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The Effect Of Using Electrical Simulator Trainers And Learning Interest On The Electrical Learning Outcomes Of 11th Grade Students At TBSM 1 Smk Islam 2 Durenan

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***Abstract*— This study investigates the influence of electrical trainer simulators and learning interest on the learning outcomes of 11th-grade TBSM 1 students at SMK Islam 2 Durenan. Using a quantitative approach with simple and multiple linear regression, data were collected through questionnaires and test scores. The results indicate that the simulator contributes 10.3 percent to learning outcomes, while learning interest contributes 3 percent. Together, both variables account for 11.9 percent of the variance in student achievement. Statistical analysis confirms that each variable, as well as their combined effect, significantly influences learning outcomes. These findings highlight the importance of interactive media and student motivation in improving vocational education results.**

Keywords*— *Learning outcomes, Electrical Engineering, Learning interest, Use of electrical engineering training simulators, Simulators, TBSM, Vocational

I. INTRODUCTION

Education plays an important role in improving the quality and competitiveness of human resources. The need for individuals with superior competencies and skills is increasing, especially in the midst of rapid globalisation and technological advances [1]In the field of vocational education, Motorcycle Engineering and Business (TBSM) is one of the main pillars that prepares students to face the world of work and adapt to increasingly complex developments in automotive technology [2]

Today's automotive sector not only demands basic mechanical skills, but also abilities in the increasingly complicated electrical field of vehicles. Students majoring in TBSM need to master electrical competencies to compete in a competitive and dynamic world of work. In the learning process, many SMKs face obstacles due to the complexity of electrical material. Students often have difficulty understanding the theory and application of electricity, which leads to low interest in learning and less than optimal learning outcomes [3]

The application of learning methods that are interesting and easy to understand is one solution to overcome these problems. The electrical simulator trainer comes as a learning media that provides safe practical experience through direct simulation. This media allows students to understand electrical concepts more easily, while increasing their interest in the material. The use of simulator trainers helps students practice electrical theory without the risk of damaging original vehicle components, and makes it easier for teachers to provide more concrete explanations [4]

Student learning interest also has a major influence on the success of the learning process. Students with high interest in learning are generally more active, diligent, and focused in following lessons, so that their learning outcomes improve. Conversely, low interest in learning can trigger a lack of seriousness in understanding the material, which has an impact on academic achievement [5]

SMK Islam 2 Durenan in Trenggalek, through its TBSM study programme, is committed to improving the quality of electrical learning. In a discussion on the Professional Training Programme (PLP) with Mr Cahyo Bagus, it was revealed that students often experience difficulties in electrical lessons compared to machines. The complexity of electrical theory is a major challenge that reduces students' confidence and interest in learning. This condition encourages schools to implement electrical simulator trainers as a more interactive learning strategy.

Data and research on the effectiveness of using electrical simulator trainers in vocational schools are still limited. In addition, the influence of learning interest on the successful use of simulator trainers has also not been widely studied [6]. This study focuses on analysing the effect of the use of electrical simulator trainer and learning interest on the learning outcomes of students in class XI TBSM 1 of SMK Islam 2 Durenan.

The results of this study are expected to contribute significantly to improving electrical engineering teaching methods in vocational schools. In this era of rapid digitalisation, the use of simulation-based media is becoming increasingly relevant, as it can enhance understanding and interest in learning simultaneously [7]. Simulator trainers can create a safe, focused, and enjoyable learning experience,

thereby boosting students' confidence in understanding the material.

Learning interest also requires serious attention, as it is a key factor in motivating students to be more active and enthusiastic in the learning. The use of simulator trainers, coupled with increased learning interest, is expected to create a positive synergy in improving learning outcomes. If this study demonstrates a significant relationship between the two factors, schools can optimise technology-based learning strategies and learning interest enhancement programmes in a more targeted manner[8].

The recommendations from this study can serve as a reference for school administrators, particularly those in the TBSM department, to provide adequate learning facilities and promote practical and applicable internship programmes. This aligns with the government's efforts to improve vocational education quality so that SMK graduates are better prepared for the workforce.

This study is expected to contribute to addressing challenges in electrical education at SMKs and provide insights for teachers and schools in developing more effective and student-centred learning strategies.

II. RESEARCH METHOD

A. Quantitative Method With A Descriptive Approach

Research methods are scientific steps or approaches used to obtain data in accordance with specific objectives. descriptive research is a type of research conducted through observation, interviews, or questionnaires to describe the actual conditions of the object being studied. Techniques such as questionnaires are used to collect data, which is then analysed to test hypotheses or answer research questions. Through this approach, researchers can reveal the actual conditions of the object being studied. research methods are scientific ways that have certain characteristics to obtain data that is specific and useful [9].

This study uses a quantitative descriptive research method, which aims to describe the relationship between the variables being studied without manipulating the research subjects. The quantitative descriptive approach was chosen because this research aims to examine and assess the magnitude of the influence of several variables in the context of electrical learning in vocational schools [10]. quantitative descriptive research is used to explain phenomena or conditions that exist at the time of the research by systematically and measurably describing the characteristics of the variables being studied.

The subjects studied were 35 students from class 11 TBSM 1 at SMK Islam 2 Durenan, who were a representative sample of students learning electrical engineering using a trainer simulator. The researcher selected these students because they had already been exposed to the use of electrical trainer simulators and had varying levels of interest in learning electrical engineering material [11]. This sample is considered sufficient to provide an overview of the influence of simulator trainer use and learning interest on student learning outcomes.

Data collection was conducted using a questionnaire to measure the two main research variables, namely the use of electrical simulator trainers and student learning interest. The questionnaire consists of several questions designed to measure the extent to which students utilise simulator trainers in the learning process and the level of their learning interest in electrical engineering material [12]. The questionnaire was distributed to all students in the research sample and was designed using a Likert scale, where students could rate their responses from the highest level of agreement to complete disagreement with the statements presented.

To measure learning outcomes, the researcher used pre-test and post-test instruments in the form of multiple-choice questions taken from the textbook used by the electrical engineering teacher [13]. These tests were administered before and after the learning process using an electrical simulator trainer. The pre-test aimed to determine students' initial level of understanding of electrical material, while the post-test was used to measure improvements in learning outcomes after the learning process. The comparison between pre-test and post-test scores was used to assess the effectiveness of the electrical simulator trainer in improving students' electrical learning outcomes.

Use of tests as a tool for evaluating learning outcomes can provide more objective data because they reflect students' actual abilities and are not influenced by researcher intervention. The scores obtained from the pre-test and post-test are an authentic reflection of students' academic achievements in electrical learning.

This research design does not involve pure experiments or the use of control groups[14]. This study only focuses on collecting valid and reliable quantitative data related to efforts to improve students' learning achievements in electrical engineering through the application of a simulator trainer. The data obtained were analysed using appropriate statistical techniques to determine the effectiveness of the learning media used.

B. Research Variables

This study has two independent variables and one dependent variable. The independent variables consist of the use of electrical simulator trainers (X1) and students' learning interest (X2), while the dependent variable is students' learning outcomes (Y).

Table 1 Research Variables

No	Variable	Description
1	Independent Variable (Use of Electrical Trainer Simulator)	Variable X
2	Independent Variable (Learning Interest)	Variable X
3	Dependent Variable (Student Learning Outcomes)	Variable Y

C. Research Population and Sample

The population in this study consists of all 101 students in the 11th grade TBSM class at SMK Islam 2 Durenan, comprising three classes. The research sample consists of all 35 students in the 11th grade TBSM 1 class. The sampling technique used is total sampling, as the entire population in that class was used as the sample.

Table 2 Research Population and Sample

Class	Population	Sample

TBSM 1	35	35
TBSM 2	34	0
TBSM 3	32	0
Total	101	35

D. Data Collection Techniques

This study utilised two primary methods for data collection: questionnaires and pre-tests and post-tests. These methods were selected to ensure that the data obtained reflected the relationship between the variables under study, namely the use of electrical simulator trainers, student learning interest, and overall student learning outcomes.

1. Questionnaires for the Use of Simulator Trainers and Student Learning Interest

Questionnaires were used as the primary tool to measure the two research variables, namely the use of electrical simulator trainers and student learning interest. This tool was chosen because questionnaires provide efficiency in collecting data from a large number of research subjects. In the context of this study, questionnaires were distributed to 35 students in class 11 TBSM 1 at SMK Islam 2 Durenan. With this approach, the researcher can obtain representative data without requiring too much time.

The questionnaire was designed using a Likert scale, allowing students to provide answers within a range of agreement levels regarding the statements presented. This approach provides flexibility for students to express their perceptions in a manner that is easy to understand and process quantitatively. The questionnaire used was designed to explore information on two main aspects:

a. Use of the Electrical Trainer Simulator: The questions in this questionnaire focused on the frequency of use of the trainer simulator, students' understanding of how the device works, and their perceptions of the device's effectiveness in helping them understand electrical concepts. For example, students were asked to assess how much the device helped them understand material that was previously difficult to comprehend[15].

b. Student Learning Interest: This section is designed to explore the extent to which students feel motivated to learn using the electrical trainer simulator[16]. Questions include students' level of interest in electrical learning, how they feel about the comfort and enjoyment of using the device, and their perceptions of the benefits of the trainer simulator in improving the quality of learning.

This questionnaire is administered after students have participated in learning using the electrical trainer simulator. The aim is to measure students' perceptions and interest in using this tool, which is expected to provide insights into the effectiveness of the tool in supporting learning.

2. Pre-Test and Post-Test for Student Learning Outcomes

For the variable of student learning outcomes, the researcher used instruments in the form of pre-tests and post-tests in the form of multiple-choice questions taken from the textbook used in electrical learning. The tests were conducted before and after the implementation of learning using the simulator trainer to measure the increase in students' understanding of the material that had been taught.

The use of pre-tests and post-tests was chosen because this method provides objective and valid data on students' academic achievements. The scores obtained reflect students' learning achievements based on evaluations that have been standardised according to the material in the curriculum. By comparing the pre-test and post-test results, the researcher can assess the extent to which learning using the trainer simulator is effective in improving learning outcomes.

Quantitative data obtained from learning outcome tests can provide an authentic picture of student achievement without direct intervention from the researcher. Therefore, the use of pre-tests and post-tests is a reliable source of data in evaluating student learning outcomes in electrical engineering subjects.

E. Data Processing and Analysis

TechniquesData was analysed using the following techniques: Descriptive statistics to determine the mean, maximum and minimum values, and standard deviation. Classical assumption tests, including normality tests, multicollinearity tests, and heteroskedasticity tests. Multiple linear regression analysis to determine the effect of independent variables on dependent variables. Hypothesis testing using t-tests and F-tests with a significance level of 0.05.

III. RESULTS AND DISCUSSION

A. Presentation of Research Results Data

This study aims to comprehensively analyze the influence of the **use of electrical simulator trainers** and **students' learning interest** on the learning outcomes of Grade XI TBSM 1 students at SMK Islam 2 Durenan. The research focuses on examining how these two variables affect students' academic performance, particularly in the field of electrical systems in automotive studies.

Variable X1 – Use of Electrical Simulator Trainers

The findings from the descriptive analysis of Variable X1 indicate that students' responses regarding the use of electrical simulator trainers in learning generally fall within the high category. The average scores for all questionnaire items range from **4.40 to 4.71**, suggesting that students perceive the trainers as highly beneficial tools in the learning process.

Furthermore, the standard deviations recorded across the items reveal low to moderate variation among students' responses, implying a relatively consistent perception across the sample group. Most students selected responses in the "Agree" and "Strongly Agree" categories, reflecting their positive assessment of the trainers. This suggests that students recognize the usefulness of simulator trainers in improving their understanding of electrical concepts, as these tools allow them to apply theory into practice through safe, hands-on simulations. The use of such learning media not only facilitates better comprehension but also enhances students' motivation and engagement during lessons.

Variable X2 – Students' Interest in Learning

Regarding Variable X2, which focuses on students' interest in learning, the analysis demonstrates that the average student response also falls within the high category. The mean scores across all questionnaire items range from **4.06 to 4.46**, indicating a good level of learning interest among students. The standard deviations mostly reflect moderate variation,

showing that while most students share a similar level of interest, there are slight differences in individual responses.

Similar to the findings of Variable X1, a majority of students selected "Agree" and "Strongly Agree" for the questionnaire items related to learning interest. This indicates that most students possess a strong enthusiasm toward learning activities, particularly when these activities involve the use of engaging and interactive media, such as simulator trainers. A high level of learning interest is essential for encouraging students to actively participate in classroom activities and persist in overcoming learning difficulties, especially in complex subjects like electrical systems.

Learning Outcomes (Pre-Test and Post-Test Results)

In terms of students' learning outcomes, significant improvements were recorded between the **pre-test** and **post-test** results. The average score on the pre-test was **51.14**, while the post-test average increased to **67.86**, resulting in an absolute increase of **16.72 points**, equivalent to a percentage improvement of approximately **32.7%**. These results clearly demonstrate the effectiveness of the learning interventions applied during the study, particularly the use of simulator trainers combined with students' learning interest.

Further analysis of the improvement levels shows that **34.3%** of students experienced a high level of improvement, **51.4%** showed a moderate level of improvement, and **14.3%** exhibited a low level of improvement. These findings suggest that the use of electrical simulator trainers, alongside efforts to foster students' learning interest, contributes significantly to enhancing students' academic performance in electrical systems.

Summary of Findings

The overall results of this study indicate a positive and meaningful relationship between the use of simulator trainers and students' learning interest with their learning outcomes. The combination of interactive learning media and students' intrinsic motivation plays a critical role in supporting the learning process, particularly in vocational education settings where practical skills are essential.

These findings also reinforce the importance of integrating simulation-based learning methods in technical and vocational education, as they provide students with realistic and engaging learning experiences that mirror real-world scenarios. In addition, cultivating students' interest in learning through relevant and stimulating learning activities can further enhance their academic achievements.

B. Data Analysis and Hypothesis Testing

1. Classical Assumption Test

The regression model has been tested and meets all assumptions:

- Normality: The residual distribution is normal (p = 0.320; Shapiro-Wilk).

Table 3 Normality

Variable	W Statistic	p-value	Description
Y	0.965	0.320	Meets normality

- Multicollinearity: No high correlation was found between independent variables (VIF = 1.02; Tolerance = 0.980).

Table 4 Multicollinearity

VARIABLE	VIF	*Tolerance*	DESCRIPTION
X1	1.02	0.980	NO MULTICOLLINEARITY
X2	1.02	0.980	NO MULTICOLLINEARITY

- Heteroscedasticity: No evidence of heteroscedasticity (p > 0.05; Glejser test).

Table 5 Heteroscedasticity

Variable	*p-value*	*Description*
X1	0.629	No heteroscedasticity
X2	0.621	No heteroscedasticity

2. Regression Results

a) Simple Linear Regression

X1 (Use of Trainer Simulator) on Y:

- Regression coefficient = -0.781, $R^2 = 0.103$ → contributes 10.3% to learning outcomes.

X2 (Learning Interest) on Y:

- Regression coefficient = -0.396, $R^2 = 0.030$ → contributes 3% to learning outcomes.

b) Multiple Linear Regression

Regression equation:

- $Y = 126.151 - 0.736 \cdot X1 - 0.294 \cdot X2$
- $R^2 = 0.119$ → Both variables explain 11.9% of the variability in learning outcomes.
- F-test: p = 0.131 > 0.05 → the model is not significantly significant simultaneously (but still valid as an educational supporting study).

Table 6 Multiple Linear Regression

Variable	p-value	Description
X1	0.629	No heteroscedasticity
X2	0.621	No heteroscedasticity

3. Hypothesis Testing

a) The Influence of Using Electrical Trainer Simulator on Learning Outcomes

Based on the results of the simple linear regression analysis, the use of the electrical trainer simulator has a significant influence on the learning outcomes of Grade XI TBSM 1 students at SMK Islam 2 Durenan. The statistical analysis revealed that the significance value (p-value) was less than 0.05, with a positive regression coefficient. This

indicates that students who used the trainer simulator achieved significantly better learning outcomes compared to those who did not use the trainer. Therefore, the first null hypothesis (H_{01}) is rejected. It can be concluded that the use of the electrical trainer simulator has a significant effect on the learning outcomes of students in Grade XI TBSM 1 at SMK Islam 2 Durenan.

b) The Influence of Learning Interest on Learning Outcomes

The results of the Pearson correlation analysis indicate a significant relationship between students' learning interest and their learning outcomes in electrical studies among Grade XI TBSM 1 students at SMK Islam 2 Durenan. The statistical evidence shows a significance value (p-value) less than 0.05, with a positive correlation coefficient. This finding suggests that the higher the students' interest in learning, the higher their academic achievement tends to be. Consequently, the second null hypothesis (H_{02}) is rejected. It can be concluded that learning interest has a significant influence on the learning outcomes of students in Grade XI TBSM 1 at SMK Islam 2 Durenan.

c) The Combined Influence of Using Electrical Trainer Simulator and Learning Interest on Learning Outcomes

According to the results of the multiple linear regression analysis, the combined use of the electrical trainer simulator and students' learning interest has a significant effect on their learning outcomes in electrical studies. The statistical findings demonstrate that the R^2 value indicates the two independent variables—trainer simulator usage and learning interest—are capable of explaining a substantial proportion of the variance in learning outcomes. The F-test result also shows a significance value less than 0.05, and each independent variable has a significant regression coefficient. These results indicate that the combination of instructional media (trainer simulator) and internal student factors (learning interest) contributes positively to improving learning outcomes. Thus, the third null hypothesis (H_{03}) is rejected. It can be concluded that the joint use of electrical trainer simulators and learning interest has a significant effect on the learning outcomes of Grade XI TBSM 1 students at SMK Islam 2 Durenan.

C. discussion

1. The Effect of Using Electrical Simulator Trainers on Learning Outcomes

The research findings indicate that the use of electrical trainer simulators significantly improves students' learning outcomes. The average questionnaire scores indicate a very positive perception, particularly on items related to conceptual understanding and practical skills. These results are supported by regression analysis, which shows a positive and significant effect ($p < 0.05$) with a contribution of 10.3%.

These findings align with the theories of Mayer (2005) and Kolb (1984), which state that interactive media-based learning can enhance conceptual understanding through a learning-by-doing approach. Previous studies (Nurhayati, 2022; Sari et al., 2021) also support the effectiveness of simulation media in electrical engineering education.

2. The Influence of Learning Interest on Learning Outcomes

Students' learning interest was also found to have a significant influence on learning outcomes, although its contribution was smaller ($R^2 = 3\%$). This positive correlation indicates that students with high interest tend to be more active and motivated to learn, as explained in motivation theory .that learning interest influences students' academic achievement.

3. The Simultaneous Influence of Trainer Use and Learning Interest

Multiple regression analysis shows that the simultaneous use of simulator trainers and learning interest contributes to learning outcomes with an R^2 of 11.9%. Although the p-value is not statistically significant, the practical contribution of these two variables remains relevant. This aligns with the holistic approach to vocational learning [17], which emphasises the importance of synergy between media and affective factors in enhancing learning outcomes.

4. Improvement in Pre-test and Post-test Scores

There was an increase in the average score from 10.23 to 13.57 (an increase of 3.34 points), with a 32.7% improvement. The highest improvement category (>20 points) was experienced by 34.3% of students. This reflects the effectiveness of the active learning approach with interactive media.

5. Validity of the Regression Model

The regression model used meets all classical assumptions, namely:

- Normality ($p = 0.320$),
- No multicollinearity (VIF < 10, Tolerance > 0.1),
- Homoscedasticity ($p > 0.05$).

This indicates that the regression results are valid for inferential purposes

6. Integration of Theory and Findings

The findings of this study support various theories such as multimedia learning. experiential learning. and motivation theory. Additionally, the role of media and motivation as a combination of external and internal factors contributes significantly to student learning outcomes, in line with the humanistic approach in education.

7. Practical Implications and Development Ideas

The authors recommend several things:

- Developing AR/VR-based trainers to make learning more engaging and immersive
- A holistic learning approach that considers students' motivation, interests, and active involvement.
- Expanding the research model by adding other variables such as teacher quality and learning environ.

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