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Development of a Google Sites-Based 3-Phase Trainer Kit Module to Improve HOTS in Vocational Education Students

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ABSTRACT

Purpose – This study aims to develop an alternative module-based model of Google Sites as a trainer kit, enhancing Higher Order Thinking Skills (HOTS) among participants in an electrical installation vocational high school. This research is unique in that it combines interactive web-based learning tools to develop critical thinking and problem-solving skills within technical education.

Methodology – The Research type used in this study is R&D (Research and Development), employing methods of product testing on users both before and after implementation. The sample consists of 111 grade 11 students from three classes in a vocational high school, who are learning with a Google Sites-based module.

Findings – Expert validation reveals that the media quality, content quality, and assessment parts of questionnaires achieve high scores; specifically, the assessment items score 93.37%, and the content score is 86.08%. Students' achievement, as measured by pre-test and post–test scores, presented a significant improvement, with an average N-Gain of 0.80, portraying a substantial increase in HOTS. Pre-test scores increased from 52.72 to 90.52 after the module was used.

Contribution – This module development aligns with SDG 4 (Quality Education), which advocates for inclusive, equitable, and quality education, as well as the promotion of lifelong learning opportunities. The module was rated as practical, easy to use, and highly effective in enhancing student learning, with a usability score of 95.83%. Overall, the Google Sites-based trainer kit module has proven to be an effective tool for improving HOTS and advancing the quality of vocational education.

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INTRODUCTION

Practical skills relevant to the workplace are taught to students, and individual vocational training makes a significant contribution in this respect. The point is to provide students with the skills they need, in fields where that often means technical ones, such as electrical engineering—specifically, three-phase electrical systems. In electrical engineering, it is essential to be familiar with three-phase AC systems, as they are widely used in power generation, delivery, and industrial equipment (Badarudin et al., 2024; Hutagalung, 2022). Unfortunately, for many of these technical subject matters, students experience difficulties acquiring them because the conventional delivery often does not offer hands-on practical work and social learning (Baskoro et al., 2023; Cobos-Torres et al., 2020; Haryudo et al., 2025; Qian & Jinzhu, 2021).

Apart from technical skills, soft skills, including higher-order thinking skills (HOTS) such as critical thinking, creativity, and problem-solving, play a vital role in the current job market. These competencies equip graduates to apply their learning in a business environment that is subject to rapid change. HOTS are especially important in Vocational schools; students should not only know technical facts but also be able to apply them creatively in the industrial field. According to previous studies, project-based learning appears to be an ideal pedagogical approach for nurturing HOTS because it engages students in real-life, authentic tasks (Alsmadi et al., 2024; López et al., 2023).

Conventional teaching methods, which often involve blackboards and overhead projectors, can elicit passive learning attitudes, hindering student engagement and understanding. This traditional teaching may hinder the development of catechin skills learning, like HOTS. Thus, there is a growing need for interactive and engaging learning types that enable students to become actively involved and achieve a more profound understanding (Bervell et al., 2022). Such teaching methods promote the learning of vocational knowledge systems and, by doing so, can be expected to increase the number of graduates who have a higher ability to teach themselves through experience in both technical and intellectual ways.

One primary viable option will be to use Google Sites as an LMS. "For complex technical concepts, as in vocational education, students may prefer to follow the learning materials more freely through the Google Site." The latter pedagogical tool will enable more interaction during the learning process, thus providing an effective way for students to learn this invaluable skill (Bervell et al., 2022; Roa et al., 2023). With the help of Google Sites, teachers can create a fun and individually driven learning experience for students.

However, there have been no specific studies regarding the use of Google Sites in improving HOTS in learning three-phase electrical engineering at the vocational high school level. Even though there are several studies on technology effectiveness in vocational education, little research has been undertaken on HOTS development using GS in general and in electrical engineering in particular. Existing research has focused on general digital tools in education without particular attention to how platforms such as Google Sites can contribute to HOTS applications within the technical domain (Kamarrudin et al., 2023; Yanto et al., 2023). The focus of the research presented in this paper is predominantly on the practical advantages of such tools, with little emphasis placed on their potential to develop higher-order skills in vocational education; thus, there is a substantial void in the current literature.

To fill the void, this research aims to investigate Google Sites as an interactive medium for learning that can improve HOTS in vocational high school students, especially in the electrical engineering subject. The main aim is to construct a three-phase Google Sites-based trainer kit that assists in enhancing HOTS and thus making students comprehend technical applications used in industry. The study makes a valuable contribution to the literature, capturing digital technology usage in vocational education to enhance students' cognitive skills, particularly in light of the globally digitalized industries they will be entering (Baidowi et al., 2023).

METHODOLOGY

Research Design

This research was based on R&D, utilizing the Google Sites-based Testing Effectiveness Trainer Kit Module as the product, which consisted of a pre-test and a post-test. This design can be used to compare students' capabilities before and after treatment, thereby providing empirical evidence of the increased usefulness of the learning aid in improving a potential higher-order thinking skill (HOTS) among students (Borg & Gall, 1983; Muhibbuddin et al., 2023). This research model was adapted into five main stages: analysis, design, development, and evaluation, to simplify the process and ensure that the module could be tested effectively in vocational education.

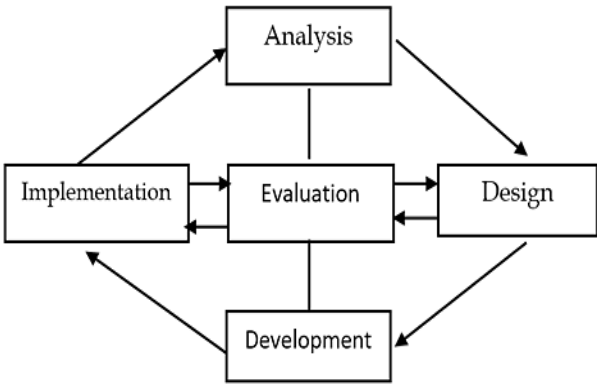

Figure 1. R&D Model (Source: Hartono & Pahlevi, 2020)

This research started with a needs analysis to identify the challenges students face in understanding Electric Motor Installation material, particularly three-phase electrical systems, and to develop their Higher Order Thinking Skills (HOTS). Mapping was carried out on curriculum requirements, student understanding, skills to be mastered, and challenges of conventional teaching in developing HOTS (Borg & Gall, 1983). Additionally, the analysis included the selection of technology, specifically the use of Google Sites as a learning platform. According to this analysis, at the design stage, three phases were defined for a Google Sites-based module: basic material introduction, concept application process through problem-based exercises, and assessment to measure the gain in HOTS development. This design is also referred to as the pre-test and post-test, in comparison with the students' achievement before and after taking the module (Badriyah et al., 2023).

In the prototype phase, a module based on this design was developed using Google Sites. The production of interactive learning media was characterized in a way that allowed students to find and access it, enabling them to interact with the material as they pleased (Bervell et al., 2022; Wulandari et al., 2023). This module was designed to support technical understanding and encourage the development of HOTS through problem-based exercises. Google Sites was chosen because it provides flexible access for students, thereby strengthening the learning process. Following production, the utilization stage was conducted by practicing the module with students and implementing it in vocational school education. The teachers were also given training on how to best leverage Google Sites in the teaching and learning process, which means that we could directly observe (first-hand) how well students received the module and its effects for HOTS within an authentic educational context (Baidowi et al., 2023).

The evaluation stage was carried out after implementation to assess the impact of using the module on improving students' HOTS. The assessment was evaluated using pre- and post-tests, which determined students' performance in skills before and after exposure to the module, based on Google Sites. The assessments also covered students' and teachers' responses to measure the module's impact on student engagement and their understanding of the technical engineering concepts (Haryadi & Pujiastuti, 2022; Muhibbuddin et al., 2023).

This evaluation provided empirical evidence of the module's effectiveness in developing students' HOTS and provided recommendations for future module improvements. The researchers focused on creating modules that aligned with the vocational school curriculum and were easily accessible to students through Google Sites. Once the modules were completed, trials were conducted to assess their impact on improving students' HOTS.

Table 1. Summary of Research Design

Measurement	Pre-test (X_1)	Treatment (O)	Post-test (X_2)
Description	Student pre-test scores	Learning using Google Sites-based training kits	Post-test scores after interacting with learning media

Participant

This study involved three classes from SMKN 1 Driyorejo, with 111 Year 11 students enrolled in the Electrical Power Installation programme. The selection of samples was conducted using purposive sampling, based on the relevance of participants' backgrounds to the research topic: to understand the three-phase electrical system and to develop higher-order thinking skills (HOTS) in Electrical Power Installation at Vocational High School. Participants were students with a background in electricity and installation. They engaged in learning electrical engineering and demonstrated two types of knowledge resources: technical skills and critical thinking abilities. The performance, students' engagement, and feedback were collected during the intervention.

Table 2. Description of Student Characteristics and Reasons for Sample Selection

Class	Number of students	Student characteristics	Reasons for sample selection
Class 11 A	37	Students with a background in basic electrical installation knowledge and fairly good technical skills.	Representation of students with a solid basic understanding and the ability to develop technical skills.
Class 11 B	37	Students who have a high interest in electrical engineering actively participate in class.	Selecting active students to explore the development of higher-order thinking skills.
Class 11 C	37	Students with varying technical skills who demonstrate a desire to improve their critical thinking skills.	Targeting students with varying levels of engagement to see the effect of the intervention on different skill levels.

Instruments

Learning assessment materials play a crucial role in planning a lesson, as they not only assess students' abilities but also can enhance students' Higher-Order Thinking Skills (HOTS) (Muryani et al., 2023). Content experts and evaluators reviewed the quality of these tools. Subject matter experts and evaluators validated these instruments to ensure their quality. In this study, the Google Sites-based Trainer Kit 3 Phase learning media were used to evaluate their effectiveness. Validation included evaluation of the media's design, format, content, and test items, carried out by three experts (two electrical engineering lecturers and a vocational teacher). The internal consistency of test items was calculated using Cronbach's Alpha to maintain homogeneity in measuring HOTS (Hazaymeh & Alomery, 2022).

Table 3. Learning Media Validation Sheet Grid

No.	Aspects	Assessment components
1	Media Design	1. The animations provided facilitate the students' learning. 2. The design and color are attractive. 3. Is it easy to use the learning media 4. Parts are introduced well and are layman-friendly.
2.	Media Format	5. The language is single, has no racial, religious, or ethnic references. 6. The materials go together quickly.

No.	Aspects	Assessment components
		7. The instruments operate as aural devices.
		8. The Website is easily accessible.
		9. The visual attractiveness of the picture in the learning media.
		10. The clarity of images displayed in the media.
		11. The transparency of the use of components in learning media.
3	Media Content	12. Media on the Website utilized matches the topic.
		13. The theory does not agree with the simulations.
		14. The media employed is suitable for the desired learning objectives.

The learning resources were content-validated by expert reviewers to determine whether the developed materials are easy to use, well-tailored, and suitable for vocational training. Provides validation that the material is accessible, appropriate to students' knowledge, and can be set up or modified as students' needs change over time.

Table 4. Validation Standard of the Learning Contents Sheet

No.	Aspects assessed	Assessment components
1	Content of the Material	1. The content is in accordance with the competencies
		2. The contents are organised according to the Learning Plan
		3. The material presented is up-to-date.
		4. The material covers the subject matter thoroughly.
		5. The content is appropriate and satisfies the Learning Outcome requirements.
		6. The material is practical and can be used in real life.
		7. The wording is written for a layperson's comprehension.
		8. The images presented are clear.
2	Strategy for Delivering the Material	9. The learning content is appropriate for the pedagogical model.
		10. Each sentence is lucid and intelligible.
		11. The content is delivered in ways that are suitable for the customers.
		12. Use of the medium is good.

Item validation guarantees the quality of questions that measure HOTS according to Bloom's Revised Taxonomy, that is: analysis (C4), evaluation (C5), and creation (C6).

Table 5. Item Validation Grid Sheet

No	Aspects assessed	Assessment components
1	Content	The question aligns with the specified indicator.
		The material being asked is relevant to the competencies being assessed.
		There is only one correct answer.
		The answer choices are logically consistent with the content.
2	Construction	The main question is formulated concisely, clearly, and firmly.
		The main question does not provide clues to the correct answer.
		The main question is free from double-negative statements.
		Any images, graphs, tables, or diagrams are clear and serve their intended purpose.
		Answer choices, especially numerical or time-related ones, are arranged in proper order (ascending or descending).
		The answer choices do not use statements like 'all of the above are wrong/correct,' or similar.
		The length of the options is relatively consistent.
		The question does not use vague or uncertain expressions, such as 'should,'

No	Aspects assessed	Assessment components
		'usually,' or 'sometimes.'
3	Language	The language used follows the rules of standard Indonesian grammar.
		The language used is communicative and transparent.
		The language does not include local or taboo expressions.
		The writing complies with Indonesian spelling standards.
		The phrasing does not contain words that may offend students.
4	Instrument Appearance	Instructions for filling out the questions are clearly written.
		The questions are arranged in a logical and easily understandable sequence.

The student response questionnaire collects feedback on the practicality, ease of use, and impact of the learning media.

Table 6. Sheet for Validation of Learning Content

No.	Aspects	Assessment components
1	Ease of Use	1. The media simply drops in with no obstructions.
		2. The media is the easy one.
		3 The materials are easily accessible.
		4. All components function properly.
2	Content of the Media	5. The contents correspond to the media.
		6. The instructional video makes courses easy to learn.
3	Media Appearance	7. The look of the media is fascinating and user-friendly.
		8. The markings on the top prove helpful in comprehension.
		9. The size, color, and font of the text fit.
4	Selection of Learning Resources	10. Consistency with the learning outcomes
		11. Relevance to the subject matter and pedagogy.
		12. Appropriateness for the students' characteristics.
5.	Impact of Use	13. know how to use the 3-phase electric motor control circuit in natural circumstances.
		14. Images and videos in the material are well comprehensible.
		15. Would like to know the 3-phase electric motor control circuit in this learning media

The learning end-product test measures competence through 20 multiple-choice questions, which reflect Bloom's cognitive taxonomy at the higher levels (analysis, evaluation, and creation) (Crisp et al., 2007).

Table 7. Cognitive Domain Learning Objectives

Achievement Indicator	Cognitive Level and Item			Total Items
	C4	C5	C6	
Combination of the 3-phase electric motor installation	1, 2, 6			3
Analyzing the 3-phase electric motor installation		3, 4, 5		3
Estimation of the 3-phase electric motor fit to be installed		9, 10, 12, 13, 15, 16		6
Predicting the 3-phase electric motor installation			7, 8, 11, 14, 17, 18, 19, 20	8
Total				20

Data analysis

A reliability analysis was conducted to evaluate the stability of the study's instruments. The instruments were deemed good if Cronbach's Alpha value was 0.7 or higher, indicating good internal consistency. If it was < 0.7, then the instruments were unreliable and should be improved (Budi, 2021). The distribution of the data was tested with the Shapiro-Wilk normality test (Hayes, 2021). H_0 assumes that the data follow a normal

distribution, and H_1 does not. To examine the average scores of the pre-test and post-test, a paired t-test was used to determine if there was a significant difference between the two scores. H_0 states that there is no significant difference, while H_1 states that there is a significant difference (Frey, 2023). Additionally, N-Gain analysis was employed to assess the level of learning improvement.

$$g = \frac{Sf - Si}{Smax - Si} \quad \text{.....(1)}$$

Where:

g = Improvement score
Sf = Post-test score
Si = Pre-test score
Smax = Maximum possible score

The results of the N-Gain analysis were categorised as high, moderate, or low improvement based on the scores obtained, in accordance with the criteria determined by Kotronoulas et al. (2023). This method is used to provide a detailed overview of the changes that occur in students after the intervention, as well as to evaluate the effectiveness of Google Sites-based learning modules in improving students' higher-order thinking skills (HOTS). This analytical approach is used to verify the effectiveness of Google Sites-based training tools in improving students' higher-order thinking skills (HOTS).

Table 8. N-Gain Score Category

Category	Range
High	g > 0.7
Medium	0.3 ≤ g ≤ 0.7
Low	g < 0.3

FINDINGS

This research developed digital learning media in the form of a three-stage training module based on Google Sites. The module is designed to enhance the Higher Order Thinking Skills (HOTS) of vocational education students. The course is designed to be consumed in an interactive, fun, and mobile/PC-friendly format with an internet-friendly interface. The intent behind designing this module is to enhance students' critical thinking and cultivate their analytical approach to industry problems ahead. The outcomes of the development of the Google Sites-based learning module are:

Figure 2. Online Learning System Shell for Electric Motor Installation

The module includes a user-friendly Home Page, an Attendance Page (for recording digital attendance), and a Learning Materials page that organizes three-phase electrical content for better comprehension. KEY 1 Book also includes a Video Materials Page for guidance on using the audio and visual content, a Library Page with additional references, and a Quiz Page to help students practice and assess both their factual knowledge and critical thinking skills. The Developer Profile Page enhances the transparency of the developer team. These characteristics facilitate the development of critical and integral thinking, enhancing the qualitative level of professional preparation and increasing competencies in the three-phase electrical engineering branch. The module has been thoroughly validated for quality, effectiveness, and utility, and refinements have been made based on validation feedback of validators and respondents as follows:

Validation Results

Media Validation

The training module developed using Google Sites has been validated by three experts with competence in media and content. The validation process was conducted to ensure that the training module meets the standards of Validity and effectiveness as a learning tool that can enhance Higher Order Thinking Skills (HOTS) in vocational education students. The results of the validation process are presented in Figure 3.

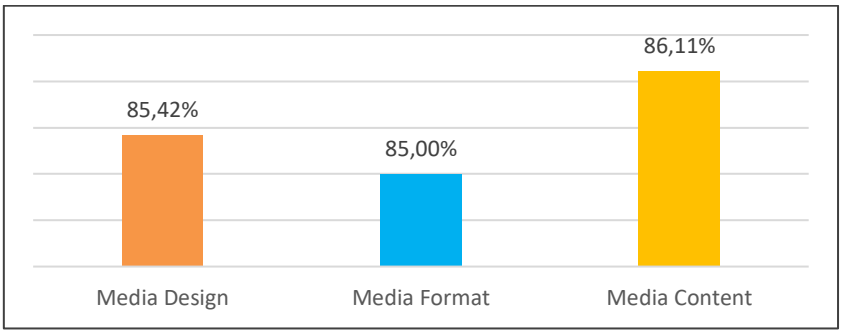

Figure 3. Percentage of Performance by Media Category

It is also noticeable from the bar chart in Figure 3 that the Media Content performance score was the highest at 86.11%, indicating that it is highly relevant and practical in helping students understand the material. Media Design and Media Format scored 85.42% and 85.00%, demonstrating an adequate level of Validity for both; however, the visual design and layout during navigation need to be enhanced. The high validity score overall indicates that the media effectively supports learning. Nevertheless, the design and layout can relatively promote more HOTS growth by elevating students' involvement in critical and analytical thinking.

Material Validation

To assess the relevance and appropriateness of the content in the Phase Trainer Kit Module 3, hosted on Google Sites, an analysis review was conducted to examine its alignment with the objectives. The following graph illustrates the percentage validity results of various material components, which show the accuracy, completeness, and effectiveness of the material in achieving vocational education objectives.

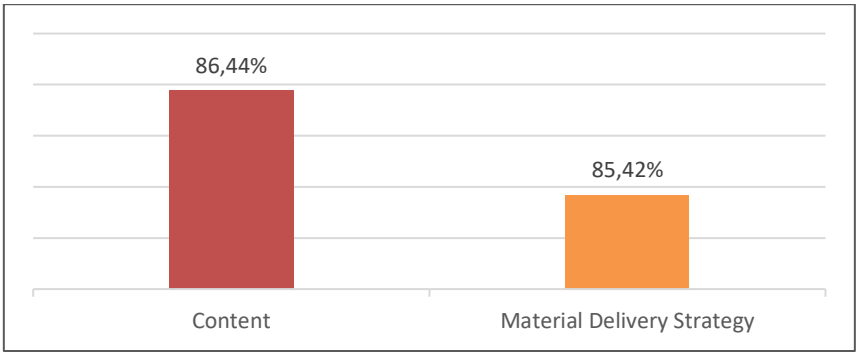

Figure 4. Graph of Material Validation Percentage

According to the graph shown in Figure 4, the validity percentage of the obtained material was recorded as 86.44%, indicating that the material provided is highly relevant and helpful for a clearer understanding of concepts within the 3 Phase Trainer Kit. Shows that the material is in line with vocational education curriculum standards and can be easily understood by students. However, suggestions for improvement include simplifying explanations in sections that are considered too technical, as well as adding more relevant practical examples so that students can more easily relate theory to practice in the industrial world.

Item Validation

The material validation in this study includes four main aspects: Question Display, Language, Material, and Construction. Each aspect is tested to ensure that the material aligns with the learning objectives and is effective for the target audience, as shown in Figure 5.

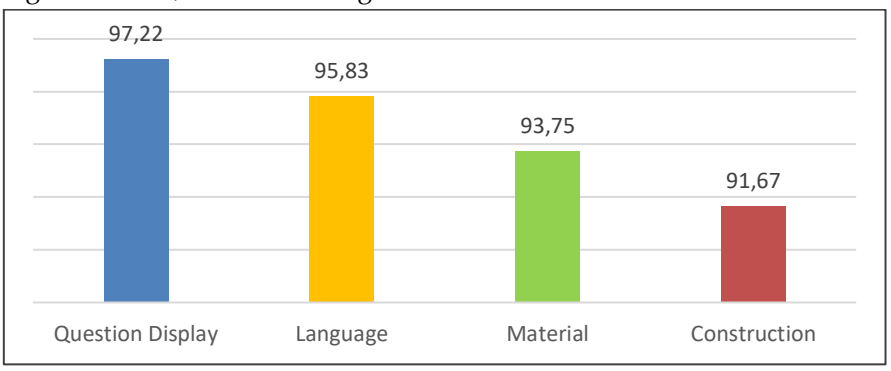

Figure 5. Results of Validation of Graphic Questions

Item Validation: The result of the Item validation is presented in Figure 5. The question presentation received the highest score, 97.22%, which implies that it is, however, well-structured and task-effective for the learning process. Overall, the language had an agreement of 95.83%, rated as straightforward and easy to understand. Content: 93.75% (94%) The content was rated as relevant and supportive of the learning objectives. Simultaneously, the construction scored 91.67%, indicating that there is still room to refine the approach to content during material presentation. The content is good and related to the learning objectives; however, a better organization of the content would improve the overall presentation. Such improvement is crucial for developing students' HOTS (Higher-Order Thinking Skills) and deepening their engagement in learning and understanding.

The Pearson correlation test was used to examine the face validity of the questions, based on which all pre-test and post-test items were deemed face valid. In the pre-test validity, all 20 items were valid, with a Pearson Correlation value greater than Rtabel (0.316) and a significance value less than 0.05, indicating that the questions are reliable for measuring participants' competence. The pre-test validity results are presented in Table 9.

Table 9. Validity of Pre-Test Items

Item	N	Pearson Correlation	Rtabel	Sig 2-tailed	Category
Item_1	37	0,804	0,316	0,001	Valid
Item_2	37	0,719	0,316	0,001	Valid
Item_3	37	0,522	0,316	0,001	Valid
Item_4	37	0,756	0,316	0,001	Valid
Item_5	37	0,660	0,316	0,001	Valid
Item_6	37	0,486	0,316	0,002	Valid
Item_7	37	0,626	0,316	0,001	Valid
Item_8	37	0,715	0,316	0,001	Valid
Item_9	37	0,548	0,316	0,001	Valid
Item_10	37	0,421	0,316	0,009	Valid
Item_11	37	0,496	0,316	0,002	Valid
Item_12	37	0,634	0,316	0,001	Valid
Item_13	37	0,337	0,316	0,041	Valid
Item_14	37	0,782	0,316	0,001	Valid
Item_15	37	0,445	0,316	0,006	Valid
Item_16	37	0,548	0,316	0,001	Valid
Item_17	37	0,422	0,316	0,009	Valid
Item_18	37	0,394	0,316	0,016	Valid

Item	N	Pearson Correlation	Rtabel	Sig 2-tailed	Category
Item_19	37	0,548	0,316	0,001	Valid
Item_20	37	0,342	0,316	0,038	Valid

Post-Test Validity The post-test validity results indicate that the whole question is valid, as all resulted in a Pearson Correlation value greater than Rtable (0.316) and significance below 0.05. which implies the reliability of these questions for assessing understanding after learning. The post-test validity results are presented in Table 10.

Table 10. Post-Test Item Validity

Item	N	Pearson Correlation	Rtabel	Sig 2-tailed	Category
Item_1	37	0,513	0,316	0,001	Valid
Item_2	37	0,594	0,316	0,001	Valid
Item_3	37	0,369	0,316	0,024	Valid
Item_4	37	0,578	0,316	0,001	Valid
Item_5	37	0,340	0,316	0,039	Valid
Item_6	37	0,523	0,316	0,001	Valid
Item_7	37	0,560	0,316	0,001	Valid
Item_8	37	0,446	0,316	0,006	Valid
Item_9	37	0,611	0,316	0,001	Valid
Item_10	37	0,484	0,316	0,002	Valid
Item_11	37	0,557	0,316	0,001	Valid
Item_12	37	0,635	0,316	0,001	Valid
Item_13	37	0,418	0,316	0,010	Valid
Item_14	37	0,680	0,316	0,001	Valid
Item_15	37	0,558	0,316	0,001	Valid
Item_16	37	0,492	0,316	0,002	Valid
Item_17	37	0,649	0,316	0,001	Valid
Item_18	37	0,490	0,316	0,002	Valid
Item_19	37	0,327	0,316	0,048	Valid
Item_20	37	0,525	0,316	0,001	Valid

The pre- and post-test questions are valid, but greater attention to the construction of the material (to provide more structure and clarity) is necessary so that participants are not confused. Overall, the validation results provide evidence that the instruments meet the requisite standard of Validity and confirm the proper measurement of the variables. Improving the construction of the material should lead to better instruments for more accurate measurements.

Furthermore, the instrument's reliability was assessed using Cronbach's Alpha. The results of the pre-test reliability revealed a Cronbach's Alpha of 0.857 with 20 items, indicating excellent internal consistency and suggesting that the test questions can be used to measure the underlying variables. The results of the pre-test reliability are presented in Table 11.

Table 11. Reliability Statistics

Cronbach's Alpha	N of Items
.857	20

The post-test reliability test confirmed a Cronbach's Alpha of 0.874, and the number of items was reduced to 20, indicating perfect internal consistency. This slightly increasing value compared to the pre-test indicates that the question on the post-test is very reliable in measuring participants' comprehension after learning. The results are presented in Table 12.

Table 12. Reliability Statistics

Cronbach's Alpha	N of Items
.874	20

The reliability test results indicate that both the pre-test and post-test instruments are highly reliable, with Cronbach's Alpha values greater than 0.70. These instruments can consistently measure participants' competence before and after learning.

Students' Responses to the Google Sites-Based 3-Phase Trainer Kit Module

The data on students' responses were obtained through a questionnaire filled out after they had conducted a trial of the learning module. This questionnaire focused on evaluating the appearance, usability, and effectiveness of the module. A small-scale trial of the module was conducted to gather supporting data for practical evaluation. The results of the response analysis are presented in Figure 6.

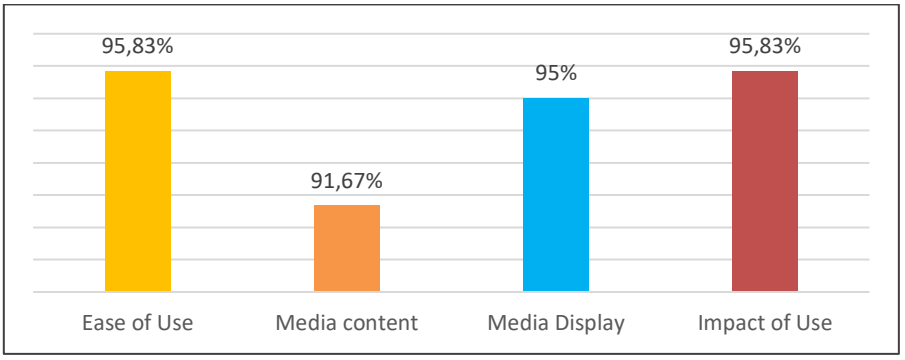

Figure 6. Graph of Percentage of Student Responses to Learning Media

It can be seen from the evaluation results in Figure 6 that the media style is efficient and easy to use, as both Ease of Use and Impact of Use achieve a score of 95.83%. The Media Display achieved 95% as the visual design appeared attractive, and the Media Content gained 91.67%, indicating that the content was relevant but needed further enhancement. The medium is generally helpful in learning, but the content depth can be improved.

Learning Outcomes

To assess how well the students learned, we compared their understanding of the topic before and after the lesson using pre-test and post-test measures. The initial understanding of the subject, as measured by the pre-test, and the improvement after the lesson, as indicated by the post-test. The improvement in students' knowledge is evident from the comparison of the average scores of both tests, as shown in Table 13.

Table 13. Student Learning Outcomes

Measurement	Average Score
Pre-test	52.72
Post-test	90.52

Table 13 shows that the mean of the students' pre-test scores was 52.72, indicating a low level of prior knowledge among the students before exposure to the teaching material. However, after learning, the mean of the post-test was 90.52, which also showed a significant difference from the pre-test. This increase indicated that instructional strategies were effective in supporting students in achieving higher levels of understanding through learning.

Normality Test

Before analyzing the differences between pre-test and post-test scores, a normality test must be conducted to ensure that the data meet the assumption of normality. The normality test presented in Table 14 uses the

Shapiro-Wilk method to determine whether the data can be analyzed using parametric tests or requires a non-parametric approach.

Table 14. Normality Test Results

	Method	Kolmogorov-Smirnov [a]			Shapiro-Wilk		
		Statistics	df	Sig.	Statistics	df	Sig.
Learning Outcomes	Pre-Test	.081	111	.200 *	.982	111	.789
	Post Test	.117	111	.200 *	.955	111	.136

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Table 14 presents the results of the normality test for pre-test and post-test scores, conducted using the Shapiro-Wilk method. Since the significance values for both pre-test (0.789) and post-test (0.136) are greater than 0.05, it indicates that the data is usually distributed. Therefore, it can be concluded that the data meet the normality assumption, and parametric statistical analysis can be applied.

Paired Samples t-Test

After ensuring that the data meet the normality assumption, the next step is to test for significant differences between pre-test and post-test scores using the paired sample t-test to analyze the differences in scores before and after the intervention, as shown in Table 15.

Table 15. Paired Sample t-Test Results

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Standard Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre-Test - Post-Test	-29,243	1,321	.217	-29,684	-28,803	-134,667	111	.000

Table 15 presents the results of the paired sample t-test, indicating a statistically significant difference in pre-test to post-test scores with an average difference of -29.243 (a significant effect) between the two tests, suggesting improvement from pre-test to post-test. The t-value and p-value ($p < 0.05$) are -134.667 and 0.000, indicating a statistically significant improvement in students' understanding due to the teaching method used.

N-Gain Analysis

The differences between pre-test and post-test scores are then computed to determine the N-Gain, which evaluates the relative improvement in students' understanding after learning. The N-Gain values vary between 0 and 1 (0 indicates no improvement, while 1 indicates the maximum improvement) as shown in Table 16.

T**able 16.** N-Gain Analysis

	N	Minimum	Maximum	Mean	Standard Deviation
Gain_Score	111	.68	.89	.8009	.05286
Gain_Percent	111	68.42	89.47	80.0871	5.28572
Valid N (listwise)	111				

According to Table 16, the N-Gain value for 111 respondents implies an average of 0.8009 (an increase in material learning by about 80%). The low standard deviation of 0.05286 indicates that the responses were not varied significantly. The minimum percentage of N-Gain is 68.42%, the maximum is 89.47%, and the average is 80.0871%. There were significant improvements for most students.

DISCUSSION

Analysis of Media and Learning Material Validation Results

The product of the Google Site-based Trainer Kit module is a method for developing the progressiveness of HOTS (Higher-Order Thinking Skills) in vocational school students, and it has been tested using various products, media, materials, and valid questions. The result of the media evaluation is shown in Fig. 3. It is clear that the content scored 86.11%, indicating that this material has high relevance and effectiveness. However, the design style and structure of the media achieved 85.42% and 85.00%, respectively, and it was possible to improve both aspects of visual design and navigation layout for enhanced comfort and usability. Material Validation: The material validation in Figure 4 is rated at 86.44%, indicating that this material item is highly effective in supporting learning objectives and is relevant to the EMP curriculum. However, there is a need to streamline some of the technical components and for further examples that are more practical to help marry theory with its application in practice (as suggested by other studies (Shojaei et al., 2023; Y. Zhang, 2021)

The assessment of the questions in Figure 5 yields excellent scores, with the questions scoring 97.22% and the language scoring 95.83%, indicating that the questions are well-structured and the language is clear and concise. The structure material was very high, reaching 91.67%, but it reflected the deficit in a transparent and integrated flow of presentation. The reliability test , using Cronbach's alpha, suggested reliability with values of 0.857 (pre-test) and 0.874 (post-test), indicating that the instrument was consistent in measuring students' competence. The results of the expert validation indicate that the learning media generally meet the requirements for reaching learning objectives , but require enhancement in terms of design and material simplification (Yanto et al., 2023). This finding could be linked to the results found in the literature that demonstrate that interactive media-based digital platforms are valuable tools for enhancing learning quality, especially to foster HOTS (Frey, 2023; López et al., 2023).

Practical Learning Media

The practicality of learning media is also a crucial factor in achieving learning success. In this study, practicality was assessed based on ease of use, content, appearance, and impact of use—Figure 13. The rating of ease of use obtained the highest percentage rating at 95.83%, which indicates that the system is easy to use and understand. Its plain design, as well as straightforward operation, ease the way students can reach and navigate through authentic material without complications of a technical nature (Hasan, 2021; Razzak et al., 2020). The content media aspect was rated 91.67%, as the material is relevant and supportive of learning objectives; however, it should have more in-depth content to be more extensive and industry-related. The media display achieved a score of 95%, representing an appealing visual design that is sufficient to allow students to access the material comfortably. The impact of media use scored 95.83%, indicating a significant positive impact on students' understanding of the material and motivation to learn. Overall, these results show that the learning media used are very practical, easily accessible, and contribute positively to the learning process (Shojaei et al., 2023; Sukma et al., 2020). However, there is still room to enrich the content, making it more in-depth and comprehensive.

Analysis of Student Learning Outcomes

The N-Gain analysis yields an average of 0.80, indicating a significant improvement in students' higher-order thinking skills (HOTS), with most students experiencing improvements ranging from 0.68 to 0.89. In line with a previous study (López et al., 2023), which suggested that the combination of digital tools and project-based learning significantly enhances cognitive skills. These findings are also consistent with Frey (2023) regarding the influence of interactive media in promoting HOTS in technical education. The significant increase in pre-test and post-test scores, which are 52.72 and 90.52, respectively, represents the success of the learning approach. The results of the normality test indicated that the distribution was normal. At the same time, the paired sample t-test revealed a p-value of 0.000, indicating a significant difference between the pre- and post-test scores. The analysis of N-Gain showed an 80% enhancement with a standard deviation of 0.05286, illustrating an absorptive effect for most students. Conclusively, modular learning was effective in improving students' comprehension, as reflected by the improvement in scores, as evidenced by a significant t-test and substantial N-Gain. These findings offer some implications for implementing interactive media in

enhancing the quality of education and students' cognitive skills (Frey, 2023; López et al., 2023)

This study presents several new findings regarding the development and evaluation of the effectiveness of Google Sites-based learning modules in promoting Higher Order Thinking Skills (HOTS) within vocational education. A key contribution of this study is the use of interactive media-based digital platforms to stimulate critical reasoning and problem-solving, particularly in vocational education. Previous studies (López et al., 2023) investigated the possibilities of digital platforms in education. However, the added value of this research lies in its analysis of a Google Sites-based Trainer Kit, which is designed to combine vocation-oriented content with HOTS development.

Furthermore, the originality of this study is based on applying practical learning media in actual vocational education. The effectiveness in developing cognitive skills (95.83%) and a high score for ease of use (95.83%) imply that the platform is efficacious in improving student learning , not only with a positive impact on learning outcomes, but also highly accessible, as it was developed for various technological literacy levels of vocational students. Adds to the literature by demonstrating how usability may have substantial effects on learning that earlier work has not closely examined.

Moreover, the N-Gain analysis reveals an 80% increase in HOTS, which suggests novel ways in which PBL, combined with interactive digital tools, can enhance students' performance in vocational education. This research provides empirical evidence of the effectiveness of a specific learning tool in a technical education setting, addressing a gap in current research on the use of Google Sites as an educational platform for developing cognitive and technical skills.

The normality test shows that the data from the pre-test and post-test follow a normal distribution. Means that parametric statistical tests, such as the paired t-test, can be used. Table 16 shows that the results of the paired t-test indicate a statistically significant difference ($p = 0.000$) between the pre-test and post-test scores. Means that the Google Sites-based Trainer Kit helps students understand the material significantly better. These findings align with previous studies conducted by Baidowi et al. (2023), which demonstrate that technology-based learning tools are effective in enhancing vocational education outcomes (Ferdiansyah et al., 2023). The significant difference between pre-test and post-test scores demonstrates the effectiveness of interactive learning media in improving student engagement and performance in technical disciplines. These results are in line with existing literature that emphasises the ability of technology-based learning tools to enhance learning.

The results show that the 3-Phase Trainer Kit is efficacious in improving HOTS, although there is room for improvement in media design. A score of 85.51% for media design indicates that students can interact more effectively with the platform, but aspects of visual design and navigation layout still require improvement. This study used a limited sample of one vocational education group; therefore, research with a larger and more diverse sample is needed to generalize the findings. Moreover, in our project, the subjective experience, such as students' feelings and motivation, was not quantified, which shall be added to interviews or an open survey (Hayes, 2021; Z. Zhang & Constandinou, 2021).

This study also captures only immediate effects; future research will be required to assess the effectiveness in the long term. They may need to consider contextual factors (eg, technological readiness and social support) in future studies. Further improvement, especially in the form of real-time feedback, will result in a more interactive and personalized learning experience (Shojaei et al., 2023). A combination of quantitative and qualitative data will also provide a more complete picture of the impact of the Trainer Kit on students, both academically and emotionally. Overall, although this study yields positive results, there is considerable room for improvement to make the Trainer Kit more effective, enhance the quality of learning, and support the achievement of SDG 4 (Frey, 2023; López et al., 2023).

The development of a Google Sites-based Trainer Kit presents opportunities for future research, such as integrating real-time feedback, which enables students to immediately identify their mistakes or achievements, thereby creating adaptive and personalized learning, in support of SDG 4 (Quality Education). Enhancing collaborative learning is also important, as it can strengthen students' technical skills and teamwork abilities, which supports SDG 4.4 on technical and vocational skills (Lambini et al., 2021).

Further research could explore the application of real-time feedback for a more adaptive learning experience. By adopting gamification, students can be motivated to take an active role in learning, making education more inclusive for lifelong learning (Artyukhov et al., 2024; Huang et al., 2024). Future studies could also investigate the use of the Trainer kit in other vocational training areas, such as Electrical Installation or Industrial Automation, to promote more flexible and sustainable types of learning (Gómez Niño et al., 2024). The integration of a PjBL will enhance students' technical and HOTS skills. Overall, the Trainer Kit contributes to achieving SDG 4 by enhancing the quality, relevance, and sustainability of education.

CONCLUSION

Based on the results of this study, the Google Sites-based training module developed to enhance Higher Order Thinking Skills (HOTS) in vocational education students demonstrated positive results across Validity, practicality, and effectiveness. The validation of media, material, and items yielded high scores, with Media Content reaching 86.11%, Material at 86.44%, and Item Presentation at 97.22%, indicating the relevance and effectiveness of the module. The module was also deemed practical, with Ease of Use and impact of Use scoring 95.83%, reflecting its user-friendliness and significant impact on the learning process. Regarding effectiveness, the comparison between pre-test scores (52.72) and post-test scores (90.52) showed a significant improvement, with an average N-Gain of 80%, indicating substantial learning gains. Reliability testing indicated that the instruments used were highly dependable, with Cronbach's Alpha values of 0.857 for the pre-test and 0.874 for the post-test. Overall, the module effectively enhanced HOTS in students, though improvements in design and material structuring could further optimize the learning experience.

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