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Development of 3D Animated Video Learning Media for the Building Construction and Utilities Subject for Grade XI DPIB at SMKN 1 Hiliran Gumanti

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ABSTRACT

This study aims to develop a 3D animated video learning media that is valid and practical for use in the Building Construction and Utilities course. The research employed a Research and Development (R&D) approach by adapting the 4D development model, which consists of four stages: Define, Design, Development, and Dissemination. The research instruments included evaluation questionnaires used to assess the learning media by subject matter experts, media experts, and students. The results of the validation process indicate that the developed learning media achieved a mean score of 4.4 (very good category) from the first subject matter expert and 4.8 (very good category) from the second subject matter expert. Meanwhile, the media expert evaluation obtained a mean score of 4.4, which is also classified as very good. Furthermore, the practicality test based on student responses showed a score of 86%, indicating that the media is highly practical for use in the learning process. Based on the overall validation and practicality results, the 3D animated video learning media developed for the Building Construction and Utilities subject is considered highly feasible and effective as a learning support tool.

INTRODUCTION

The rapid development of science and technology is closely aligned with the advancement of the education sector, which demands the availability of human resources (HR) with strong competencies and qualifications in various fields, particularly in education. Therefore, preparing qualified human resources capable of supporting development, processing, and application in vocational education and training programs, especially in the field of technology, has become an essential priority.

Education is a conscious and well-planned effort that plays a significant role in improving the quality of human resources by enhancing competencies and developing the potential of each individual. Efforts to develop human resources through education must be carefully implemented in order to produce individuals who are competent and capable of competing in the workforce. Consequently, it is necessary to ensure that students are able to learn effectively and develop resilience in facing the challenges of an ever-evolving era.

Vocational High Schools (*Sekolah Menengah Kejuruan* – SMK) are secondary educational institutions designed to prepare students to become productive individuals who are capable of working independently in accordance with their chosen fields of expertise. Graduates of vocational schools are expected to possess high quality, professional competence, and mastery of knowledge, technology, and skills relevant to their disciplines. SMK Negeri 1 Hiliran Gumanti, located in Solok Regency, West Sumatra, is one of the vocational schools committed to preparing its students to enter the workforce directly after graduation. The school offers four areas of expertise, one of which is Building Modeling and Information Design (DPIB). Students in this program study several technical subjects, including Building Construction and Utilities (*Konstruksi dan Utilitas Gedung* – KUG).

Building Construction and Utilities (KUG) is an applied science that provides significant benefits for students. This subject covers various aspects related to building design and technical

drawing, including the preparation of site plans, floor plans, elevations, cross-sections, and utility details. Mastery of building construction and utilities is expected to help students develop skills in designing buildings comprehensively, including their utility systems. Students' understanding of the learning material plays a crucial role in ensuring the effectiveness of the learning process. In the teaching and learning process, additional learning media such as instructional videos and other supporting materials are often required to enhance students' comprehension.

Based on observations and interviews conducted with teachers in the Building Modeling and Information Design (DPIB) program at SMKN 1 Hiliran Gumanti, it was found that in teaching the Building Construction and Utilities subject for Grade XI students, teachers generally deliver the material using relatively simple learning media such as PowerPoint presentations, textbooks, and projectors, followed by assignments given to students. Although these media have been utilized in the classroom, many students still experience difficulties in understanding the material presented.

Each student has a different level of learning motivation and comprehension ability. It was also observed that students tend to become bored quickly during the learning process. From the interviews with the teacher responsible for the KUG subject, it was identified that one of the topics that particularly requires more effective instructional media is the Roof Frame Structure topic. This topic contains numerous structural components, which makes it difficult for many students to fully understand the structure of roof framing systems [1].

To address students' difficulties in understanding the subject matter of building construction and utilities, it is necessary for teachers to employ appropriate learning media that can provide clear visual representations of the objects being studied. Learning media serve as a tool that enables educators to communicate effectively with students during the instructional process [2], allowing learning materials to be delivered and understood more effectively [3].

The development and production of learning media have become increasingly accessible due to rapid technological advancements in the field of education. Based on these developments, Arsyad (2009) [4], categorizes learning media into four main types: print technology media, audio-visual media, computer-based media, and integrated media combining print and computer technologies. One form of audio-visual media that has gained increasing attention in education is 3D animated video [5].

Therefore, this study aims to develop a 3D animated video learning media that is valid and practical for teaching the roof frame structure material in the Building Construction and Utilities subject for Grade XI DPIB students at SMKN 1 Hiliran Gumanti in the 2021/2022 academic year.

RESEARCH METHODS

This study employed a Research and Development (R&D) approach. Research and Development can be interpreted as a scientific method used to investigate, design, produce, and test the validity of a product [6]. According to Thiagarajan (1974), cited in [2], the stages of research and development consist of Define, Design, Development, and Dissemination, commonly referred to as the 4D model. The stages of the 4D model used in this study are described as follows.

1. Define Stage
   a. Initial Analysis

      This stage was conducted to identify the initial problems, determine the core issues, and analyze the learning needs. The analysis was carried out at SMKN 1 Hiliran Gumanti.
   b. Objective Analysis

      This step aimed to determine the extent to which the developed product was needed to address the problems identified during the learning process.
2. Design Stage

   At this stage, after developing the conceptual framework, the researcher began designing the initial prototype of the instructional product, namely the learning video. This stage included designing the visual appearance of the learning media that would be developed in this study, particularly for the roof frame structure material.

3. Development Stage

   The development stage consisted of three main activities: media production, product validation, and product testing. First, the learning media were produced in the form of a 3D animated instructional video. Second, the product design was evaluated by expert validators (lecturers) to assess its feasibility. Third, revisions were made based on the feedback obtained during the validation process. Finally, the revised product was tested on students.

4. Dissemination Stage

   The dissemination stage represents the final stage of the development process, where no further revisions are required. The final product was a 3D animated video learning media for the Building Construction and Utilities subject. In this stage, the video was packaged in the form of a CD and distributed to teachers at SMKN 1 Hiliran Gumanti so that it could be used as a supporting learning medium in the teaching and learning process.

The data collection technique used in this study employed a Likert scale questionnaire. According to Sugiyono (2017) [2], the Likert scale is used to measure individuals' attitudes, opinions, and responses toward social phenomena. In this study, five response options were provided: very good, good, fairly good, poor, and very poor [7]. The scoring system used in the Likert scale for data collection is presented in Table 1.

Table 1. Questionnaire Item Scoring Criteria

Criteria	Score
Very Good	5
Good	4
Moderate	3
Poor	2
Very Poor	1

Source: Sugiyono, 2017 [2]

The data obtained in this study consisted of quantitative and qualitative data. The qualitative data were in the form of suggestions and feedback from expert validators for improving the learning media, while the quantitative data were used to determine the feasibility of the developed product.

The steps used to analyze the feasibility of the learning media were as follows:

1. Compiling and recapitulating the research data obtained from the questionnaires.
2. Calculating the average score for each indicator based on the assessment results.
3. Classifying the obtained scores according to the established scoring criteria, as presented in Table 2.

Table 2. Score Conversion Criteria

Average Score	Classification
>4.2	Very Good
3.4 – 4.2	Good
2.6 – 3.4	Moderate
1.8 – 2.6	Poor
<1.8	Very Poor

Source: Widoyoko, 2012 [8]

The practicality of the learning media was analyzed based on students' responses obtained through a questionnaire. The results of the practicality assessment were then calculated using the following formula.

$$Practicality\ Score\ = \frac{\sum Total\ Score\ Obtained}{Maximum\ Scores}\ X\ 100\%$$

From this formula, the practicality score of the learning media was obtained. The resulting score was subsequently used to determine the category of the developed media after it had been implemented and evaluated by students. The classification of practicality levels can be seen in Table 3.

Table 3. Practicality Level Criteria

Percentage	Category
0 – 20%	Impractical
21 – 40%	Less Practical
41 – 60%	Moderately Practical
61 – 80%	Practical
81 – 100%	Highly Practical

Source: Riduwan, 2011 [9]

RESULTS AND DISCUSSION

1. Development Stage

The development stage was conducted to produce a valid and practical 3D animated video learning media for the Building Construction and Utilities subject. The development process consisted of three main steps.

a. Validation of the 3D Animated Video Learning Media

The validation process was divided into two parts: material validation and media validation.

1) Material Validation

The material validation of the 3D animated video was carried out by two expert validators who evaluated the learning content of the developed media.

Table 4. Material Expert Validation Results 1

No	Assessment Indicator	Obtained Score	Average Score	Category
1	Alignment with the Intended Learning Objectives	18	4.5	Very Good
2	Simplicity	9	4.5	Very Good
3	Message Design Elements	8	4	Good
4	Message Organization	4	4	Good
5	Instruction for Use	5	5	Very Good
		44	4.5	Very Good

Source: Primary Data Processing, 2026

As shown in Table 4, the results of the material validation indicate that the content aspect of the 3D animated learning video for the Building Construction and Utilities (KUG) subject falls into the “Very Good” category, with an average score of 4.4.

Table 5. Materia Expert Validation Result 2

No	Assessment Indicator	Obtained Score	Average Score	Category
1	Alignment with the Intended Learning Objectives	20	5	Very Good
2	Simplicity	9	4.5	Very Good
3	Message Design Elements	9	4.5	Very Good
4	Message Organization	5	5	Very Good
5	Instruction for Use	5	5	Very Good
		48	4.8	Very Good

Source: Primary Data Processing, 2026

Furthermore, as presented in Table 9, the results of the material validation for the 3D animated video learning media in the KUG subject also fall into the “Very Good” category, with an average score of 4.8.

2) Media Validation

The media validation of the 3D animated learning video was conducted by one expert validator, who evaluated the quality and feasibility of the media design and presentation.

Table 6. Media Expert Validation Result

No	Assessment Indicator	Obtained Score	Average Score	Category
1	Image	12	4	Good
2	Audio	8	4	Good
3	Text	9	4.5	Very Good
4	Video	10	5	Very Good
5	Message Presentation	5	5	Very Good
		44	4.4	Very Good

Source: Primary Data Processing, 2026

b. Student Practicality Stage

The results of the practicality test conducted with students can be seen in Table 6.

Table 7. Student Practicality Test Result

No	Assessment Indicator	Σ	%	Category
1	Ease of Use of the Media	219	86%	Highly Impractical
2	Ease of Understanding the Material	228	86%	Highly Impractical
3	Time Efficiency	141	83%	Highly Impractical
4	Ability to Increase Learning Interest	284	84%	Highly Impractical
5	Can Be Used as an Independent Learning Medium	299	88%	Highly Impractical
Total		1171	86%	Highly Impractical
Average		234	86%	Highly Impractical

Source: Primary Data Processing, 2026

Based on Table 11, it can be observed that the practicality score given by 17 students toward the 3D animated video learning media for the Building Construction and Utilities subject at SMKN 1 Hiliran Gumanti reached 86%, which falls into the “Highly Practical” category. This result indicates that the developed interactive learning media is highly practical and suitable for use in the teaching and learning process of the Building Construction and Utilities subject in schools.

c. Effectiveness Stage

The effectiveness stage was conducted by collecting students’ learning outcome data in order to determine whether there was an improvement in student learning outcomes after using the 3D animated video learning media on roof structure material [10]. The minimum passing score used in this assessment was 70. The results of the test are presented in Table 7.

Table 8. Students Pre-Test and Post-Test Result

No	Pre-Test			Post-Test		
	Answer	Score	Criteria	Answer	Score	Critera
1	6	60	Not Passed	10	100	Passed
2	6	60	Not Passed	9	90	Passed
3	5	50	Not Passed	8	80	Passed
4	4	40	Not Passed	8	80	Passed
5	5	50	Not Passed	8	80	Passed
6	6	60	Not Passed	9	90	Passed
7	5	50	Not Passed	8	80	Passed
8	4	40	Not Passed	9	90	Passed

No	Pre-Test			Post-Test		
	Answer	**Score**	**Criteria**	**Answer**	**Score**	**Critera**
9	6	60	Not Passed	8	80	Passed
10	4	40	Not Passed	8	80	Passed
11	5	50	Not Passed	8	80	Passed
12	6	60	Not Passed	10	100	Passed
13	5	50	Not Passed	8	80	Passed
14	4	40	Not Passed	8	80	Passed
15	5	50	Not Passed	8	80	Passed
16	6	60	Not Passed	9	90	Passed
17	4	40	Not Passed	8	80	Passed
Average		**50.5**	**Not Passed**	**Average**	**89.5**	**Passed**

Source: Primary Data Processing, 2026

The results show that the average score of students before using the 3D animated learning video media was 50.5 (pre-test), which falls into the not yet achieved or incomplete category. After using the learning media in the form of a 3D animated video, the students' average score increased to 89.4 (post-test), which is categorized as complete or satisfactory.

These findings indicate that there was a significant improvement in students' learning outcomes after the implementation of the 3D animated video learning media, compared to their performance prior to using the media. Therefore, it can be concluded that the developed 3D animated video learning media is highly effective in improving students' learning outcomes.

CONCLUSION

Based on the research that has been conducted, it can be concluded that the development of 3D animated video learning media for the roof frame structure material in the Building Construction and Utilities subject is feasible and practical to use in the learning process. The evaluation results show that the product assessment by Material Expert Validator 1 obtained a score of 4.4, which falls into the "Very Good" category, while Material Expert Validator 2 obtained a score of 4.8, also categorized as "Very Good." Furthermore, the Media Expert Validator obtained a score of 4.4, which is likewise classified as "Very Good." In terms of practicality, the results of the student response questionnaire from Grade XI DPIB students at SMKN 1 Hiliran Gumanti indicate that the developed learning media falls into the "Highly Practical" category, with a practicality score of 86%. Based on these evaluation results, it can be concluded that the 3D animated video learning media developed for the Building Construction and Utilities subject for Grade XI DPIB students at SMKN 1 Hiliran Gumanti is appropriate and ready to be implemented in the teaching and learning process.

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