Circuit: Jurnal Ilmiah Pendidikan Teknik Elektro
Volume 10 No. 2, March - August 2026
ISSN: 2549-3698; E-ISSN: 2549-3701
DOI: 10.22373/crc.v10i2. 32535

Development and Implementation of a PSIM-Based Learning Module for Electrical Circuits Education

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Submitted: 29-10-2025 Accepted: 27-06-2026 Published: 31-08-2026

Abstract

Instruction in the Electrical Circuits course requires graphical simulations to visualize circuit concepts without the need for physical hardware. The PSIM application module serves as an alternative tool to support simulation-based learning in this course. This study aimed to implement the PSIM application module to improve student learning outcomes and to investigate student responses to its implementation. A quantitative approach was employed, utilizing a quasi-experimental, one-group pretest-posttest design. Research instruments consisted of a learning achievement test and a response questionnaire, both validated by experts. The results showed that the average pretest score of 45.23 increased to 69.76 in the posttest. This improvement indicates that the implementation of the PSIM application module contributed to enhanced student learning outcomes. Questionnaire data also revealed a positive student response to the module, with a 79% rating falling into the high category. Thus, it can be concluded that the implementation of the PSIM-based learning module was associated with a significant improvement in students' learning outcomes in the Electrical Circuits course within the Electrical Engineering Education Study Program.

Keywords: *PSIM application module, learning outcomes, electrical circuits.*

Abstrak

Pembelajaran mata kuliah Rangkaian Listrik memerlukan simulasi grafis untuk memvisualisasikan konsep rangkaian tanpa harus mengunakan perangkat fisik. Modul aplikasi PSIM menjadi alternatif untuk mendukung simulasi dalam pembelajaran mata kuliah tersebut. Penelitian ini bertujuan untuk menerapkan modul aplikasi PSIM guna meningkatkan hasil belajar mahasiswa dan untuk menginvestigasi respon mahasiswa terhadap penerapan modul tersebut. Jenis penelitian yang digunakan adalah pendekatan kuantitatif dengan desain kuasi-eksperimen one group pretest dan posttest. Instrumen penelitian berupa tes hasil belajar dan angket respon yang telah divalidasi oleh ahli. Hasil penelitian menunjukkan bahwa nilai rata-rata pretest sebesar 45,23 meningkat menjadi 69,76 pada posttest. Peningkatan ini menunjukkan bahwa penerapan modul aplikasi PSIM berkontribusi terhadap perbaikan hasil belajar mahasiswa. Data angket juga menunjukkan bahwa mahasiswa memberikan respons positif terhadap modul, dengan persentase 79% yang termasuk dalam kategori tinggi. Dengan demikian, modul aplikasi PSIM dapat disimpulkan sebagai media pembelajaran yang efektif untuk mendukung peningkatan hasil belajar mahasiswa pada mata kuliah Rangkaian Listrik di Program Studi Pendidikan Teknik Elektro.

Kata kunci: Modul aplikasi PSIM, Hasil Belajar, Rangkaian Listrik.

Introduction

Rapid technological development and increasing industrial demands have compelled engineering education institutions to continuously refine their teaching strategies and learning resources in order to produce graduates with competencies aligned with current workforce needs [1], [2], [3]. The Electrical Engineering Education program at Ar-Raniry State Islamic University, Banda Aceh, is tasked with equipping students with both theoretical understanding and hands-on competencies in electrical and electronic engineering. Among the core courses in the curriculum, Electrical Circuits constitutes a fundamental subject that supports the understanding of more advanced electrical engineering concepts. Prior research indicates that simulation-based instructional media, including PSIM, are effective in improving students' understanding and learning achievement in electrical learning contexts[4], [5], [6], [7].

Despite its pedagogical significance, Electrical Circuits is widely recognized as a challenging subject for many students because its core concepts, including voltage, current, resistance, and circuit behavior, are abstract and difficult to represent through traditional instruction alone [8], [9], [10]. This often prevents students from effectively linking theoretical knowledge to practical problem solving. Moreover, inadequate laboratory facilities and limited access to experimental equipment restrict opportunities for hands-on practice, which may negatively influence students' conceptual understanding and learning motivation [9], [11], [12].

To address these challenges, simulation-based learning has emerged as an effective instructional approach in engineering education. Simulation software allows students to visualize circuit behavior, conduct virtual experiments, and explore the relationships among electrical parameters without requiring physical laboratory equipment [6], [13], [14]. Through simulation activities, students can directly observe how changes in circuit components and operating conditions affect circuit behavior, thereby strengthening their conceptual understanding of electrical phenomena.

One of the simulation tools widely used in electrical engineering education is PSIM (Power Simulation). PSIM provides a user-friendly environment for designing, simulating, and analyzing electrical circuits and power electronic systems. Previous studies have reported that simulation-assisted learning can improve students' conceptual understanding, problem-solving skills, and engagement in engineering courses [14], [15], [16]. The integration of simulation software into instructional activities enables students to actively construct knowledge through experimentation and visualization, making abstract concepts more accessible and meaningful [17], [18].

In this study, a PSIM-based learning module was developed and implemented as a structured instructional guide consisting of theoretical explanations, guided simulation activities, circuit analysis exercises, and independent learning tasks. Through the module, students were trained to design, simulate, and analyze series, parallel, and mixed electrical circuits using the PSIM environment. Student learning outcomes were assessed in terms of conceptual understanding, circuit analysis skills, voltage-current calculations, and interpretation of simulation results. The effectiveness of the module was evaluated through pre-test and post-test assessments, while students' perceptions toward the learning process were measured using a response questionnaire.

Although previous studies have demonstrated the educational benefits of simulation software, most investigations have focused on the use of simulation tools as supplementary learning media [19], [20], [21]. Research on the implementation of a structured PSIM-based learning module specifically designed for Electrical Circuit courses in Electrical Engineering Education programs remains limited. In addition, studies that simultaneously evaluate both learning achievement and student responses are still scarce. Therefore, this study aims to address this gap by evaluating the effectiveness of a PSIM-based learning module in enhancing student learning outcomes and by analyzing students' responses to its implementation in the Electrical Circuits course.

Literature Review

a. Learning Module

Learning modules are teaching materials that are designed in a structured manner to support students in studying a topic independently [22]. This module typically comprises theoretical explanations, illustrative examples, practice exercises, and assessment components that collectively support the deepening of students' understanding. Learning modules are effective in improving students ' understanding because they allow them to learn at their own pace and style [23]. In the context of learning Electrical Engineering, modules that use simulation applications such as PSIM help students understand electrical concepts through practical experience. These modules not only emphasize theoretical content but also enable students to directly apply and test these concepts through simulation-based activities. The use of application-based modules provides students with the opportunity to independently understand the effects of variable changes on electrical circuits.

b. Electrical circuits

An electrical circuit is a path or circuit that can flow electron charges from a voltage source or electric current [23]. The process of electron movement is what is called electricity. *Electrons* can flow in conductive materials. A circuit can be divided into two types of components, namely active and passive components. Active components are components that produce their own energy, in this case the active components can be current and voltage sources is shown in Figure 1[24].

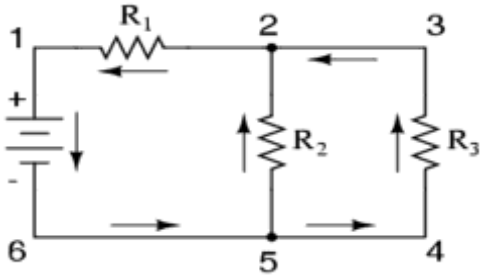


Figure 1. Electrical Circuit

c. Series Circuit

Circuit is a type of electrical circuit in which electrical components, such as resistors, lamps, capacitors, or voltage sources, are connected sequentially or linearly, so that the electric current flowing through each component has the same path [25]. In a series circuit, the end of the first component is connected to the beginning of the next

component, and this process continues until all components are connected in a single path. Consequently, if one component in a series circuit is disconnected or damaged, the flow of electricity to the entire circuit will stop. The image of a series electrical circuit is shown in Figure 2:

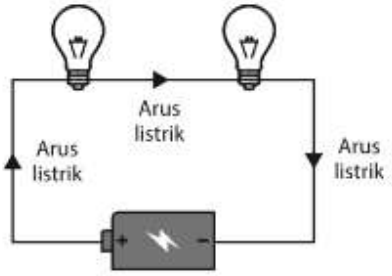


Figure 2. Series Electrical Circuit

d. Parallel Circuit

Circuit is a type of electrical circuit in which components such as resistors, lamps, capacitors, or power sources are connected side by side so that each component has its own path that is directly connected to the voltage source [26]. In a parallel circuit, each component is connected separately, resulting in the same voltage across every component as the source voltage, while the current through each component may vary according to its resistance or impedance. If one component in a parallel circuit is disconnected or damaged, the other components can still function because their current paths are not interrupted. The image of a parallel electrical circuit is shown in Figure 3:

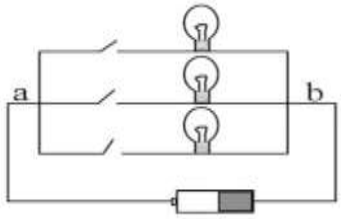


Figure 3. Parallel electrical circuit

e. Mixed Circuit

Circuit is an electrical circuit that consists of a combination of series and parallel circuits [27]. In this circuit, some electrical components such as resistors, lamps, capacitors, or other elements are connected in series, while other components are connected in parallel. Mixed circuits are designed to utilize the advantages of both types of circuits, series and parallel, while reducing weakness each [28]. Image series electricity the mixture is shown in Figure 4.

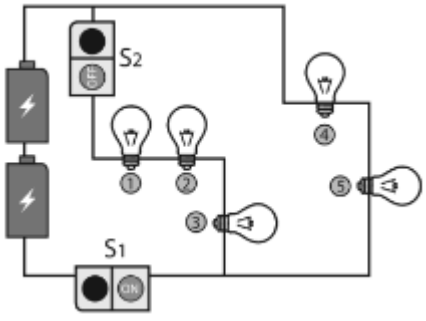


Figure 4. Mixed Electrical Circuit

f. PSIM

PSIM or *Power Simulation* is a simulation *software* created to model electrical circuits. This application allows users to design, test, and modify electrical circuits in a virtual environment. PSIM is equipped with graphical features that make it easier for students to see the interactions between components in an electrical circuit and analyze currents, voltages, and the impact of changes in component parameters. The following is an example of a circuit in PSIM software is shown in Figure 5.

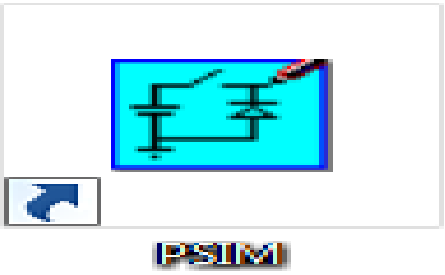


Figure 5. PSIM *Software Icon*

Several studies have demonstrated the effectiveness of simulation-based learning in engineering education. The integration of PSIM software improved students' understanding of power electronics concepts and helped optimize learning in electrical engineering courses. Similarly, the use of PSIM improved students' learning outcomes in basic electricity and electrical measurement, indicating that simulation software can support conceptual visualization and facilitate circuit analysis. These findings suggest that simulation-based tools can bridge the gap between theoretical concepts and practical applications [5], [29].

Despite these positive findings, previous studies primarily investigated PSIM as a standalone simulation tool or instructional medium. Consequently, students were generally required to explore the software independently, with limited pedagogical guidance. In contrast, the present study implements a structured PSIM learning module that integrates theoretical explanations, guided simulations, problem-solving exercises, and independent learning activities. Such an approach is expected to provide a more systematic learning experience by supporting students throughout the learning process rather than relying solely on software interaction.

This instructional design is grounded in constructivist learning theory, which emphasizes that students actively construct knowledge through exploration, experimentation, and reflection. By combining simulation activities with structured learning guidance, the PSIM learning module is expected not only to improve students' conceptual understanding of Electrical Circuits but also to enhance learning engagement and overall learning outcomes.

Method

a. Research Design

This study employed a quantitative approach using a quasi-experimental design with a one-group pretest–posttest design. The design was selected to evaluate the effectiveness of the PSIM learning module by comparing students' learning outcomes before and after the instructional intervention [30], [31]. The research was carried out in

three phases: (1) a pre-test to gauge students' baseline knowledge of Electrical Circuits, (2) the integration of a PSIM-based learning module during instruction, and (3) a post-test to evaluate improvements in learning outcomes. At the end of the intervention, students completed a response questionnaire to assess their perceptions of the learning module. The overall research procedure is presented in Figure 6.

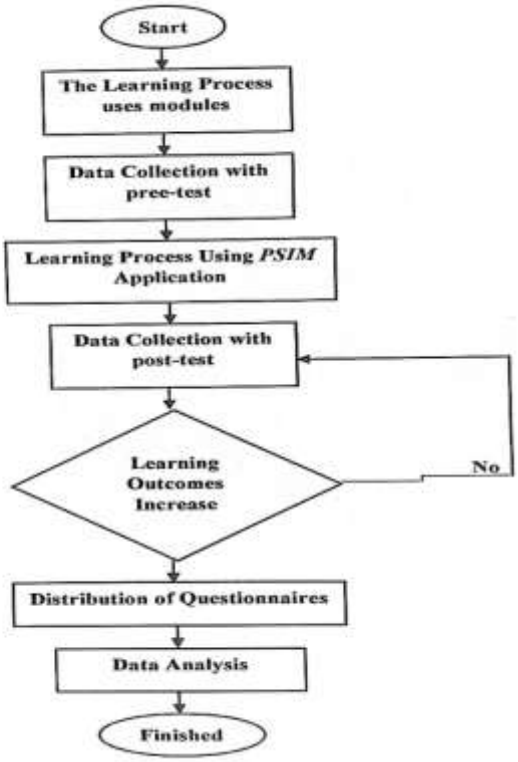


Figure 6. Research Design Flowchart

b. Research Population and Sample

The study population consisted of all students enrolled in the Electrical Circuits course within the Electrical Engineering Education Study Program at Ar-Raniry State Islamic University, Banda Aceh, during the 2024/2025 academic year. Since the total number of students taking the course was relatively small, total sampling was employed, resulting in a sample of 21 students. This approach ensured that the effectiveness of the PSIM learning module was evaluated across the entire target population available during the semester.

c. Research Instruments

This study used two instruments: an achievement test and a student response questionnaire. The achievement test comprised multiple-choice items to assess students' conceptual understanding of Electrical Circuits before and after the PSIM module implementation. The questionnaire used a five-point Likert scale (Strongly Disagree to Strongly Agree) to capture students' perceptions of the module in terms of material presentation, time efficiency, learning outcomes, and perceived benefits. Both instruments were validated by two experts in electrical engineering education and instructional media, with revisions made based on their feedback regarding content relevance, language clarity, and alignment with learning outcomes prior to administration.

d. Data collection Procedure

Data collection was conducted in four sequential stages. First, students completed a pretest to determine their initial understanding of Electrical Circuits. Second, the PSIM learning module was implemented during classroom instruction, where students learned to design, simulate, and analyze series, parallel, and mixed electrical circuits using the PSIM software. Third, students completed a posttest using questions equivalent in content and difficulty to those in the pre-test. Finally, students completed a response questionnaire to evaluate their learning experiences and perceptions of the PSIM learning module.

e. Data Analysis

The collected data were analyzed using IBM SPSS Statistics version 26. Descriptive statistics were first calculated to obtain the mean, minimum, maximum, and percentage scores of students' learning outcomes. Prior to hypothesis testing, the normality assumption was assessed using the Shapiro–Wilk test on the difference scores between the posttest and pretest results. Since the study employed a one-group pretest–posttest design, the effectiveness of the PSIM learning module was analyzed using a paired-sample t-test at a significance level of $\alpha = 0.05$ to determine whether there was a significant improvement in students' learning outcomes after the intervention. Student learning achievement was evaluated based on the Minimum Completion Criteria (KKM) established by the study program, where a score of 60 or above indicated successful learning achievement [32]. In addition, students' responses to the learning module were analyzed descriptively by calculating the percentage score for each questionnaire indicator, including material presentation, time efficiency, learning outcomes, and learning benefits [33].

Result

a. Pretest and Posttest Data Results

To assess the learning outcomes of Electrical Engineering Education students, the researchers administered pretests and posttests exclusively to students enrolled in the Electrical Circuits course, with a minimum passing grade (KKM) set at 60. The results of the pretest scores answered by students showed an average score of 45.23, which was then rounded up to 45. The lowest score obtained by students was 30, while the highest score reached 70. These data indicate variations in students' initial abilities in understanding electrical circuit material before being given treatment. When compared with the Minimum Passing Grade (KKM) that has been set, only three students managed to achieve or exceed the KKM score. This indicates that most students have not achieved the minimum standards expected at the initial stage of learning. These results also emphasize the need for efforts to use the PSIM application module, to help improve student understanding and learning outcomes.

The posttest results showed that each student experienced significant improvement, achieving the established Minimum Completion Criteria (KKM). The average score increased from 45.23 in the pretest to 69.76 in the posttest. The minimum score, which was initially 30 in the pretest, increased to 60 in the post-test, while the maximum score, which was initially 70 in the pretest, increased to 80 after the posttest.

These results indicate that the use of the PSIM application module has a significant contribution in improving student learning outcomes.

After the distribution table of Pretest and Posttest scores is created, the next step is to create a frequency distribution table of students' Pretest and Posttest scores, which involves an initial data analysis process, namely determining the relative frequency distribution table of pretest and posttest in shown in Table 1.

Table 1. Relative Frequency Distribution of *Pretest* and *Posttest*

Class Interval	Frequency	Relative Frequency (%)
	Pretest	
30-36	7	33.3%
37-43	4	19.0%
44-51	2	9.5%
52-59	5	23.8%
60-66	2	9%
67-73	1	4%
	Posttest	
65-67	8	38%
68-70	7	33%
71-73	0	0%
74-76	3	14%
77-79	0	0%
80-82	3	14%

From the Table 1, based on the pretest *results* before the implementation of the PSIM application practical module in the Electrical Circuits course and the posttest results, there are differences in the average values obtained by students. After the frequency distribution table is obtained, the next step is to conduct a series of tests using SPSS Version 26.0. The tests carried out include normality tests and hypothesis tests.

b. Normality Test

A normality test is conducted to determine whether a dataset or sample follows a normal distribution, with data considered acceptable when it approximates normality. In this study, the analyzed data were derived from pretest and posttest scores in an Electrical Circuits course. Data are deemed normally distributed if the significance (sig) value exceeds 0.05, and non-normally distributed if the sig value is below 0.05.

In this study, the data analyzed came from the pretest and posttest results of the application of the PSIM application practical module in the Electrical Circuits course. The analysis was carried out with the help of SPSS version 26.0. The test results can be seen in the following Table 2.

Table 2. Normality Test Results

		Tests of Normality					
	Category	**Kolmogorov-Smirnov [a]**			**Shapiro-Wilk**		
		Statistics	**df**	**Significance**	**Statistics**	**Df**	**Significance**
Results	Pretest	,187	21	,052	,915	21	,068
	Postest	,199	21	,030	,914	21	,065

Based on Table 2, the results of the normality test show that the significance value for the pretest is .068 while for *the posttest* it is .065. Therefore, the pretest and posttest values can be considered to be normally distributed, because the results of the normality test (sig = .068 and sig = .065) are greater than at alpha value (α = 0.05).

c. Hypothesis Testing

The hypothesis testing was conducted to determine whether the implementation of the PSIM learning module significantly improved students' learning outcomes in the Electrical Circuits course. Since the study employed a one-group pretest–posttest design, a paired-samples t-test was used to compare students' scores before and after the instructional intervention. The research hypotheses are stated as follows:
H_0: There is no significant difference between students' pre-test and post-test scores following the implementation of the PSIM application learning module.
Ha: There is a significant difference between students' pre-test and post-test scores following the implementation of the PSIM application learning module.

A paired-samples t-test is a parametric statistical test used to compare the means of two related measurements obtained from the same group of participants. This test is appropriate for evaluating learning improvement by comparing students' scores before and after receiving the instructional treatment. Prior to hypothesis testing, the normality of the data was confirmed using the Shapiro–Wilk test. The hypothesis was tested at a significance level of α = 0.05. The decision criteria were as follows: If Sig. (2-tailed) < 0.05, H_0 is rejected and H_1 is accepted. And If Sig. (2-tailed) ≥ 0.05, H_0 is accepted. The results of the paired-samples t-test obtained using of SPSS version 26.0 are presented in Table 3.

Table 3. Hypothesis Test Results

Variable	N	Mean	Std. Deviation	Mean Difference	t	df	Sig. (2-tailed)
Pre-test	21	45.23	12.98	-	-	-	-
Post-test	21	69.76	6.12	24.52	12.031	20	<0.001

Note: The paired-samples t-test showed a statistically significant difference between students' pre-test and post-test scores ($t(20) = 12.031$, $p < 0.001$), indicating that the implementation of the PSIM application learning module significantly improved students' learning outcomes. To determine whether the implementation of the PSIM application learning module significantly improved students' learning outcomes, a paired-samples t-test was conducted. This statistical test is appropriate because the same group of students completed both the pre-test and post-test after receiving the instructional intervention. Prior to hypothesis testing, the normality assumption was examined using the Shapiro–Wilk test, which indicated that the difference scores were normally distributed ($p > 0.05$).

As shown in Table 3, the mean pretest score was 45.23, while the mean posttest score increased to 69.76, resulting in a mean improvement of 24.52 points. The statistical analysis produced a t-value of 12.031 with 20 degrees of freedom and a significance value of 0.000 ($p < 0.05$). Since the significance value was lower than the significance level of 0.05, the null hypothesis (H_0) was rejected and the alternative hypothesis (Ha) was

accepted. These findings indicate that the implementation of the PSIM application learning module significantly improved students' learning outcomes in the Electrical Circuits course.

The substantial increase in students' post-test scores suggests that the PSIM-based learning module effectively enhanced students' conceptual understanding of electrical circuits. By allowing students to visualize circuit behavior, analyze electrical parameters, and conduct virtual experiments, the module helped bridge the gap between theoretical concepts and practical applications, thereby improving overall learning performance. The effectiveness of the PSIM application learning module was further evaluated using the normalized gain (N-Gain) analysis. The results are presented in Table 4.

Table 4. Normalized Gain (N-Gain) Analysis

Indicator	Score
Mean Pretest	45.23
Mean Posttest	69.76
Maximum Score	100
Mean Increase	24.52
N-Gain	0.448
Improvement Category	Medium

As shown in Table 4, the average pre-test score increased from 45.23 to 69.76 after the implementation of the PSIM learning module. The calculated N-Gain score was 0.448, which falls into the medium improvement category according to Hake's classification ($0.30 \leq g < 0.70$). This result indicates that the implementation of the PSIM application learning module produced a moderate improvement in students' conceptual understanding of Electrical Circuits. The moderate N-Gain value suggests that the PSIM learning module effectively enhanced students' learning outcomes by facilitating visualization of electrical circuit behavior and providing opportunities for interactive virtual experimentation. These findings support the paired-samples t-test results, which also demonstrated a statistically significant improvement in students' learning outcomes after the instructional intervention.

d. Respondent Questionnaire Data

Student response questionnaire data is used to see student responses to the implementation of the PSIM application practical module in the Electrical Circuits course. Data collection techniques using this questionnaire use measurements (Likert scale). Alternative answers on the questionnaire are: Strongly Agree (5), Agree (4), Undecided (3), Disagree (2), Strongly Disagree (1). Respondents simply put a check mark (√) in the column provided on the questionnaire sheet.

Table 5. Respondent Response Results Per Indicator

Indicator	No. Question Items	Value Criteria					Amount	Percentage	Percentage Per Indicator
		1	2	3	4	5			
Presentation of Material	1	1	0	7	12	1	75	71%	72%
	2	0	1	7	13	0	75	71%	
	3	0	1	5	13	2	79	75%	

Time Efficiency	4	0	0	5	14	2	81	77%	77%
	5	0	0	6	12	3	81	77%	
Learning Outcomes	6	0	1	2	12	6	86	82%	82%
	7	0	0	2	14	5	87	82%	
	8	0	1	1	14	5	86	82%	
Benefit	9	0	1	3	11	6	85	81%	82%
	10	0	0	3	12	6	87	82%	
	11	0	0	2	17	2	84	80%	
	12	0	0	1	14	6	89	85%	
Total, Score and Percentage							**995**	**79%**	

The trial was carried out by researchers by demonstrating how to operate the PSIM application and simulating series circuits, parallel circuits and series circuits. mixed based on in modules that were late compiled by previous researchers. Results of respondents' responses per indicator related to the implementation of the practical module The application of PSIM in the Electrical Circuits course is shown in table 5. obtaining a total score of 995 from 21 respondents and the percentage value obtained is 79%.

Table 6. Results of Respondents' Responses Per Individual

No	Student Name	Criteria					Total Criteria Value	Percentage
		SA	A	U	D	SD		
1	MRR	0	12	0	0	0	48	80%
2	NVI	2	10	0	0	0	50	83%
3	IH	0	9	3	0	0	45	75%
4	WR	4	8	0	0	0	52	87%
5	MZ	0	10	2	0	0	46	77%
6	RSP	3	3	6	0	0	45	75%
7	HS	1	8	2	1	0	45	75%
8	DWP	1	5	4	2	0	41	68%
9	AZ	6	6	0	0	0	54	90%
10	FAH	0	12	0	0	0	48	80%
11	NS	0	12	0	0	0	48	80%
12	RZ	0	8	4	0	0	44	73%
13	RRH	4	4	4	0	0	48	80%
14	MAS	0	6	6	0	0	42	70%
15	SSL	2	10	0	0	0	50	83%
16	RWA	3	8	1	0	0	50	83%
17	WMR	1	5	6	0	0	43	72%
18	PAQ	5	4	1	2	0	48	80%
19	MRI	4	8	0	0	0	52	87%
20	MAA	2	7	3	0	0	47	78%
21	MHZ	6	3	2	0	1	49	82%
	Total, and Percentage	**44**	**158**	**44**	**5**	**1**	**995**	**79%**

Give to score to each answer in the table above:
SA : Strongly Agree (Score 5),
A : Agree (Skore 4),
U : Undecided (Score 3),
D : Disagree (Score 2),
SD : Strongly Disagree (Score 1).

Table 6 shows the results of individual respondents' responses regarding the importance of implementing the PSIM application practical module in the Electrical Circuits course and the number of scores obtained is also the same as the results. The calculation in table 5 with the total score obtained is 995 from 21 respondents with a percentage value of 79 %. The data obtained from the respondents' responses proves that implementing the PSIM application practical module, it can facilitate understanding of material concepts. in the Electrical Circuits course. Response results respondents can be seen in the following figure 7.

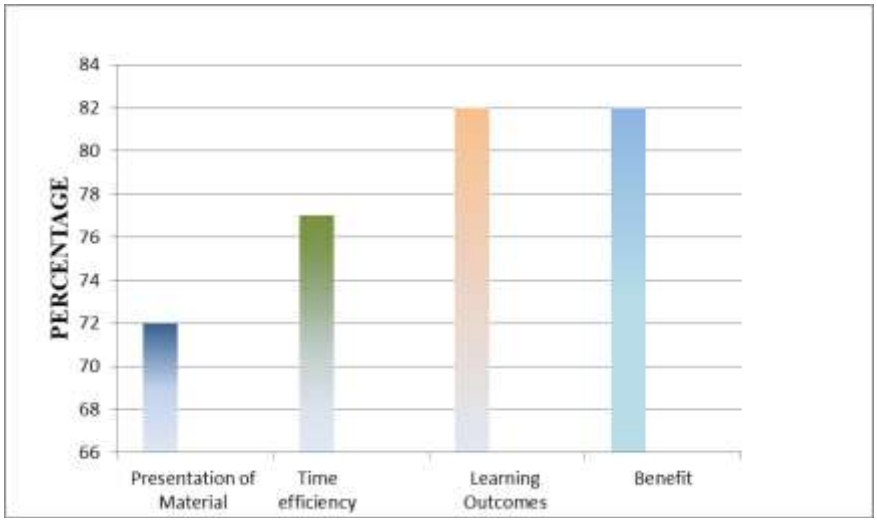


Figure 7. Presentation Graph

The results of respondents' responses per indicator from 21 students show the percentage value of each indicator. The results of respondents' responses that have been processed by researchers obtained different percentage results for each indicator. If looked at more closely, the material presentation indicator is at a higher percentage level low at 72% compared to the time efficiency indicator of 77%, learning outcomes of 82%, and benefits of 82%. Although all questionnaire indicators achieved positive responses, the material presentation indicator obtained the lowest percentage (72%). This result may indicate that some students still experienced difficulties in understanding simulation procedures and interpreting circuit behavior during the early stages of implementation. Since PSIM was newly introduced to many participants, additional guidance and tutorial sessions may be required to maximize student engagement and comprehension.

From the results of data analysis, the average score of students during the pretest was 45.23 and the average score of students during *the post-test* was 69.76. When the final test (posttest) was carried out, students were still not really serious in answering the questions given. Students had not really understood the material presented and the material contained in the practicum module, that is what caused the score not to be achieved optimally and students who had not met the KKM criteria. From the average score, it can be concluded that student grades have increased.

Based on the results of the questionnaire analysis, it can be seen that the student response to the implementation of the PSIM application practical module in the Electrical Circuits course received a good response from students, although not completely good, but most of the percentage of student responses was very high, namely with an average value of student responses. The improvement in post-test scores suggests that the PSIM module effectively supported conceptual learning. The visualization features provided by PSIM enabled students to observe voltage distribution, current flow, and circuit behavior directly, reducing the abstract nature of electrical circuit concepts. This finding is consistent with previous studies that reported simulation-based learning enhances conceptual understanding and promotes active learning. Furthermore, the positive student responses indicate that the module not only improved academic performance but also increased learning motivation. Students were able to experiment with circuit configurations without the constraints of laboratory equipment availability, making learning more flexible and interactive.

Conclusion

The implementation of the PSIM application learning module positively contributed to improving students' understanding of Electrical Circuit concepts. The increase in post-test scores compared to pre-test scores indicates that simulation-assisted learning can effectively support conceptual learning and provide meaningful learning experiences. In addition, students showed positive perceptions toward the module, suggesting that PSIM can enhance engagement and facilitate independent exploration of circuit behavior. Nevertheless, this study has several limitations. The research involved a relatively small sample size and employed a one-group experimental design without a control group. Therefore, the findings should be interpreted cautiously. Future studies are recommended to involve larger samples, include control groups, and evaluate long-term learning retention. Further development of the PSIM module may also incorporate more advanced circuit topics and interactive learning features to improve learning effectiveness.

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