

Evaluating the Feasibility of a Flipbook-Based Physics Learning Media Integrated with Local Culture: A Case Study on Matter State Changes

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ABSTRACT

The integration of technology-based learning media with local cultural contexts remains limited in physics education, particularly in teaching abstract concepts such as matter state changes. This study aimed to evaluate the feasibility of an electronic flipbook integrated with local cultural potential and to assess student responses toward its use in physics learning. This research employed a research and development (R&D) approach using the 4-D model (define, design, develop, and disseminate), limited to the development stage without classroom implementation. The validation process involved eight expert validators, while student responses were collected from 15 junior high school students. Data were obtained through validation sheets and student response questionnaires, then analyzed descriptively using percentage scores. Validation results indicated that the developed flipbook was highly feasible, with an average score of 90.75% across content, presentation, linguistic, and graphic aspects. Student responses also showed very positive evaluations, with an average score of 93.75%, particularly noting the media's attractiveness, readability, and contextual integration with local culture. These findings confirm that the electronic flipbook is a valid and feasible medium for physics learning, offering both technological innovation and cultural relevance. The integration of local cultural elements enriched the contextualization of abstract physics concepts, aligning with constructivist learning principles. However, further classroom implementation is needed to evaluate its effectiveness in improving student learning outcomes. The developed flipbook is feasible as a culturally integrated physics learning medium. Future research should focus on large-scale trials to measure its impact on students' conceptual understanding and motivation.

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1. INTRODUCTION

The lack of use of technology-based media in science learning is a problem that hinders skill development in the 21st century. These abilities include the ability to innovate, master technology, and develop skills for life and work that are important in preparing students to face challenges in this digital era (Hikmaturrosyidah & Rachmadiarti, 2022; Mulyani et al., 2023; Rehman et al., 2024). In this era, educators who have these skills are needed to make the learning process more active and interactive. The use of learning media in the science learning process is needed as a teaching aid that can influence the conditions, climate and learning environment created by the teacher (Handini et al., 2024). The selection of unsuitable learning media can pose challenges and lead to misconceptions for students in grasping scientific concepts. The concept of which is essentially abstract, making comprehension difficult without concrete examples (Mufit & Fauzan, 2023; Tumangkeng & Muya, 2024).

The achievement of good learning can be supported by the use of learning media in school, so that teachers do not have to rely solely on oral communication when teaching (Aghni, 2018; Suprpto et al., 2022; Wulandari et al., 2023). Learning media refers to all forms of media that contain messages, either specifically designed or that can be used to provide experiences and practices that support the learning process (Maelissa et al., 2024). One of the increasingly popular innovations is the use of electronic flipbook-based learning media.

Flipbook is an effective software designed to convert PDF (Portable Document Format) files into digital publications with alternating page views (Diani & Hartati, 2018; Firdaus et al., 2024; Marpaung et al., 2024). In this context, flipbooks can be understood as digital books that present a series of images that gradually move from one page to the next. In addition, flipbooks also function as media in the form of *e-books*, *e-modules*, *e-papers*, and *e-magazines* (Afikah et al., 2024). Multimedia flipbooks offer a multifaceted learning experience, integrating text, images, videos, and color to enhance learning outcomes (Mede et al., 2024). Because students are more receptive to material explanations in the form of text with pictures, rather than just words, so it affects the understanding of concepts (Mayer, 2006). In addition, flipbooks are more attractive to students, easy and cheap to produce, flexible and accessible at any time, so they can increase students' learning activities (Kosasih, 2021; Prasasti & Anas, 2023).

The importance of learning media using flipbooks in physics learning is widely studied in current research (Maynastiti et al., 2020). The study of physics plays an important role in shaping students' understanding of the basic concepts underlying natural phenomena. One of the fundamental topics in physics is matter state changes, including the transition between solid, liquid and gas (Halliday et al., 2013). A deep understanding of matter and its changes not only introduces students to scientific theories, but can also spark their interest in the application of physics in everyday life (Surya et al., 2023). However, teaching these abstract concepts can often be challenging, especially if the goal is to make the learning experience interactive and relevant to students' everyday lives (Wulandari et al., 2023). The need to integrate local potential such as local resources, cultural elements or natural phenomena can enrich the learning process, making it more relevant and interesting.

Physics learning that integrates local potential utilizes regional potential as a real example into the concept of physics, one of which is matter state changes. In the context of learning, it allows students to connect abstract concepts with everyday experiences, creating a meaningful, contextual learning environment (Reddy & Revathy, 2024). In line with Vygotsky's theory, which emphasizes the importance of social and cultural interaction in shaping cognitive development (Vygotsky, 1978). Learning according to Vygotsky's theory can be a socially mediated process, the use of cultural tools to facilitate deeper learning, and encourage collaborative learning (Suardipa, 2020). In accordance with Janaris' research, (2024) which states that the application of Vygotsky's learning theory can improve student learning outcomes in science subjects. This shows that physics learning can also be integrated into local potentials to help the learning process.

One of the local potentials that can be integrated into the physics of matter and its changes is the traditional food 'dumbek' from Tuban, East Java. Dumbek is one of the typical foods of the district that

continues to grow, with a thick content of cultural values in each of its existence (Anggara et al., 2023). This food is always present at earth alms and wedding ceremonies as it is believed to symbolise fertility. As a traditional food, dumbek can be used as a contextual example in physics learning (Fooladi et al., 2023), especially material on changes in the form of substances. The process of making dumbek which involves the transformation of raw materials into cooked food can be linked to the concept of changing substances from liquid to solid or vice versa. Dumbek is made from ingredients such as rice flour, coconut milk and coconut sugar, which give it a delicious sweet flavour. These ingredients and the process of making dumbek can be integrated into the material of physics, namely substances and their changes (Lestari et al., 2022). One of the learning approaches that makes the learning process more meaningful is learning activities that are integrated with local potential (Sriyati et al., 2023). In addition, it is an alternative to introduce the culture of a region to students.

Integrating potential into learning is a strategic approach to overcoming the cultural gap that still exists in the education system. Although many efforts have been made to create more inclusive learning, many strategies have not been able to take the local cultural context into account and integrate it deeply into the learning process (Hikmawati et al., 2020). The subject matter presented often does not consider the rich cultural heritage of the students, which can lead to a sense of alienation and disinterest in learning (Dewi & Wibawa, 2024). The proposed flipbook aims to not only deepen the understanding of scientific concepts (Agustini et al., 2022; Darmawan et al., 2024) but also aims to foster a sense of pride and strengthen cultural identity among students. In line with Dewi & Wibawa, (2024), which shows that the use of flipbooks based on local culture in science teaching materials can be effectively used to improve students' understanding of concepts. By validating and integrating local potential into learning media, it is expected that students will feel more connected and relevant to the material being taught.

The application of science in life is closely related. The delivery of complex and precise material regarding the application of physics learning integrated with local potential in everyday life is presented in an inseparable unit, this makes the electronic flipbook in this study different from previous flipbooks. Therefore, this study investigates the feasibility of the electronic physics flipbook developed for use in learning. The purpose of this study is to develop and validate electronic flipbooks as a physics learning medium integrated with local potential in matter and its changes, and to analyse students' responses to the developed learning medium.

2. METHODS

This research is a research and development (R&D) with the 4-D model. The stages of this model include define, design, develop, and disseminate, which are systematic stages in developing learning media or educational innovations (Thiagarajan, 1974). This research is a study of the development and validation of learning media, which is limited to the development stage without comprehensive classroom implementation. The definition stage involves a series of activities that identify and define the objectives of the product to be developed. The design stage includes a range of activities such as the creation of the initial design of the product and the necessary tools. Furthermore, the development stage includes the process of product validation, design improvement, limited testing (student response) and wider product testing.

In this study, each stage has been carried out in the development of electronic flipbooks of physics materials integrated with local potential. However, in the feasibility study at the development stage, the steps taken were only to evaluate the feasibility of the flipbook by validators, evaluate students' responses to the product, and make product revisions. Limited-scale and large-scale trials were still conducted, with the results described in the following article. Validators were determined using a purposive sampling technique. The validators consist of science education master's students who have expertise in the field of science, technology, and learning, as well as teachers who have at least five years of teaching experience in the field of science education (Larista et al., 2023).

The subjects in this study consisted of 8 validators and 15 students from SMP PGRI 3 Tuban, selected directly from the school who had obtained student approval and permission from relevant parties. Five were master's students and three were junior high school science teachers. The five master's students were mathematics and science students from three universities in Indonesia, namely three master's students in science education from Yogyakarta State University, one master's student in science education from Sebelas Maret State University, and one master's student in physics education from Semarang State University. The other three validators were science teachers from SMP PGRI 3 Tuban, science teachers from SMP Nurul Amanah Bangkalan, and science teachers from MTs Hidayatus Salam.

The instruments used for data collection were validation sheets and student response questionnaires. The validation assessment consisted of aspects of content, presentation, linguistic and graphic feasibility. This form is filled in by the validator atomically by selecting 'yes' with a score of 1 or 'no' with a score of 0. The validation sheet determines the feasibility of the product, namely the electronic flipbook on physics material integrated with the local potential shown in Table 1.

Table 1. Media and Material Validation Sheet

Aspect	Indicator
Content feasibility	Appropriateness to learning objectives
	Correctness of the substance of the learning material
	Benefits to add insight
	Ease of access
	Suitability of local potential integrated material
Serving	The accuracy of local potential integrated material
	Presentation of material
	Presentation of information contained in the form of text, images, videos, and animations
Linguistics	Quality of illustration display in the form of images and videos
	Conformity with EYD Indonesian language rules
	Efficient and effective use of language
Graphics	Use of font type and size in the product
	Colour composition in the product display
	Display design or user inference
	Appropriateness of application selection
	Opportunities for the development of science and technology

In addition, the student response assessment is intended to see the readability of the product by students with assessment aspects consisting of media, content, and language. The form uses a Likert scale which has 4 answer scores, namely 1 = not suitable, 2 = less suitable, 3 = suitable, and 4 = very suitable. The student response questionnaire sheet to the product can be seen in Table 2.

Table 2. Student Response Questionnaire

Aspect	Indicator
Media	Electronic flipbooks are attractive and easy to use
	Electronic flipbooks have a neat layout, are easy to read, and effective in learning
	Easy to understand the material
Content	There are examples and illustrations
	The application of cultural learning is easy to understand to the material
Language	Easy to use
	Good punctuation and understanding

The validation sheet instrument and the validated student response questionnaire were distributed to students, teachers and students via Google Form. In addition, the developed electronic flipbook provides online access and PDF format files to validators and students to facilitate the assessment. After the assessment, the data obtained through the google form will be analysed by the researchers in the form of Excel data tabulation. The data analysis technique used in the validity test is based on the validator's score for each aspect of the assessment. The equation used to calculate the percentage score is as follows:

$$V_{ah} = \frac{TS_e}{TSh} \times 100\%$$

Notes:

V_{ah} = expert validation

TS_e = total score achieved

TSh = total maximum expected score

The results obtained are adjusted to the validity criteria in table 3 below (Hasanah & Nurfalalah, 2020):

Table 3. Media and material validity criteria

Score in percent	Interpretation
85% < V ≤ 100%	Very feasible
75% < V ≤ 85%	Feasible
55% < V ≤ 75%	Less feasible
V ≤ 55%	Not feasible

The data analysis technique used in measuring the student's response to the developed electronic flipbook is based on the scores taken from the students for each aspect of the assessment. The formula that can be used in assessing student responses is as follows:

$$PS = \frac{S}{T} \times 100\%$$

Notes:

PS = Percentage of respondents' scores

S = Score obtained

T = Total score (maximum)

The results obtained are adjusted to the validity criteria in table 4 below (Kartini et al., 2020):

Table 4. Student Response Criteria

Interval score (%)	Interpretation
80 < PS ≤ 100	Very good
60 < PS ≤ 80	Good
40 < PS ≤ 60	Good enough
PS ≤ 40	Not good

3. FINDINGS AND DISCUSSION

This development research will produce a product in the form of an electronic physics book integrated with local potential on the material of substances and their changes. This research activity took place from October to December 2024. This developed digital book can be used during the learning process inside and outside the classroom, anytime and anywhere, both online using a good internet network and offline. The results of this research are described below for each stage of development.

3.1. Definition Stage

At this stage, a series of analyses are carried out to identify the current needs for addressing educational problems in an area. The analyses include aspects of students, curriculum and teaching materials. Based on the results of the student analysis, it was found that students need learning media that can attract their interest and increase their motivation to learn. In addition, students are expected to adapt to the development of globalisation, especially in the field of educational technology, one of which is the use of these technological advances. The students also have basic knowledge about the local potential that has been raised, namely 'dumbek', so that it can be used as a real example in the physics material.

Furthermore, curriculum analysis, the physics material raised in this study is substance and its changes contained in Class VII odd semester in the independent curriculum. Students stated that physics lessons integrated with local potential have many links to real examples in everyday life.

Analysis of teaching materials, students like material that can be applied and related to everyday life because they feel fully involved in learning. The context of local potential in the developed electronic physics flipbook can increase students' interest to learn the material more deeply, so that learning is more meaningful..

3.2. Design Stage

The design stage is the design stage in the preparation of the flipbook, starting with the preparation of the flipbook components, which consist of the main components of cover, content and binding. This stage also includes the design of validation assessment sheets and student response questionnaires. For the presentation of the content, the learning media selection process is carried out, and the electronic flipbooks are presented using the heyzine application. The ability of the software to present images, videos, links, audio is the reason for choosing this medium. In addition, the selection of formats in the presentation of material supported by the visualisation of images, videos, animations must also be determined in the order of each page in the flipbook to make it more effective and efficient.

The developed electronic flipbook has various complex parts, including introduction, table of contents, user's guide, concept map, learning outcomes and objectives, learning materials, learning activities, practice questions, summary, glossary, author profile with audio, video and links. The electronic flip-book consists of 3 sub-chapters of material, namely the form of substances and changes in the form of substances, physical properties and chemical properties of substances and the density of substances integrated with the local potential of 'dumbek' and there are multimedia features in it. The following are the main components of the flipbook developed as follows:



Figure 1. Cover Design Page, Video Content, Material Page

3.3. Develop Stage

At this stage, the flipbook is initially created in Microsoft Word format for the preparation of its content, then entered in the flipbook design template in the canva application. After the flipbook has been completed, it is then downloaded in the form of a PDF format data file. The PDF file will be transformed into an electronic flipbook using heyzine flipbooks. Flipbooks that have been developed can be accessed via laptops, computers, notebooks, and various gadgets with iOS or Android operating systems. Flipbooks that have been developed are then validated, after valid products can be measured for readability by student responses. Then, the flipbook is revised based on the observations and recommendations given by the validator. The following is a detailed explanation of the assessment per validation item for each aspect, shown in table 5 below:

Table 5. Results of Aspect Validation

Item	Aspect	Indicator	Percentage (%)	Categori
1	Content feasibility	Appropriateness to learning objectives	100%	Very feasible
2		Correctness of the substance of the learning material	100%	Very feasible
3		Benefits to add insight	100%	Very feasible
4		Ease of access	87.5%	Very feasible
5		Suitability of local potential integrated material	100%	Very feasible
6		The accuracy of local potential integrated material	100%	Very feasible
7		Presentation of material	100%	Very feasible
8	Serving	Presentation of information contained in the form of text, images, videos, and animations	87.5%	Very feasible
9		The quality of the illustration display in the form of images and videos	75%	Feasible
10	Language	Conformity with EYD Indonesian language rules	100%	Very feasible
11		Efficient and effective use of language	87.5%	Very feasible
12	Graphics	Use of font type and size in the product	75%	Feasible
13		Colour composition in the product display	100%	Very feasible
14		Display design or user inference	87.5%	Very feasible

15	Appropriateness of application selection	87.5%	Very feasible
16	Opportunities for the development of science and technology	100%	Very feasible
Total Average		90.75%	Very feasible

Table 5 shows that each item, the material in the flipbook is considered in accordance with the learning objectives, accurate, useful and integrated with local potential. On the other hand, in point 4 'accessibility', the score was low compared to the other points, with a percentage of 87.5%, which needs to be corrected. Accessibility of materials plays an important role in learning effectiveness, where technical barriers can reduce the achievement of learning objectives (Ali et al., 2024). Accessibility improvements will support the effectiveness of the materials and enhance the student learning experience (Salwa et al., 2023). The presentation aspect shows a total average of 81.30%, which is categorised as feasible. The indicator in item 8 obtained a score of 87.5% (very feasible), indicating that the material is well presented in various forms of media. Material conveyed through verbal and visual representations can improve students' understanding (Woolley, 2014; Níkleva & Rodríguez-Muñoz, 2022). However, indicator item 9 obtained a percentage of 75% (feasible), indicating limitations in visual quality that may affect the effectiveness of material delivery. Low-quality images and videos can hinder student attention and understanding. High-quality presentation of materials should pay attention to the principles of coherence and redundancy, so that visuals support the text effectively (Najib et al., 2023).

The results of the validation of linguistic aspects show a total average of 93.80% with a very feasible category. The indicator in item 10 obtained a score of 100%, which reflects full compliance with standardised language rules. This is in accordance with Keraf, (2009) view, which emphasises the importance of using language according to the rules to maintain the clarity, accuracy, and formality of a text, especially in an academic context. Meanwhile, item 11 obtained a score of 87.5%. Although it is still in the very feasible category, this value shows that there is room for improvement in the use of language that is more concise and to the point. According to Tarigan, (2009) states that efficient language avoids unnecessary repetition and ensures each word contributes to a clear meaning. Inefficiency can affect comprehension and fluency in reading the material. The graphic aspect with an average of 90.00% are categorised as very feasible. Items 13 and 16 obtained a percentage of 100%, indicating that the material has fulfilled graphic design principles that support aesthetics and technological sophistication. Design with harmonious colour composition can increase visual appeal and effectiveness of information delivery (Liu et al., 2022). While the lowest score in this aspect is in *item 12*, with a percentage of 75%, this shows that there are deficiencies in font selection or text size that can affect readability. Proper and consistent font selection plays an important role in maintaining readability, aesthetics and visual comfort when using electronic flipbooks (Poon, 2021).

The highest and lowest ratings of media feasibility values can be presented in the form of graphs. The highest value is in the aspect of content feasibility and the lowest in the presentation aspect. The feasibility value per aspect can be seen in the graph shown in Figure 2.

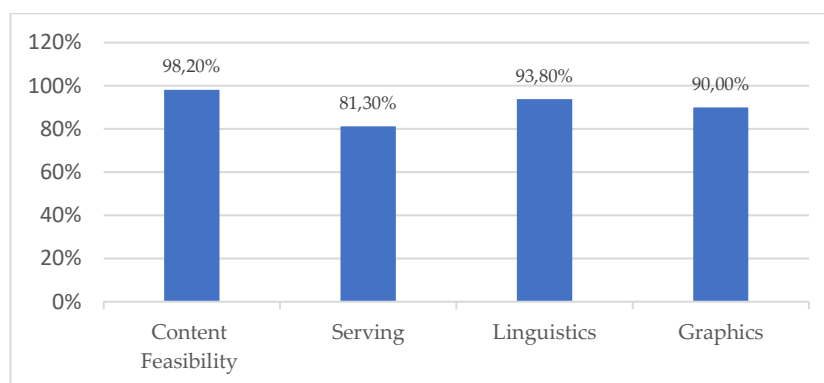


Figure 2. Electronic Flipbook Feasibility Chart for Each Aspect

The graph shows that students can get information that suits their learning needs with decent content. However, even though the content presented is very feasible, if the delivery is not tailored to the needs of students, then the understanding and reception of information will be disturbed. Therefore, these feasibility aspects are essential in building flipbook learning media suitable for students.

In addition to successful validation with validators, the developed media were also evaluated by students. The results of the students' assessment of the flipbook as a physics learning media integrated with local potential in the material and its changes are shown in Table 6 below.

Table 6. Student Response to Physics Electronic Flipbook Integrated with Local Potential

No	Aspect	Score Percentage (%)	Category
1	Media	93.33%	Very good
2	Content	92.92%	Very good
3	Language	95.00%	Very good
Total Average		93.75%	Very good

Based on Table 6, the results of the assessment of the students' responses to the developed media show an overall mean score of 93.75%, which is classified as very good. The assessment of student responses to the media aspect has a percentage score of 93.33%, this score indicates that the visual appearance and multimedia features in the flipbook are rated very highly by the students. The appearance of the electronic flipbook learning media is attractive and not boring to the students, and the colour combination on the media is also rated well by the students. The use of good digital media can increase students' engagement and understanding (Yunita et al., 2019).

In terms of content, students rated the relevance of the content material to the local potential and basic competencies of physics as very good, as shown by the percentage score of 92.92%. This is in line with Vygotsky's theory that effective learning occurs when the material is related to the environment and the students' experiences. By integrating local potential, this flipbook creates a real context that helps students to build conceptual understanding in a more meaningful way (Putranto & Marsigit, 2018; Laksana et al., 2021).

Furthermore, the language aspect received the highest score compared to other aspects, namely 95.00%, indicating that the use of language in flipbooks is considered efficient, communicative and easy for students to understand. Language in learning media must be clear, simple and appropriate to the ability of the audience. Good language choice promotes the effectiveness of knowledge transfer and minimises barriers to understanding the material (Tarigan, 2009).

Discussion

The developed electronic flipbooks demonstrate high feasibility and quality for large-scale implementation, achieving an average feasibility score of 90.75%. These findings suggest that flipbooks integrated with local potential can serve as innovative learning media, particularly in teaching the concept of substances and their changes. The evaluation results indicate a significant student need for improved conceptual understanding in physics, and the interactive, visual nature of the flipbook media effectively addresses this need (Rahmawati et al., 2025). The use of contextual content, engaging design, and communicative language supports a more efficient and effective learning process, aligning with prior research by Nasution et al. (2024), which found that technology-based media like flipbooks can enhance student motivation by up to 89%.

The integration of multimedia elements in flipbooks reflects Mayer's cognitive theory of multimedia learning, which emphasizes that combining visuals with text enhances information processing and retention (Ramadhan et al., 2025). This approach helps reduce cognitive overload and improves student engagement, as supported by Hanum et al. (2023), who argue that multimedia learning aligns with the brain's natural processing capabilities. Consequently, the positive student responses in this study affirm the instructional value of flipbooks in simplifying abstract physics concepts and promoting meaningful learning.

Beyond cognitive benefits, flipbooks also foster active and independent learning. According to Ghifari and Linggowati (2024), the medium encourages students to construct knowledge through self-directed exploration. However, while the current version is effective, content quality can still be enhanced through richer interactive materials and deeper integration of local context. This aligns with recommendations from Muliana et al. (2024), who emphasize the importance of localized, exploratory content in engaging students more deeply with scientific concepts.

The integration of local cultural elements, such as the traditional dumbek instrument, also aligns with Vygotsky's sociocultural theory, which posits that learning is mediated by social and cultural interactions (Wardani et al., 2023). By connecting physics content to students' lived experiences, the flipbook fosters contextual understanding and supports constructivist learning approaches. This makes the medium not only pedagogically sound but also culturally relevant, which is essential for diverse educational environments.

Despite its advantages, several challenges must be addressed to optimize the use of flipbooks in physics education. Limited access to technology, inconsistent media quality, and insufficient teacher readiness remain key barriers (Hardiansyah & Mulyadi, 2022; Yulianto, 2022). To address these issues, future designs should include step-by-step scaffolding, intuitive visualizations, interactive exercises, and timely feedback to enhance clarity and reduce misconceptions (Afriwardani, Jumadi, & Pribadi, 2023). Moreover, the use of simplified language and clear symbolic representations can help students grasp complex concepts more systematically.

It is important to acknowledge the limitations of the present study. As this research focused solely on the development phase of the flipbook, it did not assess its effectiveness in actual classroom settings. Furthermore, the study involved a limited number of participants, which restricts the generalizability of the findings. Future research should include implementation in real-world learning environments to evaluate the impact on cognitive, affective, and psychomotor learning outcomes.

In summary, electronic flipbooks offer a promising and innovative medium for enhancing physics education. Their ability to integrate visual, contextual, and cultural elements makes them effective tools for improving conceptual understanding and student motivation. With further refinement and broader implementation, flipbooks have the potential to significantly contribute to science learning, particularly in topics that are traditionally considered abstract or challenging.

4. CONCLUSION

The findings of this study indicate that the developed electronic flipbook is a highly feasible and effective medium for enhancing physics learning, particularly in the topic of matter and its changes, with a feasibility score of 90.75% and a positive student response rate of 93.75%. Its interactive design, contextual content, and visual elements contribute significantly to improving students' conceptual understanding and engagement. Despite these promising results, the study was limited to the development phase and involved only teacher validation and student feedback, without including expert reviews or implementation in actual classroom settings. To fully realize the potential of this media, future research should focus on classroom-based trials to evaluate its impact on learning outcomes, compare its effectiveness with conventional teaching methods, and assess its role in reducing misconceptions related to changes in matter. Additionally, further refinement of content depth and integration of local potential, along with addressing challenges such as technology access and teacher readiness, will be crucial for broader application and long-term effectiveness.

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