

Article History

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*Corresponding author
jlafahlevi01@gmail.com**DEVELOPMENT OF LEARNING MEDIA BASED ON ANIMATION VIDEO IN LEARNING HYDROCARBON MATERIAL AT GRADE XI SENIOR HIGH SCHOOL****Najla Rizani Fahlevi^{a*}, Zainuddin Muchtar^a**^aDepartment of Chemistry Education, Faculty of Mathematics and Natural Science, Universitas Negeri Medan, Medan, Indonesia, 20221**Abstract**

The impact of technological developments in education on the learning process is significant. The learning process must be developed, implemented, analyzed, and monitored to be effective and efficient. Some students find it difficult to understand the terms, theories, and structures of carbon chain structures until they make an error; students' marks in the hydrocarbon quiz, with 0% students, marked up from 61 to 100. Most students have marks in the range 31 to 40 (39%) and the least in the range 51 to 60 at 4%. Teaching the carbon chain structure requires clear visualization, which the teacher's exposure would help. A suitable medium is needed for teaching and visualizing the chain's structures. This research uses the ADDIE development model. This research begins by analyzing the problems and limitations faced in learning chemistry. The quality of animated video learning media has an assessment percentage of 84% by media experts and 91% by material experts. Based on the results of a questionnaire for 30 students, the percentage of assessment based on responses was 91% in the very good category. Based on test results on 30 students, with $t_{\text{count}} \geq t_{\text{table}}$; $22.75166617 \geq 2.045$ with the H_0 hypothesis accepted. Class XI SMA Class XI Animation Based Learning Videos are declared valid based on expert and practitioner assessments. The results of the experts' assessments consistently categorize the animated videos being developed. The general assessment of this video is very good and usable.

Keywords: ADDIE; Hydrocarbon; Learning Media; Animation Video 10.24815/jcd.v12i1.36913Attribution-NonCommercial-ShareAlike 4.0 International
(CC BY-NC-SA 4.0)**INTRODUCTION**

The impact of technological developments in education on the learning process is significant. The learning process must be developed, implemented, analyzed, and monitored to be effective and efficient. The current pandemic is a problem facing everyone in the world. This situation affects daily activities, including the teaching and learning process. One of the effects of changing conditions based on what happens during the teaching process is the lack of physical and social contact between teachers and students to prevent the spread of the virus. It can be said that it is difficult to strictly deal with the prevention of physical contact because there must be interaction between teachers and students in the teaching and learning process. Seen from the problems that emerged during the pandemic, it shows that there is a lack of development of educational media that can be accessed by students from school by teachers.

Good learning media can be the main key to the way teachers teach. The use of existing media can influence the way teachers teach. Learning media utilized appropriately in the learning process will become a more effective and efficient support tool in achieving the learning objectives. Learning media should be engaging and help students in the learning process of the material being taught; this is in line with the statement expressed by Sanaky in Puspitarini that

the benefits of instructional media include: (a) By using learning media, the learning process will be more interesting; (b) Can clarify learning materials; (c) By using instructional media, the learning process becomes more varied; and (d) Students listening to the material presented by the teacher [1].

Teachers should plan science education concerning their students and effective media and methods in teaching. As a result, hence a need for the development of flexible and engaging learning media for students. Multimedia, a form of computer science, refers to the combination of two or more than two media. The fact is that multimedia is a unity of media and reasonable coordination of media instead of a simple combination of a variety of media to show information and enhance people's understanding and memory of information [2]. One type of multimedia that can be used is animation video.

An animation video is a stir-shaped image of objects (images) arranged uniformly to follow the flow movement determined at each increment, counting the time that happened. Image or object referred to in the above definitions may include images of human, animal, or in writing [3]. The animated video design is attractive and has obtained the consent of the respondents based on the results provided through the questionnaire, which is at a high level. The respondent has shown a high level of agreement with the video

animation, which can give a better understanding [4]. Using interesting animated videos with appealing colors, motion, and visuals makes it easier for students to focus their attention and concentration on the material getting delivered.

Media for learning is used as a guide for teachers in explaining the material, making the media can be said as a method of communication. Media are various components in the student's environment that can stimulate them to learn. In line with Gagne's opinion, Briggs defines learning media as a physical form that can present messages that stimulate students to learn [5]. Media is an intermediary that transmits messages from the source to the message's recipient [6]. The principles of selecting media used for learning are (a) Suitability, (b) Clarity in presenting, (c) Ease of Access, (d) Affordability, (e) Availability, (f) Quality, (g) Availability of alternative; (h) Interactivity; (i) Organization; (j) Novelty; (k) Student oriented [7]. Education is no longer limited to classrooms; it has reached far and wide. The presentation of information has become easier; it has facilitated the audio-visual representation of information and made the teaching and learning process easier and more interactive. In a noisy classroom, microphones can be used in the teaching-learning process [8]. Besides, learning media also helps learners improve understanding, presents data with interesting and reliable information, facilitates interpretation of data, and compacts information [9]. The way to make students have learning activities in comfortable situations is through media that is appropriate to their condition. When a teacher succeeds in setting this condition, the teacher can enable the learner to learn. The last teacher should be able to guide students or learners in teaching and learning activities, and media have a role in supporting the teacher in guiding students [10]. Active processing proposes that when it comes to information selection, organization, and integration, human beings are active agents and are capable of managing the forms of information they interact with [11]. In the previous research, Mardina (2023) used e-posters with attractive displays, which can be innovative ways for effective learning [12].

Animated media is a display that combines text, graphics, and sound media in an activity to make the learning process more interesting and useful. In addition, animated video media in the form of cartoons can make students interested in understanding chemistry learning [13]. Learning videos are an alternative medium for conveying messages in the learning process to support students' learning process [14]. It can be seen from Reza, M (2023) that learning video can satisfy the requirement in subject matter [15].

Hydrocarbons are a class XI learning material that discusses carbon and hydrogen compounds closely related to everyday living, such as carbohydrates, lipids, and combustion results. Because of its difficulty

in learning, hydrocarbons are considered as difficult. Several students find it difficult to understand the terms, theories, and structures of carbon chain structures until they make an error. This can be concluded from students' marks in the hydrocarbon quiz, with 0% of students having marks up from 61 to 100. Most students have marks in the range 31 to 40 (39%) and least in the range 51 to 60 at 4%. Teaching the carbon chain structure requires clear visualization, which the teacher's exposure would help. The proper media is needed to teach and visualize the chain's structure. This study aims to provide a learning media-based animation video that is valid, practical, and advisable in teaching hydrocarbon material while measuring validity, student opinions, and students' learning outcomes.

In this research, we developed the animation video as a learning medium for senior high school students to comprehend the concept of hydrocarbons. ADDIE model was employed in an R & D research method involving 30 Senior High School No. 2 Medan students as research subjects.

METHOD

The type of research that will be conducted is Research and Development (R&D). The R&D method is a research methodology used to develop specific products and perfect products by the standards and requirements defined to create new products through several phases and validation or testing. Researchers research to gather the required data, after which system development, testing, and system evaluation are performed.

The model applied in this research is the ADDIE model. It includes analysis, design, development, implementation, and evaluation. This research procedure adapted the ADDIE development model developed by Robert Maribe Brach. The universal learning design model provides an orderly method in developing learning materials that can be utilized for traditional (face-to-face in class) and online learning, which is an understanding of ADDIE development.

This research was conducted at the SMAN 2 Tanjungbalai. This research was conducted in the odd semester of August 2023 to October 2023 of the 2023/2024 academic year. The samples determined in this were Students in XI IPA 1 in the first semester studying Hydrocarbon materials.

The data obtained from this study are qualitative and quantitative data obtained from assessments and revisions to the Hydrocarbon learning media-based Animation Video. The qualitative analysis obtained is input from expert validators to improve the product being developed. In contrast, quantitative analysis is carried out by calculating expert validation results, student responses, and learning outcomes.

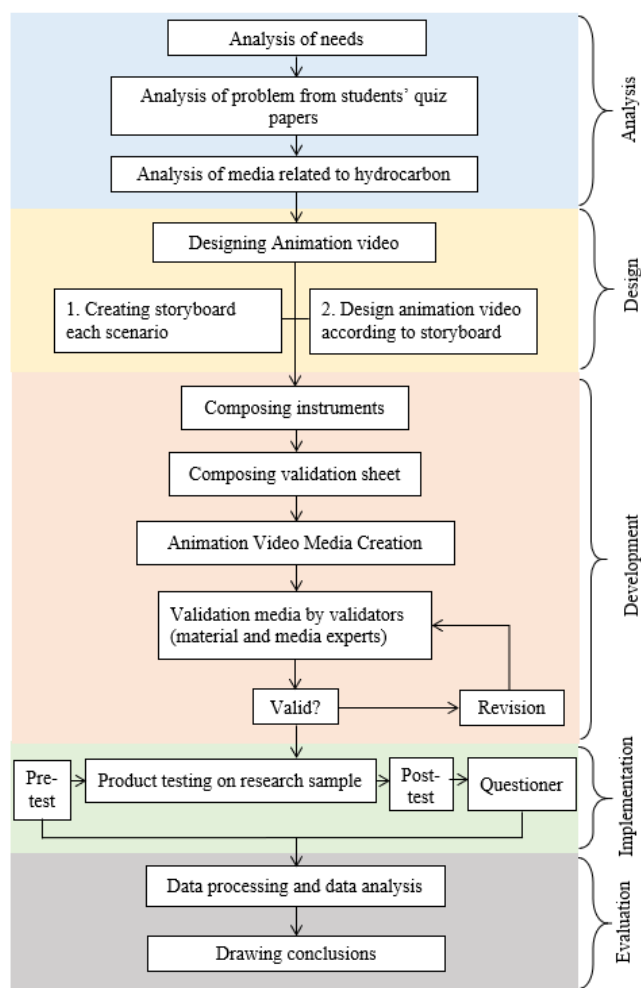


Figure 1. Research Procedure Scheme

Analysis of Validation

The teaching materials are validated using a validation sheet to media experts and calculated by the following formula:

$$P = \frac{\sum x}{\sum xi} \times 100\%$$

Where:

P: Percentage validity

$\sum xi$: The total number of ideal scores in all items

$\sum x$: The total number of answers in all items

Table 1. Level of Achievement and Quality [16]

No.	Percentage Interval	Category
1.	90 - 100	Excellent
2.	75 - 89	Good
3.	65 - 79	Fairly good
4.	55 - 64	Less
5.	<54	Invalid

Student Response Analysis

The data obtained from the questionnaire of student's responses is carried out using the following equation:

$$P = \frac{\sum x}{\sum xi} \times 100\%$$

Information:

P: Percentage validity

$\sum xi$: The total number of ideal scores in all items

$\sum x$: The total number of answers in all item

Table 2. Student Response Result Assessment Interval

No.	Score Interval (%)	Category
1	0-25.99	Very Bad
2	26-50.99	Bad
3	51-74.99	Good
4	75-100	Excellent

Test Validity

The Product Moment formula is used to calculate the correlation coefficient between the test scores (items) and the total score to determine the validity of the test items:

$$r_{xy} = \frac{N \sum XY - (\sum X)(\sum Y)}{\sqrt{\{N \sum X^2 - (\sum X)^2\} \{N \sum Y^2 - (\sum Y)^2\}}}$$

Where:

r_{xy} = correlation coefficient between X variable and Y variable

N = total of students

X = score items

Y = total score

If $r_{count} > r_{table}$, the test item is then considered valid

Test Reliability

The reliability of the test was calculated using the Kuder and Richardson-21 (KR-21) formula:

$$r_{11} = \frac{KS^2 - \bar{X}(K - \bar{X})}{S^2(K - 1)}$$

$$S^2 = \frac{\sum X^2 - \frac{(\sum X)^2}{N}}{N}$$

Where:

r_{11} = test reliability coefficient

K = number of test items

S^2 = score variance

\bar{X} = average score

N = the number of samples

Level of Difficulty

To calculate the difficulty level of the questions, the following formula is used:

$$P = \frac{B}{T}$$

Where:

P =difficulty index

B =number of students with correct answers

T =number of students

Table 3. Difficulty index criteria

P Interval	Criteria
P = 0.00	Too difficult
0.00 < P < 0.30	Difficult
0.30 < P < 0.70	Difficult Enough
0.70 < P < 1.00	Easy
P = 1.00	Too Easy

Distinguishing Power

To calculate the distinguishing power of the question, the formula is used:

$$D = \frac{BA}{JA} - \frac{BB}{JB}$$

Where:

JA = the number of test-takers in the upper group

JB = the number of test-takers in the lower group

BA = the number of the upper group who answered correctly

BB = the number of the lower group who answered correctly

Classification of distinguishing power index are:

D = negative (very poor)

D = 0.00 - 0.20 (poor)

D = 0.20 - 0.40 (satisfactory)

D = 0.40 - 0.70 (good)

D = 0.70 - 1.00 (excellent)

Student Learning Outcomes Analysis Technique

Normality Test

The normality test is a test used to determine whether the sample used in the study comes from a population that is normally distributed or not. The normality test used in this study is the Shapiro-Wilk test, which uses IBM SPSS software.

The decision-making criteria for the SPSS output results are as follows:

If $sig. > 0,05$ (5%), then H_0 is accepted, H_a is rejected; the sample comes from a normally distributed population.

If $sig. \leq 0,05$ (5%), then H_0 is rejected, H_a is accepted; the sample comes from a non-normally distributed population.

One Sample T-test

The formula used to test the descriptive hypothesis (one sample) whose interval or ratio data:

$$t_{count} = \frac{\sum d_i}{\sqrt{\frac{N \sum d^2 - (\sum d_i)^2}{N - 1}}}$$

Where:

T = t count

N = number of samples studied

d = difference between post-test and pretest-test scores

Then, the results of these calculations are tested using the right-hand side test by applicable regulations.

If the t_{count} is greater than or equal to (\geq) from the table, then H_a is accepted, and H_0 is rejected if $t_{count} \leq t(1-\alpha)(n-1)$

RESULTS AND DISCUSSION

Analysis Stage

In the analysis stage, three things were analyzed: analyzing the needs, analyzing the problem from students' quiz papers, and analyzing media related to hydrocarbon. In analyzing the needs of students, we will look at hydrocarbon-related problems. It turned out that there were students that didn't understand hydrocarbon material. Students still had many difficulties learning hydrocarbon material in the sub-topic of hydrocarbon compounds' nomenclature. This can be seen after further analysis, namely analyzing the problem from students' quiz papers. In analyzing the problem from students' quiz papers, the teacher gives the researcher the quiz paper from all students XI IPA with 100 students.

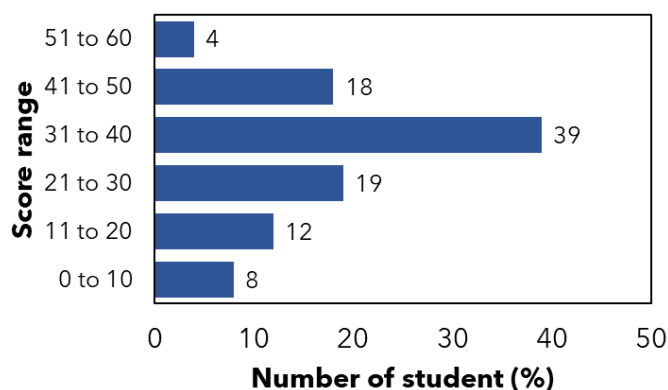


Figure 2. Students Score Percentage

After analyzing the problem from the students' quiz paper, the next analysis of hydrocarbon-related media was carried out. Hydrocarbon-related media was analyzed from media during learning in school and available media, especially video learning. It turned out that the media used in school was a chemistry book from the library. Learning videos that were available on video platforms about hydrocarbon consisted of PowerPoint, and there were better videos, but students had to pay for the service to access them. So, from the analysis results, the researcher is interested in developing a learning media on hydrocarbon material that can help students keep learning anywhere, anytime, and for free.

Design Stage

In the Design stage, the researcher created storyboards, which were illustrations that were displayed one after another to visualize the animation before it was made as large comic strips from each scene for developing the animation video. The

animation video is expected to make students understand more about hydrocarbon compounds.

In the design stage, the researcher carried out several activities, namely:

Reviewing Hydrocarbon Material

In this stage, the researcher examines the Hydrocarbon material for Senior High School grade XI in accordance with the 2013 curriculum. The class that will be conducting research is the 2013 curriculum. From the result of this study, the research materials are limited to the definition of hydrocarbon, characteristics of the carbon element, hydrocarbon classification, and hydrocarbon nomenclature.

Designing storyboard

The researcher designed the storyboard based on hydrocarbon material. Below is the sum of a storyboard used to make the animation video.

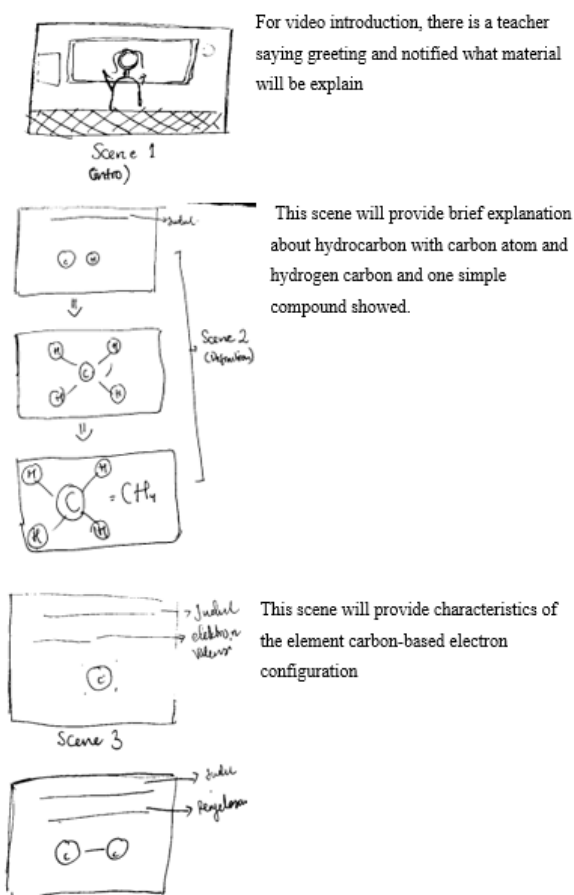


Figure 3. Video Story Board Development Stage

Composing Research Instrument

The research instruments that were used were a questionnaire and a test. The questionnaire was used for the research sample student to determine the quality of Animation media that would be developed based on their opinions. Pretest and posttest were used to determine the student learning outcomes.

The researcher prepared 30 multiple-choice questions with A, B, C, D, and E alternative answers adapted to each indicator in limited hydrocarbon

material. The test instruments were then examined on 28 class XI IPA 2 SMA Negeri 2 Tanjungbalai students. This examination aims to determine the question's validity, difficulty level, distinguishing power, and reliability.

Validity

Based on results from the student's examination, with criteria $r_{\text{count}} > r_{\text{table}}$, with $r_{\text{table}} = 0,374$, the calculated value has been adapted from the table with $N = 28$ students at a significant level = 0,05. Among the 30 items tested, there are 21 valid items and nine invalid items.

Difficulty level

The items that meet the requirements for research are classified into the Easy and Enough categories. Based on results from the student examination, 21 items were valid, nine items were in the easy category, and 12 were in the medium category.

Distinguishing Power

The eligible item is the D (Distinguishing Power) scale from 0.20 to 1.0. Based on the results from the student examination, among 21 valid items, there is 1 item that is not eligible, with 0.14.

Reliability

The Kuder and Richardson-21 (KR21) formula has been used to conduct the reliability test with question items that have been validated, with $r_{\text{count}} > r_{\text{table}}$ to consider the test reliable. From $N = 28$ students, the r_{table} is 0.374 with a significance level 0.05. The calculation result in the r_{table} is 0.83. The items are reliable due to $r_{\text{count}} > r_{\text{table}}$ ($0.83 > 0.374$). Fifteen items were included in the test instruments.

Media and Materials Expert Validation

The research instruments used in project standardization in teaching media and material are presented as a questionnaire based on references Cheppy. R (2017) with modification [17]. The data obtained at this stage is qualitative in the form of comments and suggestions for improvement.

Table 4. Validity of the learning media

No.	Assessment Component	Score	Category
1.	Visual	84	Good
2.	Audio	85	Good
3.	Typography	80	Good
4.	Presentation	85	Good
Average		84	Good

Based on the table that has been seen, the animation video media developed in Visual, Audio, Typography, and Presentation by media experts (two lecturers) obtained an average percentage of 84%. The percentage obtained stated "Good" from a scale of 75%-89% stated, "Good." The animation video is feasible or valid to be used as a learning tool.

Table 5. Results of the Material of Learning Material by the Validator

No.	Assessment Component	Score (%)	Category
1.	Content Quality	90	Excellent
2.	Language Quality	93	Excellent
Average		91	Excellent

Based on the table and diagram, the animation video media developed in Content Quality and Language Quality by material experts (one lecturer and one teacher) obtained an average percentage of 91%. The percentage obtained stated "Good" with a 90-100% scale stating "Very Good." The animation video is feasible or valid to be used as a learning tool.

After media experts validate the animation video, material experts will review the revision step based on the experts' suggestions during the validation stage.

Researchers get suggestions for the animation video media based on the validation results from the media experts. It is used to improve animation and video media. The form of suggestion and reparation can be seen in the table below.

Table 6. Media Validator Suggestion and Revision

No.	Comments	Before revision	After revision
1.	Change the background		
2.	Give different colors on C carbon.		
3.	Change the flow explanation in Scene 4		
4.	Add Summary	No Summary	
5.	Add one more quiz		

Table 7. Validator Suggestion and Revision

No.	Revision	Before	After
1.	Change "terikat" to "berikatan"		

Implementation Stage

The implementation was carried out in one class, namely class XI IPA 1 SMA Negeri 2 Tanjungbalai, with 30 students. A pretest was given to the students before the learning media was implemented. The animation video was used as learning media for the research sample. After using the animation video, a post-test was then delivered to students to evaluate their progress. Questioners were also distributed after the post-test to students to measure the students' opinions with ten statements about the animation video.

Evaluation Stage

The next stage after the implementation stage is the evaluation stage. The researcher gathered feedback from implementing learning media to develop student responses (questionnaire) and outcomes (pretest, pre-test, and post-test).

1. Result of Student Responses to Learning Media Based on Animation Video in Hydrocarbon Material

Students' responses are collected after the animation video has been presented.

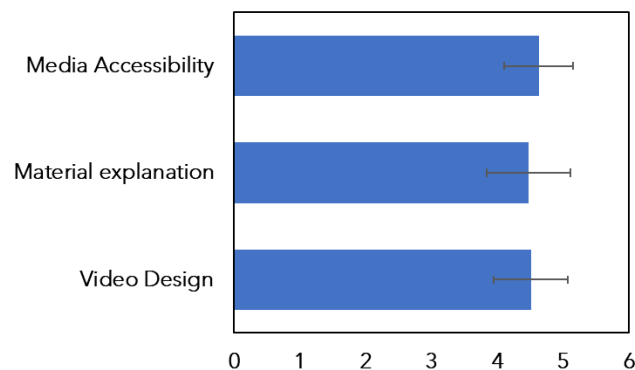


Figure 4. Students Questioner Score

Based on the percentage level of students' questionnaire results, the total percentage of student responses is 91%, with a range of 75% - 100% as a Very Good category. It shows that student responses to the animated video that have been validated are very good. Result of Student Learning Outcomes to Learning Media Based on Animation Video in Hydrocarbon Material

The analysis method that has been used in this research is one sample t-test, with the following hypothesis: H0: Students' learning outcomes increased after using learning media based on animation videos in hydrocarbon learning. Ha: Students' learning outcomes don't increase after using learning media based on animation videos in hydrocarbon learning.

To analyze student learning outcomes, the researcher conducted a pretest-test before using the animation video and a post-test after the animation video had been presented.

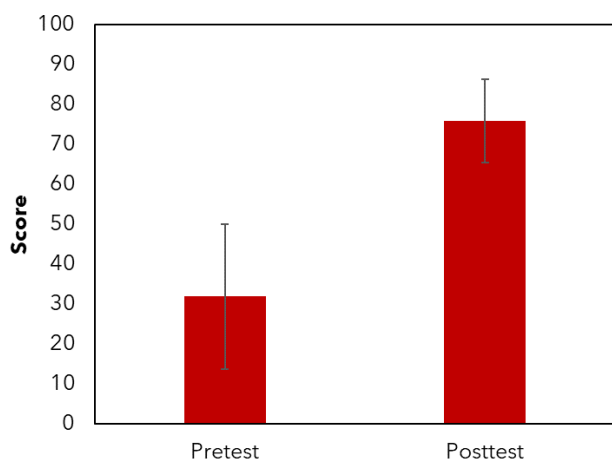


Figure 5. Students' Pre-test and Post-test Score

Pretest: Pre-test and post-test results were obtained using animation-based learning media with a sample of 30 students from class XI IPA 1. As shown in Figure 5, there is a noticeable difference in the average scores between the pre-test and post-test, increasing from 31.7 to 75.78.

The significant improvement in the average scores indicates the effectiveness of the animation-based learning media in enhancing students' understanding of the subject matter. The pre-test score of 31.7 suggests that students initially had limited knowledge or comprehension of the content. After the implementation of the animated videos as a learning tool, the average score rose dramatically to 75.78, reflecting a substantial gain in knowledge and understanding.

This result highlights the potential of visual and interactive learning aids in educational settings. Animated videos can capture students' attention more effectively than traditional teaching methods, making complex concepts easier to understand and retain. Moreover, this method can cater to various learning styles, particularly benefiting visual learners.

Student Learning Outcomes Analysis

Before calculating using the one-sample t-test, the pre-test and post-test data need to calculate the normality using SPSS. Calculating the normality is the main need for calculating one sample t-test.

Table 8. Students Pre-test and Post-test Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	.143	30	.123	.939	30	.083
Posttest	.178	30	.016	.932	30	.054

a. Lilliefors Significance Correction

Table 8 shows that the data taken is from Shapiro-Wilk because the sample is 30 students. The significance value of the pretest pre-test is 0.083, and the post-test is 0.054. Because the significance value used is 5%, 0.05, with the significant value of pre-test

and post-test greater than 0.05, it can be concluded that the student outcomes data is normally distributed. The calculation of the t-test is:

$$t = \frac{\sum d_i}{\sqrt{\frac{N \sum d_i^2 - (\sum d_i)^2}{N-1}}}$$

$$t = \frac{1319.97}{\sqrt{\frac{30 \cdot 1742320.8 - 1742320.8^2}{30-1}}}$$

$$t = \frac{1319.97}{\sqrt{\frac{97611.2121}{29}}}$$

$$t = \frac{1319.97}{\sqrt{3365.903866}}$$

$$t = \frac{58.01641031}{22.75166617}$$

The value of the t_{table} , from the table of the critical value of the T distribution, with a significance of $\alpha = 0.05$ and $df = 30-1 = 29$, is 2.045. Based on the formula's calculation, the t_{count} 's value is 22.75166617. The $t_{count} \geq t_{table}$; $22.75166617 \geq 2.045$, so the hypothesis H_a is accepted. It can be concluded that students' learning outcomes increased after using learning media based on animation videos in hydrocarbon learning. Because of this, the animation video in hydrocarbon learning is effectively used as a learning media.

CONCLUSION

Based on the results of research and data analysis in the development of learning media based on animation video in hydrocarbon material, it can be concluded that:

1. The results of the development of learning media based on an animated video in hydrocarbon material grade XI in senior high school were concluded valid based on experts' assessment, practical based on students' opinions and students' outcomes, and advisability based on validity instruments result from data, and the normality test and t-test for concluding hypothesis with H_a is accepted. With validity in material aspects, the average percentage was 84% as "Good," and the validity of material aspects with the average percentage was 91%.
2. In the data from the students' questionnaire, it can be seen that the student's responses about animation videos are Very good based on the results of the percentage level of students' questionnaire is 91%, with a range of 75% - 100% as a Very Good category.

In the data from the pre-test and post-test results, it can be seen that there is an increase in learning outcomes after the teaching treatment of the animation video as learning media in hydrocarbon materials. From these data, the average student score has

increased from the pre-test score, namely 31.7 to 75.78. With the hypothesis used in this research, H_a is accepted; the $t_{\text{count}} \geq t_{\text{table}}$; $22.751 \geq 2.045$. This research can conclude that students' learning outcomes increased after using learning media based on animation videos in hydrocarbon learning.

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