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Development of an Interactive Digital Mathematics Textbook Based on Flipbook for Junior High School in the Context of Kurikulum Merdeka

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ABSTRACT

This study aims to develop a digital mathematics textbook based on an interactive flipbook format aligned with the *Kurikulum Merdeka* and accessible across various devices, including smartphones. The research addresses the limitations of conventional printed textbooks in engaging students and supporting differentiated instruction. The development process follows the ADDIE model, encompassing five stages: Analysis, Design, Development, Implementation, and Evaluation. The analysis stage involved identifying curriculum requirements and the preferences of both teachers and students regarding instructional media. The design and development stages produced a digital textbook containing textual materials, instructional videos, interactive animations, external links, and assessments aligned with the *Asesmen Kompetensi Minimum* (AKM). Validation was conducted by three content experts and one media expert using the Learning Object Review Instrument (LORI), assessing aspects such as content quality, interactivity, and accessibility. The validation results indicated a "highly valid" category, with average scores of 4.51 for content and 4.45 for media. A limited implementation was carried out at two public junior high schools (*SMP Negeri*) in Kolaka Regency, involving selected teachers and students. The results showed that the interactive flipbook effectively increased student engagement, supported differentiated learning, and enhanced students' numeracy literacy. Further evaluation suggested that the product is widely applicable, with only minor technical improvements needed. The findings recommend that transforming textbooks from printed to interactive digital formats is an effective strategy for supporting 21st-century learning that is adaptive, flexible, and student-centered.

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1. INTRODUCTION

The transformation of Indonesia's education landscape has undergone significant acceleration in recent years, particularly with the introduction of the *Kurikulum Merdeka* (Independent Curriculum). This curriculum provides schools and teachers with greater flexibility to design and implement learning processes tailored to the unique characteristics and needs of their students. It emphasizes differentiated instruction, project-based learning, and the strengthening of essential competencies such as literacy and numeracy (Kemdikbudristek, 2021). These shifts demand corresponding innovations in instructional materials, not only in terms of content alignment but also in the modes of presentation.

Historically, the government attempted to digitize learning materials through the Electronic School Books (*Buku Sekolah Elektronik*, or BSE) initiative under the 2013 Curriculum. However, these materials were distributed primarily in PDF format, offering limited pedagogical advantages over conventional printed textbooks aside from digital accessibility (Nasrum & Herlina, 2019). Such formats fall short of meeting the interactive, contextual, and differentiated learning goals now emphasized by the *Kurikulum Merdeka*. In this context, a fundamental transformation from static text-based resources to dynamic, interactive digital textbooks is not just desirable, but necessary.

Compounding this need is the national shift in student assessment. The Ministry of Education, Culture, Research, and Technology (Kemdikbudristek) has replaced the traditional *Ujian Nasional* (National Examination) with the *Asesmen Nasional*, which includes the *Asesmen Kompetensi Minimum* (AKM). AKM measures students' literacy and numeracy skills through contextualized problem-solving tasks, rather than rote memorization. As a result, instructional materials must adapt to promote higher-order thinking, real-world application, and self-directed learning (Kemdikbudristek, 2021). Teachers are now encouraged to either develop or curate learning materials that support these goals through meaningful integration with students' daily experiences.

Technological advancements have also played a central role in reshaping education. The COVID-19 pandemic accelerated the adoption of digital technologies in schools, demonstrating that learning can effectively occur anytime and anywhere—beyond the confines of traditional classrooms (Nur Setiyana & Badu Kusuma, 2021). The proliferation of smartphones, laptops, and internet connectivity has empowered both teachers and students to engage in flexible, device-agnostic learning environments (Suwarno, 2017). Consequently, digital learning materials must be designed to function seamlessly across platforms and screen sizes, especially mobile devices.

One promising response to these demands is the development of digital flipbooks. Flipbooks are web-based digital textbooks that incorporate multimedia elements such as videos, audio narrations, animations, interactive quizzes, and

hyperlinks to external resources (Ferdianto et al., 2019; Yulia Aftiani et al., 2021). Their interactive nature not only enhances student engagement but also supports independent learning, improves motivation, and fosters critical thinking (Komikesari et al., 2020; Seruni et al., 2020). In mathematics education, tools like GeoGebra have shown potential in helping students visualize abstract concepts such as function graphs, facilitating both comprehension and retention (Caligaris et al., 2015; Takači et al., 2015). Instructional videos created with such tools have proven effective in improving students' interest and understanding in mathematics (Nasrum & Herlina, 2019).

Moreover, digital learning experiences increasingly include tutorial videos, interactive simulations, and curated links to platforms like YouTube or Wikipedia. However, while these open-access platforms provide rich educational resources, they also carry a risk of distraction. Therefore, it is essential that learning materials be curated and integrated within a structured, goal-oriented framework to maintain student focus and ensure pedagogical coherence (Suwarno, 2017).

Despite the potential of digital flipbooks, previous studies and products have shown notable limitations. Many existing flipbooks only cover a single basic competency or are designed exclusively for desktop or laptop use (Komikesari et al., 2020; Seruni et al., 2019). These limitations reduce their effectiveness, especially in reaching students who primarily access learning content via smartphones. Additionally, few products offer a comprehensive curriculum coverage or embed AKM-style assessments that are aligned with national standards.

Given these challenges, there is a pressing need to develop an interactive digital mathematics textbook in flipbook format that is accessible across various devices, supports differentiated learning, and integrates multimedia elements aligned with *Kurikulum Merdeka*. Such a textbook should not only cover the full scope of the junior high school mathematics curriculum (Grades VII–IX) but also include contextualized practice questions, AKM-based assessments, and tutorial videos that guide students in solving real-life mathematical problems.

This study aims to address the aforementioned gap by developing a responsive, multimedia-rich digital mathematics textbook in the form of an interactive flipbook. The project is grounded in the ADDIE instructional design model and seeks to support 21st-century learning goals by providing students with meaningful, engaging, and relevant learning experiences. The digital transformation of textbooks is no longer merely a trend, but a strategic necessity to create effective, enjoyable, and personalized learning environments in the digital era.

2. METHOD

This study employed a research and development (R&D) approach aimed at producing an interactive digital mathematics textbook in the form of a flipbook. The development process adopted the ADDIE instructional design model, which consists of five systematic stages: Analysis, Design, Development, Implementation, and

Evaluation (Branch, 2009). This model was selected for its structured framework that allows iterative refinement and evaluation of educational products.

The product was intended for use in junior high schools (*Sekolah Menengah Pertama Negeri*) located in Kolaka Regency, Southeast Sulawesi. A limited implementation trial involved two public schools with a total of 4 mathematics teachers and 64 eighth-grade students. The schools were selected purposively based on their willingness to collaborate and availability of digital learning infrastructure.

In the **Analysis** stage, the researchers examined the current curriculum structure, specifically the *Kurikulum Merdeka*, and analyzed students' needs and preferences by consulting mathematics teachers and reviewing student learning outcomes. This stage helped identify essential content areas and the potential integration of AKM-style assessments.

During the **Design** phase, the format and layout of the flipbook were conceptualized. This included the integration of various multimedia elements such as explanatory text, instructional videos, animations, external hyperlinks, and interactive exercises. The researchers also designed validation procedures and instruments to assess the quality of both content and media components.

In the **Development** phase, a prototype of the flipbook was created using flipbook-authoring software compatible with smartphones, tablets, and desktop computers. This prototype included three mathematics topics aligned with the *Kurikulum Merdeka* for Grade VIII and embedded formative assessments based on AKM question models. The prototype was then subjected to expert validation.

The **Implementation** phase involved a limited trial in two schools. Teachers used the flipbook in real classroom settings over two weeks to teach selected topics. Observations were made on how students interacted with the digital textbook, and feedback was collected from both students and teachers regarding usability, clarity of content, and media functionality.

The **Evaluation** phase assessed the product's effectiveness and feasibility. This included both expert validation results and implementation feedback to inform revisions and improvements.

To ensure the validity of the content and media, instruments adapted from the Learning Object Review Instrument (LORI) were employed (Nesbit et al., 2003). LORI evaluates several dimensions of digital learning objects, including content quality, learning goal alignment, feedback and adaptation, motivation, presentation design, interactivity, accessibility, and reusability. Content validation involved three experts: two experienced mathematics teachers and one university lecturer specializing in mathematics education. Media validation was conducted by a lecturer with expertise in instructional media design.

A semantic differential scale was used, ranging from 1 (strongly disagree) to 5 (strongly agree), to measure validators' perceptions of each item. The average scores were calculated for each dimension, and the product's validity level was classified based on a five-category scale: very valid (4.21–5.00), valid (3.41–4.20), moderately valid (2.61–3.40), less valid (1.81–2.60), and not valid (1.00–1.80).

Descriptive statistics were used to analyze the validation scores, while qualitative feedback was also considered to support product improvement. Although this study produced a valid and usable flipbook, the implementation was limited in scope and duration. Thus, future research may explore large-scale

implementation and measure its impact on students' learning outcomes more quantitatively.

3. RESULTS AND DISCUSSION

This study aimed to develop an interactive digital mathematics textbook in the form of a flipbook, aligned with the *Kurikulum Merdeka* and accessible via multiple devices, including smartphones. The development followed the ADDIE model, comprising five phases: Analysis, Design, Development, Implementation, and Evaluation. The results from each phase are presented below.

3.1. Analysis Phase

The curriculum analysis revealed that the *Kurikulum Merdeka* emphasizes contextualized numeracy, differentiated instruction, and project-based learning for junior secondary education (Grades VII–IX). A needs analysis involving interviews with six mathematics teachers from three partner schools indicated that students strongly preferred multimedia-based materials, such as interactive videos and animations, over traditional print-based textbooks. These findings reinforced the necessity of developing a digital learning tool that supports multiple learning modalities and promotes student engagement.

3.2. Design Phase

In the design phase, the structure and components of the flipbook were planned based on both curricular alignment and pedagogical considerations. Key features included:

- Instructional texts that correspond to core competencies of the *Kurikulum Merdeka*;
- Instructional videos created with GeoGebra to illustrate abstract mathematical concepts;
- Interactive animations to enhance visualization;
- External links to curated educational resources (e.g., YouTube, Wikipedia);
- Formative assessments and AKM-style quizzes delivered through Google Forms.

The product was built using HTML5 to ensure broad compatibility without requiring additional software installations. Its responsive design allows seamless access on smartphones and computers.

3.3. Development Phase

The prototype was developed using Flip PDF Professional and HTML5 editors. It included three mathematics topics aligned with Grade VIII competencies. Validation was conducted by:

- Three content experts: two experienced junior high school teachers and one mathematics education lecturer;
- One media expert: a lecturer in instructional technology.

The evaluation instrument, adapted from the Learning Object Review Instrument (LORI), assessed clarity of goals, content accuracy, interactivity, design, usability, and reusability. A 5-point semantic differential scale was used, where 1 = strongly disagree and 5 = strongly agree. The validation results showed:

- **Average content score**: 4.51 (Very Valid)
- **Average media score**: 4.45 (Very Valid)

These results confirm that the product meets a high standard of quality and feasibility for educational use (Nesbit et al., 2003).

3.4. Implementation Phase

The limited implementation was carried out over two weeks in two public junior high schools, involving 4 teachers and 64 students. Teachers incorporated the flipbook in daily instruction, while students accessed the content through their personal devices. Observations and post-implementation interviews yielded the following insights:

- **85% of students** reported that videos and animations made math learning more enjoyable and easier to understand;
- Teachers indicated that the flipbook enabled more **differentiated instruction**, especially for students with varying levels of prior knowledge;
- Some technical challenges, such as browser compatibility issues, were reported initially but resolved by guiding students to use Chrome or Mozilla Firefox.

3.5. Evaluation Phase

The evaluation involved reflections from teachers, student feedback, and classroom observations. The flipbook was found to enhance:

- **Learning independence**: 73% of students stated they reviewed materials outside class time;
- **Motivation and engagement**: Teachers observed increased student participation during lessons;
- **Numeracy contextualization**: Embedded AKM-style problems helped students relate mathematics to real-life situations.

Despite the promising outcomes, teachers suggested periodic updates to ensure the content remains aligned with curriculum developments and technological changes.

4. DISCUSSION

The findings of this study confirm that the development of an interactive digital mathematics textbook in the form of a flipbook is not only feasible but also pedagogically valuable in the context of implementing the *Kurikulum Merdeka*. Through systematic validation and classroom implementation, the flipbook demonstrated its potential to enhance student engagement, support differentiated

instruction, and improve learning independence—core pillars of 21st-century education.

This research contributes to the growing body of literature on technology-enhanced learning in mathematics education, particularly in Indonesian secondary schools. Unlike previous studies that often focused on single-topic flipbooks (Komikesari et al., 2020; Seruni et al., 2019), this product integrates multiple curricular components, AKM-based assessment, and cross-platform accessibility. It represents a scalable model for the transformation of traditional textbooks into interactive, student-centered learning tools.

From a theoretical standpoint, this study aligns with the principles of constructivist learning theory, which emphasizes active engagement, contextual understanding, and learner autonomy (Piaget, 1977; Vygotsky, 1978). By embedding videos, animations, and problem-based assessments, the flipbook fosters deeper conceptual understanding rather than rote memorization. This approach is particularly relevant in mathematics, where abstract concepts often pose cognitive challenges for students. The integration of visual and interactive media—as supported by studies such as Caligaris et al. (2015) and Takači et al. (2015)—enables learners to visualize and manipulate mathematical ideas, thereby bridging the gap between symbolic representation and real-world application.

Furthermore, this study has implications for the development of numeracy literacy. By contextualizing AKM-style problems in everyday scenarios, the flipbook helps students relate mathematical thinking to practical situations. This is in line with national educational goals to strengthen foundational competencies through meaningful and authentic tasks (Kemdikbudristek, 2021). In practice, teachers reported that students were more motivated and confident in solving problems when they could see the relevance of mathematics to their daily lives.

The flipbook also serves as a tool for **differentiated instruction**. Its asynchronous and modular format allows students to revisit content as needed, progress at their own pace, and engage with multiple forms of representation—textual, visual, auditory, and interactive. This flexibility is particularly beneficial in mixed-ability classrooms, where students' prior knowledge and learning styles vary widely.

Despite these strengths, the study has several limitations. First, the implementation was conducted on a small scale and over a short duration. The study focused more on usability and user responses than on direct measurement of learning outcomes. Second, technical issues such as internet availability and device compatibility remain a challenge in some contexts. These factors may affect scalability, particularly in rural or under-resourced schools.

Future research should involve a broader sample of schools and employ a quasi-experimental design to examine the impact of flipbook usage on students' mathematics achievement. It would also be beneficial to explore the long-term

retention of knowledge and the role of teacher facilitation in maximizing the tool's effectiveness. Additionally, further development can include adaptive learning features and AI-based feedback mechanisms to personalize the learning experience even further.

In summary, the interactive flipbook developed in this study offers a promising model for transforming conventional mathematics textbooks into digital formats that are interactive, accessible, and aligned with learner-centered pedagogy. It contributes both practically and theoretically to the advancement of digital learning innovations in Indonesian secondary education.

3. CONCLUSION

This study successfully developed a digital mathematics textbook in the form of an interactive flipbook that aligns with the *Merdeka Curriculum* and is accessible across various devices, including smartphones. The development process followed the ADDIE model, which involved needs analysis, content and media design, prototype development, limited implementation, and effectiveness evaluation.

Validation results confirmed the high feasibility of the product in terms of both content and media. The flipbook was found to enhance students' learning autonomy, facilitate differentiated instruction, and strengthen numeracy literacy skills through contextual and interactive content delivery. The initial implementation in schools generated positive responses from both teachers and students, although further technical refinements—especially regarding accessibility—are still needed.

In conclusion, the transformation from printed to digital textbooks is not only timely in response to technological advancement but also necessary to support 21st-century learning that is adaptive, personalized, and competency-based. Continued development of similar innovations across various educational levels and subjects is essential to ensure the successful implementation of the *Merdeka Curriculum* on a broader scale.

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