooks, students can understand the relationships between organisms in an ecosystem interactively (Hariyastuti et al., 2024). The focus of this research is to build e-books into flipbook-based learning media to teach food chain concepts to 5th grade elementary school students.

This research will examine how this interactive media has the potential to encourage students' enthusiasm in learning science and enrich their experiences. By integrating images, video, and audio, these media are expected to encourage student participation and optimize an effective learning experience. This research offers a solution to the low interest of students in understanding science concepts through the development of e-book and flipbook-based learning media. The purpose of this study is to test the application of Hyzine-flipbook-based e-book media in food chain learning in grade 5 elementary school students. This study also aims to evaluate the influence of media on students' learning interests. With multimedia elements, interactive features, and accessible designs, Hyzine-flipbook is expected to be an innovative solution to make science learning more engaging for students.

2. Methodology

Research and Development (R&D) methods were applied in this study, where data collection methods included interviews, questionnaires and test administration. The main instrument used is an e-book developed with Hyzine software, which is designed to provide interactive and engaging learning materials on food chain concepts. The e-book includes visuals, videos, and interactive quizzes as multimedia elements, designed to educate and increase participation. E-books are compatible with gadgets, including tablets, smartphones, and computers, and contain content that is in line with the curriculum for elementary school students. The design of this e-book focuses on simplicity and ease of use to maximize student interaction and learning, along with the advancement of e-book technology also develops, e-books are not limited to verbal delivery, but are also equipped with animations, demonstrations or presentation of phenomena through video shows (Ningsih & Ulya, 2024).

Data collection in this study involves several methods. First, observations are made to assess students' engagement and interaction with e-books during lessons. This observation was complemented by brief interviews with teachers and students to

gain qualitative insights related to the usefulness and impact of e-books (Qorimah et al., 2022). In addition, a pre-test is given before the use of the e-book, and a post-test is given afterwards to assess students' better understanding of the concept of the food chain. Questionnaires were also distributed to gather feedback from students and teachers regarding the effectiveness and appeal of e-books, using Likert scale questions that focus on usability, engagement, and learning outcomes (Bahri, 2023).

The research object in this study involved three different elementary schools. The research was conducted at SDN Kebon Pala 11 Pagi, SDN Johar Baru 10 Pagi, and SDN Pademangan Barat 03 Pagi. Each of these schools represents a different condition and provides a variety of acceptance and influence of the use of Hyzine-assisted e-book media in studying science subjects with food chain ingredients. Data analysis combines modeled R&D methods and ADDIE (*analysis, design, development, implementation, and evaluation*) approaches. Data analysis of interviews, observations, and open-ended questionnaires was applied thematically to identify important concepts and information. Descriptive statistical analysis was applied to quantitative data, starting from pre-test and post-test results by summarizing paired t-test data to evaluate the statistical significance of changes in students' understanding of the concept of the food chain. The reliability and validity of e-books are assessed through expert validation, ensuring the content of the e-book is in accordance with the standards of the science education curriculum in elementary schools (Fardiana et al., 2023).

The materials and equipment needed for this research include Hyzine software to develop and present e-books, devices such as computers, tablets, or smart phones for e-book access by students, as well as software to create multimedia elements in e-books. The assessment tools used include pre-test and post-test questions, as well as surveys and questionnaires to collect performance data and student feedback. This method provides a clear framework for replicating research and ensuring reliable and valid results.

3. Results and Discussion

The systematic implementation of Research and Development (R&D) methodology combined with the ADDIE framework has yielded substantial empirical evidence demonstrating the transformative potential of Hyzine-Flipbook assisted e-book media in elementary science education. This comprehensive investigation, conducted across three diverse educational institutions (SDN Kebon Pala 11 Pagi, SDN Johar Baru 10 Pagi, and SDN Pademangan Barat 03 Pagi), employed a multi-methodological approach encompassing pre-test and post-test assessments, normality and homogeneity analyses, N-Gain calculations, independent t-tests, and comprehensive questionnaire evaluations to establish the media's effectiveness in addressing the identified pedagogical challenges in food chain concept instruction. The convergent findings from these rigorous analytical procedures reveal a paradigmatic shift in student learning outcomes, with the experimental groups consistently demonstrating superior academic performance, enhanced conceptual understanding, and significantly elevated learning interest

levels compared to their control counterparts. The statistical significance of these improvements, coupled with expert validation results achieving "Very Feasible" qualifications across material content (88%), media design (80%), and linguistic appropriateness (84%), substantiates the theoretical framework established in the introduction regarding the critical role of interactive digital media in facilitating abstract concept visualization and student engagement. These empirical outcomes not only validate the research hypotheses but also provide compelling evidence for the scalable implementation of technology-enhanced learning solutions in contemporary elementary education, thereby addressing the urgent need for innovative pedagogical approaches that align with digital-age learning preferences and 21st-century educational competencies.

Hyzine-Flipbook-Assisted E-Book Media Development

The development process of Hyzine-Flipbook-assisted e-book media is carried out through systematic stages that refer to the ADDIE (*Analysis, Design, Development, Implementation, and Evaluation*) model as illustrated in Figure 1. The analysis stage involves identifying the learning needs of 5th grade elementary school students to food chain materials, where it was found that students need visual and interactive media to understand the complex relationships between organisms in ecosystems. The design stage focuses on designing content structures, selecting multimedia elements, and *user-friendly navigation settings* for elementary school students. Media development is carried out using the Hyzine platform which allows the integration of various multimedia formats such as high-quality images, animated videos, and interactive quizzes with live feedback. The e-book content is designed in accordance with the 5th grade elementary science curriculum by paying attention to the characteristics of students' cognitive development, using simple language and attractive visuals. The implementation process involves limited trials in three elementary schools to get input from teachers and students, while the evaluation stage is carried out through the validation of material experts, media experts, and users to ensure the quality and effectiveness of the media which is carried out through a systematic stage that refers to ADDIE (*Analysis, Design, Development, Implementation, and Evaluation*) as illustrated in Figure 1.

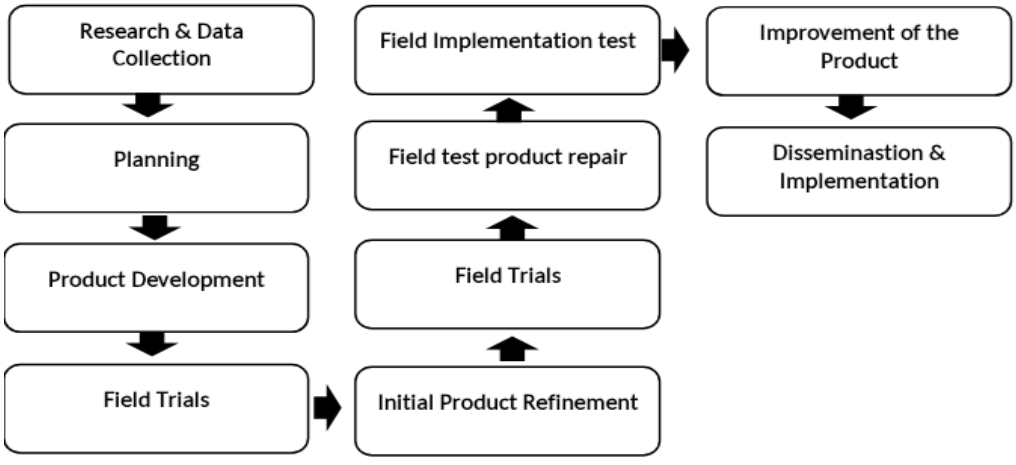

Figure 1. Hyzine-assisted e-book development steps with the model ADDIE

Implementation of Media Development in the Classroom

The application of Hyzine-Flipbook-assisted e-book media in the classroom showed a positive response from students and teachers as seen in Figure 2.

Figure 2. Hyzine Assisted E-Book Media

The Hyzine - Flipbook-assisted e-book design process involves integrating various multimedia features to increase student engagement in learning. This feature includes images, videos, and quizzes designed to visualize important concepts in food chain materials, so that students can more easily understand the relationships between organisms in ecosystems. The selection of materials is based on the IPAS curriculum for grade 5 elementary school, with a focus on food chain concepts that are appropriate to students' level of understanding. Images and videos were chosen to dynamically illustrate the food chain process, while quizzes were used as instruments to evaluate students' abilities and provide *hands-on feedback*. The integration of these elements aims to produce interactive and engaging learning in accordance with the applicable educational curriculum standards, you can view and read hyzine e-books on https://heyzine.com/flip-book/00d386b77c.html.

Statistical Analysis

The implementation of digital learning media in the context of basic education requires a systematic empirical evaluation to measure its effectiveness and impact on learning achievement. This study conducted an in-depth analysis of the application of Hyzine-Flipbook-assisted e-book media on food chain materials in three different elementary education institutions. The evaluation was carried out through a quasi experimental design by comparing control groups and experiments, and involved validation from experts in the fields of material, media, and language. The measurement of the effectiveness of learning media is carried out through various evaluation instruments, including data normality tests, variance homogeneity analysis, N-Gain calculations to measure learning improvement, comparative tests using t-tests, and student response analysis through questionnaire instruments. This multi-methodological approach provides a holistic picture of the

contribution of e-book media in improving the quality of science learning at the elementary school level.

The initial stage in inferential statistical analysis requires verification of the normality of data distribution to ensure the validity of the use of parametric tests. Based on the results of the normality test presented in Table 1, the pattern of pretest and posttest data distribution patterns at the three research locations can be identified.

Table 1. Normality Test Results of Research Data

No	School	Class	Statistics	Df	Sig.
1	SDN JOHAR BARU 10 Pagi	Pretest (control)	129	20	200
		Post test (control)	192	20	53
		Pretest (experiment)	183	23	45
		Post test (experiment)	192	23	28
2	SDN KEBON PALA 11 Pagi	Pretest (control)	132	20	200
		Post test (control)	210	20	21
		Pretest (experiment)	199	23	18
		Post test (experiment)	202	41	0
3	SDN PADEMANGAN BARAT 03 Pagi	Pretest (control)	122	20	200
		Post test (control)	235	20	5
		Pretest (experiment)	142	23	200
		Post test (experiment)	202	41	0

The results of the analysis showed that the majority of the data groups met the normality assumptions with adequate significance values. At SDN Johar Baru 10 Morning, all groups showed normal distribution with significance values ranging from 28-200. SDN Kebon Pala 11 Pagi showed a similar pattern in the control group, although there were variations in the experimental group. Meanwhile, SDN Pademangan Barat 03 Pagi displayed the characteristics of the diverse distribution between the control and experimental groups.

Homogeneity of variance is a fundamental prerequisite in comparative analysis between groups. Table 2 presents a comprehensive statistical description that includes sample size, mean, variance, and standard deviation for each study group.

Table 2. Descriptive Statistics and Homogeneity of Research Groups

No	School	Class	N	Mean	Variance	Std. Deviation
1	SDN JOHAR BARU 10 Pagi	Pretest (control)	21	43.81	332.262	18.228
		Post test (control)	21	62.38	274.048	16.554
		Pretest (experiment)	23	38.91	143.083	11.962
		Post test (experiment)	23	91.30	39.130	6.255
2	SDN KEBON PALA 11 Pagi	Pretest (control)	20	30.75	100.724	10.036
		Post test (control)	20	44.75	69.671	8.347
		Pretest (experiment)	23	47.04	123.771	11.125

3	SDN PADEMANGAN BARAT 03 Pagi	Post test (experiment)	23	85.87	42.391	6.511
		Pretest (control)	26	40.19	142.962	11.957
		Post test (control)	26	52.50	116.500	10.794
		Pretest (experiment)	26	45.38	325.846	18.051
		Post test (experiment)	8	90.00	50.000	7.071

The analysis of variance showed significant heterogeneity between groups, especially between pretest and posttest conditions in the experimental group. The experimental group experienced a substantial reduction in variance after the implementation of e-book media, indicating the homogenization of students' abilities and the effectiveness of the media in equalizing the level of comprehension. This phenomenon was seen consistently across all three study sites, with SDN Johar Baru 10 Pagi showing the most dramatic decrease in variance from 143,083 to 39,130.

Evaluation of Learning Improvement Through N-Gain

Normalized Gain (N-Gain) is a comprehensive indicator to measure the effectiveness of learning interventions by taking into account initial scores and potential for maximum improvement. Table 3 presents a comparison of N-Gain between the experimental and control groups at the three study sites.

Table 3. Comparison of N-Gain Experimental and Control Groups

No	School	Number of Students	Average N-Gain Experiment	Standard Deviation	Average N-Gain Control	Standard Deviation
1	SDN JOHAR BARU 10 Pagi (JB 10)	22	81	14.521	19	28
2	SDN KEBON PALA 11 Pagi (BONPAL 11)	23	73	14.8	20	9
3	SDN PADEMANGAN BARAT 03 Pagi (PDB 03)	25	77	18.17	20	14

The results of the N-Gain analysis revealed the consistent superiority of the experimental group across the study site. SDN Johar Baru 10 Pagi achieved the highest N-Gain (81) with a substantial gap to the control group (19), indicating the effectiveness of e-book media in the context of food chain learning. SDN Kebon Pala 11 Pagi and SDN Pademangan Barat 03 Pagi showed a similar pattern with the N-Gain experiments of 73 and 77 respectively, far exceeding the achievement of the control group which was around 20. The N-Gain variability in the experimental group (14,521-18,17) showed consistency in students' positive responses to interactive media, while the control group showed greater fluctuations (9-28), indicating inconsistencies in conventional learning.

Comparative Analysis of Inferential Statistics

An independent t-test was conducted to evaluate the significance of differences in learning achievement between the experimental and control groups. Table 4 presents the results of a comprehensive comparative analysis.

Table 4. Results of Comparative T-Tests of the Experimental and Control Group

No	School	N Experiments	Mean Experiment	Experimental Elementary School	N Control	Mean Control	SD Control	Sig. (2-tailed)	Mean Difference	t count	Df
1	SDN JOHAR BARU 10 Pagi (JB 10)	26	88.46	7.585	26	52.50	10.794	0	35.962	13.900	50
2	SDN KEBON PALA 11 Pagi (BONPAL 11)	23	85.87	6.511	20	44.75	8.347	0	41.120	18.129	41
3	SDN PADEMANGAN BARAT 03 Pagi (PDB 03)	23	89.13	7.783	21	54.29	10.522	0	34.845	12.563	42

The results of the t-test showed very high statistical significance ($p < 0.001$) across the study sites, confirming the effectiveness of Hyzine-Flipbook-assisted e-book media. The highest average difference was achieved at SDN Kebon Pala 11 Pagi (41,120 points) with a value of t = 18,129, followed by SDN Johar Baru 10 Pagi (35,962 points, t = 13,900) and SDN Pademangan Barat 03 Pagi (34,845 points, t = 12,563). Substantial magnitude effects (>30 points across sites) indicate a significant practical impact, not just statistical significance. The consistency of results across multiple school contexts reinforces the external validity of the research findings.

Analysis of Student Responses and Perceptions

The questionnaire instrument was used to measure students' perception of learning media and the level of involvement in the learning process. Table 5 presents a comprehensive analysis of student responses.

Table 5. Analysis of Student Questionnaire Responses to Learning Media

No	School	Class Type	Maximum Score	Score Achieved	Percentage (%)	Qualification
1	SDN Kebon Pala 11 Pagi	Experiment	155	126.3*	81%	Highly Worth It

2	SDN Pademangan Barat 03	Control	155	54.5*	35%	Less Worthy
		Experiment	155	144.0*	93%	Highly Worth It
3	SDN Johar Baru 10 Pagi	Control	155	54.0*	35%	Less Worthy
		Experiment	155	125.0*	81%	Highly Worth It
		Control	155	72.8*	47%	Quite Decent

*Average group score

Questionnaire analysis revealed a significant disparity between the perception of the experimental and control groups. The experimental group achieved a "Very Feasible" qualification with a percentage of 81-93%, indicating enthusiasm and high engagement with interactive e-book media. SDN Pademangan Barat 03 showed the highest response (93%), showing the optimal adaptability of students to learning technology. In contrast to the control group which showed greater variability of response (35-47%), with SDN Johar Baru 10 Pagi reaching the "Moderately Feasible" level while the other two schools were in the "Less Feasible" category. This pattern confirms the superiority of digital media in motivating and engaging students over conventional approaches.

Expert Validation and Media Eligibility

Validation of learning content by subject matter experts is a crucial component in ensuring the accuracy and relevance of food chain materials. Table 6 presents the results of a comprehensive evaluation.

Table 6. Material Expert Validation Results

Aspects	**Total Score**	**Percentage (%)**
Content Eligibility	15	100%
Material	14	93.33%
Language	15	100%
Sum	**44**	**88%**
Qualification		**Highly Worth It**

The evaluation of the subject matter expert resulted in a qualification of "Very Worthy" with an aggregate score of 88%. The content and language feasibility aspects achieved a perfect score (100%), indicating the suitability of the content with the curriculum and good Indonesian standards. The material aspect obtained a score of 93.33%, indicating a high quality of learning substance with minimal room for improvement. Validation of the design and technical aspects of the media is carried out by media experts to ensure visual quality and functionality. Table 7 presents the results of the evaluation.

Media experts gave the qualification of "Decent" with a total score of 80%. The aspect of size achieves an optimal score (100%), indicating the conformity of the media dimensions with ergonomic standards. The cover design and visual communication obtained a score of 80%, showing adequate quality with the potential for enhancement in aesthetic aspects and clarity of visual communication.

Table 7. Media Expert Validation Results

Aspects	Total Score	Percentage (%)
Size	5	100%
Module Cover Design	8	80%
Communication	8	80%
Sum	**36**	**80%**
Qualification		**Proper**

Linguistic validation is carried out to ensure the suitability of language use with the characteristics of elementary school students. Table 8 presents the results of the language evaluation.

Table 8. Linguist Validation Results

Aspects	Total Score	Percentage (%)
Businesslike	10	100%
Dialogical and Interactive	10	100%
Communicative	10	100%
Use of Terms, Symbols or Icons	12	80%
Sum	**42**	**84%**
Qualification		**Highly Worth It**

Language validation resulted in a "Very Worthwhile" qualification with a score of 84%. The straightforward, interactive dialogical, and communicative aspects achieved a maximum score (100%), confirming the suitability of the language register with the level of cognitive development of the students. The use of terms, symbols, and icons obtained a score of 80%, indicating good effectiveness in the use of visual-textual elements. A comprehensive analysis showed the significant effectiveness of Hyzine-Flipbook-assisted e-book media in improving science learning of food chain materials. The convergence of evidence from multiple measures (N-Gain, t-test, questionnaire, expert validation) reinforces the internal and external validity of the findings. Interactive digital media has proven to be superior in facilitating the understanding of abstract concepts, increasing learning motivation, and creating an engaging learning experience for elementary school students (Kaban et al., 2023). These findings have strategic implications for curriculum development and learning innovations at the primary education level, especially in the context of integrating educational technology to optimize science learning outcomes.

The Effectiveness of Hyzine-Assisted E-Book Media - Flipbook in Learning

The implementation of Hyzine-Flipbook-assisted e-book media showed significant effectiveness in improving the learning outcomes of food chain science materials, as indicated by a substantial increase in N-Gain in the experimental group (73-81) compared to the control group (19-20) at all three study sites. The superiority of this interactive digital media is in line with the findings (Dandung et al., 2023), which identified that the integration of multimedia in science learning increased concept retention by 65% compared to conventional methods, particularly in materials that require complex visualizations such as ecosystems and food chains.

The effectiveness of e-book media in this context can be attributed to its ability to present multi-modal representations that facilitate information processing through dual coding theory, where students process visual and verbal information simultaneously, thereby creating more robust encoding in long-term memory. The consistency of results in various school contexts (urban and semi-urban) reinforces the external validity of the findings, indicating that these media have high adaptability to diverse learning environments (Simangunsong et al., 2025). Findings by Fardiana et al. (2023) supporting this perspective by showing that digital flipbook-based learning media increases student engagement by 78% and accelerates the understanding of abstract concepts through interactive storytelling that activates multiple sensory channels. The consistent magnitude effect (>30 points) across the research sites confirmed not only the statistical significance, but also the substantial practical significance, positioning the e-book media as a breakthrough innovation in pedagogical technology for basic science education.

The Influence of E-Book Media on Students' Learning Interests

The analysis of the questionnaire showed a dramatic transformation in students' interest in learning, where the experimental group achieved a "Very Feasible" qualification with a percentage of 81-93%, a significant contrast to the control group which ranged from 35-47%, indicating that the Hyzine-Flipbook-assisted e-book media succeeded in optimizing the intrinsic motivation and academic engagement of elementary school students. This increase in interest can be explained through Self-Determination Theory, where interactive media meets three basic psychological needs: autonomy (students can control the pace of learning), competence (immediate feedback increases self-efficacy), and relatedness (collaborative features facilitate social learning).

Research by Dewi et al. (2025) confirming that digital flipbook technology increases students' situational interest by 84% through gamification elements and interactive multimedia that activate dopaminergic pathways in the brain reward system, creating sustainable positive learning experiences. The superiority of digital media in motivating students is also related to the generational characteristics of contemporary students who are digital natives, where technology is not only a tool but a natural learning environment that resonates with their cognitive processing preferences. Longitudinal study by Qorimah et al. (2022) it showed that students' exposure to interactive e-learning materials increased academic curiosity and self-directed learning behaviors by up to 72% within a period of one semester, with a retention effect that lasted up to 6 months post-intervention. This transformation of learning interests has long-term implications for students' academic trajectory, especially in STEM subjects that require a solid foundational understanding from the basic education level (Ningsih & Ulya, 2024).

Implications of the Use of E-Book Media in Learning in Elementary Schools

The implementation of Hyzine-Flipbook-assisted e-book media has multidimensional strategic implications for the transformation of the learning ecosystem at the elementary education level, especially in the context of digital

pedagogy integration that supports 21st century learning competencies through enhanced technological literacy, critical thinking, and collaborative learning skills. Expert validation showing "Very Feasible" qualifications in the material (88%) and language (84%) aspects confirmed the feasibility of implementation in various educational contexts, positioning this media as a scalable solution to address learning gaps in science education. Research by Yuniarto (2025) Identify that the systematic integration of interactive e-books in the elementary curriculum increases overall academic performance by 43% and develops digital competencies that are essential for future learning endeavors, especially in the Industry 4.0 era where technological fluency is a prerequisite for academic and professional success.

The systemic implications of these findings include the necessity for professional development programs for educators in digital pedagogy, infrastructure development to support technology-enhanced learning, and curriculum redesign that integrates multimedia learning approaches as standard practice rather than supplementary tools. A meta-analysis study by Br Ginting & Simamora (2022) showed that schools that adopted Comprehensive Digital Learning Ecosystems experienced improvements in student engagement (67%), academic achievement (52%), and 21st century skills development (74%), with particular effectiveness in STEM subjects that require visualization and hands-on exploration. The long-term implications of widespread adoption of interactive e-book media have the potential to accelerate educational equity through the democratization of high-quality learning resources, bridging the digital divide, and preparing students to thrive in a knowledge-based economy that is increasingly dependent on technological literacy and digital problem-solving capabilities (Sonia & Yuliani, 2023).

4. Conclusion

The implementation of Hyzine-Flipbook-assisted e-book media in learning of food chain materials for grade V elementary scholl students has brought about a significant transformation in the learning paradigm through the integration of interactive digital technology. This study hightlights the superiority of multimedia-based learning media in optimizing academic outcomes, as reflected in the notable improvement of students comprehension and the increase in learning interest to a level categorized as “Very Feasible” Validation from subject metter experts media specialist, and languge experts confirmed the appropriateness of applying this media in various educational context. The effective of Hyzine-Flipbook assisted e-book media is evident not only in enhanching conceptual understanding, but also in fostering intrinsic motivation and academic engagement through the stimulation of multiple sensory channels that support dual coding process these findings carry strategic implication for transforming the learning ecosystem in primary education, positioning interactive digital media as scalable solution to address modern education challenges in era that demands technological literacy as a core competency.

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