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Revolutionary Flipbook-Based Digital Comic: Changing Student Engagement in Learning

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Abstract

The development of digital technology has had a significant impact on various aspects of life, including education. The use of digital media in learning is a necessity to motivate and increase students' interest in learning. One form of digital media that attracts attention is flipbook-based comics. This research aims to develop digital flipbook-based comics as an innovative learning tool to increase students' interest in learning. This research uses a 4D development approach (Define, Design, Develop, and Disseminate) to design, develop, and implement digital flipbook-based comics as an innovative tool aimed at increasing students' interest in learning. This research also involved testing with a number of students to evaluate the effectiveness and attractiveness of digital flipbook-based comics as a learning tool. The data collected involves aspects of learning interest, understanding of the material, and student satisfaction with the use of digital flipbook-based comics. The research results show that the use of digital flipbook-based comics can significantly increase students' interest in learning. Students responded positively to the interactive and fun learning experience.

Keywords: digital comics; flipbook; interest in learning

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INTRODUCTION

Modern education faces new challenges in an effort to maintain students' interest in learning in the digital era (A et al., 2020; Amin et al., 2022), and in the academic era the revolution became a period of strategic innovative progress to complete routine, formal work, and various other life tasks (Basri et al., 2023; Musa et al., 2021). In the midst of abundant information, teachers need to create learning methods that arouse and maintain students' attention (Ahmad et al., 2024; Hasibuan et al., 2023; Novaliendry et al., 2023). The learning process can run effectively by providing opportunities for students to learn independently (Faradisa et al., 2023). Allows them to gain knowledge through the understanding they build during learning activities (Aswirna & Ritonga, 2020; Epi Supriyani Siregar et al., 2023). One innovation in education is to initiate brilliant ideas to overcome problems and stimulate changes in mindset in understanding subject matter (Rohmatin et al., 2022). Successful learning can be identified through achieving the goals set in the teaching and learning process (Ginanjar et al., 2023; Saputra et al., 2023). The effectiveness of learning is manifested when the set goals have been achieved (Aprilianto et al., 2022; Muttaqin, 2016).

In fact, teaching materials given are mainly limited to textbooks provided by schools, less varied, and are not interesting enough to support learning in the field of natural and social science (IPAS) (Sebayang et al., 2023). In addition to the issue of less attractive teaching materials, the teacher also faces several obstacles (Mahardikha et al., 2023; Novaliendry et al., 2023), such as a crowded or non - conducive class atmosphere, during learning, the teacher asks analytical questions (C4), only a few students can provide answers that show critical thinking, while other students answer with the answer is similar to textbooks or not even answering and at the evaluation stage, the teacher presents a story question with a level of difficulty C4 (analysis), but only a few students are able to answer correctly, while the rest students still have difficulty answering evaluation questions correctly (Novaliendry et al., 2022; Sahria et al., 2023). This can be seen in Table 1. The average value of the following semester daily tests:

Table 1. The average value of the daily semester test Source: SMK 6 Padang

No	KKM	Student	Class	Percentage	
				complete	incomplete
1.	76	25	X1	40%	60%
2.	76	25	X2	50%	50%

Description: The Minimum Completion Criteria at SMK 6 Padang is 76. If a student scores more than 76 then the student is declared to have passed (complete), but if the score is less than 76 then the student is declared not to have passed (incomplete).

Based on the interview table, it can be concluded that in SMK 6 Padang, the average semester 1 class X did not reach a high level and is still below the minimum completeness criteria (KBM). Therefore, not all class X students can achieve the competencies that have been set. One of the factors causing is the limitations of students' use of learning resources, both in the context of learning in class and independent learning. Although every student has a smartphone in the era of advanced technology, its use for learning is minimal.

So, with the renewal and use of learning media, especially digital learning media, it is very important in delivering the contents of the message from the material that will be given to foster new motivation in learning, and to make a significant contribution in the implementation of learning by utilizing information and communication technology (Amin et al., 2022; Deda et al., 2023; Rufii, 2023). Creativity and innovation in this learning become more fun and make students interested in learning (Christina Ismaniati & Baroroh Iskhamdhanah, 2023). In assessing student learning motivation can be marked by a number of indicators, such as showing interest in learning and feeling happy when doing assignments (Fitriyah & Sahda, 2023)(Satrinawati et al., 2023).

Comics are a unique form of visual communication that combines creative text and images, becomes an effective means to convey information universally and easily understood (Nabilah et al., 2021). Comics have long been recognized as an effective means to convey information in an interesting and easily digested way (Elfina et al., 2023). Involving visual, narrative, and now interactivity, Digital Flipbook presents a dynamic and entertaining world of learning (Iqbal et al., 2024). By integrating technology with creativity, we can create learning experiences that are not only informative but also inspiring (Arif et al., 2024). At the same time, the

development of digital comics can help students understand the material better through the combination of text and images presented in a simple and easy to read comic format online through mobile or tablet, can be stored easily, and can be sent to various media (Novaliendry et al., 2023; Zainadi et al., 2023).

He initial idea of Flipbook was originally used to display animation, but now it has been widely used by various vendors for various digital applications such as magazines, novels, comics, and so on (Kibtiyah et al., 2023). Flipbook is one of the software that can be used to create interesting teaching materials (Putriani & Kristiantari, 2022). Flipbook is a digital way to present books, enable the opening and closure of the page with flip movements, and arranged in such a way as to look interesting, and can be shared with colleagues through the flipbook link (Andriani et al., 2023). Utilization of flipbook media in the learning process can attract students, improve their creative thinking skills, and eliminate the impression of monotonous and boring from learning (Yani et al., 2023). In this context, the development of digital flipbook -based comics is an interesting alternative to increasing student learning interest (Daud et al., 2022).

Digital Flipbook-based comics are a form of media that combines traditional comic elements with digital technology (Kusumaningrum & Masruro, 2022). Digital Flipbook comics can combine multimedia elements, such as short videos or animations, to provide additional dimensions to the story (Ulandari & Sujana, 2023). Some digital flipbook platforms allow comic makers to customize the reader's experience (A et al., 2020), such as regulating page transitions, background colors, and sound effects (Sutin et al., 2022). In digital flipbooks, readers can navigate through comic pages by shifting or clicking, imitating the experience of opening physical pages in conventional comic books (Listianingsih et al., 2021). tudents can access digital flipbook -based comics from various devices, such as computers, tablets, or smart phones, making it easier for students to distribute and accessibility (Zega & Bawamenewi, 2023). Students can also distribute digital flipbook comics easily through online links (Prasasti & Anas, 2023).

This article will explore how the development of digital flipbook -based comics can be an effective tool in increasing student interest in learning (Sudiarti et al., 2023). Previous research shows that the use of Flipbook -based electronic teaching materials is successful and effective in improving learning outcomes, while increasing student participation in visual, oral, listening, writing, and emotional aspects (Arsita & Astawan, 2022; Dewi et al., 2021). By utilizing the uniqueness of this technology, it is hoped that we can create a learning environment that motivates, stimulates imagination, and have a positive impact on student academic development.

METHODS

The research method used is Research and Development (R&D) (Simaremare & Thesalonika, 2022), with the application of the 4D development model that includes the define, design, develop, and disseminate stages (Hobri et al., 2019; Meisarah et al., 2023; Ntobuo et al., 2018). The trial involved 50 class X students at SMK 6 Padang, divided into the X1 experimental class and the X2 control class.

The trial does not only involve students, but also related teachers. After the Flipbook Digital Flipbook Strip Learning Media is validated, a trial is carried out to collect practicality and effectiveness data. Details of research procedures can be found in the illustration in the following figure:

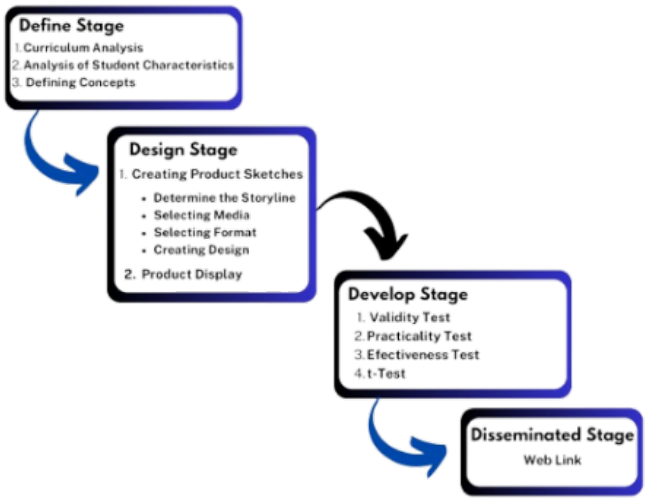

Figure 1. 4D Development Model

This research combines quantitative and qualitative data through validation, practicality and effectiveness instruments, as well as needs analysis, observation and interviews. The data collection method involves a questionnaire with an attitude scale or Likert scale and validation and practicality instruments. The instrument for measuring media effectiveness involves objective questions that analyze the validity of the items (25 questions) and assess the difference in level of difficulty of the questions and reliability. This analysis also includes a comparison of learning outcomes between the control class and the experimental class that used this media, with the Microsoft Office Excel application used as a data processing tool.

RESULTS & DISCUSSION

Define

The first step in the 4D model is to define development goals and needs. This research aims to create digital flipbook-based comics that can increase students' interest in learning. This definition becomes the basis for the next steps in the development process. In this define phase, an analysis of the needs for digital flipbook-based comic strip learning media was conducted, including curriculum analysis, student characteristics, and the concept of science project learning materials. The results of observations and interviews with teachers and students concluded that the learning resources needed for learning science project subjects include digital flipbook-based comic strip learning media.

Design

In the design stage, a digital flipbook-based comic was designed which involved identifying learning materials, determining the narrative structure, and

designing visual elements. The design must pay attention to suitability to the curriculum and visual appeal that can attract students' interest. This involves determining the concept of the learning media that will be built. Product sketches are made by referring to the definition stage that has been carried out previously.

Next, determining the storyline of the flipbook-based comic strip learning media is arranged to guide the development process. This step is carried out based on a previously planned product sketch. In this phase, the writer formulates the concept of writing the comic along with the storyline that will be presented. The process of compiling a story line includes creating scenarios, illustrations, and combining each story element with images so that it can be easily understood by readers.

The choice of learning media, tailored to facilitate the delivery of educational content and ensure accessibility, streamlines the achievement of learning objectives. This research aims to foster student understanding and interest in science and technology projects. Thus, the author opted for Comic Strips as a learning medium, utilizing Flip PDF Professional software to align with contemporary technological preferences. The digital flipbook format emulates reading a book on a screen, enhancing engagement and comprehension compared to traditional printed materials.

In the media design creation stage, researchers follow the following steps:

Figure 2. Storyboard

Storyboard is a sequential representation of image sketches that follow the storyline. Its function is to animate and convey the story line that has been created, especially in making pictorial learning media.

Figure 3. Typesetting

The typesetting process involves adding speech bubbles, text, and using the standard FOT-Pro font with a font size of 10-12pt. Fonts can also be varied for certain circumstances, so they can be adjusted to suit your needs.

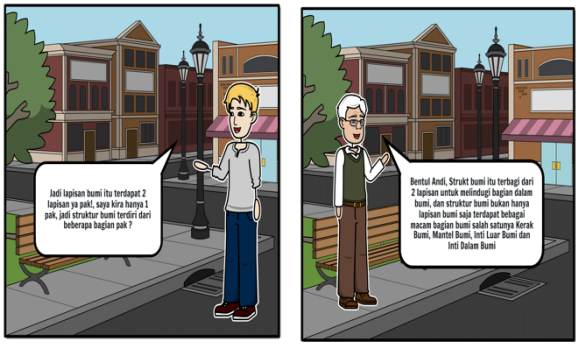

Figure 4. Coloring

Next, coloring the comic using the Flip HTML5 PRO application. The coloring process is a little complicated and takes a long time because each color has to be separated into several layers and panels, making it easier if a color error occurs or you want to delete certain parts.

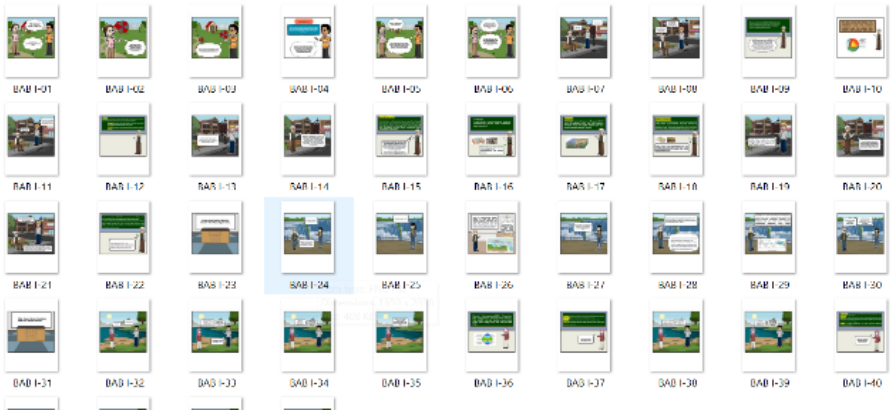

Figure 5. Comics in PNG format

After the researcher finished creating the comic strip, the file was saved in FireAlpaca Document (.mdp) format, then converted to PNG format using the 64-bit PNG format.

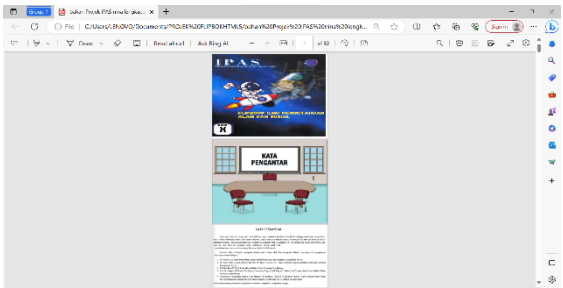

Figure 6. Convert PNG to PDF

In this step, researchers converted from PNG to PDF format. After the conversion process is complete, the learning media can be run and used.

Figure 7. Flipbook view

The final stage involves uploading and converting the PDF file into an online flipping book or flipbook, allowing for the insertion of various elements such as video, text, images, sound, practice questions, and animations, thereby enhancing interactivity and appeal as a learning tool. This digital flipbook-based comic enhances student engagement through its interactive design, featuring an intuitive interface, clear navigation, high-quality illustrations, vibrant colors, scrolling and animated pages, and multimedia integration. It's versatile, accessible online or offline, with built-in student progress tracking and data analysis capabilities for teachers or parents.

Develop

Validity test

The validator has approved the questionnaire that will be used in the validity and practicality tests and is considered suitable for use in research. Validation is carried out by the first and second validators on the content (material) of the learning media, while the third, fourth and fifth validators assess the design aspects of the learning media being developed. The instrument was then continued for material validation testing and practicality testing.

Table 2. Validator Assessment of Learning Media Materials

No	Indicator	Validity Results	Category
1.	Learning	0,89	Valid
2.	Material	0,82	Valid
	Average	0,85	Valid

Table 2 explains that the validator's assessment of each indicator aspect is added up, and the percentage of assessment according to aspect is calculated. Material evaluation is summarized based on validation categories, as seen in Table 2. Evaluation results from Table 2 show that validator 1 and validator 2 gave values of 0.89 and 0.82 for learning and material indicators, in the valid category.

Furthermore, validation of learning media involves an assessment of the designed product, as follows:

Table 3. Validator Assessment of Learning Media Design

No	Indicator	Validity Results	Category
1.	Didactic	0,84	Valid
2.	Construction	0,91	Valid
3.	Technical	0,91	Valid
	Average	0,89	Valid

Table 3 explains the results of the learning media design validator's assessment of learning media which shows that the average value of validator 1, validator 2, and validator 3 is 0.89 in the valid category. Based on Tables 2 and 3, it can be concluded that the validation of learning media shows the "Valid" category, which means the learning media meets validity standards.

Practicality Test

Data evaluating the practicality of digital flipbook-based comic strip learning media was obtained from a questionnaire that was distributed to teachers and students.

Table 4. Results of Practicality of Teacher Response Media

No	Assessment Aspects	Valuation Percentage			Category
		P1	P2	Average	
1.	Technical	96	96	96	Very Practical
2.	Contents	88	84	86	Very Practical
3.	Design	88	86	87	Very Practical
	Average		89		Very Practical

Table 4.3 shows three aspects of the practicality of digital flipbook-based comic strip learning media based on teacher responses through questionnaires. On average, technical aspects of use, time content, and design received ratings of 96%, 86%, and 87% respectively, all categorized as “very practical.” The overall average reached 89%, indicating that this media is effective in helping teachers support students in learning independently and understanding learning concepts.

Table 5. Recapitulation of Practicality of Student Response Media

No	Assessment Aspects	Valuation Percentage	Category
1.	Convenience	84,96	Very Practical
2.	Motivation	85,26	Very Practical
3.	Attractiveness	84,80	Very Practical
4.	Usefulness	84,18	Very Practical
	Average	84.80	Very Practical

Table 4.4 displays four aspects of the practicality of digital flipbook-based comic strip learning media based on student responses via questionnaires. In student evaluations, ease of use, motivation, attractiveness, and usefulness of this media reached a percentage of 84.96%, 85.26%, 84.80%, and 84.09% respectively, all of which were categorized as "very practical". The overall average student assessment was 84.80%, indicating that this media was considered practical by students and helped them understand the material.

So, evaluation of student and teacher responses to the practicality of flipbook-based digital comic strip learning media also shows positive results. The level of ease of use of media, student motivation, attractiveness and usefulness of media received very practical assessments from both groups of respondents.

Effectiveness Test

In instrument trials, most of the test questions demonstrated reliable validity, reliability and difficulty levels. Even though some questions are invalid, the overall reliability of the test remains high. The instrument validity test was carried out on Class X students at SMK 6 Padang, with 25 valid questions and 5 invalid questions. All test questions are considered reliable, with a test reliability value of 0.816, indicating a very high level of reliability. The question difficulty index shows 5

difficult questions, 1 easy question, and 24 medium questions. Differential power analysis showed 6 questions of low quality, 8 questions of sufficient quality, and 16 questions of good quality.

Table 6. Normality of control class and experimental class

No	Sig	
	Control	**Experiment**
25	0,061	0,193

Referring to Table 4.5, the significance value for the control class is 0.061, while for the experimental class it is 0.193. Therefore, it can be concluded that the data has a normal distribution because the significance value is greater than 0.05

Table 7. Homogeneity of control and experimental classes

f	Sig
25	0,222

Table 7 shows that the significance value of the homogeneity test reached 0.222, which is greater than the significance limit of 0.05. Thus, it can be concluded that the variance between the control and experimental classes is considered homogeneous. The normality and homogeneity of variance tests on the posttest data validate the use of the t-test, and the results show that the differences in learning outcomes between the control class and the experimental class are statistically significant.

Table 8. T-results

f	tcount	Sig
25	4,917	0,000

Using the t-test, a significance value of 0.000 was found, smaller than the 0.05 significance level, indicating a significant difference in learning achievement between the control class and the experimental class after using digital flipbook-based comic strip learning media. So, it can be concluded that the use of this media has a positive influence on student learning outcomes.

Learning outcomes between the control class and the experimental class were carried out using the t-test. The average posttest score for the control class was 76.4, while the experimental class reached 84.2, as seen in Figure 9 below:

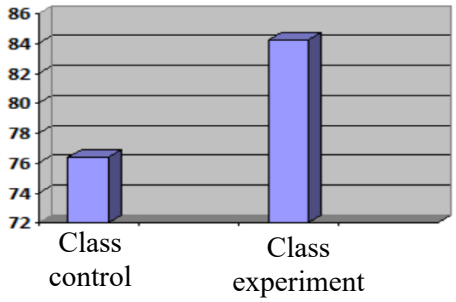

Figure 9. Improved student learning outcomes

From Figure 9 it can be seen that the control class posttest had an average of 76.4 (70-85) from 25 students, with a total score of 1910 and a standard deviation

of 4.68. On the other hand, the experimental class experienced a significant increase from the pretest, reaching a posttest average of 84.2 (75-95) from 25 students, a total score of 2105, and a standard deviation of 6.40. The analysis shows a significant increase in the learning outcomes of experimental class students.

The results of the posttest analysis show a significant increase in the learning outcomes of experimental class students, confirming that the digital flipbook-based comic strip learning media is effective in learning and can improve students' understanding of the material. With positive results from various research aspects, it can be concluded that this media is an effective and practical alternative for improving student learning outcomes in science and technology project subjects at the vocational school level.

Disseminate

After development is complete, the next step is to distribute the digital flipbook comic online to students by sharing the link. This allows the use of comics as interactive teaching materials, integration into digital learning platforms, or access via mobile devices. This media can provide significant support to the student learning process, especially in the current context. The dissemination process involves publishing online with a focus on ensuring accessibility and wide distribution.

CONCLUSION

Based on the research results, it can be concluded that the digital flipbook-based comic strip learning media developed shows a high level of validity in terms of material and design. Practicality evaluation states that this media is very practical for use by teachers and students. Trial testing of the test instrument showed acceptable validity, reliability and difficulty level of the questions. The t-test results indicate significant differences in the learning achievement of students who use this media compared to those who do not. The development of Digital Flipbook-Based Comics as an innovative learning tool shows great potential in increasing students' interest in learning.

The application of the 4D development method in this research succeeded in creating interactive and interesting learning media for students. The stages of needs analysis to implementation were carried out carefully to ensure the effectiveness of digital flipbook-based comics as a relevant educational solution in the digital era. The evaluation shows that using digital flipbook-based comics can significantly increase students' interest in learning. Students provide positive feedback on interactive, creative and fun learning experiences. Multimedia and animation elements in digital comics also increase students' understanding of learning material.

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