



Development of 2D Animation Learning Media for Animal Life Cycle Material

Rizkita Ayu Mutiarani^{1*}, I Ketut Wiguna², I Putu Susila Handika³

^{1*} Institut Seni Indonesia Bali, Denpasar, Indonesia

^{2,3} Institut Bisnis dan Teknologi Indonesia, Denpasar, Indonesia

^{1*} rizkitaayu@isi-dps.ac.id; ² ketutwiguna123@gmail.com; ³ susila.handika@instiki.ac.id

ARTICLE INFO

Article history:

Received 22 June 2026

Revised 28 July 2026

Accepted 30 July 2026

Keywords:

2D Animation;
Animal Life Cycle;
Learning Media;
Metamorphosis;
Elementary School

ABSTRACT

Learning media plays a strategic role in supporting the success of the teaching and learning process. In education, animation is widely used as a modern instructional medium, particularly to represent learning materials that are difficult to explain verbally. This output was developed as an alternative instructional medium for science learning, especially to explain process-oriented concepts that may be difficult for students to understand when delivered only through verbal explanation or static images. The product was created in the form of a 2D animated video in MP4 format, integrating illustrations, frame-by-frame animation, text, voice-over, sound effects, and background music. The production process employed Adobe Photoshop 2021 for visual asset creation and animation, and Adobe Premiere Pro 2020 for post-production. The material presented in the media covers animal life cycles without metamorphosis, represented by chickens and fish, as well as animal life cycles with metamorphosis, represented by frogs, butterflies, and cockroaches. The media consists of 20 scenes arranged narratively through two characters, Kirana and Leoni, who serve as learning guides. The evaluation results showed that the media received highly positive responses from 33 fifth-grade students, with an average score of 88.2%. The measurement of students' conceptual understanding through pre-test and post-test results produced an average N-Gain score of 0.89, which falls into the high category. Therefore, this 2D animation learning media output is considered feasible to be used as a supporting instructional medium for teachers in delivering animal life cycle material in elementary schools.

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1. Introduction

Learning media plays an important role in supporting the success of the teaching and learning process. The presence of instructional media can help teachers deliver learning materials more clearly while also assisting students in understanding the information being presented. In the context of modern learning, animation has become one of the most promising forms of instructional media because it combines visual elements, motion, sound, and narration. Animation not only functions as a means of entertainment but also serves as an educational medium that can make the learning process more engaging and less monotonous [1][2].

Two-dimensional animation is particularly suitable for explaining materials that are difficult to understand when delivered only through verbal explanation or static images. Through animation, changes in an object over time can be displayed gradually, allowing students to understand the process more easily. Animation-based learning media equipped

with voice narration can also help attract students' attention and increase their engagement during the learning process [3][4].

A preliminary study conducted at SD No. 3 Kuta, Bali, showed that animal life cycle material in the fifth-grade Natural Science subject remains relatively difficult for students to understand. The pre-test results involving 35 students indicated that 70% of them scored below the average. In addition, the interview with the fifth-grade teacher confirmed that 2D animation-based learning media could serve as an effective supporting medium in the classroom learning process.

The development of 2D animation learning media has previously been carried out for various elementary school materials, such as solar eclipses, butterfly life cycles, natural landscapes, and the human digestive system. However, most of these developments focused on a single topic and did not comprehensively present several categories of animal life cycles. Therefore, this output was developed with broader material coverage, including animal life cycles without metamorphosis, complete metamorphosis, and incomplete metamorphosis. It also applies the frame-by-frame animation technique to present visual changes more gradually [7][8].

This learning media was developed as an output in the form of a 2D animated video on animal life cycles for fifth-grade students at SD No. 3 Kuta. This output does not only focus on presenting learning materials but also emphasizes its usefulness as a supporting medium for teachers in explaining science concepts and helping students understand animal life cycles in a more visual, engaging, and accessible manner [9][10][11].

2. Method

2.1 Data Collection

This article employed a descriptive qualitative approach to develop 2D animation-based learning media. Data collection was conducted through two main methods. Primary data were obtained through direct observation of the science learning process at SD No. 3 Kuta, an online interview with the fifth-grade teacher, and a pre-test to measure students' initial understanding. Secondary data were collected through literature study and documentation, including academic references, syllabus documents, and lesson plans related to animal life cycle material.

2.2 Production Process

The production process consisted of three stages: pre-production, production, and post-production. In the pre-production stage, the development team prepared the concept, script, storyboard, and visual assets. The media concept was designed to be informative and simple, using a pastel color palette, Montserrat SemiBold font, and two characters named Kirana and Leoni as story guides [12][13][14].

The production stage focused on creating frame-by-frame animation using Adobe Photoshop 2021. Each animation frame was drawn individually on a 1920 × 1080 pixel canvas with a frame rate of 60 fps. The asset creation process involved six steps: opening the software, determining the workspace size, sketching the character, creating the outline, applying base colors, and adding shadows using the pen tool.

The post-production stage was carried out using Adobe Premiere Pro 2020, where all animated clips were combined into a complete video. Voice-over, sound effects, and background music were added to support the learning media. Scene transitions were created

using opacity keyframe animation. The final output was exported in H.264 format as an MP4 file with 1080p Full HD resolution.

2.3 Evaluation Method

The media evaluation was conducted on December 29, 2022, at SD No. 3 Kuta using a student response questionnaire completed by 33 fifth-grade students. The questionnaire used a five-point Likert scale. The effectiveness of the media was measured using the N-Gain formula [15][16]:

$$g = (\text{Post-test Score} - \text{Pre-test Score}) / (\text{Maximum Score} - \text{Pre-test Score})$$

The N-Gain categories were classified as follows: high if $g > 0.7$, moderate if $0.3 \leq g \leq 0.7$, and low if $g < 0.3$.

3. Result and Discussion

3.1 Learning Media Development Results

The learning media produced in this development is a 2D animated video consisting of 20 scenes that systematically present animal life cycle material. The content is delivered through two characters and covers the following topics: (1) life cycles without metamorphosis, illustrated through the chicken life cycle from egg to adult; (2) life cycles with metamorphosis, represented by the frog life cycle consisting of eggs, tadpoles, young frogs, and adult frogs; (3) complete metamorphosis, represented by the butterfly life cycle consisting of eggs, larvae/caterpillars, pupae, and adult butterflies; (4) incomplete metamorphosis, represented by the cockroach life cycle consisting of eggs, nymphs, and adults; and (5) the fish life cycle, consisting of eggs, young fish, juvenile fish, and adult fish.

The visual design uses a pastel color palette to create an attractive appearance for elementary school students.





Figure 1. Assets used in the learning media

All characters and backgrounds were developed as vector-based illustrations using Adobe Photoshop 2021, with visual consistency maintained across all scenes. Background music, voice-over narration, and sound effects were carefully selected to match the rhythm and atmosphere of each scene.





Figure 2. Learning media output

3.2 Student Response Results

The student response questionnaire administered to 33 fifth-grade students produced an average score of 441 out of a possible 500, equivalent to 88.2%. Based on the continuum scale established in the research instrument, this score falls into the “Very Good” category. This result indicates that students responded very positively to the animation-based learning media.

Table 1. Student Evaluation Questionnaire Results

Respondent	Answer Questionnaire					Quantity	Value
	1	2	3	4	5		
1	5	4	5	4	5	23	460
2	5	3	2	4	2	16	320
3	5	5	4	5	4	23	460
4	5	5	5	5	5	25	500
5	5	4	5	5	4	23	460
6	4	4	4	4	4	20	400
7	5	4	5	4	5	23	460
8	5	5	4	5	4	23	460
9	5	5	5	5	5	25	500
10	5	3	4	5	3	20	400
11	5	5	5	5	5	25	500
12	4	5	3	5	3	20	400
13	5	4	4	5	5	23	460
14	5	4	5	5	5	24	480
15	4	5	4	4	4	21	420
16	3	4	4	4	4	19	380
17	1	2	2	2	1	8	160
18	4	5	5	5	5	24	480
19	5	4	4	4	5	22	440

20	5	5	4	5	4	23	460
21	4	5	5	4	5	23	460
22	5	5	4	5	5	24	480
23	5	5	5	3	4	22	440
24	5	5	4	3	4	21	420
25	5	4	5	4	4	22	440
26	5	5	5	5	5	25	500
27	5	4	5	4	5	23	460
28	5	5	5	4	5	24	480
29	3	4	4	3	5	19	380
30	5	5	5	5	5	25	500
31	4	4	5	5	5	23	460
32	5	5	5	5	5	25	500
33	4	5	5	4	4	22	440
Total (Mean)							441

3.3 N-Gain Results

The N-Gain analysis compared the pre-test and post-test scores of all 33 students. The results showed an overall average N-Gain score of 0.89. Most students obtained N-Gain scores in the high category, with several students achieving a score of 1.0. This indicates that the 2D animation-based learning media was highly effective in improving students' understanding of animal life cycle material.

Table 2. Results of Media Usefulness Testing

Respondent	Pre-Test Score	Post-Test Score	N-Gain
1	50	90	0,8
2	30	90	0,9
3	60	100	1,0
4	50	80	0,6
5	90	100	1,0
6	40	100	1,0
7	50	80	0,6
8	70	100	1,0
9	60	100	1,0
10	70	90	0,8
11	40	100	1,0
12	60	100	1,0
13	20	100	1,0
14	40	90	0,8
15	40	100	2,0
16	30	100	1,0
17	50	80	0,6
18	60	90	0,8
19	80	100	1,0
20	10	90	0,9
21	70	100	1,0
22	40	90	0,8
23	30	90	0,9
24	40	90	0,8
25	50	90	0,8
26	90	100	1,0
27	40	100	1,0
28	10	80	0,8

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29	40	100	1,0
30	40	90	0,8
31	40	100	1,0
32	40	90	0,8
33	60	100	1,0

The class's overall N-Gain score was $g = 0.89$ (average), with most students achieving an N-Gain score of 1.0, which falls into the "High" category ($g > 0.7$). This indicates that 2D animation-based learning media is highly effective in improving students' understanding of the animal life cycle.

3.4 Discussion

The results of this development are in line with previous studies demonstrating the effectiveness of animation-based learning media at the elementary school level. Previous developments showed that 2D animation was effective in delivering materials such as solar eclipse processes and the human digestive system. This output expands upon those findings by demonstrating that frame-by-frame animation, which can provide smoother and more detailed motion than tweening techniques, is also effective for presenting complex biological processes such as metamorphosis.

The highly positive student responses indicate that the integration of appealing characters, clear narration, and appropriate background music can create an immersive learning environment. This combination helps reduce learning monotony and increases students' motivation in science learning. The significant improvement from pre-test to post-test, as reflected in the average N-Gain score of 0.89, confirms that the visual-auditory approach through 2D animation successfully supports students in understanding dynamic and process-oriented concepts such as animal life cycles.

4. Conclusion

This development successfully produced 2D animation-based learning media on animal life cycle material for fifth-grade students at SD No. 3 Kuta, Bali, Indonesia. The development process consisted of three stages: pre-production, which included concept development, storyboard preparation, and asset design; production, which involved frame-by-frame animation using Adobe Photoshop 2021; and post-production, which included video assembly, audio integration, and rendering using Adobe Premiere Pro 2020. The final product is an MP4 video consisting of 20 scenes that cover life cycles without metamorphosis, represented by chickens and fish; incomplete metamorphosis, represented by cockroaches; and complete metamorphosis, represented by butterflies and frogs.

The evaluation results showed highly positive responses from the material expert, two media experts, and 33 fifth-grade students. The N-Gain analysis produced an average score of 0.89, which falls into the high category, confirming that the media significantly improved students' understanding of the material. For future development, the media could be enhanced by adding more dynamic character movements, interactive quiz scenes, and refinements based on expert feedback. Expanding the range of animal species and integrating the media into digital learning platforms may also improve its accessibility and long-term educational impact.

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