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Development of an ADDIE-Based 2D Animation Learning Video to Enhance Elementary School Students' Understanding of Plane Geometry

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Keywords

2D animation, plane geometry, learning video, ADDIE model, elementary education.

Abstract

This study aimed to develop and evaluate the effectiveness of a 2D animation-based learning video on plane geometry using the ADDIE model. The research employed a Research and Development (R&D) method consisting of five stages: Analysis, Design, Development, Implementation, and Evaluation. The study involved 59 fourth-grade students at SDN Gunungsimping 01 Cilacap. Data were collected through observations, interviews, documentation, and pre-test and post-test instruments. The learning media was developed using Adobe Illustrator and Adobe After Effects to present plane geometry concepts in a more interactive and visually engaging form. The effectiveness of the media was analyzed using the N-Gain formula. The results showed that the average score of class 4A increased from 49 to 70.1, while class 4B increased from 20.7 to 48.2. The N-Gain analysis indicated moderate effectiveness, with scores of 0.414 for class 4A, 0.347 for class 4B, and an overall score of 0.374. These findings demonstrate that the developed 2D animation-based learning video effectively improved students' understanding of plane geometry concepts.

Introduction

Mathematics learning in elementary education plays a crucial role in fostering

students' logical reasoning, analytical thinking, and problem-solving skills from an early age (Ansya et al., 2024). In the context of Indonesia's educational transformation, the implementation of the Merdeka Curriculum emphasizes student-centered learning, adaptability, and contextual understanding. This curriculum encourages teachers to utilize innovative and interactive learning media to support meaningful learning experiences (Badan Standar Kurikulum dan Asesmen Pendidikan, 2022). However, despite these expectations, the effective integration of such media in classroom practices remains a significant challenge, particularly in subjects that involve abstract concepts such as mathematics.

One of the fundamental topics in elementary mathematics is plane geometry, which introduces students to the properties, area, and perimeter of two-dimensional shapes. This topic requires not only numerical understanding but also strong visual-spatial abilities to comprehend geometric relationships. According to cognitive development theory by Piaget, students at the age of 9–10 years (typically fourth grade) are in the concrete operational stage, where they begin to think logically but still rely heavily on concrete and visual representations to understand abstract concepts. Therefore, the use of appropriate learning media becomes essential to bridge the gap between abstract mathematical concepts and students' cognitive readiness (C. Maharani & Novirianti, 2025).

Empirical evidence from SDN Gunungsimping 01 Cilacap indicates that students' learning outcomes in plane geometry are relatively lower compared to other mathematical topics such as volume and data representation, although they still meet the minimum competency criteria (KKM). This suggests that students have not yet achieved optimal conceptual understanding. Furthermore, interviews with teachers reveal that many students experience difficulties in understanding geometric concepts due to the abstract nature of the material and the predominance of conventional teaching methods, which often rely on verbal explanations and static textbook illustrations. As a result, students struggle to visualize shapes and grasp the relationships between geometric properties, leading to suboptimal learning outcomes.

To address these challenges, the integration of technology-based learning media, particularly animation, has been widely recommended. Animation-based learning media can present dynamic visualizations that make abstract concepts more concrete and easier to understand. Through motion, transformation, and interactive elements, animation enables students to observe how geometric shapes behave, thereby enhancing their conceptual understanding. Previous studies have demonstrated that the use of animation in mathematics learning significantly improves students' engagement, motivation, and academic achievement (Kurniawan et al., 2024; Latif Al Ahmasi, 2024).

In addition to selecting appropriate media, a systematic instructional design model is necessary to ensure the effectiveness of the developed learning tools. The ADDIE model, which consists of Analysis, Design, Development, Implementation, and Evaluation stages, is one of the most widely used frameworks in educational media development. This model provides a structured approach to designing learning media that are aligned with learners' needs and instructional objectives. Research has shown that learning media developed using the ADDIE model are generally valid, practical, and

effective in improving learning outcomes (Syahid et al., 2024; Satria & Sutabri, 2025).

Despite the growing body of research on animation-based learning and ADDIE-based development, there is still a lack of studies that specifically focus on the development of 2D animation learning media for plane geometry at the elementary school level, particularly within the framework of the Merdeka Curriculum. Most existing studies either focus on general mathematics topics or do not integrate a systematic development model with contextual curriculum demands. Previous studies have widely discussed animation-based learning media and the implementation of the ADDIE model in education. However, most studies primarily focus on general mathematics topics, secondary education, or conventional multimedia applications without emphasizing conceptual visualization for elementary students. In addition, limited studies specifically integrate 2D animated learning media with the characteristics of the Merdeka Curriculum and elementary students' cognitive development in learning plane geometry concepts.

The novelty of this study lies in the integration of cognitive-based visual animation, contextual geometry learning, and the Merdeka Curriculum framework into a single ADDIE-based learning medium specifically designed for elementary school students. Unlike previous studies, this research emphasizes conceptual visualization of plane geometry through interactive animated representations adapted to students' concrete operational cognitive stage.

Therefore, this study aims to develop a 2D animation-based learning media using the ADDIE model, specifically designed for fourth-grade elementary students learning plane geometry. The media focuses on the concepts of area and perimeter of squares and rectangles, with additional enrichment on circles, presented through interactive and visually engaging animations. The novelty of this study lies in the integration of cognitive-based visual animation, contextual geometry learning, and the Merdeka Curriculum framework into a single ADDIE-based learning medium specifically designed for elementary school students. Unlike previous studies, this research emphasizes conceptual visualization of plane geometry through interactive animated representations adapted to students' concrete operational cognitive stage.

Methods

This study employed a Research and Development (R&D) approach using the ADDIE model. The research was conducted at SDN Gunungsimping 01 Cilacap from May to August 2025, involving 59 fourth-grade students consisting of 30 students from class 4A and 29 students from class 4B. Data collection techniques included interviews, observations, documentation, and pre-test and post-test instruments. The pre-test and post-test were used to measure students' understanding before and after using the developed learning media.

To measure the effectiveness of the use of 2D animated learning videos in improving elementary school students' understanding of plane geometry materials, the N-Gain formula was used as follows:

$$N - Gain = \frac{Post\ test\ Score - Pre\ test\ Score}{Maximum\ Score - Pre\ test\ Score}$$

The obtained N-Gain scores were classified into three categories: high (N-Gain > 0.70), moderate (0.30 ≤ N-Gain ≤ 0.70), and low (N-Gain < 0.30).

The development process followed five stages: analysis, design, development, implementation, and evaluation. The analysis stage identified learning problems, student needs, and instructional objectives. The design stage involved storyboard creation, content preparation, and interface planning. The development stage produced a 2D animated learning video using Adobe Illustrator and Adobe After Effects. The implementation stage applied the developed media in classroom learning activities. Finally, the evaluation stage assessed the effectiveness of the media through students' learning outcome improvements. The research flow is illustrated in Figure 1.

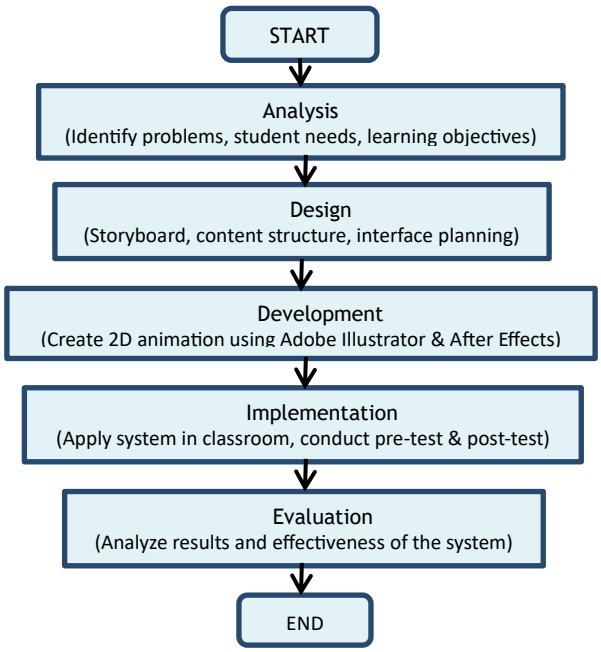

Figure 1. ADDIE-Based Multimedia System Development Flow

Results and Discussion

The results of this study consist of two main aspects, namely the process of developing the animated learning video using animation techniques in Adobe After Effects, and the effectiveness of the animation media when implemented in the learning process. The developed animation video is a 2D animation-based learning medium created using Adobe After Effects. This video was designed to assist students in understanding plane geometry concepts and was specifically intended for students of SDN Gunungsimping 01 Cilacap.

The animated learning media consists of several components, including the opening section and the main instructional content, which aims to enhance students' understanding of plane geometry, particularly squares, rectangles, and circles.

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Figure 2. The Opening Scene

Figure 2 presents the opening scene of the animated learning video, which introduces the material to be taught. This section functions as an introductory part that prepares students for learning the concepts of plane geometry.

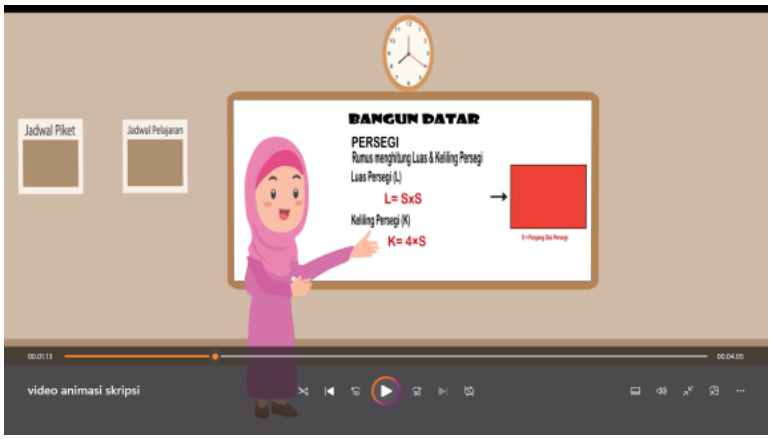

Figure 3. Teacher Explaining the Formula

Figure 3 shows the teacher explaining the formulas for the area and perimeter of a square.

Figure 4. Teacher Providing Example Problems

Figure 4 shows the teacher explaining example problems related to the area and

perimeter of a square.

The research results were obtained through tests administered to students at SDN Gunungsimping 01 Cilacap, involving a total of 59 fourth-grade students consisting of 30 students from class 4A and 29 students from class 4B. The tests were conducted to obtain data on students' understanding of plane geometry concepts before and after the implementation of the developed learning media. The collected pre-test and post-test scores were then analyzed to evaluate the effectiveness of the 2D animated learning videos. Based on the test results from classes 4A and 4B, the average pre-test scores were 49 for class 4A and 20.7 for class 4B. Meanwhile, the average post-test scores showed an improvement, reaching 70.1 for class 4A and 48.2 for class 4B. To measure the effectiveness of the use of 2D animated learning videos in improving elementary school students' understanding of plane geometry materials, the N-Gain formula was used as follows:

$$N - Gain = \frac{Post\ test\ Score - Pre\ test\ Score}{Maximum\ Score - Pre\ test\ Score}$$

To determine the effectiveness level of students' learning improvement, the obtained N-Gain scores were classified into three categories: high (N-Gain > 0.70), moderate (0.30 ≤ N-Gain ≤ 0.70), and low (N-Gain < 0.30).

$$N - Gain\ (Class\ 4A) = \frac{70{,}1 - 49}{100 - 49}$$
$$= 0{,}414 \text{ (Moderate Category)}$$
$$N - Gain\ (Class\ 4B) = \frac{48{,}2 - 20{,}7}{100 - 20{,}7}$$
$$= 0{,}347 \text{ (Moderate Category)}$$
$$Total\ Pre - test = \frac{(49 \times 30) + (20{,}7 \times 29)}{59} = 35{,}08$$
$$Total\ Post - test = \frac{(70{,}1 \times 30) + (48{,}2 \times 29)}{59} = 59{,}34$$
$$N - Gain\ (Total) = \frac{59{,}34 - 35{,}08}{100 - 35{,}08}$$
$$= 0.374 \text{ (Moderate Category)}$$

Table 1. N-Gain Values

Class	Pre-test Mean	Post-test Mean	N-Gain	Category
4A	49	70,1	0,414	Moderate
4B	20,7	48,2	0,347	Moderate
Total	35,08	59,34	0,374	Moderate

Table 1 presents the N-Gain analysis results, the average pre-test score in class 4A was 49 and increased to 70.1 in the post-test. Meanwhile, the average score in class 4B improved

from 20.7 in the pre-test to 48.2 in the post-test. Furthermore, the N-Gain analysis showed that class 4A obtained an N-Gain score of 0.414, while class 4B obtained a score of 0.347. The overall N-Gain score was 0.374, which falls into the moderate category.

These findings indicate that the developed 2D animation-based learning video was effective in improving students' understanding of plane geometry concepts. The improvement in students' learning outcomes suggests that animated visualization can help students transform abstract mathematical concepts into more concrete representations. This finding is consistent with Mayer's Cognitive Theory of Multimedia Learning, which states that students learn more effectively through the integration of visual and verbal information.

Furthermore, the developed learning media aligns with Piaget's theory of cognitive development, particularly the concrete operational stage, where elementary school students require visual and concrete representations to understand abstract concepts. Through animated visualization, students were able to better understand the relationships between shapes, formulas, and problem-solving procedures.

Conclusion

This study successfully developed a 2D animation-based learning video on plane geometry using the ADDIE model, which includes the stages of analysis, design, development, implementation, and evaluation. The developed learning media was systematically designed to meet the cognitive characteristics and learning needs of elementary school students. The implementation results demonstrated that the use of the 2D animated learning video positively contributed to students' understanding of plane geometry concepts. This improvement was reflected in the increase of average learning outcomes, where the mean score of class 4A increased from 49 to 70.1, while class 4B increased from 20.7 to 48.2. Furthermore, the N-Gain analysis showed that the effectiveness of the developed learning media was categorized as moderate, with an N-Gain score of 0.414 for class 4A, 0.347 for class 4B, and an overall N-Gain score of 0.374. These findings indicate that the developed 2D animated learning video was effective in improving students' conceptual understanding of plane geometry by transforming abstract mathematical concepts into more concrete and visually interactive representations. Therefore, the developed learning media can serve as an effective and innovative alternative for mathematics learning at the elementary school level, particularly in teaching plane geometry concepts. In addition, the media has the potential to increase students' learning motivation, engagement, and interest in the learning process. This study is limited to one school and a limited number of participants. Future research is recommended to involve larger samples, integrate more interactive multimedia features, and apply experimental statistical analysis to obtain broader and more comprehensive findings.

Reference

Ahmasi, L. A. (2024). *Efektivitas Penggunaan Media Animasi dalam Pembelajaran Matematika MI Ma'Ruf NU Kutawis Purbalingga Kelas V untuk Meningkatkan Kecerdasan Logika*

Matematika. Skripsi. Purwokerto: Universitas Islam Negeri Profesor Kiai Haji Saifuddin Zuhri.

Ansya, Y. A., dkk. (2024). Peran Evaluasi Pembelajaran pada Mata Pelajaran Matematika Kelas V Sekolah Dasar. *Jurnal Inovasi Pendidikan Matematika*, 6(2), 173–184.

Badan Standar, Kurikulum, dan Asesmen Pendidikan Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi Republik Indonesia. (2022). *Capaian Pembelajaran Mata Pelajaran Matematika Fase A - Fase F*. Diambil dari https://kurikulum.kemdikbud.go.id/file/cp/dasmen/10.%20CP%20Matematika.pdf, diakses pada 26 Mei 2025.

Kurniawan, I., dkk. (2024). Interaksi Digital Melalui Video Animasi 2D Bangun Ruang untuk Siswa Sekolah Dasar. *Jurnal Pengabdian Masyarakat*, 1(12), 1121–1126.

Maharani, C., dan Novirianti. (2025). Pengembangan Multimedia Pembelajaran Materi Bangun Datar Mata Pelajaran Matematika Kelas IV SD. *Journal of Education, Cultural and Politics*, 5(2), 336–342.

Satria, A., dan Sutabri, T. (2025). Pengembangan Pembelajaran Virtual Reality Berbasis Metaverse Menggunakan Metode ADDIE. *Router: Jurnal Teknik Informatika dan Terapan*, 3(2), 1–9.

Syahid, I. M., dkk. (2024). Model Addie dan Assure dalam Pengembangan Media Pembelajaran. *Journal of International Multidisciplinary Research*, 2(5), 258–268.