



Development of 3D Animation Video-Based Learning Media Using Sketchup in Calculating the Volume of Building Construction at SMK Negeri 1 Sogaeadu

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Abstrak

Estimasi biaya konstruksi dan properti salah satu mata pelajaran di SMK Negeri 1 Sogaeadu khususnya pada materi menghitung volume konstruksi bangunan gedung, peneliti menemukan beberapa permasalahan hasil belajar peserta didik kurang optimal. Hal ini dapat dilihat dari nilai ujian yang menunjukkan banyak peserta didik yang mendapatkan nilai di bawah kriteria ketuntasan minimal (KKM) yang telah ditetapkan yaitu 70. Tujuan pengembangan media pembelajaran berbasis video animasi 3D menggunakan SketchUp di kelas XI-BKP pada mata pelajaran estimasi biaya konstruksi dan properti adalah untuk mengevaluasi kelayakan, kepraktisan, dan keefektifan produk tersebut. Penelitian ini menggunakan model ADDIE (Analyze, Design, Development, Implementation, Evaluation). Instrumen yang digunakan adalah angket validasi untuk uji kelayakan, angket respon siswa untuk uji kepraktisan, dan esai tes untuk uji keefektifan hasil belajar. Hasil penelitian menunjukkan dari beberapa uji coba yang dilakukan dengan menggunakan angket yang digunakan oleh peneliti untuk mengetahui kelayakan, kepraktisan, dan keefektifan bahwa media berbasis video animasi menggunakan SketchUp sangat layak digunakan dengan penilaian ahli materi 89%, ahli bahasa 95,55%, dan ahli desain 92,3%. Kepraktisan media juga sangat tinggi dengan hasil uji coba perorangan 88% dan uji coba lapangan 91%. Media ini juga sangat efektif dengan tingkat efektivitas 95,1%. Berdasarkan hasil penelitian yang dilakukan dapat disimpulkan bahwa media pembelajaran berbasis video animasi 3D menggunakan SketchUp dalam menghitung volume konstruksi bangunan gedung di SMK Negeri 1 Sogaeadu kelas XI-BKP pada mata pelajaran estimasi biaya konstruksi dan properti dengan materi menghitung volume konstruksi bangunan gedung telah disusun menggunakan model ADDIE sangat layak, praktis, dan efektif digunakan dalam proses pembelajaran disekolah.

Kata Kunci: *SketchUP, Media Pembelajaran*

Abstract

Estimating construction and property costs is one of the subjects at the vocational high school Negeri 1 Sogaeadu, specifically on the topic of calculating building construction volumes. Researchers have found some issues with the learning outcomes of students, which are less than optimal. This is evident from exam scores showing that many students scored below the minimum passing criteria (MPC) set at 70. The purpose of developing a 3D animation-based learning media using SketchUp in class XI-BKP for the subject of construction and property cost estimation is to evaluate the feasibility, practicality, and effectiveness of the product. This research uses the ADDIE model (Analyze, Design, Development, Implementation, Evaluation). The instruments used are validation questionnaires for feasibility testing, student response questionnaires for practicality testing, and essay tests for effectiveness testing of learning outcomes. The research results show that from several trials conducted using questionnaires, the researchers found that the 3D animation-based media using SketchUp is highly feasible, with a material expert rating of 89%, a language expert rating of 95.55%, and a design expert rating of 92.3%. The practicality of the media is also very high, with individual trial results at 88% and field trials at 91%. This media is also very effective, with an effectiveness rate of 95.1%. Based on the research results, it can be concluded that the 3D animation-based learning media using SketchUp for calculating

building construction volumes in class XI-BKP at the vocational high school Negeri 1 Sogaeadu is highly feasible, practical, and effective for use in the school learning process.

Keywords: *SketchUP, Learning Media*

Introduction

Education is one of the most important aspects of human life and is a key factor in personal, familial, social, and societal development. This process involves the transformation of knowledge, technology, and skills. Moreover, education is a cultural process aimed at enhancing human wealth and dignity, achieved through a long, continuous process throughout life. Education is a conscious and planned effort to create a learning atmosphere and learning process so that students can effectively develop their potential to possess spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by themselves and society. According to (Zendrato et al., 2022), education plays a crucial role in enlightening the nation. To date, education has no limits in explaining its complete meaning due to its complex nature. This complexity often makes educational science an extension of education itself.

Education and learning are interconnected because learning is a fundamental process at every level. According to the Indonesian Dictionary, learning is "an effort to gain knowledge or skills," indicating that it is an effort to acquire knowledge or skills. Learning is a process through which humans achieve various competencies, skills, and attitudes. Learning begins at birth and continues until death. According to (Simaremare & Purba, 2021), learning is defined as the modification or strengthening of behavior through experiencing. Learning is a process, an activity, and not a result or goal. Learning is not just about memorizing; it is about experiencing. Learning involves the individual undergoing a process to acquire new behavioral changes as a result of interactions with their environment.

Based on the experts' opinions mentioned above, the researcher concludes that learning is a life process carried out to achieve changes in behavior, knowledge, skills, and attitudes from the experiences gained from various studied materials. Learning can also be interpreted as any psychological activity undertaken by individuals, resulting in a different behavior before and after learning. Changes in behavior or responses, due

to new experiences, gaining knowledge after learning, and practice activities are influenced by the teacher's role in the learning process to make the material easy for students to understand.

Learning is an activity inseparable from human life. Learning involves students (learners) and teachers (educators). According to (Jerry et al., 2018), learning is defined as an effort to educate students. It also involves the assistance provided by educators to facilitate the acquisition of knowledge, skills, and habits, and the formation of attitudes and beliefs in students through the learning process. In learning, teachers act as facilitators, creating an effective learning environment so that students can learn well and achieve optimal results.

For teaching Building Construction Cost Estimation, teachers need tools to support learning activities. One of the teaching aids used by teachers in the classroom is learning media. In the learning process, there is communication between teachers and students. Teachers act as information senders, while students act as information receivers. This process will be successful if both parties work smoothly, with teachers effectively conveying information and students effectively receiving it. To enhance this process, communication tools or media are needed.

To become a great school, it requires quality human resources with superior skills. Some advanced countries in education have entered the industrial revolution 5.0, while Indonesia is currently at the point of revolution 4.0 and will also enter 5.0. As technology increasingly controls human activities, education is also inseparable from technology. The use of technology in the learning process can be developed in various forms, including learning media.

Learning media are tools that can be used to convey messages from the sender to the receiver, stimulating students' thoughts, feelings, attention, and interest so that learning occurs. According to Indrawan & colleagues in (Wijoyo et al., 2020), media literally means "intermediary" or "conveyor." In the Indonesian Dictionary, media are tools, means, vehicles, intermediaries, and connectors. Learning media

serve as intermediaries or conveyors of content in visual and verbal forms for learning purposes. Generally, learning media are aids in the teaching-learning process.

According to (Jerry et al., 2018), media are integral to the teaching-learning process to achieve educational goals. According to (Pagarra H & Syawaludin, 2022), learning media concepts should contain two elements: software and hardware. Software refers to the information or messages contained in the media, while hardware refers to the equipment used to deliver the information or messages. For example, a human body model is categorized as a learning medium if it contains information that can be learned. If it does not, it is merely a visual aid. Therefore, it is essential to differentiate between learning media, visual aids, and teaching aids.

According to (Tarial et al., 2022), learning media are tools that act as intermediaries to convey messages in learning, making the teaching-learning process effective. According to (Rahmadhani et al., 2021), learning media are tools or materials that teachers can use to teach their students. Learning media are also often called aids for teachers to conduct the teaching-learning process, deliver pre-prepared learning materials, and increase students' creativity. The challenge for students in following the learning process is the lack of interest in the presentation, difficulties in understanding issues about calculating building construction volumes, and monotonous material delivery without using media.

Experts state that learning media are tools used to convey messages from the sender to the receiver, stimulating students' thoughts, feelings, interests, and attention. Learning media function as tools, intermediaries, and connectors to convey messages or ideas, such as paintings, photos, slides, films, and 3D videos about the studied objects.

One of the engaging learning media for students, especially in vocational high schools majoring in building engineering, is 3D media. According to (Tarial et al., 2022), SketchUp learning media are visual tools that attract students' attention, making them more active during the learning process. Research by (Tarial et al., 2022) shows that using 3D SketchUp learning media can increase students' learning motivation and make the learning process more enjoyable.

3D visual learning media using SketchUp significantly aid the learning process, especially

in perspective drawing materials like orthogonal and pictorial drawings, which can be applied to visual drawings such as houses or buildings. The visualization aspect of this media increases students' interest, making learning more effective. According to (Gulo et al., 2022), SketchUp is a computer program for creating 3D models, enhancing understanding of materials delivered concretely using media. 3D media aim to convey messages, stimulating students' attention, thoughts, interests, motivation, and feelings during the learning process. Additionally, it helps students easily understand the studied materials.

Based on observations At the Vocational High School Negeri 1 Sogaeadu, particularly in the Business Construction and Property major in class XI, issues were identified. Through observation and interviews with subject teachers on building construction volume estimation, several learning outcomes problems were found.

Many students scored below the minimum competency criteria of 70, as seen from exam scores and average learning outcomes over the past three years. Rarely used learning media and teacher-centered learning processes resulted in poor student responses, lack of interest, and incomplete understanding. The current media used are only textbooks, causing students to focus solely on books and lose interest in the learning process, leading to ineffective learning outcomes.

Given these issues, there is a need to develop teaching materials in the form of learning media that can increase student activity, engagement, and learning outcomes. One alternative media that can make students more active and better understand the material is 3D animated video media. Hence, the researcher is interested in conducting scientific research titled "Development of 3D Animated Video-Based Learning Media Using SketchUp in Calculating Building Construction Volumes At the Vocational High School."

Method

1.1 Development Method

ADDIE stands for Analyze, Design, Develop, Implement, and Evaluate. The ADDIE model is used to develop learning products and focuses on individual learning. It is a systematic approach that occurs over a certain period and uses a systematic approach to human knowledge and learning. Effective ADDIE instructional design emphasizes authentic tasks, complex knowledge, and real-world problems, promoting

high engagement between the learning environment and the work setting. According to Hidayat & Nizar (2021), the ADDIE model is based on an effective and efficient systematic approach that interacts between students, teachers, and the environment. Evaluation at each step of the learning process leads to development into the next step or phase.

1.2 Development Procedure

The researchers utilized the ADDIE approach developed by two leading experts, Reiser and Molenda. Although both have different formulations in describing ADDIE, Reiser uses verbs (Analyze, Design, Develop, Implement, Evaluate) to revise the steps or phases in the ADDIE model. Meanwhile, Molenda prefers to use nouns (Analysis, Design, Development, Implementation, Evaluation) to describe the components of ADDIE. This difference is indicated by the dotted lines in the scheme presented by (Hidayat & Nizar, 2021).

The ADDIE model was designed by Branch as a framework for instructional system design, with the steps as follows:



Picture 1.1 The ADDIE model

Overall, the ADDIE model comprises five steps: Analyze, Design, Develop, Implement, and Evaluate. These stages can be implemented procedurally, non-procedurally, or as a cyclical model. Some instructional design models even allow for starting from any stage. Additionally, there are instructional design models that integrate various stages. Below is a table outlining the procedural development stages of the ADDIE instructional design model:

1.2.1 Analysis

The analysis phase aims to identify the sources of performance discrepancies in learning. Teachers must be able to establish instructions to address these weaknesses, assess the required level of understanding, and design strategies based on empirical evidence to enhance learning success.

1.2.2 Design

The design phase aims to validate learning preferences and appropriate evaluation techniques. Teachers need to develop specific solutions to address knowledge and skill gaps in the implementation of learning. This phase also sets guidelines for the progression of the subsequent ADDIE stages. The "line of sight" analogy is used to emphasize the importance of visual connection between teachers and students in communication. Teachers must ensure that their perspective aligns with the students' perspective, ensuring alignment in learning objectives, strategies, and assessments. This ensures consistency and alignment in the ADDIE process.

1.2.3 Development

The Development phase aims to create and validate the selected learning materials. Teachers must find the necessary resources to implement the learning plan. After that, to implement the planned instruction, teachers need to select or develop all required tools, evaluate learning outcomes, and complete other steps in the ADDIE instructional design.

1.2.4 Implementation

The Implementation phase aims to prepare the learning environment by the teacher and to optimally engage students in the learning process. General steps in this phase include preparing both the teacher and students. The teacher must adjust the existing learning environment to allow students to begin developing the new knowledge and skills needed to address performance gaps in learning. Development and evaluation activities mark the end of the Implementation phase. Many ADDIE approaches use this phase as a step toward summative evaluation and other strategies that support the teaching and learning process.

1.2.5 Evaluation

The Evaluation phase aims to assess the quality of the product and the teaching process, both before and after the Implementation stage. Determining evaluation criteria, selecting appropriate evaluation tools, and conducting evaluations are standard procedures in this phase. The teacher must identify the level of learning success, recommend improvements for similar competencies in the future, halt any ongoing work, transfer the responsibility for project implementation and evaluation to a designated administrator or manager, and focus on the Evaluation phase.

1.3 Product Testing

1.3.1 Test Design

The product, which is a 3D animation video created using the Sketchup application, is tested for validity. The validity level of the 3D animation video is determined through the analysis of trial activities conducted in several stages, including: content and material validation review, material validation, language validation, material validation, individual trials, and field testing.

1.3.2 Type of data

The types of data obtained in this study are quantitative and qualitative. Qualitative data are collected from the scores given by design experts, content experts, language experts, and student responses. Quantitative data are obtained from expert validations, including those from content, language, and design experts, regarding the feasibility and attractiveness of the developed product. Additionally, quantitative data are collected from students after the product trial, and students as respondents evaluate the 3D animation video media created. Feedback and input provided by the validation team, including design experts, content experts, and students as respondents, are used to assess the feasibility of the 3D animation video media.

1.3.3 Data Collection Instruments

a. Validation of Student Worksheets

1) Material Validation Questionnaire

The material expert validation questionnaire is an assessment tool used to obtain data on the feasibility evaluation from material experts. After the data is collected, it is analyzed and used to improve the developed product. Below is the outline from the table regarding the material expert questionnaire in Table 1.1.

Table 1.1 Outline of Instruments for Material Experts

No.	Assessment Aspect	Indicator	Item Order
1.	Learning	The clarity of structure and flow of material in the media.	1
		Material conformity	2
		The collection of media that aligns with the material.	3
		The title and media with the	4

2.	Material	material being taught.	5
		Ease of knowing and understanding the material being taught.	6
		Ease of understanding examples in the media.	7
		The suitability of the media with participant behavior.	8
		Creative learning.	9
		Explain the material clearly	10
		Illustrations that match the material	11
		Examples of appropriate and clear drawings for building volume calculations	12
		Depth of content	13
		Accuracy of writing terms and spelling	14
		Language suitability	15
		Media clarity regarding material	16
3.	Benefit	Unlimited time and space	17
		Convenience for teachers and students	18
		Student independence	19
		Can be used by individuals and groups	20

Source: (Gulo, 2022) modified by researcher

1) Linguist Validation Questionnaire

Table 1.2 Instrument grid for linguists

No	Aspect	Indicator	Item Order
1	Straightforward	The accuracy of the sentence structure to represent the message and information to be conveyed	1
		The effectiveness of the sentences used	2
		The standard of the terms used is in accordance with the function	3
2	Communicative	Makes it easier to understand messages or information	4
		Able to motivate students	5
3	Dialogue and Interactive	Able to encourage students to think critically	6
		Suitability to students' intellectual development	7
4	Suitability to student development	Suitability to the emotional level of students	8
		Accuracy of appropriate language used	9
5	Conformity with language rules	Accurate and consistent use of terms.	10
		Utilization of accurate and consistent	12

measurement
s or metrics.
Source: (Gulo, 2022) modified by researcher

2) Media Expert Validation Questionnaire
1.3 instrument grid for media experts

No	Assessment Aspects	Indicator	Item Order
1	Audio and Visuals	Appropriateness in choosing the size and type of font used	1
		Clarity of display and sound quality on videos	2
		Suitability of language selection with content	3
		Clarity of video flow	4
		Appropriate use of animation with content	5
		Accurate use of voice	6
		Suitability of display of student characteristics	7
		The attractiveness of media presentation	8
		Suitability of media duration	9
		Interesting video flow	10
2	Media	Ease of media access	11
		Can be developed and used in the future	12
3	Benefit	Makes learning easier	13
		Media can be used anywhere and anytime	14
		Students' independence in using learning media	15

Media is able to attract students' attention
Clarity of the material presented

by using media learning resources.

Total Score Percentage

Source: (Gulo, 2022) modified by the researcher

Source: (Gulo, 2022) modified by the researcher

b. Teacher Questionnaire

This questionnaire is used to obtain teachers' opinions on the use of media in the subject of Construction and Property Cost Estimation. Teachers are asked to provide feedback or responses regarding the media for the 11th-grade students at SMK Negeri 1 Sogaeadu, which has been developed through the provided statements. This aims to align the evaluation aspects with the teachers' cognitive development.

Table 1.4 Practical Observation Questionnaire

No	Rated aspect	Score
Practicality		
1	Teachers do not find it difficult to carry out learning using media.	
2	The teacher fluently operates the media	
3	Media in triggering students' creativity	
4	Students fluently operate 3D Sketchup animated video media	
5	The ability of media to activate students in building their own knowledge.	
6	Teachers and students can utilize media repeatedly.	
7	Learning time is adjusted to media use.	
8	Media helps students understand information.	
9	Media according to students' needs.	
10	The use of media in learning follows student activities.	
11	The media is relevant to the learning material.	
12	Learning with media creates a pleasant atmosphere.	
13	Students can understand material more quickly through media.	
14	Media makes the teacher's teaching process easier.	
15	Students can complete assignments more quickly	

c. Student Respondent Questionnaire

This questionnaire is used to gather students' opinions on the use of media in the subject of Construction and Property Cost Estimation. Students are asked to provide feedback or responses to the media for the 11th-grade class at SMK Negeri 1 Sogaeadu, which has been developed through the provided statements. This aims to align the assessment aspects with the cognitive development of the students.

Table 1.5 Questionnaire Instrument Framework for Student Responses

No	Aspect	Indicator	Item Order
1	Linguistic Aspect	Clear material for easy understanding.	1
		Ease of access and navigation in studying material.	2
		Contoh yang jelas untuk memperjelas konsep.	3
		Clear examples to clarify concepts.	4
		The benefits of images and videos in explaining material visually.	5
		The use of media helps increase joy in learning.	6
		Interesting material to increase interest in learning.	7
		Interactivity with media for effective learning.	8
		Efficiency in writing to convey	9
		2	Programm ing Aspects

	information briefly and clearly.	
	Easy access to various learning materials.	10
	Selecting the right background to improve readability.	11
	Clarification of calculations to ensure clarity.	12
3	Clarity of images to clarify concepts.	13
Display Aspects	Appropriate image size to clarify information.	14
	Selection of appropriate type and size for readability.	15
	The attractiveness of the image to attract attention.	16
	The attraction of videos to increase interest in learning.	17
	Use appropriate and clear language in delivering material.	18
4	Media is used to attract and motivate students.	19
Implementation Aspects	Motivate students to think critically.	20
	Variations in presentation of material flexibility in media use.	21
		22
Source: (Gulo, 2022) modified by the researcher		
b.	Effectiveness	

To measure the effectiveness aspect, an assessment instrument in the form of a learning outcomes test is used. This instrument aims to collect data on students' learning outcomes in the Construction and Property Cost Estimation course. The learning outcomes test aims to assess the mastery of the material provided after participating in the lesson using 3D animation video media, which is conducted at the end of the learning period. The test is conducted to determine the effectiveness of the development of 3D Animation Video Learning Media.

1.1 Data Analysis Techniques

a. Qualitative Data

The qualitative data in this study includes feedback from the supervising lecturer, media experts, content experts, teachers of Construction and Property Cost Estimation, and students of Class XI-BKP at SMK Negeri 1 Sogaeadu. The researcher greatly values this feedback for the development of 3D animation video-based learning media using Sketchup. This feedback is crucial for identifying and correcting errors and weaknesses in the learning media design. Subsequently, this data of critiques, suggestions, and comments is collected by the researcher for revision and refinement, thereby improving the quality of the learning media development product.

b. Quantitative Data

Quantitative data is information that consists of numbers or values, derived from qualitative data that has been quantified. It is used to measure the value or score of the investigated variables. This data is typically collected through surveys or questionnaires distributed to respondents and then processed by researchers. In evaluating the feasibility of learning media, the assessment is carried out by assigning scores using a Likert scale with five responses, where respondents evaluate various aspects of the learning media according to the specified scale.

1. Converting qualitative values into rating scores

Table 1.6 Quality Ratings of Materials and Media

Qualitative Criteria	Score
Very good	5
Good	4
Pretty good	3
Not enough	2
Very less	1

Likert scale table according to Sugiyono (2019)

Table 1.7 Responses from Students and Teachers

Qualitative Criteria	Score
Strongly agree	5
Agree	4
Doubtful	3
Disagree	2
Don't agree	1

The assessment instrument used has 5 answer choices, so the total can be calculated using the formula below

$$:P = \frac{f}{N} \times 100\%$$

Note:

P = Percentage value,

F = Raw score obtained,

N = Maximum score

After obtaining the assessment scores, the next step is to find the average of the test sample subjects and convert it into an evaluation statement to determine whether the developed product is feasible or not.

2. Criteria for Feasibility of Learning Media

In evaluating the feasibility of a learning media to be implemented in the subject of Construction Cost Estimation and Property for the XI-BKP class at SMK Negeri 1 Sogaeadu, the obtained data is then used to assess the weight of each response and calculate the average score using the following formula:

$$P = \frac{\text{Jumlah skor yang diperoleh}}{\text{jumlah skor ideal}} \times 100 \%$$

(Arikunto, 1993)

Eligibility categories are as follows:

Table 1.8 Interpretation of Eligibility Percentage

No	Score in percent	Eligibility category
1	0 % – 20 %	Not Worth It
2	21 % – 40%	Not feasible
3	41 % – 60%	Decent Enough
4	61 % – 80%	Worthy
5	81 % – 100 %	Very Worth It

Source: (Maulidyah Firdausa Huda, 2022)

1. Criteria for the practicality of learning media:

The practicality test instrument, filled out based on the teacher's and students' perception questionnaires, is then analyzed. The data analysis techniques for practicality include

individual (audience) data analysis and student (user) perception data analysis. The analysis of these data is as follows:

$$Vp = \frac{TSEp}{S-Max} \times 100$$

(Kumalasani, 2018)

Keterangan:

Vp : Practicality validation

TSEp : Total empirical score of practicality

S-max: Maximum expected score

Table 1.9 Practicality Criteria for Learning Media

No	Score in percent (%)	Eligibility Category
1	< 20 %	Impractical
2	21 – 40%	Less Practical
3	41 – 60%	Quite Practical
4	61 – 80%	Practical
5	81 – 100 %	Very Practical

Source : (Rafiq et al., 2022)

1. Criteria for the Effectiveness of Learning Media

Analysis of the effectiveness of using learning media can be carried out by first conducting an evaluation of student learning outcomes. The analysis of the effectiveness of using media is performed using the following formula:

$$Hasil = \frac{\text{Skor yang tuntas}}{\text{Jumal Siswa}} \times 100 \%$$

The percentage of the effectiveness level of the media used for learning can be seen from the following table:

Table 1.10 Percentage of Media Effectiveness Level

No	Achievement rate (%)	Category
1	90 – 100 %	Very effective
2	80 – 89 %	effective
3	65 – 79 %	Effective enough
4	55 – 64 %	Less effective
5	0 – 54 %	Ineffective

The success criteria of this study are determined if the validation results from media experts, material experts, and subject teachers for the construction volume estimation material for class XI-BKP are at least categorized as good, and student responses are at least in the very good category. Thus, if the assessments from the validators and the feedback from the students meet the targets or criteria set, the 3D animated video-based learning media using SketchUp is considered suitable for use in teaching construction volume calculations.

Result and Discussion

The development of this media product involves collecting trial data from class XI students at SMK Negeri 1 Sogaeadu. After observing and identifying field issues, the researcher designed 3D animated video-based learning media for the Construction Cost Estimation and Property subject, specifically for calculating building construction volume, using the ADDIE model. The aim of this research is to develop a valid, practical, feasible, and effective 3D animated video-based media for teaching building construction volume calculations in class XI at SMK Negeri 1 Sogaeadu.

The ADDIE development model consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The 3D animated video-based media designed by the researcher was validated by material experts, language experts, and media experts. The results of this media development research can be explained as follows:

2.2.1 Stage Analyze

The analysis phase aims to identify and analyze the problems faced by students and teachers (Prasetyo, 2020). Additionally, this phase seeks to gather information needed to develop educational media. Activities conducted during the analysis phase include conducting needs analysis through interviews and questionnaires, determining the scope of the material, formulating instructional objectives, identifying student characteristics, setting boundaries, determining and collecting resources, developing a process plan, and analyzing core competencies and basic competencies for idea development (Prasetyo, 2020).

- a. Needs Analysis
- b. Determining the Scope of the Material
- c. Formulating Instructional Objectives
- d. Identifying Student Characteristics
- e. Setting Boundaries
- f. Determining and Collecting Resources
- g. Developing a Process Plan
- h. Analyzing Core Competencies and Basic Competencies Basis for Idea Development

2.2.2 Stage Design

After the analysis, the next step is design, which involves verifying the desired performance and determining appropriate testing methods. The creation of the Animation-Based Learning Media Prototype involves a series of steps, starting from the digitization of images

based on core competencies, building volume calculations, image animation, voice recording for narration, adding background music, and finally combining everything into an animated video.

- 1. Validation of the Animation-Based Learning Media Prototype
- 2. Revision of the Animation-Based Learning Media Prototype

The supervising lecturer guides the researcher to validate the product with three field experts: a material expert, a language expert, and a design expert. They are:

- a. Anugerah Septiaman Harefa, S.T., M.Ars, lecturer in the Building Engineering Education Program at Nias University.
- b. Noveri Amal Jaya Harefa, S.Pd., M.Pd., lecturer in the Indonesian Language and Literature Education Program at Nias University.
- c. Arisman Telaumbanua, S.Pd., M.Pd.T., lecturer in the Building Engineering Education Program at Nias University.

Validation by the material expert was conducted by Anugerah Septiaman Harefa, S.T., M.Ars, to obtain product revision guidance. The assessment was carried out through a validation sheet, with two revisions for media validation. The results of the material expert's assessment can be seen in the following table.

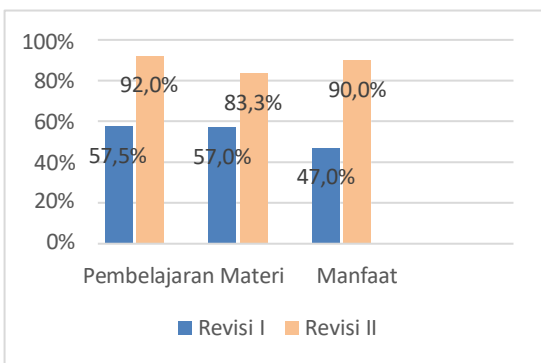
Table 2.1 Results of the Questionnaire for the Feasibility Assessment of 3D Animation Video Learning Media by Subject Matter Experts

No.	Asses sment Aspec ts	Indicator	Score	
			Revi sion I	Revis ion II
1.	Learn ing	1. Systematic clarity and flow of material in the media	3	4
		2. Truth	3	4
		3. Collection of relevant media	2	5
		4. Suitability of the media	2	4

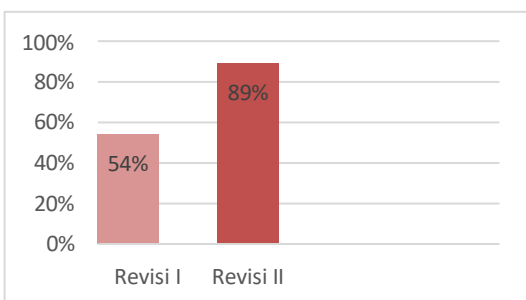
	title with the material presented		
	5. Ease of understanding the material presented	3	5
	6. Ease of understanding illustrations in the media	4	5
	7. Suitability of the media to the characteristics of students	3	5
	8. Interesting learning	3	5
	Number of Each Aspect	23	37
	Number of Percentages for Each Aspect	57,5%	92,5%
	9. Clarity of material description	3	5
	10. Suitability of illustrations to material	3	4
2. Materi	11. Suitability of image examples to clarify building volume calculations	3	4
	12. Depth of material content	3	3
	13. Accuracy in writing terms and spelling	3	4
	14. Language suitability	2	5
	Number of Each Aspect	17	25

	Number of Percentages for Each Aspect	57%	83,3%
	15. Media clarity regarding the material	2	5
	16. Unlimited time and space	2	5
3. Manfaat	17. Convenience for teachers and students	2	5
	18. Student independence	3	4
	19. Can be used by individuals and groups	3	4
	20. Arouse curiosity	2	4
	Number of Each Aspect	14	27
	Number of Percentages for Each Aspect	47%	90%
	Total Score for All Aspects Achievement Presentation	54%	89%

The results of the material expert validation from three aspects from the first revision to the second revision can be seen in the following graph:



Graph 4.1 Product Validation Results for Each Aspect by Material Experts



Graph 4.2 Average Results of Revision I and Revision II by Material Experts

a. Language Expert Validation Data

Language validation was conducted by Mr. Noveri Amal Jaya Harefa, S.Pd., M.Pd., a lecturer in the Indonesian Language and Literature Education Study Program, Faculty of Teacher Training and Education, Universitas Nias. This validation was carried out to obtain information to guide the revision of the produced product. The assessment method used a validation sheet. This media validation was carried out in two rounds of revisions. Therefore, the assessment from the language expert can be seen in the following table.

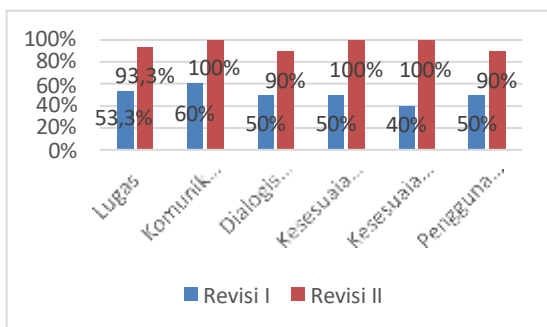
Table 4.2 Results of the Feasibility Assessment Questionnaire for 3D Animation Video-Based Learning Media by Language Expert Validators

No	Aspect	Indactor	Revisi I Skor	Revisi II Skor
1		The accuracy of the sentence structure to represent the message and	3	5

	informati on to be conveyed		
	The effectiveness of the sentences used	2	4
	The standard of the terms used is in accordance with the function	3	5
	Number of Each Aspect	8	14
	Total Score for Each Aspect	53,3 %	93,3 %
	Makes it easier to understand messages or information		
2	Communicative	3	5
	Number of Each Aspect	3	5
	Total Score for Each Aspect	60 %	100 %
	Able to motivate students	2	5
3	Dialogic and Interactive	3	4
	Number of Each Aspect	5	9
	Total Score for Each Aspect	50 %	90 %
	Suitability to students' intellectual development	2	5
4	Suitability to student development	3	5

Number of Each Aspect	5	10
Total Score for Each Aspect	50 %	100 %
5	Conformity with language rules	Accuracy of grammar used
		2 5
Number of Each Aspect	2	5
Total Score for Each Aspect	40 %	100 %
6	Use of terms, calculations and measurements	Use of terms that are precise and unchanging Use calculations or measurements that are precise and do not change
		3 5
		2 4
Number of Each Aspect	5	9
Total Score for Each Aspect	50 %	90 %
Total Score for All Aspects	28	52
Achievement Presentation	55,55 %	95,55 %

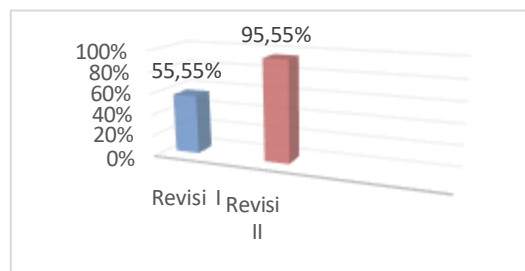
The results of the language expert validation from six aspects can be seen in the following graph:



Graph 4.3 Results of Product Validation for Each Aspect of Revisions I and II by Language Experts

The average results from language experts on the learning media product with revision I achievement of 55.55% and revision II

achievement of 95.55% can be seen in the following graph:



Graph 4.4 Average Results of Revisions I and II by Language Experts

a. Data of Validation Results by Design Experts

The validation by the design expert was conducted by Mr. Arisman Telaumbanua, S.Pd., M.Pd.T, as a lecturer in the Building Engineering Education Study Program, Faculty of Teacher Training and Education, Nias University. Validation was conducted to obtain information used as a guide for revising the produced product. The assessment method is through a validation sheet. Therefore, the assessment from design experts can be seen in the table below:

Table 4.3 Results of the Questionnaire on the Feasibility Assessment of 3D Animated Video-Based Learning Media by Design Expert Validators

No	Assessment Aspects	Indicator	Score Revision I	Score Revision II
1	Audio dan Visual	Accurate selection of font size and type	3	4
		Clarity of display and sound quality in the video	2	5
		Suitability of language selection with content	4	5
		Clarity of video flow	3	4
		Appropriate use of animation with content	3	5

		Accurate use of voice	2	4
		Suitability of video display to student characteristics	3	4
		The attractiveness of the media presentation	3	5
		Number of Each Aspect	20	36
		Total Score for Each Aspect	50	90
			%	%
		Appropriate media duration	3	4
		Interesting video flow	4	5
2	Media	Ease of media access	3	5
		Can be developed and used in the future	3	5
		Number of Each Aspect	13	19
		Total Score for Each Aspect	65	95
			%	%
		Makes learning easier	3	5
		Media can be used anywhere and anytime	2	5
		Students' independence in using learning media	3	4
3	Benefit	1. Media is able to attract students' attention	3	4
		2. Clarity of the material	3	5

	presented	
Number of Each Aspect	14	23
Total Score for Each Aspect	56	92
	%	%
Percentage of Achievement	57	92,3
	%	%

The results of the design expert validation across three aspects, from Revision I to Revision II, can be seen in the chart below::

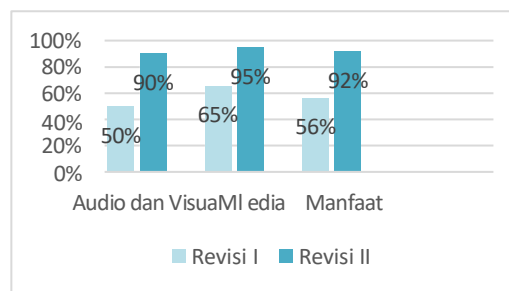
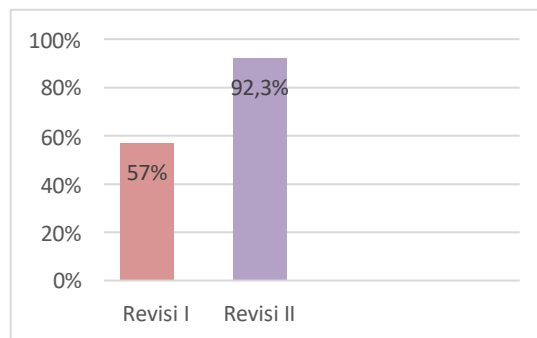


Chart 4.5 Average Results for Each Aspect by Design Expert

The average results from the design expert on the instructional media product, with Revision I achieving 57% and Revision II achieving 92,3%, can be seen in the following graph:



Graph 4.6: Average Results by Design Expert

4.4.4 Stage Implementation

The implementation stage involves applying a developed product and soliciting feedback from students and teachers regarding the designed media (Prasetyo, 2020). The implementation stage consists of two activities: the implementation of animated video learning media for students and the implementation of animated video learning media for teachers on Building Construction Cost Estimation.

a. Individual Trial Results

After being validated by experts, the product was then tested at SMK Negeri 1

Sogaeadu in class XI-BKP with a total of 6 students. During the individual trial, the researcher distributed questionnaires to assess the practicality of the media. The results of the individual trials can be seen in the following table:

Tabel 4.4 Hasil Uji Coba Perorangan

N o	Nama Siswa	Sko r	Present ase	Kriteria Kepraktis an
1	Jhon Saputra Zebua	20	91 %	Sangat Praktis
2	Salman Zebua	19	86 %	Sangat Praktis
3	Gusardi Gulo	19	86 %	Sangat Praktis
4	Aguspriman Hura	21	95 %	Sangat Praktis
5	Notatema Anugrah Zendrato	19	86 %	Sangat Praktis
6	Kariaman Waruwu	19	86 %	Sangat Praktis
Jumlah Skor				127
Presentase				88 %
Kriteria Kepraktisan				Sangat Praktis

a. Field Trial Results

After being validated by experts, it was then field-tested at SMK Negeri 1 Sogaeadu with 25 students from class XI-BKP. Based on the field test, the researcher distributed response questionnaires to determine the practicality of the media. The assessment of the field test can be seen in the following table:

Table 4.5 Field Test Results

N o	Nama Siswa	Sko r	Presenta se	Kriteria Kepraktis an
1	Triman Syukur Laoli	21	95 %	Sangat Praktis
2	Gregorius Aljana Metanoidraha Romi	19	86 %	Sangat Praktis
3	Julianto Gea	19	86 %	Sangat Praktis
4	Hironimus Alexall	19	86 %	Sangat Praktis

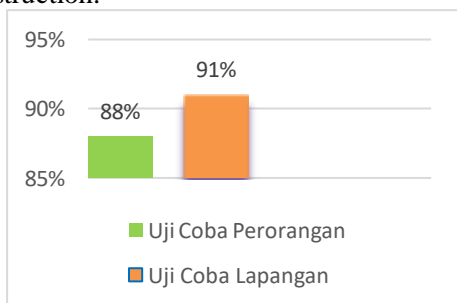
5	Hizisno Gulo Otonius Gulo	21	95 %	Sangat Praktis
6	Kafitus Waruwu	19	86 %	Sangat Praktis
7	Sehati Harefa	20	91 %	Sangat Praktis
8	Firman Jaya Buaya Joni	21	95 %	Sangat Praktis
9	Rahmat Putra Buaya	20	91 %	Sangat Praktis
10	Zoin Bate'e	21	95 %	Sangat Praktis
11	Sarman Gulo	21	95 %	Sangat Praktis
12	Vendi Setia Putra	20	91 %	Sangat Praktis
13	Zai Arisman Waruwu	21	95 %	Sangat Praktis
14	Suardin Lawolo	19	86 %	Sangat Praktis
15	Desrin Kristian Totonaf	21	95 %	Sangat Praktis
16	Lawolo Vinki Stevainus	20	91 %	Sangat Praktis
17	Waruwu Serdinus Gulo	21	95 %	Sangat Praktis
18	Surya Rahmat Dani	21	95 %	Sangat Praktis
19	Gulo Nofri Saputra	20	91 %	Sangat Praktis
20	Waruwu Meldi Putra	19	86 %	Sangat Praktis
21	Kristof Halawa Aiderman Bate'e	21	95 %	Sangat Praktis
22	Lefirma n Dohare	21	95 %	Sangat Praktis

23	Yosua Julisman Hura Wahyu Saputra Zebua Jelisman Aluin	20	91 %	Sangat Praktis
24	Cermat Zendrat	19	86 %	Sangat Praktis
Jumlah Skor Presentase Kriteria Kepraktisan		505 91 %		Sangat Praktis

No 1

4.4.5 Stage Evaluation

The Evaluation stage involves assessing responses to the media test questions given to 2 students at the end of the material, as well as filling out student response questionnaires and answering the provided test questions. In this evaluation, there is 1 student who did not complete the requirements, and 30 students who did complete them. These scores were obtained from the final learning test, which is the competency test administered at the end of the instruction.



1.1.6 Product Testing Results

4.4.1 Practicality of 3D Animated Video Media for Teachers and Students

a. Student

The product trial was conducted at SMK Negeri 1 Sogaeadu. Individual trials were carried out in class XI-BKP, and field trials were also conducted in class XI-BKP. The individual trial involved 6 people, while the field trial included 25 people in class XI-BKP. The purpose of these trials was to determine students' responses to the 3D Animated Video Learning Media through a response assessment sheet in the form of a questionnaire.

The results of the trial can be obtained through the evaluation using a student response questionnaire. The assessment of the student questionnaire can be seen in the table below:

Table 4.6 Assessment of Media Practicality

Uji Coba Produk	Banyak Sampel	Skor Perolehan	Skor Maksimal	Tingkat Pencapaian	Kategori
Uji Coba Perorangan	6 orang	127	132	88 %	Sangat Praktis
Uji Coba Lapangan	25 orang	505	505	91 %	Sangat Praktis

Source: Researcher 2024

The product testing has been conducted through individual trials and field trials. In the individual trials, the achievement level was 88%, categorized as very practical. Subsequently, the researcher conducted field trials with an achievement level of 91%, also categorized as very practical.

After conducting two rounds of testing for the 3D Animated Video-Based Media product, including individual trials and field trials, the results achieved were categorized as "Very Practical" for each. The results of the product testing conducted with students can be seen in the graph below:

Chart 4.7: Average Results of Individual Trials and Field Testing

Note:

Individual Trial: 88%

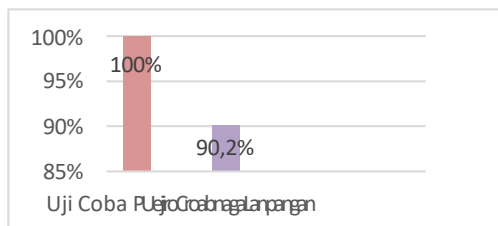
Field Trial: 91%

4.2.2 Effectiveness of 3D Animation-Based Video Media

a. Individual Trial

The effectiveness of student learning outcomes is assessed through tests based on the material presented in the form of essay questions within the media. This stage is conducted to determine the effectiveness of 3D Animated Video-Based Media based on student learning outcomes. Individual trials were conducted at SMK Negeri 1 Sogaeadu, class XI-BKP, with a sample of 6 students using 3D animated video-

based learning. The effectiveness results for students in the individual trial showed an average



score of 100%.

b. Uji Coba Lapangan

The effectiveness of this media was evaluated using student learning tests in the form of essay questions included in the media, with student responses recorded on provided answer sheets. The effectiveness test was conducted at SMK Negeri 1 Sogaeadu, class XI-BKP, with a sample of 25 students. The 3D animated video-based learning activity achieved a result of 90.2%. This trial was intended to assess the effectiveness of 3D animated video-based learning media through student learning outcomes.

Table 4.8 Evaluation of the Completeness of the Effectiveness of 3D Animation Video-Based Media in Individual and Field Trials

No	Uji Keefektifitas	Jumlah peserta didik KKM	Banyaknya seluruh peserta didik	Hasil perolehan	Tingkat keberhasilan	Keterangan
1	Uji Coba Perorangan	6	6	100 %	>89 %	Sangat Efektif
2	Uji Coba Lapangan	24	25	90,2 %	>89 %	Sangat Efektif

Source: Researcher 2024

The students' learning outcomes from individual trials and field tests can be seen in the graph below:

Figure 4.8 Average Results of Individual Trials and Field Tests

Conclusion

Based on the results of the above research and development, it can be concluded that:

- The 3D animation video-based learning media using SketchUp for calculating the volume of building construction at SMK Negeri 1 Sogaeadu class XI-BKP has been developed using the ADDIE model and validated by material experts, language experts, and media design experts, receiving a rating categorized as very feasible.
- The 3D video-based learning media using SketchUp at SMK Negeri 1 Sogaeadu for class XI-BKP in the subject of Construction Cost Estimation and Property, with material on calculating the volume of building construction, was developed using the ADDIE model and received a rating categorized as Very Practical based on student response questionnaires.
- The 3D animation video-based learning media using SketchUp at SMK Negeri 1 Sogaeadu for class XI-BKP in the subject of Construction Cost Estimation and Property, with material on calculating the volume of building construction, was developed using the ADDIE model and received a rating categorized as Very Effective based on student learning outcome tests.

Based on the research conducted, it can be concluded that the 3D animation video-based learning media using SketchUp for calculating the volume of building construction at SMK Negeri 1 Sogaeadu class XI-BKP in the subject of construction cost estimation and property, with the material on calculating the volume of building construction, was developed using the ADDIE model and is very suitable, practical, and effective for use in the school learning process.

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Curriculum Vitae

Ipar Jaya Lai (Ipar) was born in Dao-Dao Zanuwo Village, Susua, South Nias, North Sumatra on July 28, 2001, the fifth of six children of Boroli Laia (father) and Tinisa Wau (mother). He completed his elementary

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