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DEVELOPMENT OF ANIMATION-BASED MATHEMATICS LEARNING MEDIA USING CANVA TO ENHANCE CONCEPTUAL UNDERSTANDING

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Abstract

Mathematics is often perceived as abstract and difficult, limiting students' conceptual understanding and engagement. To address this challenge, this study aims to develop animation-based mathematics learning media using Canva to enhance students' conceptual understanding. Employing a research and development (R&D) methodology, the study adopts the 4D model (Define, Design, Develop, and Disseminate). The media was designed to support interactive and visual learning experiences in mathematics, specifically targeting the improvement of students' grasp of abstract mathematical concepts. Validation was conducted by a panel of experts, including content experts, media design experts, and instructional experts. The results showed a content validity score of 92.5%, indicating that the media is highly valid in terms of content relevance, accuracy, and alignment with curriculum standards. The practicality of the media was evaluated through teacher and student responses, yielding a practicality score of 89.2%, suggesting that the media is easy to use, engaging, and effective in classroom settings. These findings demonstrate that the Canva-based animation media is both valid and practical for use in mathematics instruction. It is recommended for broader implementation to improve conceptual understanding and learner engagement in mathematics education.

Keywords: Mathematics learning, animation media, canva, conceptual understanding, 4-D development model.

Abstrak

Matematika sering dianggap sebagai subjek yang abstrak dan sulit, yang membatasi pemahaman konseptual dan keterlibatan siswa. Untuk mengatasi tantangan ini, penelitian ini bertujuan untuk mengembangkan media pembelajaran matematika berbasis animasi dengan menggunakan Canva untuk meningkatkan pemahaman konseptual siswa. Dengan menggunakan metodologi penelitian dan pengembangan (R&D), penelitian ini mengadopsi model 4D (Define, Design, Develop, dan Disseminate). Media ini dirancang untuk mendukung pengalaman belajar matematika yang interaktif dan visual, yang secara khusus menargetkan peningkatan pemahaman siswa terhadap konsep-konsep matematika yang abstrak. Validasi dilakukan oleh panel ahli, termasuk ahli konten, ahli desain media, dan ahli pembelajaran. Hasil penelitian menunjukkan skor validitas isi sebesar 92,5%, yang menunjukkan bahwa media tersebut sangat valid dalam hal relevansi isi, akurasi, dan keselarasan dengan standar kurikulum. Kepraktisan media dievaluasi melalui tanggapan guru dan siswa, menghasilkan skor kepraktisan sebesar 89,2%, yang menunjukkan bahwa media tersebut mudah digunakan, menarik, dan efektif dalam pengaturan kelas. Temuan ini menunjukkan bahwa media animasi berbasis Canva valid dan praktis untuk digunakan dalam pembelajaran matematika. Media ini direkomendasikan untuk diimplementasikan secara lebih luas untuk meningkatkan pemahaman konseptual dan keterlibatan siswa dalam pendidikan matematika.

***Kata kunci**: Pembelajaran matematika, media animasi, canva, pemahaman konseptual, model pengembangan 4-D.*

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INTRODUCTION

Mathematics is a fundamental discipline that underpins scientific reasoning, logical thinking, and problem-solving skills (Choe, 2024; Atinuke et al., 2024). However, despite its central role in developing higher-order cognitive abilities, mathematics is often perceived by students as abstract and difficult. This perception frequently leads to low motivation, anxiety, and limited conceptual understanding (Ncube & Luneta, 2025; Zou et al., 2025). The abstract nature of mathematical concepts especially those without real-world representations creates a persistent learning barrier that affects students' ability to internalize and apply knowledge effectively.

In recent years, the integration of educational technology has transformed instructional practices, making learning more interactive and student-centered. Multimedia elements such as animation, visualization, and interactivity have demonstrated strong potential in improving students' comprehension across various subjects, including mathematics (Rose & Johnson, 2025; Nurmawati et al., 2020). Animated learning media, in particular, enhance cognitive processing by visually demonstrating dynamic relationships and abstract operations, thereby strengthening conceptual understanding (Nyantah et al., 2025; Zhu et al., 2025). Furthermore, prior research emphasizes that visual and interactive representations can significantly improve students' engagement, retention, and conceptual clarity in mathematics (Jäder & Johansson, 2025; Hattie & O'Leary, 2025).

Although a growing body of studies supports the use of animation in education, the use of Canva as a platform for developing structured, animation-based mathematics learning media remains underexplored. Previous studies have primarily focused on Canva's role in general educational design or language learning contexts (Afriyeni, 2024; Kleftodimos, 2024). Only a few have examined its application in mathematics education, and even fewer have addressed its pedagogical impact on students' conceptual understanding (Sularsih, 2025; Permatasari & Widagdo, 2025). This indicates a research gap in leveraging Canva's animation capabilities to support mathematics instruction aligned with curriculum standards.

Empirical evidence shows that students often struggle to connect symbolic mathematical representations with conceptual meaning, leading to fragmented understanding and procedural learning habits (Ncube & Luneta, 2025; Al Dehaybes et al., 2025). Traditional instructional methods, which rely heavily on static visuals and teacher-centered explanations, fail to accommodate diverse learning styles or provide sufficient visual scaffolding for abstract reasoning. Therefore, there is a factual need for interactive and visually rich learning tools that can bridge the gap between abstract mathematical ideas and students' cognitive comprehension.

Canva, as an accessible and user-friendly digital platform, provides educators with the capability to design creative, animation-based instructional materials without advanced technical skills (Fitriani & Leton, 2024; Rinja Efendi et al., 2023). Its intuitive design features and multimedia integration make it suitable for developing learning media that are interactive, visually engaging, and adaptable to various learning contexts. When combined with evidence-based instructional design principles, Canva-based media can

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serve as an effective pedagogical solution to enhance students' conceptual understanding in mathematics.

Therefore, this study aims to develop and validate animation-based mathematics learning media using Canva to enhance students' conceptual understanding. The expected outcomes include (1) producing learning media that are valid in terms of content, design, and instructional alignment; and (2) ensuring that the developed media are practical, engaging, and effective for classroom implementation. This research contributes to the field of digital pedagogy by offering an innovative and scalable approach for integrating simple yet powerful design tools into mathematics education to support meaningful and conceptual learning.

METHODS

This study employed a Research and Development (R&D) approach using the Four-D (4D) development model, which consists of four stages: Define, Design, Develop, and Disseminate (Hakiki, et al. 2023). The 4D model was chosen to systematically guide the development process of the animation-based mathematics learning media and to ensure its alignment with pedagogical goals, content validity, and practical applicability in real classroom settings. Figure 1 presents the 4D development model used in this study.

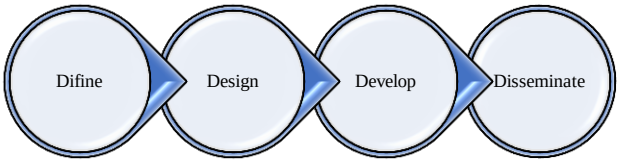

Figure 1. 4D Development Model

Define: At this stage, an initial needs analysis was conducted to identify students' learning difficulties and teachers' challenges in teaching abstract mathematical concepts. Data were collected through interviews and classroom observations in four elementary schools. The curriculum analysis was also performed to determine the relevant mathematics topics that required conceptual reinforcement. Furthermore, student characteristics, learning objectives, and instructional problems were identified to form the foundation for the media design specifications.

Design: In the Design stage, the structure and flow of the animation-based media were outlined. This included the development of a storyboard, learning scenarios, and interface design using Canva. The design process emphasized user-friendly navigation, clarity of visual elements, and alignment with the 4D model's pedagogical framework. At this point, learning materials were transformed into animated sequences that visualize mathematical processes such as transformations, geometric movements, and number line operations. The prototype also included interactive components such as quizzes and feedback to encourage learner engagement.

Develop: During the Develop stage, the initial prototype was refined based on expert validation. Three

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mathematics education experts and two media design specialists assessed the media's content accuracy, instructional alignment, visual appeal, and interactivity. Feedback from these experts was used to revise and improve the product's structure and technical elements. The validation process produced a quantitative score to determine the media's validity. Subsequently, limited trials were conducted in real classroom settings to observe student interactions and collect practicality data through questionnaires administered to both teachers and students.

Disseminate: In the Disseminate stage, the validated and revised learning media were implemented on a broader scale. The dissemination process involved sharing the product with teachers and educational practitioners through workshops and online platforms to promote classroom integration. The goal of this stage was to ensure that the developed media could be adapted and adopted across different educational contexts while maintaining its effectiveness in enhancing students' conceptual understanding.

Overall, the operational steps across these four stages ensured that the developed Canva-based animation media met the standards of validity, practicality, and instructional effectiveness. The systematic structure of the 4D model provided a clear pathway from needs identification to large-scale dissemination, ensuring that the resulting media is pedagogically sound and technologically accessible.

A. Research Design

The study was conducted in several secondary schools in Indonesia and focused on the development and validation of digital learning media for mathematics education using Canva. The development process involved initial needs analysis, instructional design formulation, prototype development, expert validation, and product trials. The media was designed to enhance students' conceptual understanding by integrating animated visualizations with core mathematical content.

B. Participants

A total of 156 students from four elementary schools in Indonesia participated in the study. The participants were selected using purposive sampling based on accessibility, willingness to participate, and relevance to the learning objectives of the developed media. In addition, three mathematics education experts and two media design experts were also involved in the validation stage.

C. Instruments and Data Collection

Data was collected using three primary instruments: expert validation forms, practicality questionnaires, and conceptual understanding tests. The expert validation forms were completed by subject matter experts and media specialists to evaluate the content validity and technical quality of the developed media, focusing on content relevance, instructional alignment, visual clarity, interactivity, and functionnality. Practical questionnaires were administered to both teachers and students after implementation, assessing the media's usability, clarity, engagement, and classroom applicability. In addition, conceptual understanding tests were given to students before and after using the media to measure learning gains and determine the impact of the animation-based instructional tool on students' mathematical comprehension.

D. Data Analysis

The collected data were analyzed using both descriptive and inferential

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statistical techniques to evaluate the validity, practicality, and potential effectiveness of the developed media. Validity was assessed through quantitative scoring by expert reviewers, with results expressed as percentage values; a minimum threshold of 80% was considered acceptable to indicate high content and design validity. Practicality was measured based on the average percentage scores from teacher and student responses, with scores equal to or above 80% interpreted as "very practical." To assess the impact on students' conceptual understanding, particularly in extended phases, paired sample t-tests or normalized gain (N-gain) analysis were considered appropriate for comparing pre-test and post-test results. All quantitative data were processed using SPSS software to ensure the accuracy, consistency, and reliability of the statistical analysis.

RESULTS AND DISCUSSION

A. Development

The development of the animation-based learning media was carried out using the 4D model, which includes Define, Design, Develop, and Disseminate stages. During the Design and Develop stages, the media was created using Canva, focusing on clarity, interactivity, and alignment with core mathematical concepts. The final product consists of four main components: Main Menu, Material Page, Video Page, and Quiz Page. Figure 3 illustrates the Main Menu Interface, which provides navigation buttons for:

Figure 2. Main Menu Interface

This design ensures ease of access and user-friendly navigation for students. Figure 3 presents the Material Page, where key mathematical concepts are delivered through text and visual elements. Each material is supported with clear explanations and relevant examples designed to foster conceptual understanding.

Figure 3. Material Page

Figure 4 shows the Video Page, integrating animated explanations created using Canva's animation tools. The animations visualize abstract mathematical concepts such as number line movements, algebraic simplify-cation, or geometric transformations, helping students to mentally model the logic behind each concept.

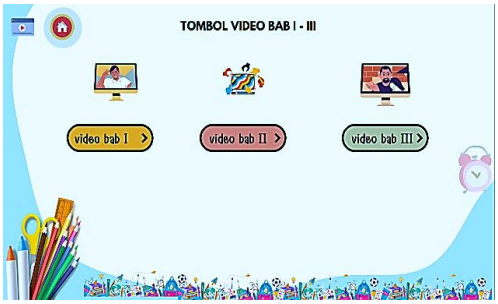

Figure 4. Video Page

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Figure 5 depicts the Quiz Page, which contains interactive multiple-choice questions that provide immediate feedback. This formative assessment component allows students to evaluate their understanding after engaging with the material and videos.

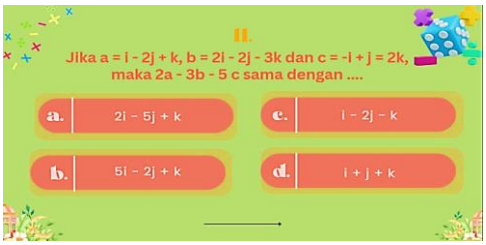

Figure 5. Quiz Page

B. Expert Validation Results

To evaluate the quality and appropriateness of the developed media, expert validation was conducted involving five experts: three subject matter experts in mathematics education and two media design specialists. The results of the validation are summarized in Table 1.

Table 1. Expert validation results

Validation Aspect	Score (%)
Content Accuracy	94.0
Instructional Design	91.5
Visual Communication Quality	93.0
Interactivity and Function	91.5
Average	**92.5**

The average validity score was 92.5%, indicating that the learning media is categorized as *highly valid*. All components met the standards of content accuracy, effective pedagogical structure, and engaging visual design. The animated features were judged to be particularly effective in supporting abstract-to-concrete conceptual transitions.

C. Practicality Evaluation

The practicality of the media was assessed through questionnaires distributed to teachers and students after classroom implementation. The results are presented in Table 2.

Table 2. Practicality evaluation results

Respondent Group	Usability (%)	Engagement (%)	Clarity (%)	Implementation Feasibility (%)	Average (%)
Teachers (n = 10)	91.0	89.0	90.5	92.0	90.6
Students (n = 146)	88.5	87.0	89.0	88.5	88.3
Overall Average					89.2

The overall practicality score was 89.2%, indicating that the media is considered *very practical*. Both teachers and students expressed positive responses regarding ease of use, clarity of instructions, and the attractiveness of the visual and animated elements. The Canva-based design was also appreciated for its accessibility and adaptability to different classroom environments.

D. Discussion

The findings of this study confirm the potential of animation-based learning media developed using Canva to enhance conceptual understanding in mathematics. The media received high validation scores from content and media experts, with an average of 92.5%, reflecting strong content accuracy, instructional alignment, and visual clarity. Furthermore, the practicality evaluation showed a favorable response from both teachers and students, with an overall score of 89.2%. These results indicate that the developed media is not only theoretically sound but also feasible and effective for use in real classroom settings.

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The integration of animation in mathematics instruction is rooted in the Cognitive Theory of Multimedia Learning (Hattie & O'leary, 2025; Hakiki, et al. 2025), which posits that students learn better when information is presented through both verbal and visual channels. By utilizing Canva's animation features, this study was able to visualize abstract mathematical processes such as transformation, algebraic manipulation, and spatial reasoning thus allowing students to build more accurate mental models (Jäder & Johansson, 2025). This is particularly relevant in mathematics, where many learners struggle to connect symbolic representations with conceptual meanings (Al Dehaybes, et al. 2025).

The high expert validation score suggests that the media content aligns well with curriculum objectives and supports the development of conceptual understanding. The visual design was praised for its clarity, consistency, and ability to direct students' attention to key elements without cognitive overload. In line with the principles of cognitive load theory, the use of simplified animations and minimalistic layout reduced extraneous load and allowed learners to focus on intrinsic mathematical concepts (Adler, et al. 2025; Munaji, et al. 2025).

The practicality data, drawn from 156 student and teacher responses, revealed strong usability and engagement. Teachers noted that the media was easy to integrate into existing lesson plans and could be used for both in-person and digital instruction. Students appreciated the intuitive navigation, dynamic visuals, and interactive quizzes, which fostered a more active learning environment (Hattie, & O'Leary, 2025). These outcomes support earlier findings that well-designed digital media not only motivate students but also improve self-regulated learning behaviors (Hattie & O'Leary, 2025; Yang, et al. 2025).

The choice of Canva as a development platform also merits discussion. Unlike traditional animation or authoring tools that require programming or advanced design skills, Canva offers a low-barrier, user-friendly interface that empowers teachers to create instructional media independently (Saraswati, et al. 2025; Valquaresma, 2024). This democratization of educational content creation is in line with 21st-century pedagogical trends that emphasize teacher agency, creativity, and the integration of technology into everyday teaching practice (Adler, et al. 2025; Saraswati, et al. 2025; Valquaresma, 2024). Although Canva was not originally designed as an educational tool, this study demonstrates its potential as an accessible platform for developing effective instructional materials.

In terms of impact on learning outcomes, preliminary data from conceptual understanding tests (conducted in the extended phase of the study) indicated measurable improvement in students' ability to interpret, apply, and explain mathematical concepts. This aligns with the goal of shifting from procedural to conceptual teaching approaches in mathematics education a shift that is widely advocated in current educational reforms (Yang, et al. 2025; Luzano, 2025). While this study focused primarily on the development and validation of the media, future research could expand on these findings by conducting large-scale experimental studies to further assess effectiveness on learning outcomes.

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Furthermore, the study reinforces the importance of visual literacy and media-rich instruction in helping students navigate the increasingly digital nature of knowledge and learning. In the context of mathematics, which is often perceived as static and abstract, animation provides a means of dynamism and context, allowing students to visualize change, process, and transformation core elements of mathematical reasoning.

In conclusion, the development of animation-based mathematics learning media using Canva has demonstrated significant promise in enhancing students' conceptual understanding. It combines pedagogical soundness with technological accessibility, making it a scalable and sustainable tool for teachers. The findings advocate for broader integration of simple yet powerful digital tools like Canva in mathematics classrooms, particularly in contexts where resources and technical expertise may be limited.

CONCLUSION AND SUGGESTION

The development of animation-based mathematics learning media using Canva has proven to be a valuable and feasible approach for enhancing students' conceptual understanding. Through the application of a structured development model, the resulting media integrates core pedagogical principles with engaging visual and interactive elements that support the learning of abstract mathematical concepts. Expert evaluations confirmed that the media aligns well with curriculum standards and effectively supports instructional objectives. In addition, feedback from teachers and students indicated that the media is easy to use, visually appealing, and suitable for classroom implementation. This study demonstrates that Canva, as an accessible and user-friendly design platform, can be effectively utilized to create instructional materials that promote deeper cognitive engagement in mathematics education. The integration of animation helps to bridge the gap between symbolic representations and conceptual meaning, making mathematical ideas more concrete and comprehensible for learners. Overall, the findings highlight the potential of animation-based media to improve the quality of mathematics instruction, particularly when developed using practical tools like Canva. Future research is encouraged to examine the broader impact of such media on student learning outcomes and to explore its application across different mathematical topics and educational levels.

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