



## The Effect of Google Sites-Based Physics Learning Media with Problem-Based Learning on Student Outcomes

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### ABSTRACT

The limited integration of technology and innovative approaches in physics education has frequently hindered students' ability to comprehend abstract and complex concepts, contributing to suboptimal learning outcomes. This study investigates the impact of google sites-based physics instructional media, implemented in conjunction with a problem based learning model, on the learning outcomes of class XI students at Senior High School 1 Darul Imarah, explicitly focusing on momentum and impulse topics. This research employs a quantitative approach using a quasi-experimental methodology with a nonequivalent control group design. The entire cohort of class XI students served as the population, with purposive sampling used to select class XI F-4 as the experimental group and XI F-5 as the control group. Data collection was performed through pretests and posttests, utilizing 20 multiple-choice questions designed to assess student comprehension. Data analysis was conducted using an independent sample t-test to determine the significance of differences between groups. The analysis revealed that a t-value (count) of 2.205 exceeded the critical t-value (table) of 1.996, indicating a statistically significant difference in learning outcomes associated with google sites-based physics instructional media using the problem based learning model with respect to learning outcomes. These findings demonstrate that the integration of google sites as an instructional medium, coupled with the problem based learning approach, significantly enhances students' learning outcomes in the study of momentum and impulse.

## INTRODUCTION

In the 21st century, education has undergone significant changes that demand new approaches in the learning process. Technology in education has become essential, not only as a tool for learning but also as a means to develop skills such as collaboration, communication, and problem-solving (Waruwu et al., 2024). Moreover, the integration of technology in education enhances student engagement, expands access to learning resources, and enables more flexible, student-centered learning experiences (Melati et al., 2023). This shift highlights the need for educational methods that prepare students to face increasingly complex global challenges, especially in fields like physics education, where students need to understand fundamental concepts and apply them effectively (Rizaldi et al., 2022).

In physics education, the integration of technology supported by innovative teaching models is crucial for improving the quality of learning and student learning outcomes (Iskandar, 2019). Technologies such as educational applications, digital simulations, and interactive platforms are becoming increasingly popular in supporting more interactive learning experiences. These tools allow

students to interact directly with the material, deepen their understanding through hands-on exploration, and engage in independent learning. However, one of the main challenges in implementing technology-based physics education is the lack of adequate facilities and technological resources in schools, which limits active student interaction with learning materials (An'navi & Sukartono, 2023).

The lack of active student engagement with the material or classmates can hinder deep understanding of complex physics concepts. Limited access to resources and technology in schools exacerbates this problem, making it difficult for many students to experience an interactive and optimal learning environment. As Widiyanto et al. (2021) stated, the application of innovative teaching models supported by technology can increase student engagement and strengthen concept understanding, particularly in challenging subjects like physics.

Google Sites, as a technology-based learning media that can be accessed through common devices such as computers and smartphones, offers a practical solution to resource limitations in schools. This platform supports interactive and collaborative learning, enabling students to interact more effectively with the material (Firdaus et al., 2021; Ningsih et al., 2023). In addition to media, teaching models that encourage active learning, such as Problem-Based Learning, can complement the use of Google Sites. Problem-Based Learning places students in problem-solving situations that require the application of physics concepts, supporting collaboration skills and deep learning. Google Sites can be used to present problems, provide learning resources, and facilitate peer discussions, thus effectively supporting the Problem-Based Learning model (Rahmi et al., 2021).

Observations at Senior High School 1 Darul Imarah during the MBKM USK Unggul program from August to November 2022 showed that, despite efforts to integrate technology, digital media like Google Sites had not been utilized. The learning process still heavily relied on traditional media such as whiteboards, textbooks, and occasional PowerPoint presentations. Follow-up observations on January 31, 2024, confirmed that the learning environment had largely remained unchanged, with minimal application of active or participatory learning models.

The lack of optimal use of technology in the classroom affects learning outcomes, as supported by Hasanah et al. (2021), who stated that limited use of technology in education hinders active student engagement. The same was conveyed by Apriliana (2021), who noted that the lack of innovative teaching models is a significant barrier to achieving optimal learning outcomes. Recent physics test results showed that only 8 out of 34 students achieved the Minimum Completion Criteria (KKM) of 75, reflecting the need for improvements in teaching.

Although previous research has explored the effectiveness of technology-based learning media like Google Sites or teaching models like Problem-Based Learning, few studies have specifically combined both elements in physics education. Most studies focus on the effectiveness of Google Sites as a learning platform or the application of Problem-Based Learning as a teaching approach. However, no research has examined the combination of these two approaches to assess their impact on physics learning outcomes. Therefore, this study aims to fill this gap by exploring the integration of Google Sites with the Problem-Based Learning model to improve student learning outcomes in physics education, especially in environments like Senior High School 1 Darul Imarah, where technology and innovative teaching methods have not been fully implemented. This research contributes to the field of education by offering new solutions to existing challenges in physics learning (Koesnandar, 2020).

## **RESEARCH METHODS**

### **Research Approach**

This study uses a quantitative approach to measure the impact of using Google Sites-based physics learning media with the Problem-Based Learning model on students' learning outcomes through statistical analysis. The quantitative approach was chosen because the data collected is numerical (student learning outcomes), which can be statistically analyzed to draw conclusions about the effect. The method used is experimental, with a quasi-experimental design (nonequivalent control group design), which allows the researcher to control variables that may influence student learning outcomes and provides a clearer picture of the impact of the applied learning media. The quasi-experimental design with two groups (experimental class and control class) was chosen because random group

assignment is not feasible, but it still allows for a more accurate comparison of learning outcomes between the two groups. This research design aligns with the study's objective to explore and measure the effect of using Google Sites with the Problem-Based Learning model on student learning outcomes, as well as to obtain valid data on the differences in learning outcomes between the experimental and control groups.

### Research Participants

The population of this study consists of 246 students in seven 11th grade classes at Senior High School 1 Darul Imarah during the 2024/2025 academic year. A purposive sampling technique was employed to select two classes: XI F-4 (34 students) as the experimental group, which utilized Google Sites with the Problem-Based Learning model, and XI F-5 (35 students) as the control group, which used PowerPoint with the same model. These classes were chosen because they were deemed representative of the student population with similar academic backgrounds, and the sample size was considered sufficient to achieve reliable statistical analysis based on the research design.

### Research Instruments

The instrument used in this study is a multiple-choice test consisting of 20 questions, each with five answer options. This instrument was developed by the researcher to measure students' cognitive learning outcomes on the topics of momentum and impulse. Before use, the instrument was validated for content by two physics subject matter experts to ensure that the questions aligned with the learning objectives and covered all relevant aspects of the material being taught. The instrument was not pilot-tested but directly used after validation to assess students' understanding of the taught material. Below is the table of the question matrix used in the test instrument:

| No           | Indicator | Number of Items | Question Numbers   |
|--------------|-----------|-----------------|--------------------|
| 1            | C1        | 5               | 1, 6, 14, 17, 18   |
| 2            | C2        | 6               | 2, 4, 7, 9, 15, 19 |
| 3            | C3        | 5               | 5, 11, 12, 16, 20  |
| 4            | C4        | 4               | 3, 8, 10, 13       |
| <b>Total</b> |           | <b>20</b>       |                    |

### Data Collection

Data were collected through pretests and posttests to evaluate students' learning outcomes. The pretest was administered to assess students' initial knowledge, while the posttest was conducted after the implementation of Google Sites with the Problem-Based Learning model in the experimental group and PowerPoint with the same model in the control group. Both tests aimed to measure changes in students' knowledge of the topics of momentum and impulse. The instrument used was a multiple-choice test, which was administered by the researcher in both the experimental and control classes during the 2024/2025 semester at SENIOR HIGH SCHOOL 1 Darul Imarah. The collected data were used to analyze students' learning outcomes after the implementation of Google Sites-based learning and PowerPoint.

### Data Analysis

In this study, the data analysis aims to test the validity of the instruments, conduct prerequisite tests, and perform hypothesis testing, aligned with the research objective. The data analyzed are quantitative data, specifically the results of students' learning tests.

- **Instrument Validity Test**

To confirm the instrument's accuracy, validity tests were performed by two experts, with the instrument deemed valid if the scores met the "Very Valid" or "Valid" criteria in the table below.

| Score Range                    | Interpretation |
|--------------------------------|----------------|
| $3.25 < \text{skor} \leq 4.00$ | Very Valid     |

|                                |            |
|--------------------------------|------------|
| $2.25 < \text{skor} \leq 3.25$ | Valid      |
| $1.70 < \text{skor} \leq 2.25$ | Less Valid |
| $1.00 < \text{skor} \leq 1.70$ | Invalid    |

Source: Ratumanan & Laurens (2011)

In this study, the validity scores from the expert evaluations were above 3.25, meaning the instrument is categorized as **Very Valid**.

- Prerequisites Data Tests

Before hypothesis testing, the normality and homogeneity tests were conducted to ensure the data met the assumptions of the t-test:

- Normality Test:** Using the Chi-Square test to check whether the data follow a normal distribution.
- Homogeneity Test:** Using the F-test to ensure the variances between groups are equal.

- Hypothesis Testing

After passing the prerequisite tests, an **Independent Samples t-Test** is conducted to assess the difference in learning outcomes between the experimental and control groups. The formula used for the t-test is:

$$t_{\text{count}} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2} \left( \frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

(Sugiyono, 2019:263)

This test is performed to determine whether there is a significant difference between the two groups at the 0.05 significance level. If  $-t_{(1-1/2\alpha)} > t_{\text{count}} > t_{(1-1/2\alpha)}$ , the null hypothesis ( $H_0$ ) is rejected, indicating that there is a significant difference between the two groups.

## RESULTS AND DISCUSSION

### Results

This study aimed to investigate the effect of Google Sites-based physics learning media integrated with the Problem-Based Learning model on students' learning outcomes in the topic of momentum and impulse for class XI students at SENIOR HIGH SCHOOL 1 Darul Imarah.

- Validity Test

Here are the results of the validity test for the instruments used in this study

**Table 3.** Validity of Instruments

| No | Type of Instrument    | Average Rating | Category   |
|----|-----------------------|----------------|------------|
| 1  | Teaching Module       | 3.58           | Very Valid |
| 2  | Learning Media        | 4.47           | Very Valid |
| 3  | Learning Outcome Test | 3.79           | Very Valid |

Source: Validated by experts, 2024 (data processed)

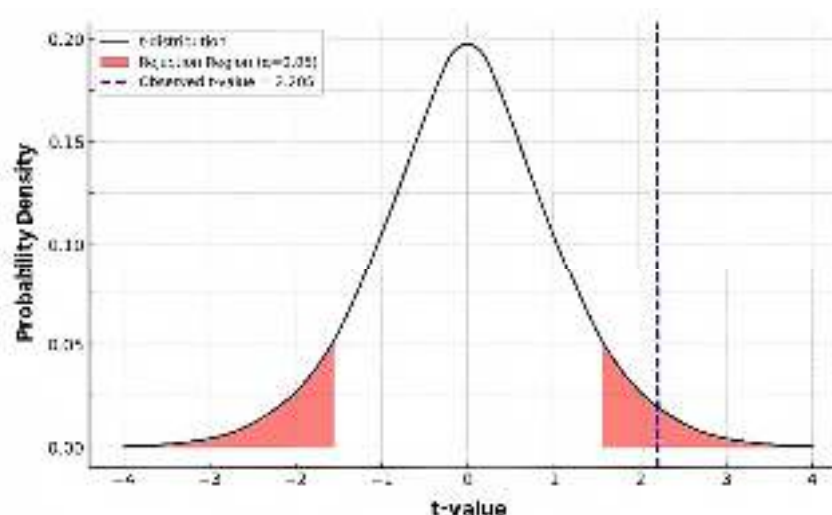
- Hypothesis Test Results

The following table presents the results of the t-test comparing the learning outcomes between the experimental group using Google Sites and the control group using PowerPoint:

**Table 4.** Hypothesis Test Results

| Group              | n  | Mean ( $\bar{x}$ ) | S      | $t_{\text{count}}$ | $t_{\text{table}}$ | Conclusion          |
|--------------------|----|--------------------|--------|--------------------|--------------------|---------------------|
| Experimental Class | 34 | 83.12              | 11.631 | 2.205              | 1.996              | Hypothesis Accepted |
| Control Class      | 35 | 76.94              |        |                    |                    |                     |

The calculated t-value (2.205) is greater than the critical t-value (1.996) at a 0.05 significance level, indicating a significant difference between the two groups.



**Figure 1.** Two-Tailed t-Test Distribution Curve

Based on the results of the research data analysis, the two-tailed t-test showed a significant difference between the learning outcomes of students in the experimental class, which used physics learning media based on google sites with a problem-based learning model and the control class using a powerpoint presentation with a problem-based learning model. The t-value of 2.205 is greater than  $\pm t(1-1/2\alpha)$  of  $\pm 1.996$  at a significance level of 5% (with  $\alpha/2 = 2.5\%$  in each tail for a two-tailed t-test). Thus, the null hypothesis ( $H_0$ ), which states that there is no difference in learning outcomes between students in the two classes, is rejected. This shows that physics learning media based on google sites using a problem-based learning model has a significant effect on learning outcomes in the momentum and impulse material.

## Discussion

The analysis results indicate that the use of Google Sites as an instructional medium integrated with the Problem-Based Learning model has a significant effect on student learning outcomes in the topic of momentum and impulse among 11th-grade students at Senior High School 1 Darul Imarah. This aligns with the research objective, which aimed to determine the difference in learning outcomes between the experimental class using Google Sites and the control class using PowerPoint. The findings suggest that Google Sites yields better learning outcomes than PowerPoint.

The primary reason for this outcome is that Google Sites allows for interactive features and easier access, which supports a more active and collaborative learning environment. This facilitates increased student engagement in the learning process, whereas PowerPoint tends to be more static, potentially limiting active participation and interaction. Thus, the independent variable (Google Sites-based learning media with the Problem-Based Learning model) has a positive effect on the dependent variable (learning outcomes).

The relationship between these findings and previous studies is also noteworthy. Research by Islanda and Darmawan (2023) found that technology-based media like Google Sites can positively impact student learning outcomes, while Mirani (2023) showed that the Problem-Based Learning model, supported by interactive media, enhances learning outcomes more effectively than media that do not promote active student interaction. Therefore, these findings are consistent with previous studies emphasizing the importance of interactive media in learning.

However, this study is limited to the short-term effects of using this instructional media. Further research is recommended to explore the long-term impact of using Google Sites with the Problem-Based Learning model on student learning outcomes in various learning contexts and conditions.

## CONCLUSION

Based on the research results, it can be concluded that the use of Google Sites as a learning medium integrated with the Problem-Based Learning (PBL) model significantly improves student learning outcomes on momentum and impulse material in class XI at SMA Negeri 1 Darul Imarah. This is due to the interactive and easily accessible nature of Google Sites, which encourages higher student engagement and collaboration compared to more static media such as PowerPoint. The findings of this study align with previous research emphasising the importance of using technology-based and interactive learning media to improve learning outcomes. However, this study only examined short-term effects, so further research is recommended to explore the long-term impact of using Google Sites integrated with the PBL model across various subjects and learning contexts.

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