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An Investigation of the Influence of the 5E-LC Model on The Learning Outcome and Practical Performance of Vocational School Students

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Abstract

This study aimed to ascertain the impact of implementing the engagement, exploration, explanation, extension, and evaluation (5E) learning cycle model on learning outcomes and practical performance in vocational school subjects. This quantitative study employs a quasi-experimental design utilising a non-equivalent control group design. This study involved a control group and an experimental group. The study focused on vocational students in Serang City, and the sampling method employed was purposive sampling. The measures include multiple-choice tests for learning outcomes and practical performance questionnaires, utilising 4-point Likert scales. The data were analysed using the multivariate analysis of variance test and the independent sample test. The findings indicate a significant disparity between the average post-test scores of the experimental class and the control class. Furthermore, it shows a substantial disparity between the mean score of the experimental class in practice performance and the control class in practice performance. Therefore, it can be inferred that the 5E-LC model has an impact on both learning outcomes and practical performance in the field of electric lighting installation. In vocational secondary schools, teachers are required to possess the ability to apply the 5E-LC model in teaching subjects relevant to their field of study.

1. Introduction

Vocational schools are crucial in providing students with the necessary practical skills and knowledge required for immediate employment and success in certain trades and technical professions. In order to enhance student outcomes in these rapidly changing domains, vocational education should prioritize teaching techniques that efficiently foster both the acquisition of knowledge and the development of practical skills. While various instructional approaches exist, the 5E Learning Cycle Model (5E-LC Model) has emerged as a promising constructivist strategy with the potential to enhance learning and improve student understanding and performance across various disciplines and subjects (e.g., (Açişli et al., 2011; Aini et al., 2020; Fikri et al., 2018; Grau et al., 2021; Victor & Olufunke, 2021)). The 5E-LC Model revolves around five interrelated phases: Engage, Explore, Explain, Elaborate, and Evaluate. This methodical approach seeks to actively engage pupils in the process of acquiring knowledge. It begins by sparking curiosity and connecting to prior knowledge (Engage), followed by hands-on investigation (Explore). Next, formal concepts and terminology are introduced (Explain), building upon students' discoveries. The model encourages deeper understanding through application (Elaborate) and provides opportunities for both formative and summative assessment (Evaluate).

The studies mentioned in the article focus on the general achievement of students (Abamba, 2021; Pangestika & Prasetyo, 2018) or in specific subjects like consumer behaviour (Sulaiman et al., 2020) and spatial geography (Handoyo & Susilo, 2020). None of the studies mentioned focus on vocational education. This research aims to investigate the influence of the 5E-LC Model on the learning outcomes and practical performance of students in a vocational school setting (Esen et al., 2023). This means it looks at applying the 5E-LC model to a new educational context and assessing its impact on students' vocational skills.

Increasing evidence indicates that the 5E-LC Model is highly effective in conventional educational environments. Research has shown that it has the capacity to enhance student involvement, conceptual comprehension, and overall academic achievement (Aini et al., 2020; Merdekawati, 2017; Odunayo Victor & Theodora Olufunke, 2021; Özenç et al., 2020). However, there is a significant lack of research on the specific impact of the 5E-LC Model in the field of vocational education. Although the model's focus on experiential learning and the application of information is well-suited for vocational training, there is limited research specifically investigating its impact on the learning outcomes and practical performance of vocational students. The 5E-LC is an instructional model that promotes independent learning of the concept's meaning among students, without relying on teacher guidance (Runisah, 2019). Thus, the 5E-LC model fosters innovative education. Nevertheless, the reality is that the learning and practice activities now undertaken by students have yet to yield significant results, as students often struggle to comprehend the various stages involved in the practice process. Consequently, students' cognitive and psychomotor abilities are deficient in both theoretical and practical learning activities.

In vocational education for electrical engineering, students must possess both knowledge competencies and technical skills (Darmawan et al., 2020; Hamid et al., 2025; Setiawan et al., 2025). This is particularly important in the field of electrical power installation engineering, where students need to understand electrical circuits and the use of electronic components. By acquiring these skills, students are able to apply them in practical settings rather than solely relying on theoretical knowledge (Kholifah, Nurtanto, Kassymova, et al., 2024; Swaramarinda et al., 2021). According to Pangestika & Prasetyo (2018) students perform better in the 5E-LC model when they are provided with interactive multimedia. This aligns with the belief that using the 5E-LC instruction correctly leads to effective concept learning and the ability to apply those concepts.

The findings from the observations conducted at a vocational school in Serang City indicate that the teacher-centered learning approach is comparatively ineffective, resulting in student disengagement and reduced participation in learning activities. The students display a lack of enthusiasm, often remain silent, engage in solitary activities, and demonstrate minimal attentiveness towards the teacher's explanations. Throughout the practicum process, the teacher's communicated knowledge inadvertently hindered students' ability to engage in independent and active critical thinking. Consequently, pupils develop a passive attitude and lack comprehension of the supplied challenges, which hinders their ability to perform practical operations. This significantly affects the number of students who fail to achieve full mastery of the curriculum and do not meet the minimum grade requirements. To address the existing issues in vocational schools in Serang City, Solo City, and Yogyakarta City, it is necessary to implement the 5E-LC model, as there is a noticeable discrepancy between the theoretical rationale and practical application in this field.

Research in areas such as Serang City has shown that traditional teacher-centered methods in vocational schools result in student disengagement, insufficient independent critical thinking, and inadequate mastery of practical skills. These problems emphasize the need for a change in teaching methods that not only involve students but also improve their practical learning outcomes. Research conducted in several educational contexts has demonstrated positive outcomes with the use of the 5E-LC Model. For instance, research conducted by Abamba (2021); Pangestika & Prasetyo (2018) provide evidence of the model's efficacy in enhancing overall student performance. Certain academic disciplines, such as consumer behavior (Sulaiman et al., 2020) and spatial geography (Özenç et al., 2020), have also derived advantages from the application of the model. Nevertheless, there is a notable deficiency in the existing body of knowledge concerning its use in vocational education. Although its emphasis on experiential learning makes the model highly suitable for vocational training, there is a scarcity of research investigating its influence on the learning outcomes and practical performance of vocational students.

However, despite the overall favorable results, several studies have emphasized difficulties linked to the 5E-LC Model. Research conducted by Runisah (2019) indicates that although the approach encourages self-directed learning, it may not be equally efficacious for all students, especially those who have difficulties with self-directed knowledge acquisition. Moreover, the findings of this study are subject to methodological constraints, including small sample sizes and non-randomized participant selection (e.g., (Merdekawati, 2017; Pangestika & Prasetyo, 2018) which give rise to uncertainty regarding their generalizability.

This research seeks to address this gap by investigating the implementation of the 5E-LC Model in a vocational school setting. This study will investigate whether this pedagogical technique improves student outcomes when compared to conventional teaching approaches. This study is particularly significant for various reasons. By evaluating the efficacy of the 5E-LC Model in a vocational setting, we can determine whether this learner-focused approach efficiently facilitates the acquisition of practical skills (Majid et al., 2020). Furthermore, the findings could provide valuable perspectives for vocational instructors who are searching for evidence-based approaches to enhance student learning and achievement. If the 5E-LC Model demonstrates efficacy, it has the potential to be integrated into vocational curricula and teacher training programs to improve teaching methods. The research gap of this study lies in the lack of research investigating the impact of learning cycles on the development of vocational skills and acquisition of knowledge among students.

The research question that will guide this study is: Does the implementation of the 5E-LC Model in vocational schools result in enhanced learning outcomes and practical performance when compared to traditional teaching methods? The hypothesis of this study is as follows: **Ho:** There is no effect of the 5E-LC Model on learning outcomes in the subject of Electrical Lighting Installation at Vocational Secondary School**; Ha:** There is an effect of the 5E-LC Model on learning outcomes in the subject of Electrical Lighting Installation at Vocational Secondary School**.** The second hypothesis is **Ho:** There is no effect of the 5E-LC Model on practical performance in the subject of Electrical Lighting Installation at Vocational Secondary School**; Ha:** There is an effect of the 5E-LC Model on practical performance in the subject of Electrical Lighting Installation at Vocational Secondary School. This study enhances the field of vocational education by presenting empirical information regarding the possible advantages of implementing the 5E-LC Model. The findings can provide valuable insights to educators, administrators, and curriculum creators regarding effective techniques to enhance student learning and provide them with the necessary skills for a smooth transition into vocational careers. Furthermore, it addresses an existing deficiency in the scholarly literature, opening up opportunities for additional exploration into enhancing teaching techniques in vocational education.

2. Literature Review

The 5E-LC is a learning model based on constructivism, as described by Grau et al. (2021). According to Grau et al. (2021) this aligns with the belief that the 5E-LC model has the ability to consistently alter teacher learning methods and facilitate long-term conceptual learning for students. According to Aköz et al. (2022), the 5E learning model facilitates the establishment of a lasting learning environment by incorporating engaging activities that capture students' attention and enable them to acquire essential knowledge and skills.

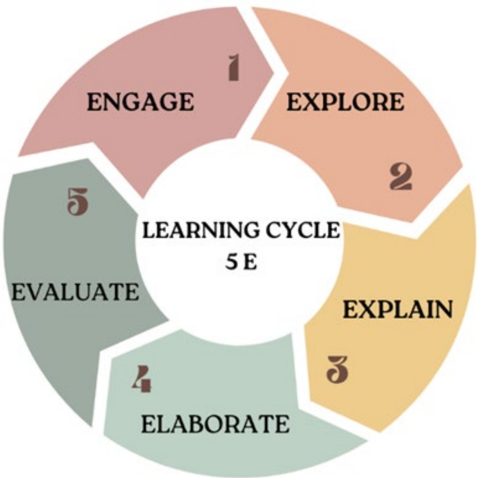

Fig. 1 *The 5E-LC model*

This aligns with the viewpoint expressed by Abamba (2021). The implementation of the 5E-LC has effectively enhanced the reputation of students in the field of science and contributed to the enhancement of their learning process. Desouza (2017) states that the 5E-LC model, which is founded on research, recognizes the importance of learning in a social setting and emphasizes the need for cooperation, collaboration, and the development of shared ideas in order to facilitate learning. According to Aini et al. (2020) the 5E-LC model is a learning model that actively involves students in the learning process. The 5E-LC consists of five phases: engagement, exploration, explanation, elaboration, and evaluation. The 5E-LC model's cycle is illustrated in Fig. 1.

Educational framework the 5E-LC is comprised of multiple distinct stages (Balta & Sarac, 2016).

2.1 The first step in the 5E-LC model is to **engage** students by assessing their skill indicators, namely their capacity to ask questions. The ongoing involvement phase during each class will significantly influence the development of pupils' capacity to inquire. In line with the viewpoint expressed by Choowong & Worapun (2021) it is suggested that teachers can commence their lessons by elucidating the learning objectives and employing role-playing scenarios to captivate students' attention and facilitate their recollection of knowledge taught in earlier sessions.

2.2 The second step, the **exploration** stage, allows students to generate new hypotheses based on their learning and then test them through empirical methods (Ruiz-Martín & Bybee, 2022). According to (Kazempour et al., 2020), in this stage, individuals work collaboratively in teams and have the chance to share their ideas and receive feedback from both peers and teachers.

2.3 **Explain**, during the explanation stage, students will actively look for terms that are relevant to the learning assignment. The teacher will guide the students' focus towards a specific aspect of the exploration experience. Students offer explanations, after which professors present or elucidate commonalities or concepts derived from student explanations. Teachers also provide explanations during the stages of involvement and discovery exploration (Abdullah Sani, 2019). According to Priawasana & Muis (2021), the explanation stage of learning encourages students to articulate their understanding of concepts acquired during the engagement stage. This involves using their own sentences, seeking evidence and clarification for their explanations, and engaging in discussion activities.

2.4 **Elaboration,** this stage involves engaging students in additional activities that facilitate the transfer to new situations closely related to generalizing concepts, processes, or skills (Schallert et al., 2022). This is in line with Victor & Olufunke (2021) that students can utilize their new information in this phase by proposing solutions, creating new challenges, making decisions, and introducing logical consequences.

2.5 **Evaluation**, the evaluation stage involves assessing students using all indicators of critical thinking abilities, enabling them to self-evaluate and track their progress. This is because critical thinking is a skilled and active interpretation and evaluation of observations and communication, as well as information and arguments (Balta & Sarac, 2016)

3. Method

This research is a form of quantitative research that focuses on objective phenomena and is analyzed using quasi-experimental methods (Choe et al., 2014; Eliza, 2025; Gopalan et al., 2020; Hamid et al., 2024; Kholifah et al., 2025; Kim & Clasing-Manquian, 2023; Syahril et al., 2022). The non-equivalent control group design is employed to observe the impact of an action, where the experimental group is not randomly assigned (Krishnan, 2019). The Nonequivalent control group design can be illustrated in Fig. 2.

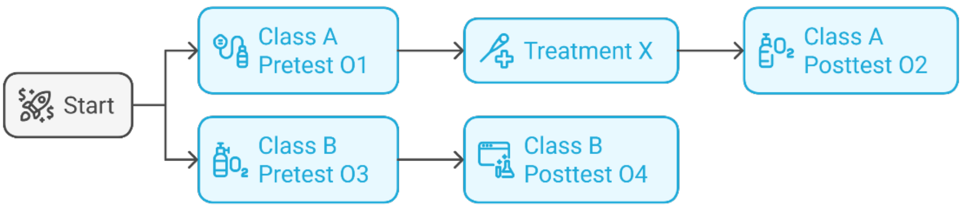

Fig. 2 *The non-equivalent control group design*

Information:

O1 = Experimental group before treatment
O2 = Experimental group after treatment
O3 = Control group before treatment
O4 = Untreated control group
X = treatment (use of the 5E-LC model)

The study focused on a demographic of 79 students enrolled in grade XI at a vocational school in Serang City. The control class consisted of 40 students, while the experimental class had 39 students. This study employed purposive sampling, selecting individuals based on specified qualities pertinent to the study's objectives. The research sample comprised 79 students enrolled in the Electrical Installation Engineering program at vocational school No. 2 Serang City. Forty students from grade of XI electrical installation engineering program no. 2 class were designated to the control group, whereas thirty-nine students from grade of XI Electrical Installation Engineering program no. 4 class were allocated to the experimental group.

To collect data, instruments such as documentation and tests were used. The assessment of cognitive abilities used multiple-choice test learning outcomes, while psychomotor assessment was conducted using practical exams, worksheets (competency tests), job sheets, and questionnaires with 4-point Likert scales. The instrument's validity and reliability were evaluated using SPSS version 25.0. The validity test results include 25 items of learning outcome variables (pretest) with an overall range of 0.089–0.911, as well as 25 posttest questions with an overall range of 0.057–0.790. The student performance sheet (SPS) has up to 10 items, with overall values ranging from 0.002 to 0.964. Additionally, there are up to 5 practice performance factors, with overall results ranging from 0.557 to 0.703. During the pretest, a reliability test was conducted on the instrument, resulting in an alpha coefficient value of 0.823, which met the criterion for high reliability. The posttest variables have an alpha coefficient value of 0.838, which also meets the high requirement. The student performance sheet has an alpha coefficient value of 0.703, meeting the high requirements. The alpha coefficient value of the practice performance variable is 0.627, indicating a high level of reliability.

All participants have provided consent and agreed voluntarily to serve as sources of research (Aluwihare-Samaranayake, 2012). Furthermore, consent has been secured from all participating in the research to carry out the overall research activities. Participant identity data are presented anonymously using pseudonyms. This study received approval from the supervisor and ethics committee of Yogyakarta State University before the field research. All collected data, including participant identities, is ensured to be confidential and utilized solely for research purposes, thereby not impacting participants' future outcomes (Houghton et al., 2010; Tolich, 2020).

4. Result and Discussion

The collected data for the normality test consisted of pretest values in the experimental class with a significance level of 0.224 and posttest values in the experimental class of 0.136, where the significance level of both values was greater than 0.05. The normality test was conducted on the control class, yielding a pretest value of 0.268 and a posttest value of 0.159 using the Kolmogorov-Smirnov test. The significance value was found to be greater than 0.05. In addition, the worksheet data for students in the experimental class was 0.985, whereas for the control class it was 0.167. It is worth noting that the significance value is greater than 0.05. Therefore, it can be inferred that the student learning outcomes, as measured by pretest instruments, posttests, and student worksheets, follow a normal distribution. Table 1 shows the outcomes of the data normality test of learning outcomes.

Table 1 *Normality test results (Kolmogorov-Smirnov)*

	Statistic	df	Sig.
Pretest Experiment	1.046	38	.224
Posttest Experiment	1.159	38	.136
Pretest Control	1.002	39	.268
Posttest Control	1.125	39	.159
Practical performance Experiment	.883	38	.417
Practical performance Control	1.311	39	.064

Note: df = Degree of freedom, and Sig.=Significancy

In the experimental class, a significance level of 0.417 was observed, while in the control class it was 0.064. It is worth noting that the significance level in both classes is greater than the threshold of 0.05. Therefore, it may be inferred that the practical performance capacity of students, as measured by the questionnaire instrument, follows a normal distribution. The data normality test of practical performance can be seen in Table 1.

The homogeneity test was conducted using pre-test and post-test data, as well as worksheets from the experimental class pupils who were taught using the 5E-LC paradigm, whereas the control classes were taught using the traditional methodology. The scores of students on the pre-test, post-test, and worksheets were collected. The significance level was determined using the Levene test, with a mean value of 0.208, a median value of 0.295, a median and adjusted degrees of freedom (df) value of 0.295, and a trimmed mean value of 0.218. The significance level (sig) was found to be greater than 0.05. Therefore, it can be inferred that the pre-test instrument, post-test, and worksheets of learners from both the experimental class and the control class exhibit homogeneous variances, indicating that they are drawn from the same population. Table 2 shows the result of the homogeneity test of learning outcomes.

Table 2 *Learning outcomes homogeneity test results*

		Levene Statistic	df1	df2	Sig.
Pretest, Posttest, SPS	Mean	1.597	1	170	.208
	Median	1.104	1	170	.295
	Adjusted df	1.104	1	169.321	.295
	Trimmed mean	1.531	1	170	.218

Note: df = Degree of freedom, and Sig.=Significancy

The homogeneity test was conducted on the data acquired from the experimental class students who used the 5E-LC model and the control class students who used a traditional model. The student practicum scores were assessed for significance using the Levene test, which yielded a mean value of 0.322 and a median value of 0.368. Once the necessary tests have been fulfilled, the subsequent step involves conducting a hypothesis test using SPSS software. In order to determine whether the use of the 5E-LC model has an impact on student learning outcomes and practical performance, a parametric analysis of the Independent Sample T-test is conducted. This is based on the assumption that the learning outcomes and practical performance of students follow a normal distribution and are similar. The median and adjusted degrees of freedom (df) value is 0.369, while the trimmed mean value is 0.428. The significance level is greater than 0.05. It can be inferred that the questionnaire instruments used in the experimental class and the control class have similar characteristics or are derived from the same population. Table 3 shows the result of the homogeneity test for practical performance.

Table 3 *Practical performance homogeneity test results*

		Levene Statistic	df1	df2	Sig.
Practical performance	Mean	.994	1	77	.322
	Median	.820	1	77	.368
	Adjusted df	.820	1	59.834	.369
	Trimmed mean	.635	1	77	.428

Note: df = Degree of freedom, and Sig.=Significancy

During the final post-test, a statistically significant result was achieved with a p-value of 0.000, which is less than the significance level of 0.05. Furthermore, the value of T_calculate = 5.090 is greater than the value of T_table = 2.026, indicating a considerable difference. It can be inferred that there is a disparity in the mean learning outcomes between students who use the 5E-LC model and those who use conventional models in the subject of electric lighting installations. From the provided data, it can be inferred that the null hypothesis (Ho) was rejected and the alternative hypothesis (Ha) was accepted with a confidence level of 95%. This indicates a substantial disparity between the mean post-test score of the experimental class and the control class. This study aims to evaluate the validity of hypothesis 1, which investigates the impact of the 5E-LC model on student learning outcomes in electric lighting installation subjects. The result of the hypothesis test for learning outcomes can be seen in Table 4.

During the learning process, the experimental class was instructed using student worksheets and taught using the 5E-LC model, whereas the control class utilized student worksheets taught using traditional methods. These student worksheets aid students in developing concepts and applying them during learning activities. At this stage, the students were divided into multiple groups, and the average score (mean) for each group in the experimental class was 87.14, while in the control class it was 85.71. During the Engage stage, the teacher stimulates and cultivates pupils' curiosity and enthusiasm for learning. This aligns with the viewpoint expressed by Schallert et al. (2022) that the initial stage of activities should serve to inspire and establish connections with students' prior experiences.

Table 4 *The result of the hypothesis test for learning outcome*

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F-value	Sig.	t-value	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Learning outcome	Equal variances assumed	.033	.857	5.090	77	.000	9.728	1.911
	Equal variances not assumed			5.097	76.491	.000	9.728	1.908

Note: df = Degree of freedom

During the exploration stage, teachers establish groups and appoint facilitators. This aligns with the viewpoint expressed by Ruiz-Martín & Bybee (2022) that students must discover suitable new concepts that effectively elucidate the subject matter. The revised explanation should be both "comprehensible" (able to be understood by the learner) and "coherent" (logically consistent with existing knowledge and able to account for the available evidence). The explanation stage involves group discussions, idea exchanges, and presentations. According to Açişli et al. (2011), this aligns with the belief that in the third phase, teachers utilize students' observations and data to formulate scientific explanations for their findings.

In the fourth stage, known as Elaboration, students engage in critical thinking and problem-solving. Lastly, the Evaluation stage involves a comprehensive assessment and reflection by students and all group members to determine the knowledge and skills they have acquired. According to Şahin & Baturay (2016) during this phase, students assess and reflect on their learning and consider its practical application in their everyday lives. According to Ylostalo (2020), student learning can be enhanced by utilizing repetitive exercises, engaging in peer discussions, and receiving ongoing feedback from instructors. This approach contributes to the development of a holistic teaching model. According to Guven et al. (2022), their research findings support the idea that using the 5E learning model in science education with robotics coding applications enhances student creativity. The model encourages students to generate ideas for solving real-life problems and promotes an active learning environment through cooperation and teamwork. This type of learning has a positive impact on student learning outcomes.

Table 6 *The result of the hypothesis test for practical performance*

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F-value	Sig.	t-value	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Practical performance	Equal variances assumed	.994	.322	4.794	77	.000	2.534	.529
	Equal variances not assumed			4.818	68.259	.000	2.534	.526

Note: df = Degree of freedom

According to Table 6, an independent sample test was conducted on practice performance. The value of sig (2-tailed) is 0.000, which is less than 0.05. Furthermore, the observation of T_calculate = 4.794 being greater than T_table = 2.028 indicates a substantial difference. The practice performance hypothesis test was conducted to ascertain if there was a statistically significant difference in the average scores between the experimental class and the control class. Based on this evidence, it may be inferred that the null hypothesis (Ho) was rejected and the alternative hypothesis (Ha) was accepted. Hence, there exists a disparity in the mean score of student practice performance in experimental courses employing the 5E-LC model compared to students utilizing conventional models or lectures.

This study aims to evaluate the validity of hypothesis 2, which examines the impact of the 5E-LC model on students' practical performance in electric lighting installation disciplines. The 5E-LC model serves as a guide for students to effectively engage in a practical exercise on one-phase lighting installation. This model encourages students to actively grasp concepts on an individual basis. It consists of five stages that students must progress through: engage, exploration, explanation, elaboration, and evaluation. This aligns with the viewpoint expressed by Gao & Hew (2022). This framework comprises five distinct phases: engagement, exploration, explanation, elaboration, and evaluation. Each phase possesses notable qualities and is designed to tackle learning challenges as they arise. According to Lin, Ong, and Grau in Asrizal et al. (2022) the learning model comprises five distinct phases: engage, explore, explain, elaborate, and evaluate. Each of these phases has a distinct purpose and aids students in formulating and comprehending scientific knowledge, attitudes, and skills.

According to Özenç et al. (2020), the 5E-LC model has been found to positively impact students' comprehension of force and motion concepts. According to the findings of the hypothesis test, as stated by Fikri et al. (2018), there is a significant difference in students' skill competencies, shown by a T_calculate value greater than the T_table value. Implementing a constructivist approach using the 5E-LC model can enhance the skill proficiency of students in the classroom. Given the assertion that practicum is crucial in the learning process, students can be observed actively engaging with the subject, facilitating a better understanding. According to Hamid et al. (2020), their research findings indicate that there are variations in learning outcomes in the psychomotor domain between students who are instructed using the 5E-LC model and those who are taught using a direct model for installing competence standards.

The results of a multivariate test examining the relationship between learning outcomes and practice performance. According to the data in Table 7, the multivariate analysis test showed that all the F_values for Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root were 14.159^b, with a significance (2-tailed) value of 0.000. This equation represents the value of F as 14.159 times (^{b}), and the value of p is less than 0.05. Based on the provided data, it can be inferred that the null hypothesis (Ho) was rejected and the alternative hypothesis (Ha) was accepted. Therefore, there are disparities in the mean score of educational achievements and student practical performance between experimental courses employing the 5E-LC model and classes utilizing conventional models or lectures.

This study aims to evaluate the validity of two hypotheses. The first hypothesis examines the impact of the 5E-LC model on student learning outcomes in electric lighting installation subjects. The second hypothesis investigates the influence of the 5E-LC model on student practice performance in electric lighting installation subjects. According to to Resmol & Leasa (2022), students in the experimental class are more motivated to learn compared to those in the control class. In the control class, the teacher does not utilize any specific learning model but nonetheless teaches using a scientific method similar to the experimental class.

Table 7 *The result of the multivariate test for learning outcome and practical performance*

Effect		Value	F-value	Hypothesis df	Error df	Sig.	Partial Eta Squared
The 5E-LC model	Pillai's Trace	.271	14.159^b	2.000	76.000	.000	.271
	Wilks' Lambda	.729	14.159^b	2.000	76.000	.000	.271
	Hotelling's Trace	.373	14.159^b	2.000	76.000	.000	.271
	Roy's Largest Root	.373	14.159^b	2.000	76.000	.000	.271

Note: df = Degree of freedom, and Sig.=Significancy

In their study, Rahayu et al. (2019) discovered that the 5E-LC model facilitates the connection between students' existing knowledge and the formation of new experiences. This process occurs through five distinct stages: engagement, exploration, explanation, elaboration, and evaluation. According to Cakır (2017), the 5E-LC approach is beneficial for teachers as it offers practical illustrations of how structuralist methods may be applied in course processing. Additionally, it provides effective reform-based instruction and can aid in curriculum creation. According to Merdekawati (2017), the use of the 5E-LC can be an effective solution to enhance the quality of chemistry practical courses. The 5E-LC provides a structured approach that enables students to actively engage in experiments following the scientific method. Moreover, the engage stage fosters students' curiosity and enthusiasm for the forthcoming experiments.

According to the findings of a study conducted by Çömez et al. (2022), activities designed using web 2.0 tools and following the 5E-LC model are more successful in enhancing student achievement in remote education compared to activities aligned with the science curriculum. According to the findings of a study conducted by Kadıoğlu et al. (2021), the 5E learning model, which incorporates the techno-pedagogical lesson plan (Kholifah, Nurtanto, Mutohhari, et al., 2024), is more effective in enhancing academic achievement compared to the method outlined in the 8th grade Turkish language course curriculum. According to Fikri et al. (2018), the findings of the hypothesis test indicate that implementing the constructivism approach using the 5E-LC model can enhance the skill competency of students in senior high school in Padang City. Given the assertion that practicum is crucial in the learning process, students can be observed actively engaging with the subject, hence facilitating comprehension.

The main objective of this study was to investigate whether the introduction of the 5E-LC model in vocational schools would result in improved learning outcomes and practical performance compared to conventional teaching approaches. The findings unequivocally substantiate the notion that the 5E-LC model exerts a beneficial influence on student learning achievements and practical competencies. Statistically significant disparities in average scores between the experimental group (using the 5E-LC model) and the control group (using traditional methods) validate that the 5E-LC model promotes superior academic performance and proficiency enhancement in the field of electric lighting installations.

The study findings provide strong evidence that the implementation of the 5E-LC model has a substantial positive impact on both the academic achievements and practical skills of vocational school students engaged in the study of electric lighting installations. This conclusion is derived from the statistically significant results acquired from both the scores on the post-test and the evaluations of practical performance. More precisely, the p-value of 0.000, which is much lower than the established significance level of 0.05, together with the computed T-values (T_calculate = 5.090 for learning outcomes and T_calculate = 4.794 for practical performance), both of which surpass their corresponding critical values (T_table = 2.026 for learning outcomes and T_table = 2.028 for practical performance), offer strong evidence supporting the effectiveness of the 5E-LC model in this educational setting.

Several significant implications arise from the findings of this study for the subject of vocational education. First, it is proposed that the 5E-LC model has significant potential as an educational instrument to augment both theoretical comprehension and practical abilities in vocational disciplines. Considering the primary focus of vocational education on practical learning and the acquisition of specialized technical skills, the structured and experiential approach of the 5E-LC model is highly compatible with these educational objectives. The 5E-LC model has the potential to mitigate a number of issues linked to conventional teacher-centered teaching approaches, including student disengagement and inadequate practical performance, by promoting active participation, critical thinking, and practical application.

5. Conclusion

The findings of the independent sample test and multivariate analysis of variance indicate a significant disparity between the average post-test scores of the experimental class and the control class. Furthermore, there is a substantial disparity between the mean score of the experimental class in practice performance and the control class in practice performance. Therefore, it can be inferred that the 5E-LC model has an impact on both learning outcomes and practical performance in the field of electric lighting installation. In vocational secondary schools, teachers are required to possess the ability to utilize the 5E-LC model in teaching subjects relevant to their field of study. This emphasizes the importance of the 5E-LC model in fostering both cognitive and practical abilities and makes a substantial contribution to the understanding of successful teaching techniques in vocational education. The findings of this study have significant implications for educators, curriculum developers, and policymakers aiming to enhance the quality of vocational training and better prepare students for the requirements of the contemporary job market. Nevertheless, it is crucial to recognize the limitations of this research. The study was carried out using a selected sample from a particular occupational discipline, which could limit the applicability of the results to other professional domains or educational environments. Moreover, the relatively limited number of participants and the focus on immediate results may not fully capture the long-term effects of the 5E-LC model.

This strategy promotes active involvement, critical thinking, and real-world application in vocational training by involving students in five phases: Engage, Explore, Explain, Elaborate, and Evaluate. Subsequent study ought to examine the efficacy of the 5E-LC model across several vocational domains, incorporate bigger and more heterogeneous sample sizes, and assess its enduring influence on students' competencies. Moreover, integrating educational technology within the 5E-LC framework could augment its relevance and efficacy in contemporary vocational education, serving as a formidable instrument for cultivating students' theoretical and practical skills across diverse fields. Future research should aim to overcome these limitations by investigating the impact of the 5E-LC model in various vocational fields and with larger and more diverse groups of participants. Furthermore, longitudinal studies could offer valuable insights into the long-term effects of the 5E-LC model on students' vocational skills. Additionally, a thorough analysis of the incorporation of educational technology within the 5E-LC framework may provide fresh opportunities to improve its efficiency and expand its applicability in vocational education.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Ida Nugroho Saputro, Mustofa Abi Hamid, Muhammad Nurtanto;* ***data collection:*** *Ida Nugroho Saputro, Mustofa Abi Hamid;* ***analysis and interpretation of results:*** *Ida Nugroho Saputro, Mustofa Abi Hamid, Muhammad Nurtanto, Didik Rohmantoro; Nuur Wachid Abdul Majid;* ***draft manuscript preparation:*** *Ida Nugroho Saputro. All authors reviewed the results and approved the final version of the manuscript.*

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