




Development of Sites Google Learning Media to Improve Student Learning Comprehension

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ARTICLE INFO	ABSTRACT
<p>Artikel History: Received: 07 December 2025 Revised: 20 January 2026 Published: 30 January 2026</p> <p>Keywords: Learning Media, Google Sites, Research & Development, Student understanding.</p>	<p>Objective: This study aimed to develop Google Sites-based learning media for Basic Electronics Engineering, focusing on active and passive components, and to evaluate their feasibility and impact on student comprehension. The research was guided by three questions: (1) How is the media developed? (2) How feasible is it? (3) Does it improve comprehension? Method: The Research and Development (R&D) approach utilized the 4D model (Define, Design, Develop, Disseminate), with dissemination limited to a field trial. Three experts, including two lecturers and one vocational teacher, validated the media, materials, and test items using a 1–4 Likert scale. The media was implemented with 34 Grade X students from SMK Negeri 1 Jetis, Mojokerto. Student comprehension was assessed using a validated 20-item multiple-choice pretest and post-test. Results: The developed media, named El-Learn, was highly feasible (mean validation score = 3.80/4.00 or 95%). Student comprehension improved significantly from a pretest mean of 53.00 to 86.53 (N=34), with an N-Gain of 0.69, showing moderate improvement and approaching the high threshold of 0.70. Conclusion: The Google Sites-based learning media was highly feasible and enhanced comprehension of abstract electronics concepts in vocational education. Limitations of the study include the use of a one-group pretest-posttest design and implementation at a single school. Future research should incorporate control groups, larger sample sizes, and additional vocational subjects.</p>
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INTRODUCTION

The progression of the Industrial Revolution 4.0, marked by digitalization and the widespread adoption of electronic technology, has significantly influenced the educational sector. Institutions that fail to adapt to these technological advancements risk falling behind (Amelia, 2023). Consequently, educational systems must adjust and innovate to align with these changes (Maritsa et al., 2021). Creative and innovative development of learning media is essential to support technology integration in education. Effective implementation requires curriculum integration, sufficient infrastructure, and ongoing teacher training. These measures enable students to participate in interactive learning accessible at any time and from any location (Budiman et al., 2019).

The development of this learning media is based on Mayer's Cognitive Theory of Multimedia Learning (2009), which asserts that learners achieve deeper conceptual understanding when information is delivered through both verbal and visual channels rather than solely through words. This theoretical framework is especially pertinent to vocational education, where abstract electronics concepts such as Ohm's Law and Kirchhoff's Laws require visualization for effective comprehension. Integrating text, instructional videos (Edpuzzle), interactive simulations (PhET), and quizzes within a unified Google Sites platform reduces cognitive load and fosters meaningful learning. This approach aligns with technology-enhanced learning, which prioritizes multimedia integration to improve learner engagement and instructional clarity (Mayer, 2009).

Learning activities in Basic Electronics Engineering at vocational high schools continue to face challenges, particularly in active and passive electronic components, which require a strong conceptual understanding. Observations of 34 Grade X students at SMK Negeri 1 Jetis indicated that only 6 students (17.6%) could independently and accurately answer questions related to Ohm's Law. In contrast, 22 students (64.7%) remained passive, awaiting peers' responses, while 6 students (17.6%) were reluctant to participate in class discussions. These results suggest persistent difficulties in grasping abstract electronics concepts and applying them to problem-solving contexts. This observation aligns with findings by Raothao, Maneewan, and Sunan (2023), who reported that online web-based instruction using Google Sites effectively addressed learning challenges in electronic devices and circuits among vocational students in Thailand. Similarly, Wahyudianto et al. (2025) demonstrated that interactive learning media significantly enhanced learner engagement and conceptual clarity in Fundamentals of Electronics Engineering.

A further challenge identified in this study is the limited availability of learning media and instructional resources, including a shortage of textbooks, which diminishes classroom learning effectiveness. Additionally, students reported decreased motivation when instruction relied primarily on theoretical explanations and note-taking, with little practical activity. This gap between students' need for interactive learning media to comprehend abstract concepts and the continued use of conventional teaching methods in schools persists (Ramadhani et al., 2023). Accordingly, this study aims to provide interactive digital media that addresses these learning barriers and supports the Ministry of Education's technology-integrated learning transformation.

Developing interactive learning media integrated with Google Sites offers a viable solution. Google Sites was chosen for several reasons: it is free and accessible on multiple devices without requiring additional installation; it integrates seamlessly with Google services such as Google Forms, YouTube, and Google Drive; it supports embedding interactive content including instructional videos (Edpuzzle), simulations (PhET), and quizzes; and it is user-friendly for both teachers and students. In addition to serving as a platform for material delivery, Google Sites provides an accessible learning resource beyond classroom hours (Raothao et al., 2023). Interactive media facilitate two-way communication, enabling students to respond, receive feedback, and engage actively through features such as learning videos, quizzes, and simulations (Hirzi & Ibrahim, 2025). Instructional videos have been shown to increase student engagement and improve comprehension (Biantoro, 2024). Prior research has demonstrated the strong potential of Google

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Sites as a learning medium. For example, Sapiro et al. (2025) reported that a Google Sites-based module significantly enhanced higher-order thinking skills among vocational students, with an average N-Gain of 0.80 and pretest-posttest scores rising from 52.72 to 90.52. Manuswongkarn and Thamrongkunanant (2024) found that flipped classroom activities on Google Sites improved analytical thinking skills in DC circuit construction, with students in the experimental group outperforming those in the control group ($p < 0.05$). Ariyanto & Prakoso (2024) also observed improved comprehension among vocational students using Google Sites-based media. Similarly, Yolanda Saputra, & Effendi, (2021) reported that Google Sites used in the Electric Motor Installation subject was highly valid (88.81%), highly practical (91.10%), and effective in improving learning outcomes, with an average score of 85%. However, research specifically addressing abstract electronic concepts supported by simulations and quizzes remains limited.

The Research and Development (R&D) model is considered an appropriate approach because it enables products to be tested, validated, and refined based on user needs before implementation. Prayitno & Hidayati (2021) highlighted the importance of needs analysis in media development to ensure product effectiveness and relevance. Employing the R&D approach ensures that the resulting interactive media not only serves as an additional learning tool but also enhances learning quality and strengthens the digital competencies of both teachers and students.

The novelty of this research is the development of interactive Google Sites learning media specifically tailored for the Basic Electronics Engineering subject, with a focus on active and passive electronic components. This study integrates a range of features into a single platform, including interactive videos (Edpuzzle), concept simulations (PhET), student worksheets, and pre- and post-test evaluations. This comprehensive integration enhances the focus, practicality, and effectiveness of the media for Grade X. Based on the preceding background, the research questions are as follows: (1) How is Google Sites learning media developed for Basic Electronics Engineering subjects? (2) How feasible is the developed Google Sites learning media for use in Basic Electronics Engineering instruction? (3) How does the developed Google Sites learning media enhance students' comprehension in Basic Electronics Engineering, particularly regarding active and passive electronic components? electronic components?

METHOD

Research Design and Procedures

A Research and Development (R&D) design was employed to develop Google Sites-based learning media to enhance students' comprehension of Basic Electronics Engineering. The R&D approach was selected for its suitability to producing educational products through systematic stages of design, validation, revision, and implementation. According to Sugiyono (2013), R&D is utilized to develop and test products to ensure their feasibility and effectiveness in educational contexts. Similarly, Gall, Gall, and Borg (2003) state that R&D in education is a systematic process involving the design, development, and evaluation of products to address specific needs. Consequently, this method aligns with the objective of developing interactive learning media integrated with Google Sites to improve students' understanding of electronic concepts.

The development process followed the 4D model introduced by Thiagarajan, Semmel, and Semmel (1974), which includes the Define, Design, Develop, and Disseminate stages. In this study, the Disseminate stage was adapted to a limited field implementation due to time and scope constraints. Such modifications are recognized as acceptable within educational development research (Rahmi et al., 2021).

Table 1. Stages of the 4D Development Model

Stage	Activities	Outputs
Define	Problem identification, student characteristics analysis, curriculum analysis, media needs analysis	Needs assessment report; learning objectives; material scope
Design	Google Sites structure design, page layout, navigation system, learning menus, multimedia integration, instrument preparation	Initial prototype; validation sheets; questionnaires; comprehension tests
Develop	Expert validation, product revision, limited field trial, student response collection	Validated and revised product; feasibility data; practicality data
Disseminate	Limited classroom implementation and product evaluation	Final product; effectiveness data

Population and Sample

The study population comprised all Grade X students enrolled in electronics-related vocational programs at SMK Negeri 1 Jetis, Mojokerto, specifically those in Audio Video Engineering (TAV) and Industrial Electronics Engineering (TEI). The sample comprised Grade X students from the Audio Video Engineering (TAV) program, selected through purposive sampling. The selection was based on the following criteria: (1) the TAV class schedule for Basic Electronics Engineering subjects aligned with the developed materials; (2) students had access to devices such as smartphones or computers to utilize the Google Sites media; and (3) students expressed willingness to participate. The Industrial Electronics Engineering (TEI) class was excluded due to scheduling misalignment with the developed materials. A total of 34 students participated in the limited field trial. This sample size aligns with recommendations for limited trials in development research, as Sugiyono (2013) suggests that such trials may involve 20–50 respondents.

Data Collection and Instruments

This study collected both quantitative and qualitative data. Quantitative data were obtained from validation scores, student response questionnaires, and comprehension test results. Qualitative data were derived from classroom observations, interviews, documentation, and expert recommendations.

Table 2. Data Sources and Instruments

Data Type	Source	Instrument	Purpose
Quantitative	Validators (3 experts)	Validation sheets	Assess media feasibility
Quantitative	Students (N=34)	Response questionnaire	Assess practicality
Quantitative	Students (N=34)	Comprehension test (pretest-posttest)	Measure improvement
Qualitative	Classroom	Observation sheets	Identify initial conditions
Qualitative	Validators	Expert suggestions	Improve product quality
Qualitative	Documents	Documentation	Support findings

The data collection techniques and instruments were as follows:

1. Observation

Observations were conducted to identify classroom conditions, learning challenges, and the instructional media utilized in Basic Electronics Engineering classes. Three separate observations were completed prior to media development to ensure the product addressed authentic classroom needs.

2. Expert Validation

Material and media experts evaluated the feasibility of the developed Google Sites learning media using validation sheets that addressed content, design, usability, and learning suitability. The validation involved three experts: two university lecturers and one vocational school teacher. Each expert assessed the media using a 1–4 Likert scale across multiple criteria. This validation process is consistent with the recommendations of Gall et al. (2003), who emphasize that expert validation is essential in product development to ensure quality, relevance, and alignment with classroom needs.

Table 3. Validation Aspects and Indicators

Aspect	Indicators	Number of Items
Design Media	Visual design, layout, colours, typography, navigation, interface, interactivity	6
Instructional Suitability	Content relevance, learning objectives alignment, material organisation, clarity of instructions	5
Media Usability	Ease of access, ease of operation, flexibility, accessibility across devices	4

3. Student Response Questionnaire

Following implementation, questionnaires were distributed to evaluate students' perceptions of the developed media on ease of use, usefulness, attractiveness, and learning support. The instrument was adapted from the Technology Acceptance Model (TAM), a framework validated in numerous studies. The measured aspects included perceived usefulness, perceived ease of use, attitude toward usage, and behavioral intention to reuse (Davis, 1989).

Table 4. Student Response Questionnaire Aspects

Aspect	Indicators	Number of Items
Ease of Use	Ease of access, ease of navigation, clarity of instructions	4
Usefulness	Benefits for learning, support for understanding, effectiveness	4
Attitude toward Use	Interest, enjoyment, engagement	3
Intention to Reuse	Willingness to use again, recommendation to others	3

4. Comprehension Test (Pre-test and Post-test)

Pre- and post-tests were administered to assess improvements in students' comprehension following the implementation of the media. The tests addressed topics such as active and passive electronic components, Ohm's Law, Kirchhoff's Laws, and basic circuit analysis. The assessment instrument comprised 20 validated multiple-choice questions, developed in accordance with

curriculum-based learning indicators. All questionnaire items utilized a four-point Likert scale ranging from strongly disagree to strongly agree. The scoring for the scale was as follows:

Table 5. Likert Scale Scoring

No	Response	Score
1	Strongly Agree / Very Good	4
2	Agree / Good	3
3	Disagree / Poor	2
4	Strongly Disagree / Very Poor	1

Validity and Reliability of Instruments

Three experts, including two university lecturers and one vocational school teacher, assessed the instruments for content validity by evaluating the relevance, clarity, and appropriateness of each item. The Content Validity Index (CVI) for the comprehension test was calculated and yielded a value of 0.85, indicating high content validity. Following expert feedback, four items were revised to improve wording and answer choices, and two items were replaced due to inconsistency with the learning indicators.

The reliability of the comprehension test was evaluated using Cronbach's Alpha following a pilot test with 20 students who were not part of the main sample. The resulting reliability coefficient was $\alpha = 0.82$, indicating high reliability. For the student response questionnaire, the reliability coefficient was $\alpha = 0.85$, which is considered very high. The validation sheets were not subjected to reliability testing because they function as judgmental instruments based on expert assessment.

Table 6. Instrument Validity and Reliability Summary

Instrument	Validators	CVI	Cronbach's Alpha	Category
Comprehension Test	3 experts	0.85	0.82	High/Reliable
Student Response Questionnaire	3 experts	-	0.85	Very High/Reliable
Validation Sheets	3 experts	-	-	Judgmental (not tested)

Data Analysis

1. Descriptive Statistics

Validation results and student response questionnaire data were analyzed by calculating mean scores, which were subsequently classified into feasibility categories. The interpretation categories were determined according to the following criteria:

Table 7. Feasibility Interpretation Criteria

No	Score Range	Category
1	3.26 – 4.00	Very Feasible / Very Good
2	2.51 – 3.25	Feasible / Good
3	1.76 – 2.50	Less Feasible / Poor
4	1.00 – 1.75	Very Less Feasible / Very Poor

High scores indicated that the developed media was valid and practical for classroom use.

2. Learning Comprehension Improvement

Student comprehension improvement was evaluated using the normalized gain (N-Gain) formula, as proposed by Hake (1998), and calculated from pre-test and post-test scores.

Table 8. N-Gain Interpretation Criteria

No	Score Range	Category
1	$g \geq 0.70$	High
2	$0.30 \leq g < 0.70$	Medium
3	$g < 0.30$	Low

The instructional media were deemed effective if the improvement corresponded to the medium or high categories. This criterion is consistent with established practices in educational research for evaluating instructional interventions.

3. Qualitative Analysis

Qualitative data from observations and expert suggestions were analyzed using the interactive model of Miles, Huberman, and Saldaña (2014), which consists of three stages: (1) data reduction, which involves selecting and focusing raw data from observations and expert feedback; (2) data display, which presents data in descriptive narrative form to facilitate interpretation; and (3) conclusion drawing, which involves iteratively comparing data from multiple sources, including expert suggestions, observations, and documentation. The resulting findings supported the quantitative results and informed improvements to the final product.

RESULT AND DISCUSSION

Product Development Results

The study resulted in the development of an interactive learning medium, **El-Learn** (Electrical Learning), which is integrated with Google Sites. This medium was created to support learning activities in Basic Electronics Engineering for tenth-grade vocational students. El-Learn facilitates students' understanding of abstract concepts by combining text materials, instructional videos, quizzes, worksheets, and simulations.

The homepage of the medium features main navigation menus, including Material 1, Material 2, Quiz, Exercises, Worksheet, and Simulation. The layout was intentionally designed to be simple and systematic, facilitating student access to each feature. The materials page covers two primary topics: active and passive electronic components and basic electronic laws. Each topic is integrated with discussion forums and learning videos via Edpuzzle, enabling students to respond to questions embedded within the videos. Furthermore, the simulation page links to PhET Interactive Simulations to help students visualize circuit concepts.

Integrating multiple learning features within a single platform supports independent learning and fosters a more diverse educational environment. This result aligns with the findings of Ariyanto et al. (2024), who noted that Google Sites can function as an effective interactive learning platform by consolidating various digital learning resources. Likewise, Raothao, Maneewan, and Sunan (2023) found that online web-based instruction using Google Sites effectively addressed learning challenges in electronic devices and circuits for vocational students.

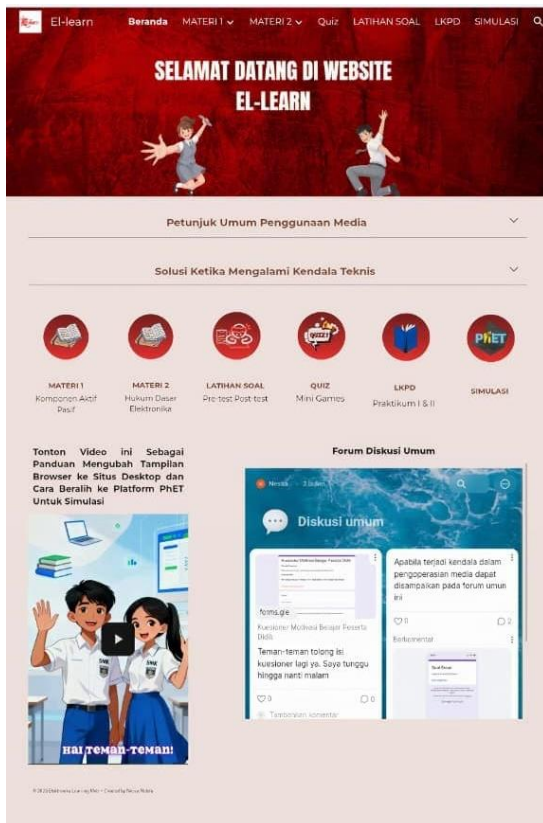


Figure 1. Homepage view of Google Sites



Figure 2. Material page view of Google Sites

Media Feasibility Validation Results

The developed product was validated by three validators consisting of two university lecturers and one vocational school teacher. Validation covered media design, instructional suitability, and usability aspects.

Table 9. Media Validation Results (N = 3 Validators)

No.	Aspect	Mean Score	SD	Category
1	Design Media	3.83	0.29	Very Feasible
2	Instructional Suitability	3.78	0.42	Very Feasible
3	Media Usability	3.75	0.35	Very Feasible
Mean		3.80	0.35	Very Feasible

*) Note: Scale 1–4; Very Feasible = 3.26 – 4.00

The average score of 3.80 (SD = 0.27) shows that the material content was highly appropriate for learning objectives. The highest score in language (4.00) indicates that the material was written clearly and was easy for students to understand. Clear language is especially important in electronics learning because students must understand technical concepts accurately (Wahyudianto et al., 2025).

Validators recommended adding more calculation exercises in sections related to Ohm's Law and Kirchhoff's Law. This suggestion reflects the importance of balancing conceptual explanations with procedural practice. According to Mayer (2009), multimedia learning is most effective when it combines both conceptual and procedural knowledge through multiple representations.

Student Responses Toward Google Sites Learning Media

Student responses were measured after implementation using a questionnaire adapted from the Technology Acceptance Model (TAM), including perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention (Davis, 1989).

Table 3. Student Response Results (N = 34 Students)

No.	Aspect	Mean Score	SD	Category
1	Ease of Use	3.58	0.42	Very Good
2	Usefulness	3.66	0.38	Very Good
3	Attitude toward Use	3.64	0.41	Very Good
4	Intention to Reuse	3.61	0.45	Very Good
	Mean	3.62	0.42	Very Good

*) **Note:** Scale 1–4; Very Good = 3.26 – 4.00

The overall score of 3.62 (SD = 0.42) indicates that students positively and very highly accepted the developed media. Students reported that the media was useful for understanding materials, enjoyable to use, and worth using again outside classroom hours. These findings suggest that students are more motivated when learning media provides flexible access, attractive visuals, and interactive activities.

Although all aspects of student responses were in the very high category (3.58–3.66), the "Ease of Use" aspect (3.58) was slightly lower than "Usefulness" (3.66). This indicates that some students may have experienced minor technical difficulties when accessing or navigating the Google Sites media. This aligns with validators' suggestions to add clearer labels under navigation icons. Therefore, improvements to the user interface are needed to further enhance the ease of use of the media. This finding is consistent with Manuswongkarn and Thamrongkunanant (2024), who found that flipped classroom learning activities through Google Sites significantly enhanced analytical thinking skills, with students in the experimental group demonstrating higher academic performance compared to the control group ($p < 0.05$).

Improvement of Student Learning Comprehension

The effectiveness of the media was measured using a one-group pretest-posttest design involving 34 students.

Table 4. Comparison of Pretest and Posttest Scores (N = 34 Students)

No.	Aspect	Mean Score	SD	Category
1	Mean Score	53.00	86.53	+33.53
2	Standard Deviation (SD)	12.45	8.76	-3.69
3	Highest Score (Max)	75	100	+25
4	Lowest Score (Min)	30	65	+35
5	Median	52.50	87.00	+34.50
	N-Gain		0.69	Moderate (approaching high)

The average score increased from 53.00 (SD = 12.45) in the pretest to 86.53 (SD = 8.76) in the posttest. This substantial improvement indicates that students gained better understanding after learning through the developed media. The average N-Gain score of 0.69 (SD = 0.15) falls within the moderate category and is close to the high category threshold of 0.70.

Table 4.1. Distribution of Pretest and Posttest Scores by Category (N = 34 Students)

No.	Score Category	Pretest (n)	Pretest (%)	Posttest (n)	Posttest (%)
1	Very High (86–100)	0	0%	21	61.8%
2	High (71–85)	4	11.8%	11	32.4%
3	Moderate (56–70)	10	29.4%	2	5.9%
4	Low (≤ 55)	20	58.8%	0	0%
Total		34	100%	34	100%

In the pretest, 58.8% of students (20 students) were in the low category (≤ 55). In the posttest, 94.2% of students (32 students) were in the high to very high categories (≥ 71). No students remained in the low category in the posttest, demonstrating a significant improvement in comprehension after using El-Learn media.

Table 5. Distribution of N-Gain Scores by Category (N = 34 Students)

No.	N-Gain Category	Score Range	Number of Students	Percentage	Mean N-Gain	Standard Deviation (SD)
1	High	$g \geq 0.70$	15	44.1%	0.69	0.15
2	Moderate	$0.30 \leq g < 0.70$	17	50.0%		
3	Low	$g < 0.30$	2	5.9%		
	Total		34	100%		

The distribution of N-Gain scores shows that the majority of students (94.1%) experienced improvement in the moderate to high categories. Only 2 students (5.9%) were in the low category. This indicates that El-Learn media was effective for most students, although a small number did not show significant improvement. This may be due to other factors such as learning motivation, prior knowledge, or technical difficulties in accessing the media (Hake, 1998).

Table 5.1. Summary of Student Comprehension Improvement

No.	Indicator	Pretest	Posttest	N-Gain
1	Mean Score	53.00	86.53	0.69
2	Category	Low	High	Moderate (approaching high)
3	Improvement (%)	-	+63.26%	-

The improvement likely occurred because students learned through multiple representations: reading materials, watching videos, answering quizzes, and using simulations. According to Mayer's Cognitive Theory of Multimedia Learning (2009), students understand concepts better when verbal and visual information are combined meaningfully. In electronics learning, simulations are particularly useful because they help students observe processes that are difficult to see physically. This finding is consistent with Sapiro et al. (2025), who reported that a Google Sites-based module significantly improved higher-order thinking skills among vocational students, with an average N-Gain of 0.80.

DISCUSSION

The results demonstrate that Google Sites-based learning media is feasible, practical, and effective for improving student comprehension. First, high expert validation scores (3.80) indicate that the media meets pedagogical and technical quality standards. Second, strong student responses (3.62)

show that the media was accepted positively and can support independent learning. Third, the significant increase in posttest scores and moderate N-Gain (0.69) confirms that the media contributes to better understanding of electronics concepts.

These findings support previous studies by Yolanda Saputra, & Effendi, (2021), who found that Google Sites media was valid, practical, and effective in vocational learning. However, this study extends previous research by integrating multiple features such as Edpuzzle videos, PhET simulations, quizzes, and worksheets in one platform. This integrated approach provides a more holistic learning experience (Wahyudianto et al., 2025).

Table 6. Comparison of Findings with Previous Studies

No.	Study	Context	Key Findings	Similarities with Current Study
1	Saputra & Effendi (2021)	Electric Motor Installation, Indonesia	Valid (88.81%), practical (91.10%), effective (85% score)	Google Sites effective in vocational learning
2	Ariyanto & Prakoso (2024)	Argumentation Text, Indonesia	Google Sites media improved student comprehension	Google Sites improved student understanding
3	Raothao et al. (2023)	Electronic Devices and Circuit, Thailand	Online web-based instruction addressed learning difficulties	Google Sites addressed learning difficulties in electronics
	Sapiro et al. (2025)	3-Phase Trainer Kit, Indonesia	N-Gain 0.80 (high), pretest 52.72→90.52	Google Sites improved HOTS in vocational students
	Manuswongkarn & Thamrongkunant (2024)	DC Circuit, Thailand	Experimental group outperformed control group (p<0.05)	Google Sites enhanced analytical thinking
	Current Study	Basic Electronics Engineering, Indonesia	Validation 3.80, Response 3.62, N-Gain 0.69	Integrated Edpuzzle, PhET, quizzes, worksheets in one platform

The study also implies that vocational education requires contextual and interactive media because many technical subjects involve abstract concepts and practical applications. Therefore, teachers should consider adopting similar technology-based learning environments to improve classroom engagement and conceptual mastery. Overall, El-Learn demonstrates that Google Sites can be transformed from a simple website builder into a comprehensive learning ecosystem that supports student comprehension in vocational education.

Limitations of the Study

This study has several limitations. First, the one-group pretest-posttest design without a control group means that the improvement in comprehension cannot be compared with a group that did not use the media. Second, the field trial was limited to one class (34 students) at a single school, so generalisation must be done cautiously. Third, the modification of the Disseminate stage into a limited field trial means that the product has not been tested on a broader population. Fourth, the study did not measure long-term retention of student comprehension. Fifth, the reliability of the

comprehension test ($\alpha = 0.82$) and student response questionnaire ($\alpha = 0.85$) were acceptable, but further refinement could improve instrument quality. Future research is recommended to address these limitations.

CONCLUSION

Based on the research conducted on 34 Grade X students from the Audio Video Engineering (TAV) program at SMK Negeri 1 Jetis, Mojokerto, it can be concluded that the Google Sites-based learning media named El-Learn (Electrical Learning) was successfully developed using the 4D model with the Disseminate stage modified into a limited field trial, integrating comprehensive features such as learning materials, interactive videos (Edpuzzle), concept simulations (PhET), worksheets, quizzes, and pre-test-post-test evaluations into a single accessible platform. The developed media was declared highly feasible based on expert validation, with an average validation score of 3.80 out of 4.00 (95%) for both media and material aspects, while student responses were very positive with an average score of 3.62, indicating that the media was considered useful, attractive, and easy to access. Furthermore, the media proved effective in improving student comprehension, as evidenced by a significant increase in mean scores from 53.00 in the pretest to 86.53 in the posttest (63.26% improvement), with an average N-Gain of 0.69 (moderate category, approaching the high threshold of 0.70). The distribution of N-Gain scores revealed that 94.1% of students experienced meaningful improvement, with 44.1% achieving high improvement, 50.0% achieving moderate improvement, and only 5.9% achieving low improvement. Thus, all three research objectives were successfully achieved, confirming that El-Learn is a feasible and effective digital learning solution for improving student comprehension in Basic Electronics Engineering.

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