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DEVELOPMENT OF GOOGLE SITES EQUIPPED WITH INSTRUCTIONAL VIDEOS TO IMPROVE UNDERSTANDING OF BASIC ELECTRONICS ENGINEERING

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Abstract

The use of technology-based learning media is needed to support the learning process in the Basic Electronics Engineering subject, particularly in the active and passive component elements. This study aims to develop interactive learning media integrated with Google Sites equipped with learning videos that motivate learning, as well as to determine the feasibility of the media, students' responses, the improvement of students' understanding, and the relationship between learning motivation and students' understanding. This research employed the Research and Development (R&D) method using the 4D development model. Media validation was conducted by three experts who assessed the aspects of media, material, test items, student response questionnaire instruments, and motivation questionnaire instruments. The results showed that the Google Sites-integrated interactive learning media was categorized as highly feasible for use in learning, with an average validation score of 3.80. Students' responses were in the very high category with an average score of 3.62. Students' understanding increased from an average pretest score of 53 to 86.53 in the posttest, with an N-Gain value of 0.69 in the medium category. In addition, there was a significant relationship between learning motivation and students' level of understanding, a significance value of 0.002 < 0.05, correlation coefficient of 0.503 indicating a positive relationship in the moderate category. However, in its implementation, there are limitations in the integration of the media, particularly in the use of Edpuzzle, resulting in suboptimal control over student interaction features. Therefore, future research is recommended to utilize other platforms, such as a Learning Management System (LMS), which can better support access control and interactivity.

Keywords:

Learning Media, Interactive, Google Sites, Learning Videos, Learning Motivation, Understanding

1. INTRODUCTION

In the digital era, the development of science and technology has had a significant impact on various aspects of life, including education. These conditions require learning processes that are able to adapt to the needs of the 21st century, such as digital literacy, critical thinking skills, communication, collaboration, and creativity. Therefore, the use of technology in learning has become important so that learning activities are more relevant to current developments. The use of technology is also expected to improve the quality of learning in schools more effectively and efficiently [1].

The use of technology in learning plays an important role in increasing students' motivation and understanding. Learning media not only functions as a tool for delivering material, but is also able to create a more interesting and interactive learning atmosphere according to students' characteristics. In addition, the application of technology can be a solution to differences in students' learning styles, whether visual, auditory, or kinesthetic. Thus, the learning process can take place more effectively, flexibly, and meaningfully for students [2], [3].

However, field conditions show that learning Basic Electronics Engineering at SMKN 1 Jetis still faces several obstacles. Students tend to have difficulty understanding abstract concepts such as active and passive components, Ohm's law, and resistance circuits because these materials require analytical skills and good conceptual understanding. Observation results indicate that most students are still passive during the learning process and lack confidence in answering questions. In addition, students still depend on their peers during group discussions [4]. The limitations of learning media and the lack of learning resources make the learning process still teacher-centered. Learning activities that only focus on theoretical explanations and summarizing assignments cause students' learning motivation to be low. These conditions indicate a gap between students' needs for interactive learning media and the conventional learning practices still implemented in the classroom. Therefore, innovation in learning media is needed to meet students' needs in the digital era [5].

Several previous studies have shown that Google Sites has the potential to be an effective digital learning medium. Google Sites has been proven to be valid, practical, and able to improve student learning outcomes in various subjects. In addition, Google Sites-based media is considered capable of improving vocational students' understanding because it can be accessed anytime and anywhere. These advantages make Google Sites feasible to be used as an alternative web-based learning medium [6], [7]. However, previous studies were still limited to presenting materials and simple evaluations. The integration of more comprehensive learning features such as interactive videos, virtual simulations, digital worksheets, and automatic quizzes in one platform has not been widely developed. Therefore, this study develops interactive media based on Google Sites equipped with learning videos, PhET simulations, digital worksheets, pre-tests, and post-tests in the subject of Basic Electronics Engineering. This development is expected to improve learning quality and student engagement in the learning process.

The objectives of this study are to determine the feasibility of the developed media. In addition, this study aims to identify students' responses to the use of the media in learning. This study also analyzes the improvement of students' understanding after using the media. Furthermore, this study examines the relationship between learning motivation and students' level of understanding.

2. LITERATUR REVIEW

Learning media are important components in the teaching and learning process because they function as intermediaries in delivering instructional messages from teachers to students. Effective learning media not only help explain material more clearly, but also increase students' attention, motivation, and

active participation during learning activities. In modern education, the role of learning media has expanded from conventional teaching aids into digital tools that support meaningful and student-centered learning experiences [8], [9]. The use of appropriate learning media can also help teachers create more efficient learning processes and improve students' learning outcomes in various subjects.

Interactive media are one form of digital learning media that enable two-way interaction between users and the system. Unlike passive media, interactive media allow students to control their learning process through navigation features, quizzes, simulations, and direct feedback. Interactive learning environments also support communication between teachers and students through discussion forums, comments, or online responses. These characteristics make interactive media effective in increasing engagement, independence, and conceptual understanding [10], [11]. The use of interactive media is highly relevant to vocational education because students require practical, visual, and contextual learning experiences. Through interactive features, students can learn independently while still receiving guidance through structured digital content. This condition encourages students to become more active participants rather than passive recipients of information. Therefore, interactive media are considered suitable for improving learning quality in technical and vocational subjects.

Among various digital platforms, Google Sites has strong potential as a web-based learning medium because it is easy to design, accessible anytime and anywhere, and does not require advanced programming skills. Teachers can integrate text, images, videos, documents, and external applications into one platform. Previous studies reported that Google Sites is valid, practical, and effective in improving student learning outcomes and motivation, especially in vocational education settings [12]. Another advantage of Google Sites is its flexibility in organizing learning materials in a structured manner. Teachers can design learning pages based on topics, competencies, or weekly meetings so that students can access materials systematically. In addition, the platform supports mobile access, allowing students to learn through smartphones or laptops according to their needs. This flexibility makes Google Sites suitable for blended and independent learning environments.

The effectiveness of web-based learning media can be improved through the integration of supporting tools such as instructional videos, simulations, worksheets, and online assessments. Learning videos are useful for explaining procedures and abstract concepts through audio-visual presentation, while interactive videos can improve students' motivation and engagement. Simulations such as PhET provide virtual experimentation opportunities that help students visualize scientific or technical concepts. In addition, platforms such as Google Forms, Quizizz, and Padlet can be used for formative assessment, gamified quizzes, and collaborative discussions [13], [14]. The integration of several tools into one learning platform creates a more complete learning ecosystem. Students can study theory, watch demonstrations, conduct virtual practice, answer quizzes, and discuss ideas in one place. Such integration reduces dependence on separate applications and improves the efficiency of the learning process. As a result, students are expected to experience more engaging and organized learning activities.

Learning motivation is an important factor influencing students' academic achievement and persistence in learning. According to the ARCS model, motivation can be increased when learning media are able to attract attention, provide relevance, build confidence, and create satisfaction. Therefore, interactive digital media that combine attractive visuals, active participation, and immediate feedback are highly relevant for increasing students' motivation [15]. Students with high learning motivation tend to show better concentration, stronger persistence, and greater willingness to solve learning problems. In contrast, low motivation often causes boredom, passivity, and poor academic performance. Therefore, teachers need to provide learning environments that stimulate students' curiosity and encourage active participation. The use of innovative media can become one strategy to strengthen students' internal and external motivation.

Understanding is a cognitive ability that goes beyond memorizing facts and involves interpreting, explaining, relating, and applying concepts. In Basic Electronics Engineering, students are expected to understand active and passive components, Ohm's law, Kirchhoff's law, and simple circuit analysis. However, these topics are often considered difficult because they require analytical skills and conceptual reasoning. Therefore, appropriate learning media are needed to help students understand abstract electronics concepts more effectively (Bloom et al., 1956). Improved conceptual understanding can be seen when students are able to explain principles in their own words, solve related problems, and apply concepts in new situations. In technical education, conceptual understanding is essential because it becomes the foundation for practical skills and troubleshooting abilities. Without proper understanding, students may only memorize formulas without knowing their application. Hence, learning media should support both theory comprehension and practical reasoning.

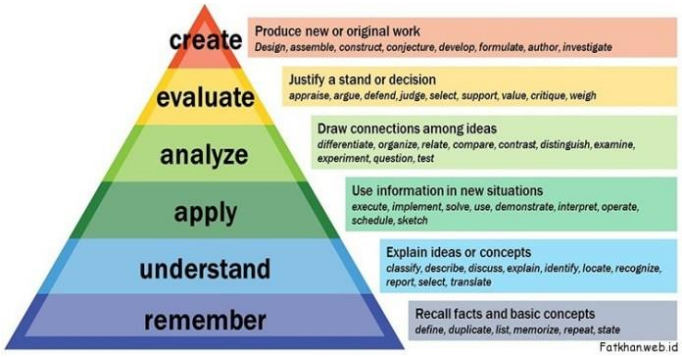

Fig.1. Taksonomi Bloom

Although previous studies have shown the effectiveness of Google Sites, learning videos, and interactive media separately, limited studies have integrated Google Sites with instructional videos, PhET simulations, worksheets, quizzes, and collaborative tools in one platform for Basic Electronics Engineering learning. Therefore, this study develops an integrated interactive learning medium to improve students' understanding and learning motivation. Such development is expected to provide a more innovative and comprehensive solution for vocational education learning needs.

3. METHODS

3.1 RESEARCH DESIGN AND PROCEDURES

This study employed a Research and Development (R&D) design to develop Google Sites learning media for improving student learning comprehension in Basic Electronics Engineering. The R&D approach was selected because it is appropriate for producing educational products through systematic stages of design, validation, revision, and implementation. According to Sugiyono [17], R&D is used to develop and test products in order to ensure their feasibility and effectiveness in educational settings. Therefore, this method was considered suitable for the objective of this study, namely developing interactive learning media integrated with Google Sites to improve students' comprehension of electronic concepts.

The development process adopted the 4D model proposed by [18], consisting of Define, Design, Develop, and Disseminate stages. However, the Disseminate stage was modified into a limited field implementation due to time and scope limitations. This modification is acceptable in educational development research [19].

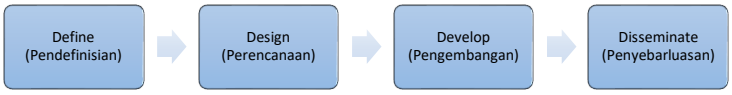

Fig.2. Development Model

The procedures of the study were carried out as follows:

3.1.1 Define Stage:

This stage aimed to identify learning problems, student characteristics, curriculum demands, and media needs. Preliminary observations showed that learning activities still relied on conventional teaching methods and static learning resources, resulting in limited student participation and low comprehension of abstract concepts in Basic Electronics Engineering. Student characteristics, prior knowledge, and learning difficulties were also analyzed. Curriculum analysis focused on Grade X competencies related to active and passive electronic components, Ohm's Law, Kirchhoff's Laws, and simple electrical circuits.

3.1.2 Design Stage:

At this stage, the initial prototype of the learning media was prepared. The researcher designed the structure of the Google Sites platform, page layouts, navigation systems, learning menus, and multimedia integration. Research instruments were also prepared, including validation sheets, student response questionnaires, and comprehension tests.

The prototype consisted of several menus, including homepage, learning materials, exercises, quizzes, worksheets, and simulations. Interactive features integrated into the media included Edpuzzle for instructional videos, Google Forms for exercises, and PhET/CircuitLab for circuit simulations.

3.1.3 Develop Stage:

The prototype was evaluated through expert validation and limited field testing. Material experts assessed content suitability, conceptual accuracy, and clarity of explanation. Media experts assessed interface design, navigation, usability, and interactivity. After receiving feedback, the product was revised to improve its quality.

The revised product was then implemented in a limited field trial to determine its practicality and effectiveness in improving student learning comprehension. Student responses were collected after using the developed media.

3.1.4 Disseminate Stage Modification:

The original Disseminate stage was not conducted on a large scale. Instead, the final stage was limited to classroom implementation and product evaluation because of research limitations in time, cost, and scope.

3.2 DATA COLLECTION AND INSTRUMENT

Both quantitative and qualitative data were collected in this study. Quantitative data were obtained from validation scores, student response questionnaires, and comprehension test results. Qualitative data were obtained from classroom observations, interviews, documentation, and expert suggestions. The data collection techniques and instruments were as follows:

3.2.1 Observation:

Observation was conducted to identify initial classroom conditions, learning problems, and existing instructional media used in Basic Electronics Engineering classes.

3.2.2 Expert Validation:

Validation sheets were used by material experts and media experts to evaluate the feasibility of the developed Google Sites learning media in terms of content, design, usability, and learning suitability.

3.2.3 Student Response Questionnaire:

Questionnaires were distributed after implementation to identify student perceptions of the developed media regarding ease of use, usefulness, attractiveness, and learning support.

3.2.4 Comprehension Test (Pre-test and Post-test):

Tests were administered before and after the implementation of the media to measure improvement in student learning comprehension. The tests covered active and passive electronic components, Ohm's Law, Kirchhoff's Laws, and basic circuit analysis. All questionnaire instruments used a four-point Likert scale ranging from strongly disagree to strongly agree.

3.3 DATA ANALYS

3.3.1 Descriptive Statistics:

Validation results from media experts, material experts, and student response questionnaires were analyzed using mean scores and then converted into feasibility categories. Higher scores indicated that the developed learning media was valid, practical, and suitable for implementation in classroom learning. Descriptive statistics were also used to summarize students' responses toward the usability, attractiveness, and effectiveness of the media.

3.3.2 Learning Comprehension Improvement:

The improvement of students' learning comprehension was analyzed using the normalized gain (N-Gain) formula proposed by [20], based on pre-test and post-test scores. N-Gain values

were interpreted into high, medium, or low improvement categories. The developed media was considered effective if the improvement reached medium or high categories. This analysis was used to measure the extent to which students' understanding increased after using the interactive learning media.

3.3.3 Prerequisite Tests:

Prerequisite tests were conducted to ensure that the data met the statistical assumptions required for correlation analysis. Normality testing was performed using the Shapiro–Wilk test to determine whether the data were normally distributed. The data were considered normally distributed if the significance value (Sig.) was greater than 0.05. Linearity testing was conducted to examine whether the relationship between learning motivation and students' comprehension was linear. This test was carried out using ANOVA analysis. The relationship was considered linear if the significance value of Linearity was less than 0.05 and the significance value of Deviation from Linearity was greater than 0.05.

3.3.4 Correlation Analysis of Learning Motivation and Comprehension:

Correlation analysis was conducted to determine the direction and strength of the relationship between students' learning motivation and their comprehension of Basic Electronics Engineering concepts. The data analyzed consisted of students' motivation questionnaire scores and post-test comprehension scores. Because the data did not meet the normality assumption, the Spearman's rho correlation test was applied using SPSS software. The correlation coefficient was interpreted based on [17].

Table.1. Value interpretation criteria

Interval Coefficient	Level
0,00 – 0,199	Very low
0,20 – 0,399	low
0,40 – 0,599	Moderate
0,60 – 0,799	Strong
0,80 – 1,000	Very Strong

If the significance value < than 0.05, the relationship between learning motivation and comprehension was considered statistically significant.

4. RESULT AND DISCUSSION

This study produced an interactive learning media based on Google Sites called El-learn (Electrical Learning), designed to support the learning of Basic Electronics Engineering. The media integrates learning materials, interactive videos, exercises, quizzes, worksheets (LKPD), and PhET-based simulations to enhance students' understanding and engagement.

4.1 FEASIBILITY OF LEARNING MEDIA

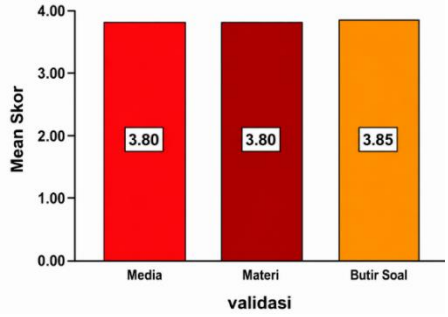

Fig.3. Chart bar of validation results

As shown in Fig.3, the validation results show that the developed course material achieved an average score of 3.80, classified as very valid. Content validation also achieved an average score of 3.80, while test item validation achieved a score of 3.85, also classified as very valid. These results indicate that the course material meets the requirements of design, educational relevance, and usability.

The high scores indicate that the integration of different learning components into a single platform was positively evaluated by the experts. This course material combines content, interactive videos, PhET simulations, worksheets, and quizzes, allowing students to access diverse learning resources through a single platform. This integration promotes independent learning and classroom activities in a stimulating environment, reducing the need to switch between applications. Furthermore, the inclusion of PhET simulations helps students visualize basic abstract concepts in electronics engineering, such as electrical circuits and current flow, making the learning process more meaningful and engaging.

These findings are consistent with those of Saski and Sudarwanto [21], who state that the viability of educational media is determined by their practicality and technical feasibility. If the developed media meet these criteria, it indicates their suitability for implementation in the learning process. However, despite high validation rates, the media still depend on internet connectivity and access to digital devices, which may limit their implementation in schools with inadequate technological infrastructure. Therefore, future development could focus on increasing accessibility and extending the media to broader educational contexts.

4.2 STUDENT RESPONSE TO THE MEDIA

Students' responses were analyzed using the Technology Acceptance Model (TAM), which includes perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention to use.The results show an average score of 3.62, categorized as very high. The highest score (3.88) was found in indicators related to display clarity, learning enjoyment, and intention to reuse the media, while the lowest score (3.41) remained within a good category.

The average scores for each TAM aspect are presented in Fig.4. The results show consistently high scores across all aspects, ranging from 3.58 to 3.66. Perceived usefulness obtained the highest average score (3.66), followed by attitude toward using (3.64), behavioral intention to use (3.61), and perceived ease of use (3.58). The relatively small differences among the four aspects indicate that students perceived the developed media positively in terms of usefulness, ease of use, attitude, and intention to continue using it.

High scores in interface clarity, learning enjoyment, and intent to reuse multimedia content suggest that the integration of various learning resources into Google Sites has successfully created an engaging and interactive learning environment. Although perceived ease of use obtained the lowest average score among the TAM aspects, the score remained within the very high category. This suggests that the media was generally easy to use, although some students may have benefited from additional guidance when using certain features, particularly those involving simulations and online learning activities.

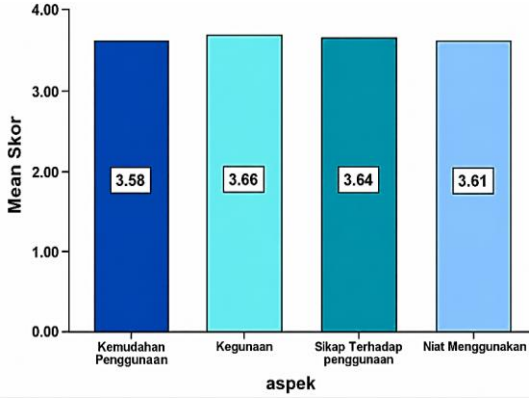

Fig.4. Student Response to the Media Result

4.3 IMPROVEMENT OF STUDENTS' UNDERSTANDING

The improvement in students' understanding was analyzed using a One Group Pretest-Posttest design. The results show that the average pretest score was 53, while the average posttest score increased to 86.53. The average N-Gain value obtained was 0.69, which falls into the moderate (tending to high) category. To measure the level of improvement, the Normalized Gain (N-Gain) was calculated as follows:

$$g=(post_{test}-pre_{test})/(maximum-pre_{test}) \quad (1)$$

The substantial increase between pretest and posttest scores indicates that the developed teaching materials positively contributed to students' understanding of basic electrical engineering concepts. This improvement can be attributed to the integration of teaching materials, interactive videos, PhET simulations, worksheets, and quizzes, which provide students with multiple opportunities to explore and consolidate concepts. In particular, simulations help visualize abstract concepts such as electrical circuits, current flow, and component behavior, allowing students to connect theoretical explanations with practical representations.

This finding is supported [7], who reported that technology-based learning media can create interactive learning environments and improve student learning outcomes. The findings suggest that the developed media facilitate active learning and support conceptual understanding rather than relying solely on memorization. However, the improvement should be interpreted with caution as the study used a single-group pretest-posttest design with no control group. Therefore, factors other than the intervention may have contributed to the observed learning improvements. Future studies using experimental designs and larger samples are recommended to provide more robust evidence on the effectiveness of the developed media.

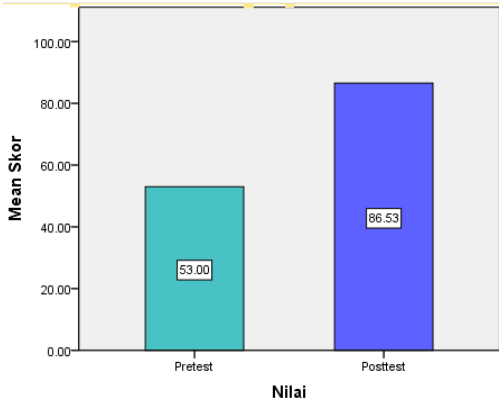

Fig.5. Comprehension value comparison

4.4 CORRELATION LEARNING MOTIVATION WITH UNDERSTANDING

The analysis shows that students' learning motivation falls into the very high category, with an average score of 3.89. The breakdown of scores by aspect is presented in Fig.6. Both intrinsic and extrinsic motivation were categorized as very high, indicating that the developed media was able to support students' internal interest as well as external encouragement to learn. The results of the Spearman Rho correlation analysis are presented in Fig.7. The Spearman Rho correlation test reveals a correlation coefficient of 0.503 with a significance value of 0.002 < 0.05, indicating a moderate positive and significant relationship between learning motivation and students' understanding.

Students with greater learning motivation tend to achieve better conceptual understanding. Motivated students are generally more willing to interact with learning materials, complete learning activities, explore simulations, and actively participate in the learning process. The interactive features embedded in the developed media, such as videos, quizzes, worksheets, and PhET simulations, may help maintain student interest and encourage active participation in learning activities, which could support conceptual understanding.

This finding is consistent with Hikmah and Saputra [22], who also found a significant relationship between learning motivation and students' comprehension. However, the correlation identified in this study should not be interpreted as a direct causal relationship. Other factors, such as prior knowledge, learning strategies, and technological skills, may also influence students' understanding. Therefore, future studies are recommended to investigate additional variables that may contribute to learning outcomes in technology-supported learning environments. Therefore, future studies are recommended to investigate additional variables that may contribute to learning outcomes in technology-supported learning environments [22].

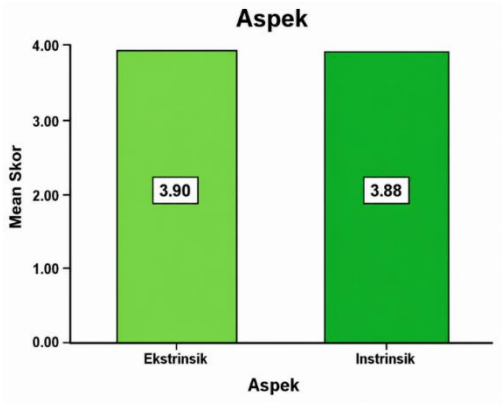

Fig.6. Score results for motivation aspect

Nonparametric Correlations

Correlations

			Motivasi	Pemahaman
Spearman's rho	Motivasi	Correlation Coefficient	1.000	.503**
		Sig. (2-tailed)	.	.002
		N	34	34
	Pemahaman	Correlation Coefficient	.503**	1.000
		Sig. (2-tailed)	.002	.
		N	34	34

**. Correlation is significant at the 0.01 level (2-tailed).

Fig.7. Correlation results

5. CONCLUSION AND RECCOMENDATIONS

Based on the results and discussion, the developed Google Sites-based interactive learning media is proven to be highly feasible, well-accepted, and effective in improving students' understanding of Basic Electronics Engineering. The feasibility aspect is indicated by the average validation score of 3.80, confirming that the media meets the required standards in terms of design, content, and usability. In addition, students' responses show a very high level of acceptance, with an average score of 3.62, indicating that the media provides a positive and meaningful learning experience.

The effectiveness of the media is reflected in the improvement of learning outcomes, as shown by the increase in average scores from 53 (pretest) to 86.53 (posttest), with an N-Gain value of 0.69, categorized as moderate. Furthermore, a significant positive relationship was found between learning motivation and students' understanding, with a correlation coefficient of 0.503 and a significance value of $0.002 < 0.05$. These findings indicate that the integration of interactive learning media can enhance both students' motivation and conceptual understanding.

This study has several limitations. First, the research was conducted using a small sample consisting of students from only one class in a vocational school. Second, the effectiveness of the interactive learning media was evaluated only on the topic of active and passive electronic components and was implemented over a relatively short period of four days. Third, some learning activities relied on external platforms, such as Edpuzzle, which provided limited control over student access and monitoring of learning activities. Therefore, the findings of this study should be interpreted within the context of these limitations.

Recommendation For teachers, it is recommended to utilize Google Sites-based interactive learning media integrated with videos, simulations, and quizzes as an alternative approach in teaching Basic Electronics Engineering or related subjects, as it can enhance students' motivation and support better understanding.

For schools, it is recommended to support the implementation of technology-based learning by facilitating the use of digital learning media and encouraging the integration of interactive tools to enhance the overall learning process.

For future research, it is suggested to involve a larger sample size and explore alternative platforms for developing interactive learning media, particularly those that provide better control over student access and activity monitoring in video-based learning tools such as Edpuzzle. Additionally, future studies may apply similar media to different topics or subjects to obtain more comprehensive findings.

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