DEVELOPMENT OF DIGITAL BOOK-BASED TEACHING MATERIALS TO ENHANCE THE EFFECTIVENESS OF SCIENCE LEARNING FOR FOURTH GRADE AT MIT BERKAH

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Abstract

This research aims to develop digital book-based teaching materials to increase the effectiveness of Natural Sciences (IPAS) learning in elementary schools. With the development of information technology, the use of digital books as a learning resource can provide a more interactive, interesting and easily accessible learning experience for students. The research method used was research and development (R&D) with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The first stage begins with a needs analysis, followed by designing and developing digital books that are adapted to the applicable curriculum. Furthermore, the digital book was tested on a number of students to determine the extent to which this book could increase students' understanding and involvement in science learning. The results show that digital book-based teaching materials increase students' learning motivation, understanding of the material, and practical skills in science subjects. Therefore, the development of digital book-based teaching materials is highly recommended as an alternative to improving the quality of learning, which is

more effective and enjoyable.

Keywords: ADDIE Model, Digital book- based Teaching Materials, Educational Technology, Natural sciences.

Abstrak

Penelitian ini bertujuan untuk mengembangkan bahan ajar berbasis buku digital dalam upaya meningkatkan efektivitas pembelajaran Ilmu Pengetahuan Alam dan Sosial (IPAS) di sekolah dasar. Seiring dengan perkembangan teknologi informasi, pemanfaatan buku digital sebagai sumber belajar dapat memberikan pengalaman pembelajaran yang lebih interaktif, menarik, dan mudah diakses oleh siswa. Metode penelitian yang digunakan adalah penelitian dan pengembangan (R&D) dengan model ADDIE (Analysis, Design, Development, Implementation, Evaluation). Tahap pertama dimulai dengan analisis kebutuhan, diikuti dengan perancangan dan pengembangan buku digital yang disesuaikan dengan kurikulum yang berlaku. Selanjutnya, buku digital yang dikembangkan diuji cobakan pada sejumlah siswa untuk mengetahui sejauh mana buku ini dapat meningkatkan pemahaman dan keterlibatan siswa dalam pembelajaran IPAS. Hasil penelitian menunjukkan bahwa bahan ajar berbasis buku digital dapat meningkatkan motivasi belajar, pemahaman materi, serta keterampilan praktis siswa dalam mata pelajaran IPAS. Oleh karena itu, pengembangan bahan ajar berbasis buku digital sangat dianjurkan sebagai alternatif dalam meningkatkan kualitas pembelajaran yang lebih efektif dan menyenangkan.

Kata Kunci: Pengembangan, Bahan Ajar Digital, Teknologi Pendidikan

INTRODUCTION

The advancement of the digital era has made technology-based learning media an essential element in the educational process. Technology enables educators to create learning experiences that are more interactive, efficient, and engaging for students (Lestari & Wardhani, 2024). The advancement of information technology in the current era of globalization has driven the development of learning media toward greater sophistication. The utilization of information and communication technology (ICT) offers various opportunities in education, including the use of digital media as a tool to enhance the effectiveness of the learning process (Anshori, 2018). Along with the changing times, learning in elementary schools is increasingly shifting towards the use of technology to assist students in understanding the material. Digital books designed to focus on pedagogical aspects can provide more engaging and effective learning experiences (Nurdiana, 2020).

Digital books offer students the opportunity to learn independently, anytime and anywhere, while allowing them to interact directly with the material being taught. Digital books not only present content in text form but also integrate various multimedia elements such as images, videos, animations, and quizzes, which can enhance students' understanding (Suryani, 2020)According to Suyanto (2018), digital books provide a more interactive learning experience and enable students to engage directly with the content presented. Digital books also support independent learning, as students can access them anytime and anywhere. Moreover, digital books excel in delivering information in various formats, such as text, images, animations, and videos, which assist students in understanding more complex materials (Sulaiman R. , 2020).

Science and Social Studies (IPAS) is an integral part of the elementary school curriculum that combines two fields of study: Natural Science (IPA) and Social Science (IPS). This subject aims to provide students with a basic understanding of natural phenomena and the dynamics of

social life around them. IPAS learning in elementary schools covers fundamental concepts related to the natural environment, living organisms, natural resources, and social interactions within communities (Sulaiman A. , 2019). Science and Social Studies (IPAS) is one of the subjects that can benefit from this technology due to the often abstract nature of the material, which can be difficult for students to understand.

IPAS learning in elementary schools aims to equip students with fundamental knowledge, including material about nature and society that is relevant to daily life, which also encourages students to develop scientific and social attitudes that will shape their character. With this comprehensive approach, IPAS learning not only teaches facts, but also guides students to understand and apply knowledge in their lives (Suprapto, 2020). Therefore, it is important for educators to create teaching materials that not only convey information clearly but also engage students' interest, encouraging them to delve deeper into the concepts being taught (Rahmawati, 2018).

Although the use of technology in education is rapidly growing, challenges in its implementation still exist, such as the lack of teaching materials tailored to students' needs and characteristics, particularly at the elementary level. Not all teachers and students are able to make optimal use of technology. One of the main obstacles is the lack of teaching materials developed specifically for the curriculum needs, as well as the limited skills of teachers in integrating technology into the learning process (Sari, 2019). In this context, the development of digital book-based teaching materials for IPAS learning is crucial, as it not only supports a better understanding of scientific concepts, but also makes it easier for teachers to deliver more varied and engaging content.

Based on the analysis conducted, several issues have been identified regarding the needs of teachers and Grade IV students at MI Terpadu Berkah Palangka Raya. These include low student motivation, lack of knowledge, and classroom learning that still relies heavily on worksheets (LKS). Moreover, the learning process is still conventional, with material explanations mainly dependent on textbooks. The pretest results of Grade IV students indicated low learning outcomes in the IPAS subject. Therefore we propose the development of a digital book as an interactive learning material for the IPAS subject. This initiative aims to facilitate students' understanding and enhance creativity. Specifically, we suggest that the Grade IV homeroom teacher create digital learning materials as interactive media for the topic "Changes in States of Matter" in the IPAS subject.

Based on the identified issues, the researcher plans to develop digital learning materials in the form of a digital book integrated with interactive learning media. The choice of interactive media is motivated by its ability to incorporate various types of content, such as text, videos, images, and three-dimensional objects, which can enhance students' engagement and interest. Additionally, the developed learning materials can be accessed through Android smartphones in the APK file format. These digital learning tools are structured to include learning objectives, learning objective pathways, achievement criteria, learning materials and instructions for self-directed learning activities aligned with basic competencies or performance indicators. The materials were also tailored to match students' comprehension levels, featuring an introduction that aligns with their understanding. To support the learning process further, students are provided with exercises to test their understanding, ensuring continuous learning support.

METHODS

This research was conducted from November 11 to 22, 2024, at MI Terpadu Berkah Palangka Raya. The type of research used is Research and Development (R&D), which refers to activities carried out by companies or individuals to develop new or improved products and processes (Mesra & Polii, 2023). The purpose of research and development is to create a product by identifying potential problems, designing, and developing the product (Waruwu, 2024). This study involves product development, product evaluation, the application of technology in learning, and the development of learning systems (Sugiyono, 2016).

This research utilizes the ADDIE model, an instructional design framework used to create and develop more effective and efficient learning experiences. ADDIE is an acronym representing the five main stages of this model: Analysis, Design, Development, Implementation, dan Evaluation (Purnamasari, 2019).
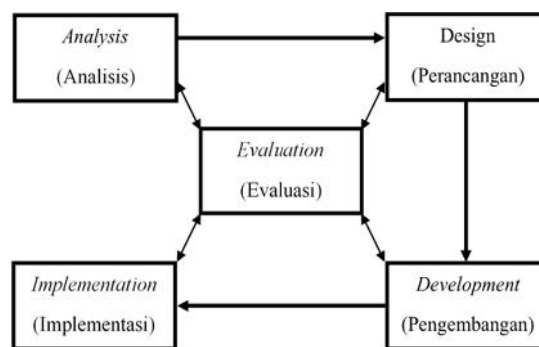
Figure 1. ADDIE Model

Data collection techniques refer to various methods that researchers can use to gather information. Some of the methods used in data collection for this research include interviews, observations, documentation, and questionnaire completion (Makbul, 2021). Quantitative data is a type of data that is expressed in numerical form and can be measured and analyzed using statistical techniques. The data is used to describe variables or phenomena that can be counted, such as quantity, frequency, or intensity of an event. Quantitative data are typically obtained through structured instruments, such as questionnaires, surveys, or experimental measurements that provide clear numerical results (Creswell, 2014).

In expert validation, data is also collected in the form of critiques, suggestions, and comments from experts regarding the digital learning materials for the IPAS topic of "Changes in States of Matter." A questionnaire was used as the data-collection instrument for this development. The questionnaire was administered to the subjects being tested. The questionnaire included the following question:
a) Material Expert Evaluation Questionnaire,
b) Design Expert Evaluation Questionnaire,
c) Questionnaire For Assessing book teaching materials by class IV teachers at MI integrated Berkah Palangkaraya ;
d) Field Trial Student Evaluation Questionnaire (Syabrina & Sulistyowati, 2020).

The product developed in this research was designed to be valid/feasible, practical, and highly effective for learning. To measure the feasibility of the product, questionnaires were distributed to material and design experts. Meanwhile, to test the product's effectiveness, the researcher used pretest and posttest questions to observe improvements in students' learning outcomes.

RESULTS AND DISCUSSION

RESULTS

The experimental results included field trials and expert validation, while the process involved testing in one classroom and validation by subject matter and design experts. This step is conducted to determine the feasibility of the developed product and ensure that it meets quality standards, functionality, and user needs (Wulandari & Purwanto, 2017).

1. **Material Expert**

The initial stage of this research is conducting validation of the material to be used. The results of this validation process are presented in the diagram below, which illustrates the evaluations from subject matter experts regarding the digital-based instructional book developed as a learning medium.
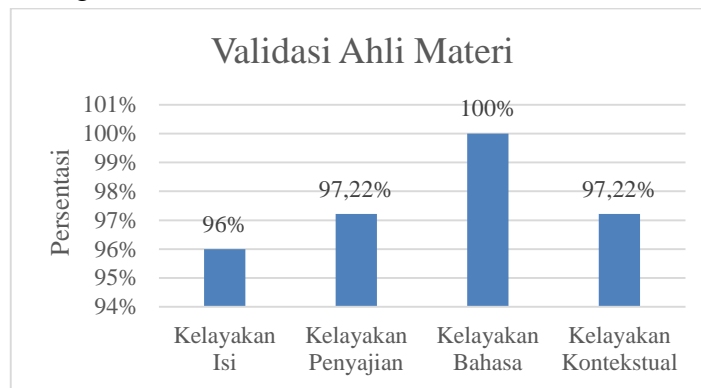
Figure 2. Graphic of Material Expert Assessment

Based on Figure 2, the results of the material expert validation indicate that the development of digital learning materials for the IPAS subject on "Changes in States of Matter" for Grade IV at MI Terpadu Berkah Palangka Raya achieved a very high level of feasibility, reaching 92.85%. This indicates that the learning media meets the criteria for content feasibility, presentation, language, and contextual relevance.

The suggestion from the subject matter expert to the researcher was to refine the product.

Table 2. Suggestions for improvement from material experts

No	Before	After
	Add Learning Material Content	

2. Design Expert

The next step was design expert validation. The validation stage by design experts is a crucial step in the development of learning materials. Through evaluations by design experts, the resulting learning materials are expected to possess high quality and be effective in supporting the learning process. The results of the design expert validation are presented in the diagram below.
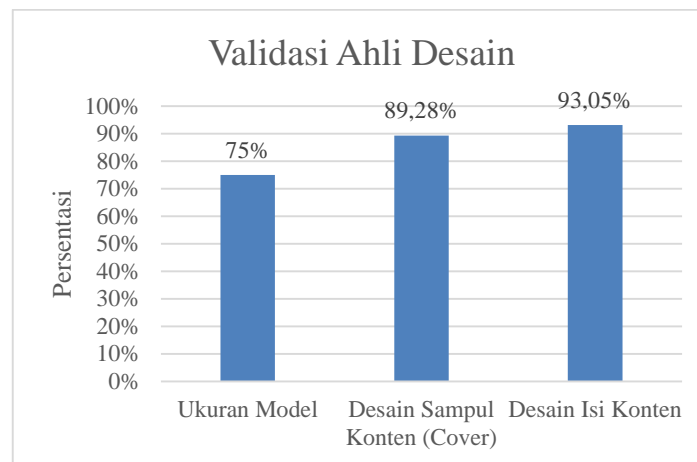
Figure 3. Design Expert Assessment Chart

Based on the design expert validation results shown in Figure 3, the development of teaching materials in the form of a digital book for the IPAS subject on "Changes in the States of Matter" for fourth-grade students at MI Terpadu Berkah Palangka Raya was deemed highly feasible, with a score of 90.74%. Although some aspects, particularly the model size, need improvement, the overall design of this teaching book is already excellent and can effectively help students to understand the topic of changes in the states of matter more efficiently.

The suggestion from the design expert to the researcher is to improve the product.

Table 3. Suggestions for improvements from design experts

No	Before	After
Ensure uniform font type and size across all page		

3. Teacher Assessment Results

Teachers, as practitioners, assess the digital textbook teaching materials that have been developed, as shown in the image below. Based on field trial results, the data is presented in the form of a graph, which illustrates the effectiveness and responses to the tested teaching materials. This graph provides a clearer understanding of the performance of the digital textbook materials in the field and their contribution to the learning proces
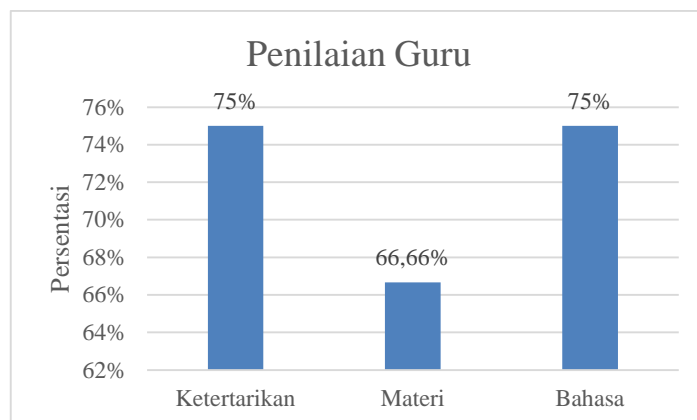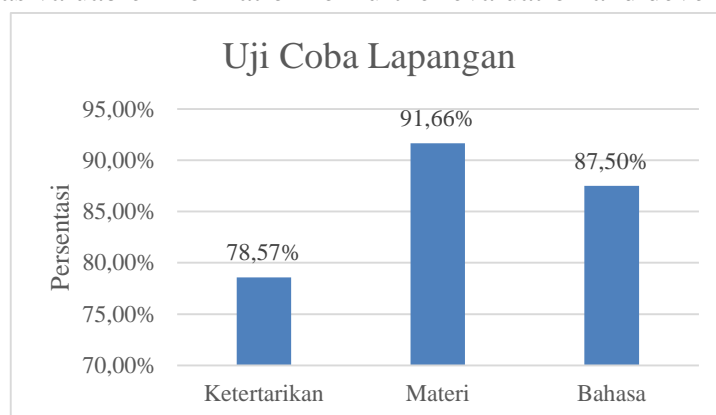
Figure 4. Teacher Assessment Graph

Based on teacher assessments, the digital textbook teaching materials were rated as excellent, with a score of 72.05%, particularly in terms of engaging students' interest. Although there is some room for improvement in the material aspect, overall, these teaching materials are ready to be tested in the field. This result demonstrates the potential of digital textbook materials to enhance the quality of learning.

4. **Field Trial Results**

The test conducted with 23 fourth-grade students at MI Terpadu Berkah produced data that was subsequently analyzed. The results of this field trial are presented in the graph below, which illustrates the students' performance on the test. This graph provides insights into the students' level of understanding and ability regarding the material that has been taught, as well as valuable information for further evaluation and development.

Figure 5. Field Trial Assessment Graph

The results of the field trial indicate that the developed digital textbook teaching materials are highly effective and highly suitable for use, with a rating of 85.29% in supporting the learning process. Students responded positively to all aspects of the teaching materials, especially the presented content. This suggests that these teaching materials can serve as an interesting and effective alternative in the learning process.

DISCUSSION

1. Product Development

Analysis

At this stage, the researcher conducted an in-depth analysis to identify students' needs based on learning materials and the uniqueness of each individual. This process aims to design teaching materials that are not only academically relevant but also engaging and capable of motivating students (Rahman & Setiawan, 2023).

Observations and interviews with teachers were conducted to understand student behavior in the learning process. Students aged 9-11 generally exhibit a high level of curiosity, particularly toward evolving digital media. Therefore, a technology-based approach becomes a potential solution to enhance the effectiveness of learning in the fourth grade at MI Terpadu Berkah Palangka Raya (Putri & Hartono, 2023).

Subsequently, the needs analysis phase involved gathering information from various sources, such as questionnaires and discussions with students. The data collected was analyzed to develop a learning strategy that meets the cognitive, affective, and psychomotor needs of the students (Wijayanti, 2023).

Design

In the design phase, the researcher develops a product in the form of digital teaching materials that focus on interactive learning media. This phase began with the creation of a flowchart and storyboard as guides for the development process. A flowchart was created to visualize the learning activity flow systematically, while the storyboard was used to design the layout and content in detail (Nugroho & Lestari, 2022).

This design process was carried out to ensure that each element in the teaching materials was organized according to the learning objectives. In addition, the storyboard serves as a reference for integrating text, images, and animations to make the learning process more engaging and easier for students to understand (Handayani & Pratama , 2023).

As part of the evaluation step, the researcher evised the storyboard based on expert validation results. This phase aims to refine the design to meet the users' needs and create a more effective teaching material product (Setyawan & Ananda, 2023).

1. Flowchart

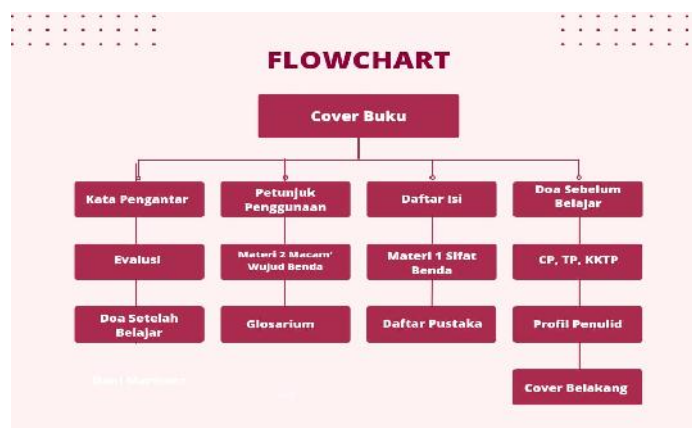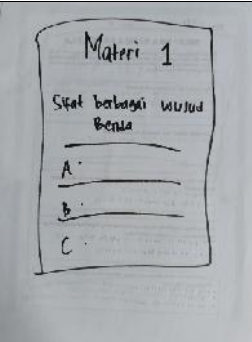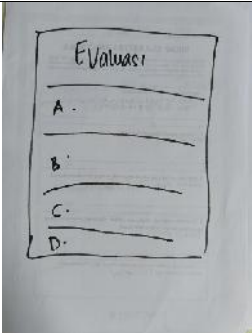**Figure 6. Flowchart**

2. Storyboard

Table 4. Storyboard

|	
This page contains the title, subject, class, and logo.	On the next page, there is the identity of the teaching materials followed by CP,TP and KKTP
The next page contains the lesson material in the form of images and explanations of the changes in the states of matter, along with a link to additional material available via a link/QR code.	The teaching materials include evaluations/exercise questions related to the topic of changes in the states of matter. On the following page, there is a prayer after learning, a glossary, a list of references, and the author's profile.

Development

In the development phase, all components of the teaching materials were organized according to the design established earlier. During this phase, the learning media can be enhanced with multimedia elements such as audio, video, animations, and images to enrich the students' learning experience and increase the appeal of the material. The addition of interactive buttons that link to websites or platforms like YouTube can also improve the interactivity and accessibility of the learning content (Pratama, 2022). These elements are expected to create a more dynamic and enjoyable learning experience for students.

Implementation

Implementation is the phase in which the developed teaching materials are applied, and the materials are tested by media and subject matter experts. Additionally, the teaching materials are also applied to students through field trials involving 23 students. This is the final stage of the testing process, where the developed learning application or media is directly tested with students to observe its effectiveness and their responses (Haryanto & Mulyadi, 2020).

The implementation phase can be seen in the diagram below, which illustrates the steps taken in applying the developed teaching materials.
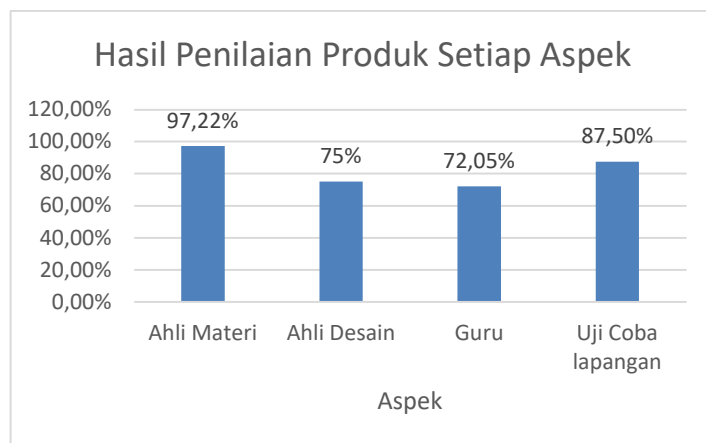
Figure 7. Overall Assessment Graph

Based on the data obtained, the digital textbook learning media is rated to have good quality. However, experts have suggested enriching the content and standardizing the visual elements, such as font type and size. These suggestions were followed by the researcher to improve the quality of the media.

Evaluation

The final stage in the ADDIE model is evaluation, which involves the application of the product to students. The main goal of this stage is to assess how effectively the learning materials can impact students' learning outcomes (Setiawan & Riana, 2023). In this stage, the researcher conducted a formative evaluation, which was implemented through tests included in the learning materials. These formative tests consist of a pretest and a posttest, designed to measure the progress of students' understanding before and after using the learning materials. (Mulyadi & Fitria, 2022).

Development Of Learning Outcomes
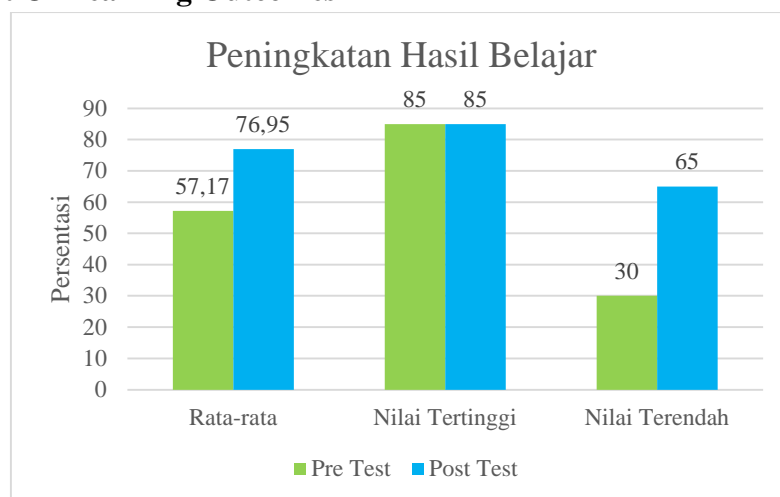
Figure 8. Graph of Improvement in Learning Outcomes

Based on the diagram above, it can be concluded that the use of digital book-based learning materials has a significant positive impact on students' learning outcomes. The digital book has proven to be effective in helping students better understand the subject matter, benefiting both students with high and low initial abilities.

CONCLUSION

This research successfully developed digital book-based learning materials designed to enhance the effectiveness of teaching Natural and Social Sciences (IPAS) at elementary schools.

Using the ADDIE development model, the research followed the stages of analysis, design, development, implementation, and evaluation to produce interactive learning materials that meet the needs of students. The digital book is equipped with multimedia elements such as text, images, videos, animations, and quizzes, providing a more engaging, interactive, and easily accessible learning experience.

The validation results show that the digital book-based learning materials have a very high feasibility level, both in terms of content and design. The material expert rating reached 92.85%, whereas the design expert gave a score of 90.74%. Improvement suggestions, such as adding more learning content and aligning the visual display, have been implemented to enhance the product's quality. Teacher assessments and field trial results also showed positive responses, with an effectiveness rate of 85.29% based on the improvement in students' learning outcomes.

The use of these digital learning materials has had a positive impact on students' motivation, understanding of the materials and practical skills in IPAS learning, particularly on the topic of changes in states of matter. Additionally, the analysis of pretest and posttest results shows a significant improvement in students' learning outcomes. Therefore, this digital book can serve as an effective alternative to support more interactive, enjoyable, and relevant IPAS learning, catering to the needs of students in the digital era.

Based on the research findings, the development of digital book-based learning materials is highly recommended for wider application. Furthermore, the successful implementation of this approach serves as important evidence of the significance of innovation in the field of education, particularly in utilizing technology to enhance the quality of learning.

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