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Development of Google Sites-Based E-Learning Animation Video for Learning Atomic Theory

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A B S T R A C T

The rapid advancement of digital technology offers significant opportunities to develop innovative, interactive, and adaptive learning media that align with the learning characteristics of the 21st-century generation. This study aims to develop and evaluate animated video-based instructional materials on the topic of atomic theory development, integrated through Google Sites, and to determine their validity, practicality, and effectiveness. The research employed the Research and Development (R&D) method using the ADDIE model, which includes analysis, design, development, implementation, and evaluation stages. The study involved two subject matter experts, two media experts, two instructional practitioners, and tenth-grade students from SMAIT Istiqamah YPAIT Balikpapan. The validation results indicated a high level of feasibility with a score of 94.92% (very valid). Practicality assessments yielded scores of 90.73% from teachers (very practical) and 76.74% from students (practical). The effectiveness test demonstrated improved learning outcomes, with an N-Gain score of 0.70 (medium category) and an effect size of 3.71 (very strong category). These findings suggest that Google Sites-based animated video media effectively enhance students' conceptual understanding, motivation, and learning independence, making it a relevant and innovative alternative for digital-based chemistry learning.

1. Introduction

Education serves as a fundamental pillar in developing a competent, adaptive, and globally competitive workforce in the modern era. The swift advancement of information and communication technology has affected diverse spheres of human activity, education being no exception. The digitalization of learning is now a crucial strategy for making teaching and learning more engaging, interactive, and aligned with the characteristics of the 21st-century generation (Permana et al., 2024). The utilization of digital-based learning media not only functions as a learning aid, but has become an integral part in improving the effectiveness of learning at various levels of education.

In learning chemistry at the high school level, one of the challenging materials to understand is the development of atomic theory. This material covers the evolution of atomic models from Dalton's atomic model to quantum mechanics. Because it is abstract and cannot be observed directly, this concept is often difficult for learners to understand without the help of adequate visual media (Widodo, 2024; Stieff, 2019). Learning material on the development of atomic theory still relies heavily on the use of simple PowerPoint media that is static and less interactive. This results in insufficient learner engagement during instructional activities and poor academic performance (Nurramadhani et al., 2025).

Less interactive learning media in the atomic theory development material can hinder students' understanding. This indicates a need for innovation in technology-based learning media that offer greater interactivity and engagement. One of the media with great potential for development is animated videos. This media presents abstract material more concretely through a combination of visuals, audio, and movement, helping students more readily grasp the concepts being presented. The results showed that animation media contributed significantly to improving the comprehension of subject matter that was difficult to grasp solely through text or oral explanations (Astuti et al., 2021; Rahmawati et al., 2022). Moreover, the visual and dynamic qualities of learning videos are shown to improve learners' engagement and motivation during instruction (Hanif, 2020).

To maximize the accessibility and flexibility of the media, the animated video was developed in the Google Sites platform. Google Sites is a web-based service that allows teachers to organize teaching materials systematically and interactively. The platform also supports the integration of various media, such as videos, images, and practice questions, that can be accessed by students anytime and anywhere (Pamungkasih et al., 2024). Research by Bahari et al. (2023) shows that Google Sites is effective in increasing learners' learning engagement because it is easy to use and supports independent learning. In line with the results of these studies, the development of e-learning-based animated videos by utilizing Google Sites is believed to be one of the effective solutions in improving the quality of chemistry learning, especially on the material of the development of atomic theory. This media development aims to present abstract concepts in a more accessible way, encouraging students to learn independently in line with the characteristics of today's digital generation.

Based on the background above, this research develops Google Sites-based animated video learning media for the topic of atomic theory. The media is designed to increase motivation and help students understand abstract concepts through visual and interactive approaches. Google Sites provides flexible access and supports independent learning. The research covers the stages of design, development, and validation to ensure the resulting media is valid, practical, and effective. The objective of this research is to create and validate an innovative learning medium that can enhance student motivation, foster interactivity, and improve conceptual understanding in chemistry, particularly regarding the development of atomic theory.

2. Methodology

Types of Research

This type of research is an R&D (Research and Development) approach employing the ADDIE model, which includes the phases of Analysis, Design, Development, Implementation, and Evaluation. This research starts with conducting a needs assessment to determine the characteristics of the media needed, followed by designing storyboards and making animated videos integrated into Google Sites, and then testing the validity, practicality, and effectiveness of Google Sites-based animated videos. The ADDIE model was selected due to its structured approach and suitability for developing technology-based media development. Each phase is carried out sequentially and aims to ensure the media is effective. The analysis phase identifies problems and gathers information. The design phase plans objectives and content flow. The development phase produces and tests the media. Implementation and evaluation assess the quality and impact.

Research Subjects and Objects

The subjects in this research consisted of 2 material experts, 2 media experts, 2 chemistry teachers, and X grade students of SMAIT Istiqamah YPAIT Balikpapan. The research object is a Google Sites-based animated video learning medium that explores the development of atomic theory. Developed through the ADDIE model, it assesses the validity, practicality, and effectiveness. The involvement of experts ensures the media meets content and technical standards. Chemistry teachers provide curriculum feedback. Students assess practicality in class. The selection of subjects aims for a comprehensive evaluation.

Data Types and Sources

The data in this study includes qualitative and quantitative data. Qualitative data were obtained from observations, interviews, and expert and teacher responses regarding the needs and suitability of the media. Meanwhile, quantitative data includes validation scores, student response questionnaires, and pre-test and post-test results to measure the effectiveness of learning media. Combining both types allows for a thorough and objective analysis. Qualitative data explores user perceptions, while quantitative data provides measurable outcomes. This approach strengthens research validity.

Data Collection Technique

Data collection begins at the analysis stage with documentation studies, observations, interviews, and student needs questionnaires. At the design and development stage, validation questionnaires were given to experts and practitioners to assess the quality of the media quantitatively and qualitatively. During the implementation stage, pre-test and post-test are carried out to assess improvements in instructional activities, gauge the usability and acceptance of the media. Each instrument is chosen based on its suitability. Observations describe

classroom conditions. Interviews explore deeper insights. Questionnaires collect responses efficiently.

Data Analysis Technique

Subject matter specialists and media professionals conducted validation through a Likert-scale questionnaire using the formula, percentage = (score obtained / maximum score) × 100% and categorized according to Table 1. After the validation process, the practicality of the media was evaluated based on students' perceptions of accessibility, visual design, and usability (Fransisca et al., 2019). Practicality scores were calculated with the formula, percentage = (total score obtained / total score maximum) × 100%. The results were then classified into categories as shown in Table 2.

Table 1. Validity Level Categories

Validity Percentage (V) (%)	Categories
81< V ≤ 100	Very valid
61< V ≤ 80	Valid
41< V ≤ 60	Valid enough
21< V ≤ 40	Less valid
0< V ≤ 20	Invalid

Table 2. Practicality Level Categories

Practicality Percentage (P) (%)	Categories
81< P ≤ 100	Very practical
61< P ≤ 80	Practical
41< P ≤ 60	Practical enough
21< P ≤ 40	Less practical

The student response questionnaire was used to measure perceptions of the quality of learning received, specifically to explore aspects of ease, material relevance, and learning satisfaction. The questionnaire consisted of several indicators, including ease of access, attractive appearance, suitability of the material, increased interest in learning, and overall learning satisfaction. These indicators were designed to comprehensively capture students' experiences in using the developed learning media. In line with Galatsopoulou et al. (2022), students' perceptions are influenced by the quality of the content, the relevance of the material, and the media's contribution to the educational process. The questionnaire responses were then analyzed using Microsoft Excel with the formula: percentage = (score obtained / maximum score) × 100%. The results were then categorized based on these indicators to provide a clear overview of student acceptance and satisfaction with the media.

The percentage of activeness results is classified based on the range provided in Table 3, which serves to describe the level of teacher and student engagement during the implementation of the learning media. The impact of the media is assessed through an analysis of pre-test and post-test results to assess the improvement in student learning outcomes. The N-Gain formula used is: N-Gain = (posttest score - pretest score) / (maximum score - pretest score), and the results are

then interpreted using the N-Gain classification as shown in Table 4. This procedure refers to the study by Ariesta et al. (2019), which assessed improvements in learning outcomes within an e-learning environment.

Table 3. Categories of Teacher and Student Activities (Nurrahmadani et al., 2025).

Percentage of Teacher and Student Activities (A) (%)	Categories
$74.00 < A \leq 100$	Very good
$50.00 < A \leq 74.00$	Good
$24.00 < A \leq 50.00$	Simply
$0 < A \leq 24.00$	Less

Table 4. N-Gain Category

N-Gain Score (G)	Categories
$G > 0.70$	High
$0.30 < G \leq 0.70$	Medium
$G \leq 0.30$	Low

The significant improvement in learning outcomes was further analyzed by calculating the effect size using Microsoft Excel, with the interpretation of categories referring to Cohen's criteria (Nurrahmadhani et al., 2025). The formula used is: Effect size = (Average posttest – Average pretest) / (standard deviation pretest) × 100%. In addition, the results are interpreted according to the classification that can be seen in Table 5. In addition, the percentage of student and teacher responses was analyzed using Microsoft Excel and classified into four categories following the model proposed by Lu'luilmaknun et al. (2020), which is relevant for evaluating technology-based learning media. The formula used is, percentage = (total score of respondents / maximum number of scores) × 100%, and the interpretation of these categories can be seen in Table 6. This comprehensive approach ensures that both the effectiveness of learning outcomes and user perceptions are systematically evaluated.

Table 5. Effect Size Categories

Effect Size (d)	Categories
$d > 1.00$	Very Strong
$0.50 < d \leq 1.00$	Strong
$0.20 < d \leq 0.50$	Medium
$0 < d \leq 0.20$	Weak

Table 6. Categories of Teacher and Student Response Percentages

Response percentage (R) (%)	Categories
$R \geq 85.00$	Very positive
$70.00 < R \leq 85.00$	Positive
$50.00 \leq R < 70.00$	Less positive
$0 < 50.00$	Not positive

3. Results and Discussion

Results

Analysis Stage

The analysis stage began with observations and interviews that showed the need to develop interactive learning media to increase student enthusiasm for material on the development of atomic theory. Previously used media were still static in nature, making them less capable of visualizing abstract concepts interestingly. A literature review was conducted to identify the weaknesses of similar media that had been developed previously. The study revealed that the animated video media used had limitations, such as monotonous visuals, unclear navigation, and minimal integration with online platforms (Herrington & Sweeder, 2025). Based on these findings, an innovation was developed in the form of Google Sites-based animated videos that combine animation, audio narration, explanatory text, and interactive exercises, and can be accessed through various devices. A student needs analysis was conducted by distributing questionnaires to determine their preferences regarding media content and design. The results indicate that most students prefer media with dynamic visuals, clear audio, concise explanations, practical access, and interactive evaluation. The percentage of student needs analysis results is presented in Figure 1.

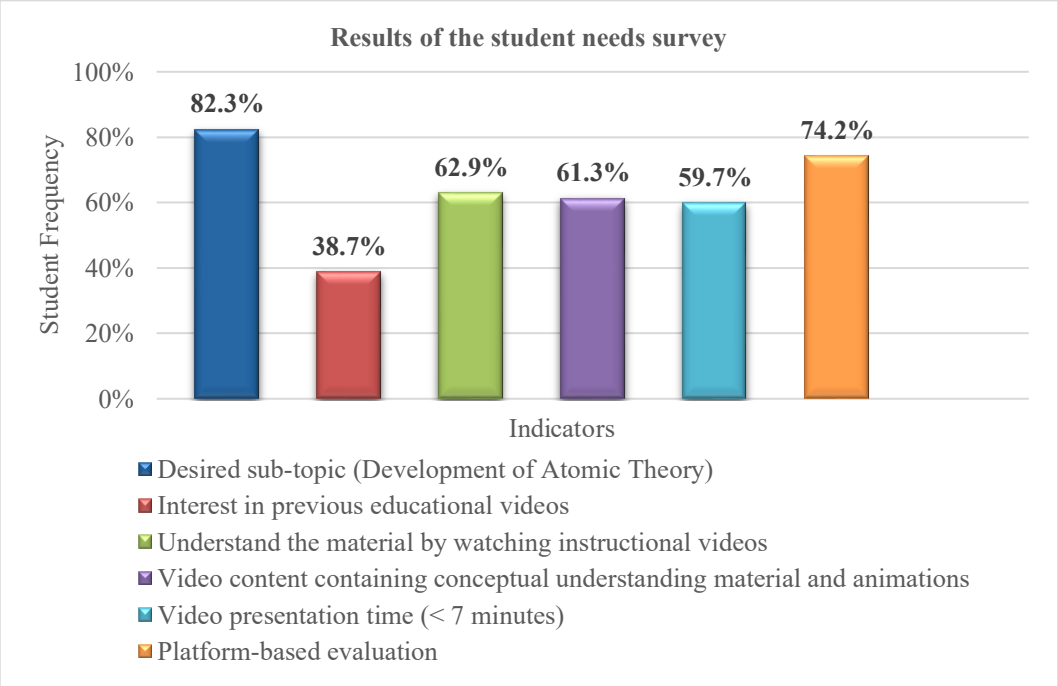

Figure 1. Results of student needs analysis

Based on the result of the needs analysis presented in Figure 1, it can be seen that 82.30% of respondents considered the development of atomic theory to be the most difficult material to understand because it is abstract and requires dynamic visual representation. These findings are consistent with those of Tepla et al. (2022), who

found that employing animation significantly enhances motivation and conceptual understanding in science education, including chemistry. Meanwhile, only 38.70% of students found the previous learning videos helpful, indicating that the media used remained static and uninteresting in visualizing concepts. A total of 62.90% of students stated that they found it easier to understand the material by watching instructional videos, indicating the need for appropriate audio-visual media. Furthermore, 61.30% of students prefer video content that includes explanations of concepts accompanied by animations, making complex material easier to understand. A total of 59.70% of students emphasized the importance of video presentation time being less than seven minutes because long durations reduce learning focus, and 74.20% of students suggested interactive platform-based evaluations such as Quizizz, which are considered more enjoyable and provide immediate feedback.

Design Stage

Based on the analysis results, interactive animated videos utilizing the Google Sites platform were chosen as the media for teaching content related to the progression of atomic theory. This selection was based on interviews with chemistry teachers who emphasized the need for media that could visualize abstract concepts clearly and attractively. The results of the student needs questionnaire also showed a desire for media that not only contained text but also included animations, images, and interactive online exercises. Google Sites was designed as an interactive web page to support the learning process, as shown in Figure 2. The material is presented through explanatory texts, animated videos, and interactive evaluation questions via Google Forms. The design process began with drafting materials in accordance with learning outcomes, creating animated videos using Canva and CapCut, and developing interactive questions that provided automatic feedback (Figure 3). The interface design focuses on consistent layout, colors, and typography. Thus, this media not only serves to present content in the form of text but also provides dynamic visuals, audio narration, and interactive features that can increase student motivation to learn.

Figure 2. Google Sites Website Home Page Display Animated Video

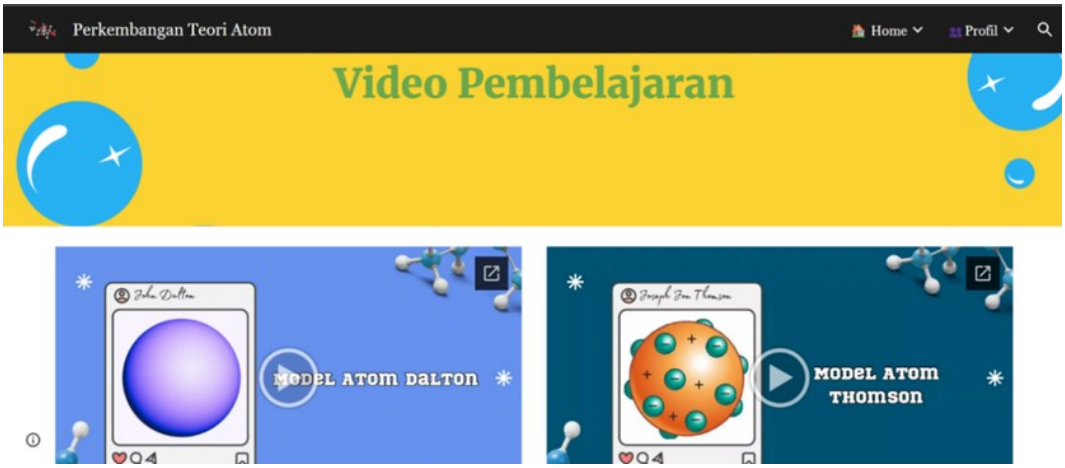

Figure 3. Front view of the learning video and Google Sites

Development Stage

Initial Product Development

The initial product developed was an interactive animated video learning media based on Google Sites on the subject of the Development of Atomic Theory. Development begins with drafting materials based on the learning outcomes that have been determined in the analysis stage. The material is packaged in the form of a storyboard that contains the sequence of content presentation, illustrations, text, and audio narration. Animated videos were created using Canva for visual design and CapCut for synchronizing animations, text, and narration audio. The animated video results were then integrated into Google Sites, which was designed with several main pages, namely the home page, learning outcomes, concept map, learning materials, interactive exercises, evaluation, bibliography, developer profiles, and closing remarks. Interactive exercises are created using Google Forms, which provide automatic feedback for each answer.

Expert Validation

The initial product that has been developed is then validated by six validators consisting of two subject matter experts, two media experts, and two learning practitioners. The aspects assessed include the suitability of the material content with the curriculum, clarity of presentation, visual and audio quality, ease of navigation, and media interactivity. Table 7 shows that the average validity percentage of the learning media reached 94.92%. Referring to the validity level criteria, this value falls into the highly valid category (81%–100%), indicating that the media is ready to be implemented in the field trial stage. During the validation process, media experts highlight the initial appearance, consistency in the use of colors and fonts, and audio quality that needs to be adjusted for greater clarity. Subject matter experts emphasize clarity of learning objectives, appropriateness of atomic illustrations, and alignment of narration with animated visualizations, while learning practitioners emphasize language comprehension, relevance of interactive exercises, and appeal of media in the classroom. After revisions were made based

on this feedback, the product was declared highly valid and ready to be implemented in learning.

Table 7. Results of Animation Video Expert Validation Test

Validation	Percentage score (%)	Category
Media expert	92.55	Very valid
Subject matter expert	96.44	Very valid
Learning practitioner	95.76	Very valid
Average (%)	94.92	Very valid

Implementation Stage

The animated video, which had been validated by the validator, was then tested in classes X-A and X-B at SMAIT Istiqamah YPAIT Balikpapan with 55 students on the subject of the Development of Atomic Theory (Figure 4). The trial was conducted twice a week, with each session lasting 2 x 45 minutes. This implementation aims to assess the practicality and effectiveness of Google Sites-based animated videos in improving students' understanding of the material on the development of atomic theory. In the implementation stage, learning activities began with a pre-test to measure initial understanding, followed by the use of the animated video during lessons, and ended with a post-test to assess learning gains.

Figure 4. Learning process using animated videos

The Practicality of Google Sites-based Animated Video

During the implementation phase, the practicality of animated videos in the Atomic Theory Development material was evaluated through questionnaires distributed to teachers and students and reinforced by observing learning activities. Details of the practicality assessment results for these media are presented in Table 8. Based on Table 8, Google Sites-based animated videos received a practicality rating of 90.73% from teachers and 76.74% from students, both of which are classified as practical. This demonstrates that the developed media offers user-friendly access, supports material delivery, and aligns well with students' learning characteristics, which are in line with the study by Tepla et al. (2022), confirming that interactive animation-based learning media improve ease of use, student engagement, and

learning effectiveness in the classroom. The data supporting the student practicality survey results are derived through monitoring of both teacher and student activities throughout the learning process. Based on the activity category (Table 3), the final scores for both teachers and students fell within the 74–100% range, indicating very good criteria. The observation percentages can be seen in Figure 5.

Table 8. Results of the Teacher and Student Practicality Questionnaire

Practicality Questionnaire	Percentage (%)	Category
Teacher	90.73	Very practical
Students	76.74	Practical

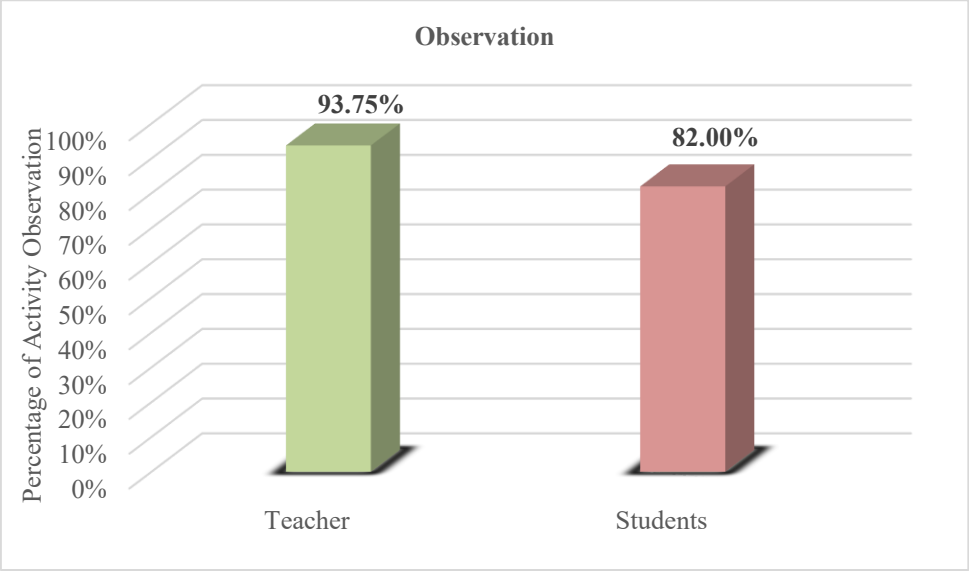

Figure 5. Results of observations of teacher and student activities

Effectiveness of Google Sites-based Animated Video

Student learning outcomes, measured through pre-tests and post-tests, were used to assess the effectiveness of the Google Sites-based animated videos developed. These scores are presented in Table 9. Table 9 demonstrates an improvement in students' achievement following the implementation of Google Sites-based animated videos, shifting from the very low category to the enough category. Effectiveness is assessed using N-Gain analysis. Before the N-Gain test is conducted, a prerequisite test of normality and homogeneity is first carried out using the Shapiro-Wilk test as a reference for decision-making.

Table 9. Average Written Test Scores of Students

Written test	Value	Category
Pre-test	30.68	Very low
Post-test	78.51	Enough

Normality Test and Homogeneity Test

The purpose of the normality test is to assess if the pretest and posttest data follow a normal distribution as a prerequisite for parametric analysis. The results of the Shapiro-Wilk normality test are presented in Table 10. Based on the test results in Table 10, the average pretest and posttest scores are normally distributed with a significance of > 0.05. These results indicate that the use of animated videos produces data that meets the assumption of normality, allowing the analysis to proceed to the homogeneity test stage. A homogeneity test was conducted to ensure that the pretest and posttest data had the same variance in both classes. Levene's Test was performed using SPSS software, with the results displayed in Table 11. These results indicate that the pretest and posttest scores for comprehension skills of students in classes X-A and X-B are homogeneous with a significance of > 0.05, so that testing can be continued with a t-test.

Table 10. Normality Test

Normality test (Shapiro-Wilk)			
Class	**N**	**Pretest**	**Posttest**
X-A	25	0.299	0.250
X-B	30	0.287	0.051
Description		Normal	Normal

Table 11. Homogeneity Test

Class	Data	Sig	Description
X-A	Pretest-Posttest	0.982	Homogeneous
X-B	Pretest-Posttest	0.086	Homogeneous

Paired Sample t-Test and N-Gain Test

The paired sample t-test was employed to assess the significance of the difference in learners' performance prior to and following the implementation of animated video instructional media. The t-test results are shown in Table 12. The data in Table 12 shows that the paired t-test results for classes X-A and X-B are 0.0001, which means ≤ 0.05, indicating a statistically significant difference in students' learning outcomes between the pretest and posttest; therefore, the analysis was continued with an N-Gain test and effect size. After significant differences were identified through t-tests, N-Gain analysis was conducted to measure students' level of conceptual understanding. The N-Gain value is calculated based on the average pretest and posttest results, as shown in Table 13. Table 13 shows an N-Gain value of 0.70, which is classified as medium. This indicates that animated video learning media can significantly enhance student learning outcomes, albeit with medium effectiveness.

Table 12. Paired t-test for classes X-A and X-B

Class	t-test		
	N	**df**	**Sig (2-tailed)**
X-A	25	24	0.0001
X-B	30	29	0.0001

Table 13. N-Gain Values

Result Learning	$\underline{X}$ pretest	$\underline{X}$ posttest	N-Gain
	30.68	78.51	0.70

Effect Size Test

In addition to employing N-Gain analysis, the effectiveness of the media was further examined using effect size calculations to assess the degree of its impact on enhancing students' academic achievement. The findings of these calculations are shown in Table 14. Table 14 shows an effect size of 3.71, placing it in the very strong category (d > 1.00) and signifying that the use of Google Sites-based animated video media has a substantial impact on enhancing learning outcomes.

Table 14. Effect Size Values

Result Learning	$\underline{X}$ pretest	$\underline{X}$ posttest	Std. Deviation pre	Effect Size
	30.68	78.51	12.43	3.71

In addition, student responses to the use of Google Sites-based animated videos in atomic theory development material show that this media is effective in training their comprehension skills, as evidenced by the findings from the student response questionnaire are presented in Figure 6, with descriptions A (Ease of understanding the material), B (Active participation in learning), C (Practicality and media features), and D (Student interest). Based on Table 6, the student response questionnaire regarding learning with Google Sites-based animated videos that have been implemented in the classroom shows that all indicators measured are in the positive category, with an average ease of understanding the material of 76.47%, activity in learning of 76.00%, practicality and media features of 76.52%, and student interest at 81.07%.

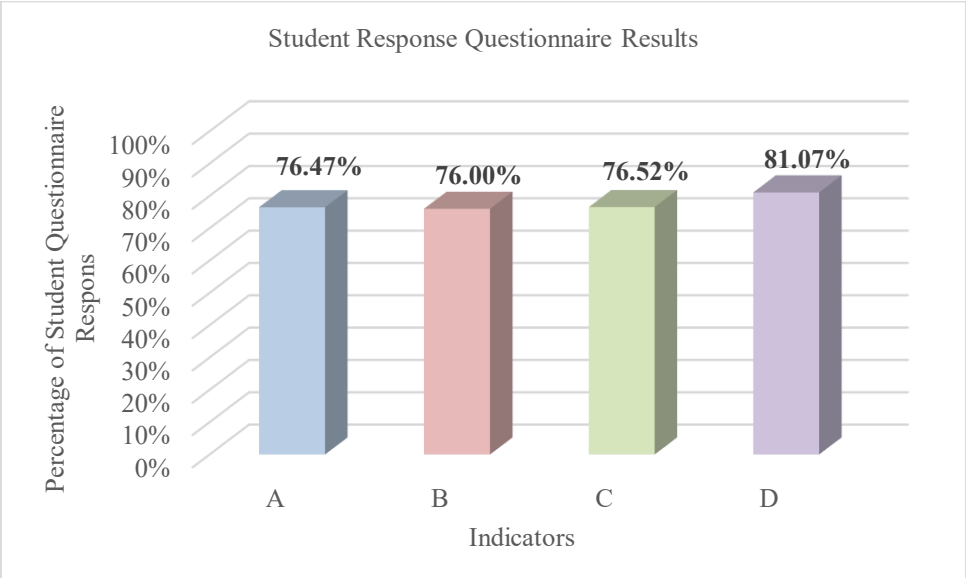

Figure 6. Results of Student Response Questionnaire Survey

Discussion

The development of animated video learning media utilizing Google Sites on the subject of atomic theory was carried out with the aim of improving students' understanding of abstract and difficult-to-visualize concepts. The material on the development of atomic theory encompasses concepts that demand high-level thinking skills, as students need to grasp the evolution of atomic models from Dalton to quantum mechanics, a process that can be confusing when presented solely through conventional methods. Animated video-based learning media was chosen because it can present clear visualizations of concepts, facilitate students' comprehension of the material, and increase motivation and engagement in learning (Tepla et al., 2022). In addition, Google Sites offers a flexible and accessible learning platform, allowing students to learn independently at any time and from anywhere. According to Bahari et al. (2023), integrating video and interactive evaluation in Google Sites can boost students' participation and reinforce their grasp of concepts via technology-based independent learning.

Based on the needs analysis and learning media results, we developed interactive animated videos packaged in Google Sites. The design stage includes planning content, visual appearance, and navigation flow in accordance with modern learning design principles. The material is divided into several video segments with a maximum duration of seven minutes to reduce the cognitive load on students, as recommended by the multimedia learning theory put forward by (Liu, 2025). In addition, Google Sites is designed with a consistent layout, contrasting colors, and clear navigation for ease of use. Interactive evaluations in the form of online quizzes are also integrated to provide immediate feedback, which, according to Rahim (2024), has been proven effective in increasing student engagement and conceptual understanding.

The development stage involved creating a storyboard that included visual sequences, text, and audio narration. The visual design was created using Canva, while the process of combining animation, text, and audio was done with CapCut. The selection of these applications is based on their ease of use and effectiveness in producing high-quality educational videos. According to Mulyono et al. (2025), Canva and CapCut are the right tools for developing learning media because they can enhance teachers' creativity in producing interesting content. Once the video is complete, the content is uploaded to Google Sites, which is designed to have a page structure consisting of a home page, learning outcomes, concept maps, materials, interactive exercises, and evaluations.

The developed product was then validated by six validators, comprising two subject matter experts, two media experts, and two learning practitioners. Validation is conducted to assess the suitability of content, visual quality, ease of navigation, and level of media interactivity. The validation results indicated a score of 94.92%, placing it in the highly valid category. Subject matter experts provided suggestions regarding a more systematic presentation of quantum mechanics concepts, while media experts recommended improvements in audio quality and design consistency. This validation process is consistent with the findings of Aris &

Mansor (2023), who assert that the involvement of multiple experts in media development guarantees the final product meets both pedagogical and technical standards before implementation.

The implementation phase was conducted with class X of SMAIT Istiqamah YPAIT Balikpapan, involving them in classroom activities utilizing the developed learning media. The lesson began with a pre-test to measure students' initial understanding, followed by the delivery of material through Google Sites, and ended with a post-test. Throughout the instructional period, the activities of teachers and students were observed. The results showed that teacher activity reached 93.75% and student activity reached 82.00%, both of which were classified as excellent. This shows that animated video-based learning media successfully increase student engagement during learning, in line with the findings of Kurniawati & Aini (2022), who stated that interactive media are capable of fostering a more engaging environment for learning and motivating students to participate.

In addition, the results of the practicality survey show that this media is considered very practical by teachers with a score of 90.73% and practical by students with a score of 76.74%. The average student response rate was 77.52%, which is considered very positive, indicating that this medium is easy to use and suits the needs of digital native students. This is in line with research by Bahri et al. (2024), which states that students' positive perceptions of digital media are influenced by ease of access and the relevance of content to the learning process. Furthermore, the practicality survey results reinforce that the integration of animated videos into classroom learning can support the implementation of technology-based instruction effectively.

The effectiveness evaluation was conducted through an analysis of the pre-test and post-test results. The N-Gain value obtained was 0.70, which is classified as medium, indicating an increase in student understanding after using the media. In addition, the effect size calculation produced a value of 3.71, which is classified as very strong. According to Nurrahmadhani et al. (2025), an effect size above 1.00 indicates that the media exerts a substantial influence on enhancing students' academic achievement. These findings are consistent with the study by Batamuliza et al. (2024), which reported that interactive media utilizing visual elements are able to substantially improve students' academic performance. A substantial effect size can greatly influence the learning process, leading to improved effectiveness of the learning outcomes (Olii et al., 2024).

Overall, the development of Google Sites-based animated videos has proven to be valid, practical, and effective. This media facilitates understanding of abstract concepts in the Development of Atomic Theory material through dynamic visualizations, clear audio narration, and interactivity, thereby increasing learning motivation and providing a more interactive learning experience. Google Sites support also provides flexible access, allowing students to study independently anytime, anywhere. With its effectiveness demonstrated through increased

motivation, learning outcomes, and student activity, this medium is recommended for chemistry and other science subjects that require concept visualization.

4. Conclusion

This study resulted in the successful development of animated video learning media using Google Sites for teaching atomic theory. Validation by content experts, media experts, teachers, and students confirmed that the media met educational and technical standards. The research showed that this media is valid, practical, and effective for high school chemistry learning. Both teachers and students found it easier to understand abstract concepts, such as the development of atomic theory, through visual and interactive learning. The animated videos not only improved students' comprehension but also increased their motivation and participation in class. Classroom implementation demonstrated that students could better visualize and master scientific concepts typically difficult to convey through conventional methods. Overall, the research objectives were achieved, and the developed media proved to be an innovative and successful solution for supporting conceptual understanding in chemistry. This study highlights the importance of integrating technology-based media in science education and shows that animated videos can significantly enhance the quality and outcomes of student learning.

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