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Feasibility Of Digital Flipbooks as Physics Teaching Media in Terms of Reproduction

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Abstract

Various media that utilize technology in implementing teaching materials make the teaching-learning process more innovative and increase students' curiosity. This study aims to develop and validate a digital flipbook for physics education, focusing on reproduction topics. This study applied the research and development (R&D) design using the 4-D model, which consists of define, design, develop, and disseminates. This study is only up to the validation stage and revision of the validation results. The validation subjects in this study are 16 people. The result shows that the developed media is valid, totaling 97.51%. This learning media will be very helpful for students to better understand the understanding of physics in the application of everyday life, namely in the reproductive system. The feasibility instrument for digital physics flipbooks in reproduction developed can also be a reference for teachers to research the feasibility of other learning media. The digital flipbook of physics in reproduction is expected to be further developed in further research, namely in the implementation stage, to test its effectiveness in the science learning process.

Keywords: digital flipbook, feasibility, learning media, physics in reproduction, physics education

INTRODUCTION

Learning in the 21st century supports students to participate independently and actively by involving their creative abilities (Chan et al., 2021). Teachers and schools are expected to develop students' abilities, soft skills, and life skills to understand better the process of absorbing new knowledge (Rubini et al., 2018; Chen & Xiao, 2021). The teacher offers the primary learning materials, and students then explore the materials by studying independently and in groups (Taştan et al., 2018; Fauth et al., 2019). The abilities possessed by students are different, so the learning process is also different (Ecevit & Kıngır, 2022). The students who have high understanding and thinking skills will be able to learn the material quickly, and vice versa (Anggraini, Budiyono & Pratiwi, 2019; Riadi, Atini & Ferita, 2019).

Along with the developing science and technology, teaching activities must adapt to the existing challenges (Cathy et al., 2018; Dimitriadou & Lanitis, 2023). Technology utilization in teaching activities needs to be fully maximized; utilization is still limited to finding materials by students

(Isnaeni & Agustina, 2018). However, technology can be used as an interactive teaching medium using mobile devices and computers to make students active (Rahayu, Zutiasari & Munadhiroh, 2021). With various media used to implement teaching materials, the teaching-learning process becomes more innovative and increases students' curiosity (Maksum & Purwanto, 2022).

Concept of Digital Flipbook

Teaching media can distribute teaching materials to stimulate students' attention, interest, and thoughts (Ediyani et al., 2020). Media use in teaching can change how students learn to obtain and adapt information (Sarmi, Ratnawulan & Gusnedi, 2019; Astalini et al., 2021). Teaching media also allows teachers to develop skills in creating learning techniques to produce maximum results (Risniawati, Serevina & Delina, 2020).

Interactive teaching media consists of teaching materials that contain written material and various images related to the material being taught; some videos can increase understanding of the material taught in everyday life (Almulla, 2023; Sahronih, Purwanto & Sumantri, 2019; Kustyarini, Utami & Koesmijati, 2020). Interactive multimedia teaching materials can be like flipbooks (Suarman, Hendripides & Hikmah, 2018). Flipbooks can help answer this phenomenon because they can be adjusted to the student's learning speed intensity.

A flipbook is a digital book containing text, images, audio, and video information that can be accessed through electronic devices such as mobile phones and computers (Saraswati, Linda & Herdini, 2019; Ristanto et al., 2020). Flipbook is one of the teaching media made from a pile of paper resembling a thick book; on each page, a process of something is described, which later looks moving (Situmorang et al., 2018; Evenddy et al., 2021). In the smallest learning unit, there are elements of multimedia and navigation to achieve specific teaching objectives, which are presented in a digital format (Maksum & Purwanto, 2022).

Flipbooks can help students in the teaching process and increase students' interest in learning independently (Rahayu, Zutiasari & Munadhiroh, 2021). Flipbook has several advantages: it can present learning material in words, sentences, and pictures and be equipped with colors. In addition, it is more attractive to students, easy to make and inexpensive, easy to carry everywhere, and can be accessed at any time to increase student learning activities (Kartika, Purwanto & Risdianto, 2024).

The importance of learning media using flipbooks in physics education is widely studied in current educational research. According to Maynastiti, Serevina & Sugihartono (2020), using a flipbook can improve physics problem-solving skills. Flipbooks help teachers provide clear media to describe their application in everyday life (Annisa, Miriam & Suyidno, 2022). This is consistent with the research conducted by Kartika, Purwanto & Risdianto (2024) that students experienced increased learning motivation after using a physics flipbook. Flipbook-based digital e-book learning media trains students' critical thinking skills (Azizah & Sucahyo, 2022). With students' critical thinking skills trained, it can improve students' physics learning outcomes (Susanti, Yennita & Azhar, 2020). Thus, these findings show that flipbook-based learning media is very suitable for students in physics.

Several theories support using flipbook learning media, including Piaget's cognitive development theory and Mayer's Cognitive Multimedia Learning (CTML) theory. This confirms that students can learn more deeply from pictures and other menus in flipbooks than from learning from a collection of words alone. Moreover, students play an active role in learning, from observing to carrying out activities with material support that increase their understanding and creativity in specific ideas or knowledge (Almulla, 2023).

Concept of Physic In Reproduction

Curriculum 2013 develops science learning as an integrated subject, not a scientific discipline. Science is concerned with many fields ranging from minor structures to the universe. These disciplines include environmental, social, physical, chemical, biological, soil science, and earth and space sciences related to everyday life (Hodson, 2014). In teaching science, teachers are expected to provide material that can describe and relate to each teaching material that supports each other to facilitate students to understand concepts (Suratmi, Laihat & Santri, 2018).

The teaching of science with sub-biology and physics is very closely related. Biology studies everything related to living things: animals, plants, and microbes (Kışoğlu, 2018). Physics studies nature, natural phenomena, or all occurring interactions (Marlina & Sriyanti, 2020). So Biophysics is a branch of physics that applies principles, approaches, or physics methods in studying or understanding a biological problem (Sharpe & Abrahams, 2020).

The application of the fields of natural science in life is very much related. Physics and chemistry, chemistry and biology, and physics and biology are unseparated pairs. The delivery of complex and precise material regarding applying physics and biology learning in everyday life is presented in an inseparable unit that makes this digital flipbook in this study different from previous ones. Therefore, this study investigates the feasibility of a digital physics flipbook in reproduction developed to be used in learning. This study aims to achieve the following objectives:

a. Develop a digital flipbook as a learning media of physics in reproduction.
b. Validate a digital flipbook as a learning media of physics in reproduction.

METHODS

Research Design

This research is research and development (R&D) with a 4-D model. The stages of the 4-D development model include definition, design, development, and dissemination (Thiagarajan, Semmel & Semmel, 1974). The definition stage consists of activities including identifying and formulating the objectives of the product to be developed. The design stage consists of activities, including initial product and instrument drafts. The development stage includes product validation, product revisions, limited trials, and extensive product trials. The dissemination stage includes disseminating research results in feasible, valid, and practical products and conducting scientific publications.

In this research and development, every stage has been carried out in developing the digital flipbook of physics material. However, in the feasibility study at the development stage, the steps taken are only to evaluate the feasibility of the flipbook by the validator and to revise the product. Limited-scale and large-scale trials are still carried out, with the results outlined in the following article. The validators are established by using the purposive sampling technique.

Participants

This study has a validator subject totaling 16 people. Eight were master's students, and eight were middle and high school teachers. Eight master's students are students of the faculties of mathematics and natural sciences of three universities in Indonesia. In detail, six master's students of science education at Universitas Negeri Yogyakarta, one master's student of science education at Universitas Negeri Makassar, and one master's student of biology education at Universitas Negeri Padang.

The other eight validators are middle and high school teachers. They are natural science teachers in junior high school and physics and biology teachers in high schools in several regions in Indonesia. In detail, they consist of one teacher of State Junior High School (SMPN) 1 Mandau, one teacher of SMPN 25 Makassar, one teacher of SMPN 1 Lilirilau, one teacher of SMPN Satap Homebase, one teacher of MTs Darunnaiem Pesse, one teacher of MTs An-nur, and two teachers of SMAN 3 Takalar.

Instrument

The instrument used in the data collection is a validation sheet. It was developed directly by the researcher based on the synthesis of previous researchers (Suarman, Hendripides & Hikmah, 2018; Fahmi et al., 2019; Saraswati, Linda & Herdini, 2019; Sarmi, Ratnawulan & Gusnedi, 2019; Prasetyono & Hariyono, 2020; Risniawati, Serevina & Delina, 2020; Ristanto et al., 2020; Situmorang, Yustina & Syafii, 2020; Evenddy et al., 2021; Rahayu, Zutiasari & Munadhiroh, 2021). It consists of six aspects of the assessment: didactic, construction, content knowledge, technical, language, and media. It was filled in by the validator diatomically by selecting "yes," which was given a score of 1. or choosing "no," which was given a score of 0.

The didactic aspect focuses on the processes and elements of teaching, the construction aspect focuses on developing teaching support components, and the content knowledge aspect focuses on the presentation of teaching materials. The technical aspect focuses on the suitability of the learning content, the language aspect focuses on the presentation of the language used, and the media aspect focuses on overall media presentation and use. The validation sheet determines the product's feasibility, namely a digital physics flipbook in reproduction shown in TABLE 1. The SPSS analysis showed the instrument's reliability was high, with an alpha Cronbach value of 0.859 and all items of the instrument used were valid.

TABLE 1. Validation Sheet

Aspects		Indicators
Didactic	1.	The material studied follows KI, KD, and the indicators to be achieved.
	2.	The material presented follows the things found in everyday life.
	3.	The material presented makes it easier for students to understand concepts.
Construction	1.	The flipbook has a foreword
	2.	The flipbook has a table of contents
	3.	The flipbook has a table of pictures
	4.	The flipbook has instructions for using a practical flipbook
	5.	The flipbook has a motivational section
	6.	The flipbook has a bibliography
	7.	The flipbook has a glossary
	8.	The flipbook has an index
	9.	The flipbook has an author profile
Content	1.	The content presented is systematic.
	2.	The content contained in the flipbook is explicit and easy to understand.
	3.	The content presented encourages students to think scientifically.
	4.	The content presented is complete and includes aspects of physics and biology.
	5.	The flipbook has practice questions to train students' higher-order thinking skills.
Technical	1.	The flipbook uses a legible font size.
	2.	The flipbook uses an appropriate and effective typeface.
	3.	The flipbook uses appropriate punctuation.
	4.	The picture used is in line with the concept.
	5.	Description of the picture is according to the image.
Language	1.	The sentences in the flipbook are excellent and use correct Indonesian grammatical rules.
	2.	The language used in the flipbook is communicative and interactive.
	3.	The choice of words used to compose sentences does not cause ambiguity.
	4.	The language used is easy to understand and clear.
Media	1.	The layout appropriate.
	2.	The use of color is appropriate.
	3.	There is a harmony among color, text, and a coherent image.
	4.	The flipbook display design is simple and attractive.
	5.	The background sound is harmonious and matching so that the teaching materials are perceived comprehensively.
	6.	The development and use of flipbook learning media is effective and efficient in.
	7.	The flipbook is feasible and easy to use.
	8.	The flipbook can be installed/run on various existing hardware and software.

Data Collection and Analysis

Validation sheets were distributed to master's students and teachers via a Google form. In addition, the developed digital flipbook provided validators with online access and PDF format files to make it easier for validators to make assessments. After the validator receives the developed digital flipbook, the validator provides an assessment through the validation sheet on Google Forms, which is received back by the researcher in Excel data tabulation. There are no obstacles in this data collection procedure because the validator is given instructions on how to fill in the validation sheet and instructions on how to use the developed flipbook. The data analysis technique used in the validity test was based on scores

taken from the validator for each assessment aspect. How to calculate the percentage score using the following EQUATION (1).

$$R = \frac{f}{n} \times 100\% \quad (1)$$

Notes:
R = percentage score
F = total score obtained
N = maximum score obtained

The result obtained was adjusted to the validity criteria in TABLE 2 below (Saraswati, Linda & Herdini, 2019).

TABLE 2. Validity Criteria

Percentage (%)	Validity Criteria
75.00-100	Valid
50.00-74.99	Sufficiently Valid
25.00-49.99	Less Valid
0.00-24.99	Invalid

RESULTS AND DISCUSSION

This development research produces a product in the form of a digital physics flipbook in breeding. This research activity takes place from March-May 2023. This digital flipbook developed can be used during the learning process inside and outside the classroom, anytime and anywhere, either online using a good internet network or offline. The following explains the findings of this study for each stage of development.

Define Stage

At this stage, various analyses were conducted to determine the current need to solve an educational problem in an area (Wijaya, Syarifuddin & Asmi, 2022; Saputro, 2023). The analysis conducted includes the analysis of the student, curriculum, and teaching materials. The student analysis results show that students need learning media that attract their interest and motivation to learn. Furthermore, students are expected to be able to adapt to changes in globalization in the field of technology in the world of education, one of which is by utilizing this technology.

In the analysis of the curriculum, the students said that teaching biology and physics at junior and senior high schools has many links and intersects. Regarding sustainable teaching, teaching can only be done after students learn another material.

In analyzing the teaching materials, students like the materials that can be applied and connected to everyday life because they feel they are fully involved in learning. Biology is closely related to all life processes; it is better if the materials presented in biology learning are applicable. Physics is an exact science used in many functions of activities carried out by humans. So that, these two subjects – biology and physics – have many relationships, one of which is physics in reproduction.

Design Stage

The design stage is for designing a digital flipbook, from the front cover and content components to the back cover entirely and thoroughly (Sugiharni, 2023). In addition, at this stage, a validation sheet is also designed, and the validator will use it to conduct an assessment. The developed digital flipbook contains various complex parts, including an introduction, table of contents, list of pictures, instructions for use, motivation, core competencies and essential competencies, learning materials, practice

questions, bibliography, glossary, index, and author profile which is equipped with audio, video, and links. Illustrates the parts in the digital flipbook presented in FIGURE 1.

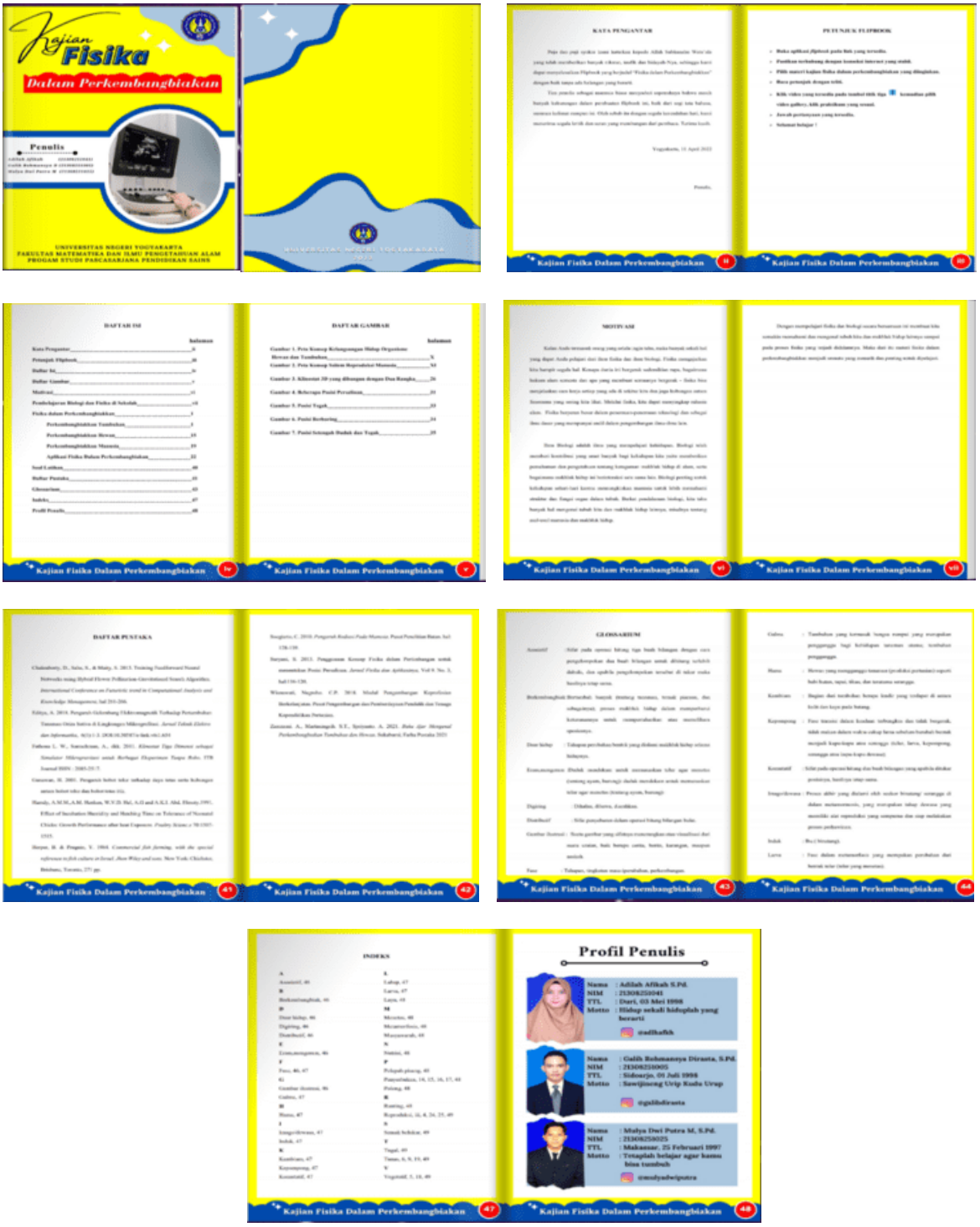

FIGURE 1. The Parts in The Digital Flipbook

This developed digital flipbook on the physics of reproduction consists of three main discussions of integrated physics and biology content, namely the process of fertilization of eggs by sperm, the process of birth, and electromagnetic waves on plant growth and development, presented in FIGURE 2.

FIGURE 2. Physics Content in Reproduction

Develop Stage

At the development stage, initially, the flipbook was made in Microsoft Word. Then it was converted into a portable data format (PDF) file and transformed into a flipbook using flipbook.html 5. Teachers and students can access this digital flipbook online and offline using computers, laptops, notebooks, and various gadgets with Android and iOS operating systems. The developed flipbook was then validated. Finally, the flipbook was revised in response to the observations and recommendations provided by the validator. FIGURE 3 shows all aspects of the digital flipbook validation sheet for physics practicum guides in guided inquiry-based breeding are in the valid category, with the validation results having an average percentage of 97.51%. The aspect with the highest validity is the construction aspect, and the aspect with the lowest validity is the language aspect.

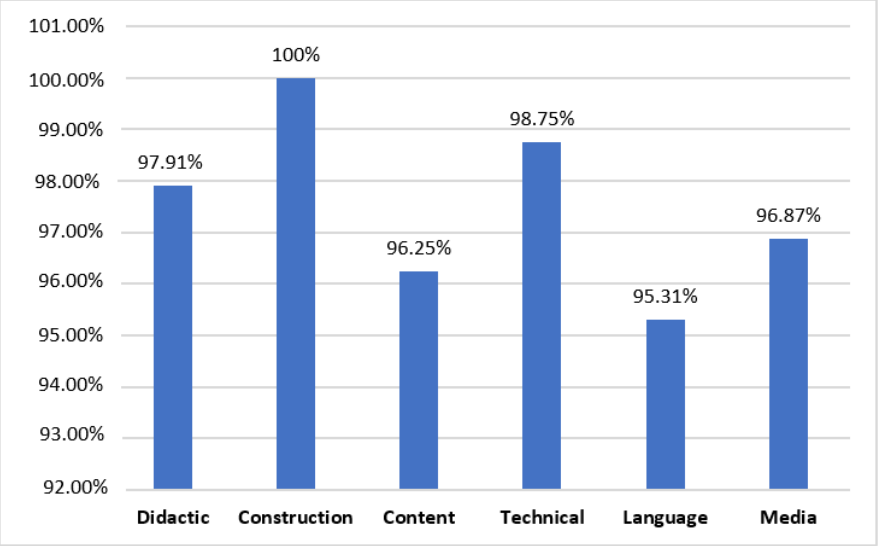

FIGURE 3. Validation Results of Each Aspect

The following explains in detail the validation items for each aspect described in TABLE 3 below.

Didactic Aspect

TABLE 3. Validation Result of Didactic Aspect

Items	Percentage (%)	Category
1	100	Valid
2	93.75	Valid
3	100	Valid
Total		97.91%

TABLE 3 shows that Items 1 and 3 in the didactic validation − "The material being studied is in line with the core competence, basic competence, and the indicators to be achieved" and "The material presented makes it easier for students to understand concepts"− get a total percentage (100%). The developed flipbook pays attention to and relates the basic competencies of physics and biology subjects at junior and senior high schools. For example, physics for junior high school grade 8, semester 2 discusses straight force and its application in motion. High school physics grades 10 and 11 discuss energy, work, momentum, impulse, vibration, and waves. Biology for junior high school, grade 9, semester 1, discusses the reproductive system and reproductive system, and biology for high school level, grade 12, semester 1, discusses factors that affect growth and development.

This flipbook consists of three stages. The first stage discusses biological materials, the second stage discusses physics materials, and in the third stage, from each material explained in the two sections above, the concepts studied are combined into one discussion, namely about what physics applications occur in reproduction in living things. FIGURE 4 below shows the materials being studied according to the essential competencies to be achieved.

FIGURE 4. Materials Based on Basic Competence

Construction Aspect

TABLE 4. Validation Result of Construction Aspect

Items	Percentage (%)	Category
1	100	Valid
2	100	Valid
3	100	Valid
4	100	Valid
5	100	Valid
6	100	Valid
7	100	Valid
8	100	Valid
9	100	Valid
Total		100%

TABLE 4 shows the result of the validation construction aspect, which found that all items in the construction aspect are in a valid category with a total percentage. The validator considered that the developed flipbook media had complete and appropriate construction aspects. Every learning medium developed by teachers and researchers must pay attention to the completeness of its components or parts [42], [43].

Content Aspect

TABLE 5. Validation Result of Content Aspect

Items	Percentage (%)	Category
1	100	Valid
2	93.75	Valid
3	100	Valid
4	100	Valid
5	87.50	Valid
Total		96.25 %

TABLE 5 shows that Items 1, 3, and 4 in the content validation are in valid categories with total percentages. These items explain that the content presented in the flipbook is systematic, it encourages students to think scientifically, and the content is complete and includes aspects of physics and biology. By applying the physics concepts to biological events encountered in everyday life, students train their higher-order thinking skills by linking the two ideas (Sharpe & Abrahams, 2020). This can improve critical and creative thinking skills and students' learning interests (Wartono, Hudha & Batlolona, 2018).

Item 5 in the construction validation, saying, "The flipbook has practice questions to train students' higher-order thinking skill," is in a valid category with the lowest percentage. The developed flipbook is equipped with questions related to the overall content that has been discussed. It aims to see students' understanding of the content that has been described and to train students' critical thinking skills (Suniasih & Sujana, 2023). Suggestions are obtained in the comments column, and improvements have been made regarding access to practice questions on the flipbook. The question links can be seen directly on the paper; students can click on the question link. Students do not have to click on the visible column question first. FIGURE 5 below shows the practice questions on the flipbook before revision (a) and after revision (b).

(a) (b)

FIGURE 5. Revision of Practice Questions

Technical Aspect

The results of the Technical Aspect Validation can be seen in TABLE 6.

TABLE 6. Validation Result of Technical Aspect

Items	Percentage (%)	Category
1	100	Valid
2	93.75	Valid
3	100	Valid
4	100	Valid
5	100	Valid
Total		98.75%

TABLE 6 shows that Item 2 in the construction validation, saying “The flipbook uses an appropriate and effective typeface,” has the lowest percentage of the other items. Suggestions are obtained in the comments column, and improvements have been made to make the typeface more attractive so students are more motivated to use the developed flipbook (Maksum & Purwanto, 2022). FIGURE 6 below shows the font before revision (a) and the font after revision (b).

(a) (b)

FIGURE 6. Font Revision

Language Aspect

The results of the Language Aspect Validation are presented in TABLE 7.

TABLE 7. Validation Result of Language Aspect

Items	Percentage (%)	Category
1	100	Valid
2	93.75	Valid
3	87.50	Valid
4	100	Valid
Total		95.31%

TABLE 7 shows that Item 3 in the validation language aspect, saying, "The choice of words used to compose sentences does not cause ambiguity," is in a valid category with the lowest percentage. Suggestions are found in the comment column, which says some words and terms are difficult for junior high school students to understand, and improvements have been made using easy and commonly understood words. Adding a collection of difficult words to the glossary makes it easier for students to understand the meaning of the explanation (Vidić, 2021). The results of the Media Aspect Validation are presented in TABLE 8.

Media Aspect

TABLE 8. Validation Result of Media Aspect

Items	Percentage (%)	Category
1	100	Valid
2	100	Valid
3	100	Valid
4	100	Valid
5	81.25	Valid
6	100	Valid
7	100	Valid
8	93.75	Valid
Total		96.87%

TABLE 8 shows that Item 5 in the validation of media aspect, saying, "The background sound is harmonious and matching so that the teaching materials are perceived comprehensively," is in a valid category with the lowest percentage. Suggestions are obtained in the comment column, and improvements have been made, namely using a more harmonious background sound and not disturbing the concentration of students in understanding the learning material. In addition, the flipbook is

equipped with a large and small background sound volume setting and an off-volume menu so that students can fully adjust it according to their wishes.

CONCLUSION

Flipbooks as a learning medium can be practically used in the classroom to help the teacher convey understanding to the students and to help the students process the information provided by the teacher. This developed flipbook contributes to the advancement of educational technology, especially in integrating physics and biology concepts in science learning. It has innovation and potential as a model for learning tools that can be integrated with other learning.

Based on the findings, it can be concluded that the development of the digital flipbook of physics in reproduction is declared valid by the validator. The percentage is 97.91% in the didactic aspect, 100% in the construction aspect, 96.25% in the content aspect, 98.75% in the technical aspect, 95.31% in the language aspect, and 96.87% in the media aspect; thus, with an average percentage of 97.51%.

The need for technological resources or potential challenges in integrating flipbooks into the existing curriculum are limitations of this study. The digital physics flipbook in reproduction still needs to provide a place to collect the answers to the questions given; this place will later be helpful for students to be able to access learning media and learning outcomes at the same time. Future researchers can add a answers collection section by integrating a digital portfolio feature where students can track their learning progress and results.

The instrument for the feasibility of the developed digital physics flipbook in reproduction can be a reference for research on the feasibility of other learning media. Future research that can be done next is to test the effectiveness of the products that have been developed, their impact on different student demographics, and further development of interactive features that can help guide future research and improvements.

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