JKTP: Jurnal Kajian Teknologi Pendidikan
Vol. 9, No. 4, November 2026: 534-544
e-ISSN: 2615-8787
DOI: 10.17977/um038v9i42026p534-544
https://journal-fip.um.ac.id/index.php/jktp

DEVELOPMENT OF AI-ASSISTED MOTION CLAY VIDEOS ON PLANT PARTS FOR ELEMENTARY SCHOOL STUDENTS

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Article History
Received: 10 October 2026, Accepted: 05 November 2026, ***Published: 11 November 2026***

Abstrak
Materi bagian-bagian tumbuhan memerlukan dukungan visual agar pebelajar sekolah dasar dapat mengamati hubungan antara struktur dan fungsi setiap bagian. Penelitian ini mengembangkan Video Motion Clay, yakni animasi digital dengan tampilan menyerupai plastisin yang diproduksi menggunakan teknologi kecerdasan buatan, sekaligus mengevaluasi kelayakan awal produk untuk pembelajaran kelas dua di SD Negeri Rumahtita. Penelitian menerapkan pendekatan pengembangan dengan model empat tahap yang pelaksanaannya dibatasi pada pendefinisian, perancangan, dan pengembangan. Setelah kebutuhan pembelajaran diidentifikasi, menyiapkan *storyboard* dan instruksi animasi, memproduksi adegan menggunakan Google Flow AI dengan dukungan ChatGPT, serta menyunting hasilnya memakai CapCut. Produk dinilai oleh ahli media dan seorang guru sebagai ahli materi, kemudian disempurnakan serta dicobakan kepada kelompok pebelajar yang berbeda secara bertahap. Informasi dikumpulkan melalui pengamatan, wawancara, dokumentasi, dan angket, lalu diolah secara deskriptif. Kedua validator memberikan penilaian yang memenuhi kriteria validasi penelitian dan masukan perbaikan ditindaklanjuti sebelum uji coba. Tanggapan pebelajar umumnya positif terhadap penggunaan video. Hasil tersebut mendukung kelayakan awal produk sebagai alternatif media pembelajaran, tetapi belum membuktikan dampaknya terhadap capaian belajar.

Kata Kunci: Motion Clay; Media Pembelajaran; Animasi Berbantuan AI; Bagian Tumbuhan; Sekolah Dasar

Abstract
Learning about plant parts requires visual support so elementary school students can observe the relationships between plant structures and their functions. This study developed Video Motion Clay, a digitally produced animation with a clay-like appearance generated with artificial intelligence, and examined its preliminary suitability for second-grade instruction at SD Negeri Rumahtita. A research and development approach was employed using a four-stage framework implemented through defining, designing, and developing activities. Following an analysis of learning needs, the researchers prepared a storyboard and animation instructions, generated scenes with Google Flow AI supported by ChatGPT, and edited the clips using CapCut. A media specialist and a teacher acting as the subject-matter expert assessed the product. Their feedback informed revisions before trials with separate groups of pupils. Evidence was collected through observations, interviews, documentation, and questionnaires, and interpreted descriptively. Both expert assessments satisfied the study's stated validation criteria, while user trials yielded generally positive student responses. These findings support the product's preliminary suitability as an alternative instructional resource. They do not, however, establish improvements in learning achievement, which should be examined in a subsequent effectiveness study.

Keywords*: Motion Clay; Learning Media; AI-Assisted Animation; Plant Parts; Elementary School*

To cite this article:
Larwuy, M., Wajabula, C. M., Ilelapotoa, T. M., Kaifuan, V. B., Piris, M. M. G., & Sampingan, D. E. (2026). Bridging elementary school students' concrete understanding: development of motion clay video media on the parts of plants. *JKTP: Jurnal Kajian Teknologi Pendidikan*, *9*(4), 534–544. doi: 10.17977/um038v9i42026p534-544

INTRODUCTION

The development of instructional media in elementary schools should begin with the learning challenges faced by students rather than the desire to use the latest applications. Digital technology offers various options for presenting objects, movements, and relationships between components that are not always easy to understand through teacher explanations. Videos combining moving images and narration represent one form of such presentation. Nevertheless, the presence of audiovisual elements does not guarantee that a medium is aligned with learning objectives; content accuracy, message design, and user characteristics must remain primary considerations (Fitriani et al., 2020; Kanellopoulou et al., 2019).

For students in the lower grades of elementary school, explanations of scientific concepts need to be connected to observable phenomena. The literature on cognitive development emphasizes the role of concrete representations when children begin to learn relationships between form, function, and processes (Babakr et al., 2019; Marlina & Rohmani, 2026). This is relevant to Natural Science learning, which involves several processes that are not directly visible. When learning relies solely on reading materials or lectures, students have limited opportunities to observe these relationships (Agustiningrum et al., 2023). Therefore, visual representations that are specifically directed toward the concepts being studied are needed, rather than images used merely to decorate explanations.

Introducing the parts of plants is an example of a topic that requires such support. In addition to identifying roots, stems, leaves, flowers, and fruits, students must recognize the primary functions of each part. The forms of plant parts are relatively easy to observe, but certain functions, such as water absorption by roots, are difficult to observe directly. The use of media that presents structures while visualizing processes has the potential to help teachers clarify the relationship between the two. The need for concrete representations in elementary school science learning has also been discussed by Inawan et al. (2022).

The needs analysis conducted at SD Negeri Rumahtita revealed that material presentation still relied on textbooks and verbal explanations. The availability of varied media capable of demonstrating the functions of plant parts through movement was inadequate. These local findings provided the rationale for designing an audiovisual learning resource that could be used by second-grade teachers to complement instruction. The required medium does not need to replace activities involving the observation of real plants; rather, its role is to provide visual examples and sequences of explanations that are difficult to present through static images.

Previous studies provide a basis for selecting animation. Aulia et al. (2026) and Hanif (2020) examined the use of animated videos in elementary school learning. Hapsari et al. (2019) reported positive learning outcomes from the use of motion graphics in their research context. Meanwhile, Ploetzner et al. (2021) demonstrated that the advantages of animation over static images depend on the type of changing information that needs to be learned. These findings support the consideration of animation as a medium, but they cannot be directly regarded as evidence that every developed video will improve students' understanding.

One possible visual style is animation that resembles objects made of plasticine or clay. This visual style needs to be distinguished from conventional claymation techniques, as claymation requires physical objects to be repositioned and recorded using stop-motion techniques. This study did not record physical plasticine objects but instead generated digital clay-style scenes using AI technology. Literature on stop-motion remains useful for understanding the potential of visual representations and sequences in science modeling, but its production procedures should not be equated with those of this product (Farrokhnia et al., 2020; Wishart, 2017). Studies on multiple

representations and meaning-making in science explanations also provide considerations for connecting visuals and narration in a coherent sequence (Nielsen et al., 2022).

Animated media should be designed according to students' needs, particularly when the material involves functions that need to be simplified. In related studies, Mufidah et al. (2020) discussed the development of stop-motion videos for science topics, while Sutiono et al. (2021) examined three-dimensional object representations for learning. Hanifah et al. (2025) and Papantoni et al. (2026) discussed the application of clay-style or stop-motion animation in different educational contexts. These findings do not provide a basis for equating learning outcomes across age groups and subjects, but they demonstrate the range of design decisions that need to be considered when developing visual media.

The availability of artificial intelligence technology introduces production methods that differ from manual animation. Visual scenarios can be translated into instructions or prompts, generated as several clips, and then reviewed and edited before being used in learning. Salma et al. (2025) and Syahida (2024) provide examples of the use of digital technology and AI in developing animated media. However, the use of applications cannot be separated from instructional design. Reyna (2021) emphasizes the integration of conceptual considerations, technical skills, and audiovisual quality in the creation of digital media.

In this study, classroom needs were translated into a storyboard and script, which were then developed into prompts with the assistance of ChatGPT. Google Flow AI was used to produce the scenes, while CapCut was used to assemble, edit, and synchronize the audiovisual elements. The product was not immediately implemented with students after production: the media was first examined, assessed by experts, and revised. This approach positions AI as a production tool subject to instructional decisions and human evaluation.

The contribution of this study lies in documenting the process of developing AI-assisted clay-style video media designed to address the learning needs associated with the topic of plant parts in Grade II at SD Negeri Rumahtita. The study employed a four-stage development model limited to the product development stage, followed by assessments from a media expert, a teacher serving as a subject matter expert, and user responses. Thus, the study focuses on the production process, validation, and initial acceptance of the media; it does not examine causal effects on improvements in learning outcomes.

Based on these needs, this study aims to develop Motion Clay Video media for the topic of plant parts and examine expert assessments and student responses following its use. The findings are expected to provide an example of AI-assisted audiovisual design that can be evaluated, refined, and further developed for other learning contexts.

METHOD

This study employed a Research and Development (R&D) method using the 4-D model developed by Thiagarajan et al. (1974), which comprises four stages: Define, Design, Develop, and Disseminate. The development process was limited to the Develop stage to produce and assess the feasibility of AI-assisted digital clay-style animated video media for the topic of plant parts in Grade II at SD Negeri Rumahtita; the Disseminate stage was not conducted. The study was carried out from July 13 to September 30, 2026. The subjects included a media expert, one teacher serving as a subject matter expert, and 18 different Grade II students: 3 participants in the individual trial, 5 in the small-group trial, and 10 in the field trial.

The research procedures are presented in Figure 1. The Define stage involved analyzing learning problems, student characteristics, tasks, concepts, and learning objectives. The Design stage produced a storyboard, script, visual design, and presentation format for roots, stems, leaves, flowers, and fruits. In the Develop stage, ChatGPT was used to formulate prompts based on the storyboard; Google Flow AI generated clay-style animated clips; and CapCut was used to combine the clips, adjust their duration, and add narration, text, and audio. Clips that did not meet the requirements were revised by refining the prompts. The initial product was reviewed, validated by both experts, and revised based on their feedback. It was then tested in stages with different groups of students to obtain user responses.

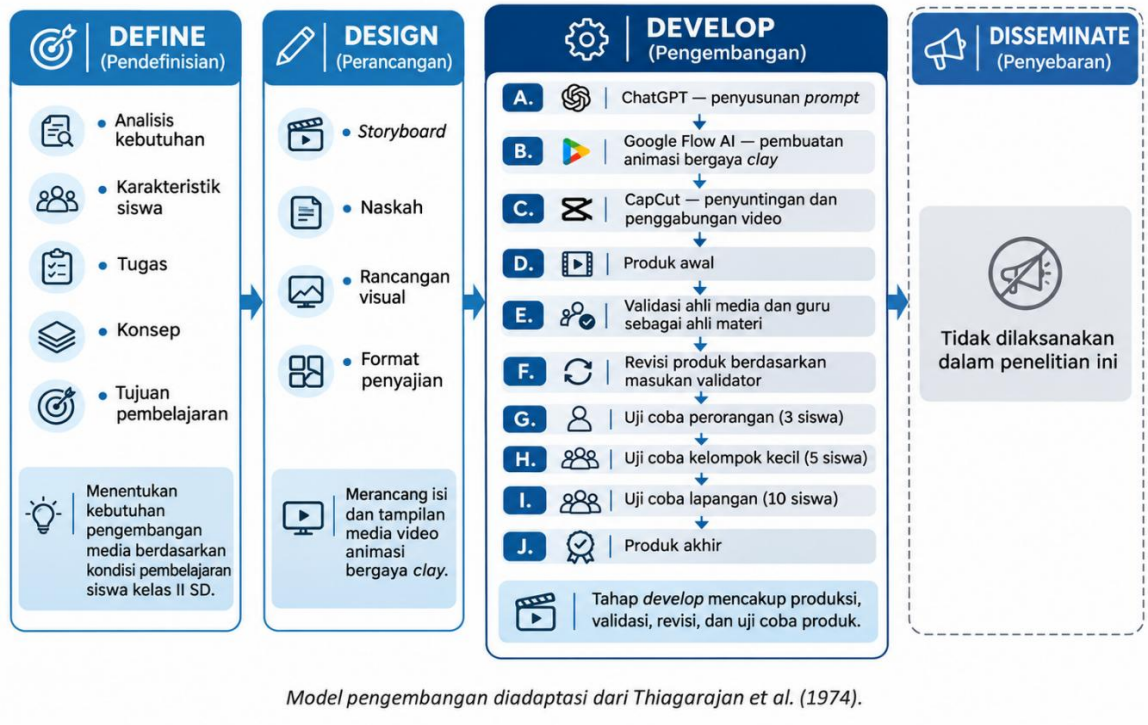


Figure 1. Development Procedure for Motion Clay Video Media Using the 4-D Model

Data were collected through observations and interviews regarding learning needs, development documentation, expert assessment questionnaires, and student response questionnaires. Table 1 presents the validation framework for the media expert, consisting of 12 items rated on a 1–4 scale. The assessment covered appearance, animation, audio, text, interaction, duration, and the suitability of the media for science learning.

Table 1. Framework of the Media Expert Validation Instrument

No	Assessment Aspect	Item Number
1	Visual and Character	1-3
2	Animation motion	4
3	Audio and Narration	5-6
4	Text	7-8
5	Interaction	9
6	Duration and Attractiveness	10-11
7	Learning suitability	12

Table 2 presents the assessment framework for the teacher serving as the subject matter expert, consisting of 10 items rated on a 1–4 scale. The assessment aspects include content accuracy and relevance, systematic organization, language, contextual examples, cognitive appropriateness, and support for understanding.

Table 2. Framework of the Subject Matter Expert Instrument

No	Assessment Aspect	Item Number
1	Content Relevance and Accuracy	1, 2, 10
2	Presentation, Language, and Examples	3-6
3	Cognitive Appropriateness and Learning Support	7-9

Table 3 presents the framework of the student response questionnaire, which consists of nine Yes/No items. This instrument measures students' interest, audio clarity, perceived understanding and knowledge of plant functions, and learning experiences using the media.

Table 3. Framework of the Student Response Questionnaire

No	Assessment Aspect	Item Number
1	Interest and Characteristics	1-2
2	Audio Clarity	3
3	Perceived Understanding	4
4	Perceived Functions of Roots, Stems, and Leaves	5-7
5	Enjoyment and Intention to Reuse	8-9

Qualitative data from observations, interviews, documentation, and validator feedback were analyzed descriptively to determine the necessary revisions. Expert assessment scores and student responses were converted into percentages of the maximum possible scores according to their respective scales. The percentages for each trial stage were calculated separately and then averaged arithmetically. The feasibility categories were based on Riduwan (2012): 81–100% very feasible, 61–80% feasible, 41–60% moderately feasible, 21–40% less feasible, and 0–20% not feasible. The minimum feasibility threshold was set at 61%.

RESULTS

This study produced Motion Clay Video media on the topic of plant parts for Grade II students at SD Negeri Rumahtita. The development process employed the 4-D model, limited to the Define, Design, and Develop stages. The needs analysis revealed that learning was still dominated by teacher explanations and the use of textbooks, indicating the need for audiovisual media that could present plant parts and their functions in a more concrete manner.

The resulting product was an AI-assisted digital clay-style animated video with a duration of 3 minutes and 41 seconds. The video introduces roots, stems, leaves, flowers, and fruits, along with their respective functions, and includes simple questions to reinforce the learning material. The production process involved ChatGPT for prompt development, Google Flow AI for animation generation, and CapCut for video editing.



Cuplikan produk akhir (00:15) • Sumber: dokumentasi video penelitian

Figure 2. Video Opening of the Motion Clay Video Media

Figure 2 shows the opening screen of the final product, featuring clay-style plant characters, bright colors, and a child character accompanying the presentation of the learning material. This visual design is part of an audiovisual concept tailored to the characteristics of Grade II students. The subsequent presentation incorporates animated movements, narration, and visualizations of plant functions to support the clarity of the instructional message.

The initial product was validated by a media expert and a teacher serving as a subject matter expert. The assessment results presented in Table 4 show that the media expert assigned a score of 44 out of a maximum of 48 (91.67%), while the subject matter expert assigned a score of 40 out of a maximum of 40 (100%). Both assessments yielded high percentages and served as the basis for validation decisions in accordance with the criteria established in this study.

Table 4. Validation Results of the Motion Clay Video Media

Validator	Item Number	Score	Maximum Score	Percentage	Decision
Media Expert	12	44	48	91.67%	Valid
Subject Expert	10	40	40	100%	Valid

Despite the high assessment scores, the media expert provided feedback regarding the suitability of the material presentation level to the characteristics of Grade II students. Meanwhile, the subject matter expert gave a positive assessment of the instructional content and suggested developing similar media for other topics. Table 5 summarizes the feedback from both validators and the corresponding revisions made by the developer. The revisions focused on simplifying the presentation, adding guiding questions, reinforcing concepts through repetition, and improving visualizations without altering the main content.

Table 5. Validator Feedback and Follow-up Product Revisions

Validator	Evaluation Results and Suggestion	Follow-Up Actions
Media Expert	The initial presentation was considered more appropriate for Grade IV elementary school students and therefore required adjustments for Grade II students.	Simplified the presentation, added and repeated guiding questions, and refined the visualizations of the learning material.
Subject Expert	The subject matter was considered appropriate; the expert recommended developing similar media for other learning topics.	No substantive revisions were made. The suggestion was considered a recommendation for future development.



Figure 3. Comparison of Root Function Visualizations Before and After Revision

The visual changes to the product are shown in Figure 3 through a comparison of the root scene before and after revision. In the initial product, the roots were visualized alongside water flowing around the soil surface. Following the revision, the root system was presented through a soil cross-section, making the root structure and water movement more clearly depicted. This change represents an improvement in the presentation of the learning material based on the media expert's feedback, rather than direct evidence of improved student understanding.

Overall, the validation results indicate that the product met the established criteria based on the assessments of the media expert and subject matter expert. Following the incorporation of the validators' feedback, the product was considered to have met the initial feasibility requirements for proceeding to user trials.

The revised media was tested in stages with 18 Grade II students at SD Negeri Rumahtita. The individual trial involved 3 students, the small-group trial involved 5 students, and the field trial involved 10 students. Different participants took part in each stage; therefore, no student participated in more than one stage. The trials aimed to obtain responses regarding interest, clarity of presentation, perceived ease of understanding the material, and the experience of using the media.

Table 6 presents a summary of student responses across the three trial stages. Based on the reported percentages, the individual trial yielded 100% positive responses, the small-group trial 94%, and the field trial 95%, with a simple arithmetic mean across the stages of 96.33%. These results indicate generally positive acceptance, although not all student responses in the small-group and field trials were positive.

Table 6. Summary of Student Responses to the Motion Clay Video Media

Trial Stage	Respondent Number	Positive Response Percentage
Individual	3	100 %
Small Group	5	94 %
Field	10	95 %
Average between trial stage	**18**	**96,33 %**

Student responses provide information about their experiences using the media, rather than serving as a basis for validity decisions or measuring improvements in learning outcomes. Thus, expert assessments serve as the basis for determining the initial feasibility of the product, while the trial results provide an overview of student acceptance of the media as users.

DISCUSSION

The results showed that the Motion Clay Video learning media on the topic of “Plant Parts” for Grade II students at SD Negeri Rumahtita achieved a feasibility percentage of 96.33%, categorized as Very Feasible. This high feasibility score was supported by the results of the staged trials, namely 100% in the individual trial, 94% in the small-group trial, and 95% in the field trial. These percentages indicate that the developed media met the feasibility criteria in terms of content, visual appearance, audiovisual quality, practicality, and usefulness in elementary school science learning (Smaldino et al., 2008).

The development results demonstrate the integration of conceptual, technical, and audiovisual aspects in designing digital learning media. The conceptual aspect was realized through storyboard development and instructional message design; the technical aspect involved the use of ChatGPT, Google Flow AI, and CapCut in the video production process; while the audiovisual aspect encompassed the arrangement of characters, colors, movements, text, and audio to support clear material delivery. This integration is consistent with digital media development frameworks that emphasize the importance of message planning, proficiency in production tools, and audiovisual presentation quality (Reyna, 2021).

The success of the Motion Clay Video media in achieving a very high feasibility level was influenced by the alignment of its design with the cognitive developmental characteristics of elementary school students. According to Piaget's theory of cognitive development, Grade II elementary school students (aged 7–8 years) are at the concrete operational stage, during which they require tangible visual objects and physical representations to understand abstract concepts (Boeree, 2003; Piaget, 2003). At SD Negeri Rumahtita, the topic of plant parts and their functions had

previously been delivered solely through lectures and static illustrations in textbooks, making it difficult for students to develop a comprehensive understanding.

In this study, the use of digital clay-style animation enabled plant parts to be presented through visual representations resembling three-dimensional objects. Character appearances, animated movements, and visualizations of the functions of each plant part were designed to help students observe the relationships between the forms and functions of plant parts in a more structured manner. This presentation is consistent with the learning needs of Grade II elementary school students, who still require concrete representations to understand concepts. Although physical plasticine objects were not used, clay-style animation can serve as an alternative visual representation to support material explanations. However, the extent to which this media improves student understanding still needs to be established through specific learning outcome assessments. In line with the findings of Wishart (2017), the manipulation of clay characters in stop-motion animation serves as a form of concrete modeling that helps students transform intangible tacit knowledge into explicit visualizations. These physical representations provide a strong cognitive foundation for students aged 7–8 years to recognize the actual forms of plant organs.

Product revisions based on feedback from the media expert demonstrate the importance of aligning the complexity of material presentation with students' cognitive characteristics. Although the initial product already featured an attractive visual appearance, the material presentation still required adjustments to make it easier for Grade II elementary school students to follow. The addition of guiding questions and concept repetition represented adjustments to the instructional message delivery strategy, intended to direct students' attention and provide opportunities to recall previously learned information. Theoretically, these adjustments are consistent with multimedia learning principles, which emphasize the importance of organizing information according to students' cognitive processing capacity (Mayer, 2009). Changes to the visualization of plant parts, particularly the depiction of roots and water movement in the soil, also provided a more structured representation of the relationship between plant structure and function. Thus, the revision process demonstrates that media development is not solely oriented toward visual appeal but also considers the alignment of instructional messages with students' needs. Nevertheless, the benefits of these adjustments in improving student understanding and memory retention still require specific learning outcome assessments, as validation and user response data primarily provide information about the feasibility and acceptance of the media.

Theoretically, the effectiveness of this media can be explained through Mayer's (2009) Cognitive Theory of Multimedia Learning (CTML). CTML states that human information processing occurs through two separate channels (auditory and visual), each with limited capacity. Motion Clay Video integrates communicative verbal narration, explanatory text, and visual animation in a balanced manner through a dual-coding system, thereby facilitating students' organization and integration of new information into long-term memory without imposing excessive cognitive load (Mayer, 2009; Sweller, 1988). From the perspective of Instructional Message Design, the arrangement of visual and auditory channels in Motion Clay Video directs attention and facilitates students' gradual comprehension of the instructional sequence (Bishop, 2014). Visual arrangement, color harmony, and the segmentation of the video into sections over a 3-minute duration ensure that instructional messages are delivered in a focused and systematic manner. This process aligns with the mechanisms of transduction and cumulative semiotic progression described by Nielsen et al. (2022), whereby the translation of meaning from physical clay models into animated sequences and narrative explanations helps students connect visual symbols with biological concepts in a coherent manner.

Support for these research findings can also be found in various reputable empirical studies. Salma (2025) demonstrated that the use of interactive visual-based animated video media could significantly improve elementary school students' understanding of IPAS concepts. Similarly, the findings of Cholik and Umaroh (2023) and Aswatun et al. (2025) reinforce that integrating narration, audio, and engaging animated characters can enhance students' motivation, attention, and active involvement during the learning process. These results are further supported by the experimental findings of Hapsari et al. (2019), which demonstrated that motion graphic animated video media consistently produced substantially higher science concept comprehension outcomes than static visual media among elementary school students, owing to its ability to dynamically visualize relationships between different elements of the learning material.

Although the media received highly positive responses overall, the field trial results revealed an important observation regarding the small-group trial (94%) and field trial (95%). A small proportion of students still provided less favorable responses to the indicators concerning understanding the functions of roots and leaves. Field notes and interviews indicated that biological processes in roots (water and nutrient absorption) and leaves (photosynthesis/food production) involved a higher level of abstraction than recognizing the physical forms of stems, flowers, or fruits. These microprocesses are part of scientific phenomena that cannot be observed with the naked eye (invisible processes), and therefore require more detailed and gradual visual modeling to enable students aged 7–8 years to understand them comprehensively.

These minor learning difficulties highlight the importance of reflection in the R&D media development process. As Papantoni et al. (2026) reported, stop-motion animation-based learning should facilitate repeated reframing of the material through storyboard arrangement that visualizes biological processes in gradual sequences. Therefore, further development of the Motion Clay Video media will focus on adding zoom-in/micro-animation illustrations of the internal structure of roots and the leaf surface, extending the explanatory narration in these segments, and incorporating simple reflective questions or interactive quizzes at the end of each segment to reinforce student retention. These improvement measures are consistent with sustainable media development frameworks that emphasize the evaluation of trial feedback to refine the pedagogical functions of media (Reyna, 2021).

CONCLUSION

This study produced Motion Clay Video, a digital clay-style animated medium designed to introduce plant parts and their functions to second-grade elementary school students. The product was developed through needs analysis, instructional message design, AI-assisted scene production, expert validation, revision, and user trials. Both validators assigned high assessment scores, while students' responses to the use of the media were generally positive. These results provide a basis for the initial feasibility of the media as a supplementary learning resource. This study was limited to product development and feasibility assessment and therefore did not provide direct evidence of improved learning outcomes. Accordingly, future research is recommended to examine the effectiveness of the media in improving students' conceptual understanding and to explore the use of AI-assisted clay-style animation for other learning topics.

ACKNOWLEDGEMENT

This research was funded by the 2026 DIPA of the State Christian Institute of Ambon (IAKN Ambon) (Number: 177 of 2026) through the Student Research with Faculty Mentorship scheme. The authors also express their gratitude to the Institute for Research and Community Service (LPPM) of IAKN Ambon for the facilities and support provided throughout the research.

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