THE DEVELOPMENT OF OUTDOOR ELECTRICAL INSTALLATION SKILLS THROUGH MIAP LEARNING MODEL COMBINED WITH SIMULATION-BASED LEARNING FOR VOCATIONAL CERTIFICATE STUDENTS IN LOPBURI TECHNICAL COLLEGE

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ABSTRACT

This study aimed to develop a learning management model that integrates the MIAP model with simulation-based learning for vocational certificate students in Lopburi Technical College. The sample included 19 third-year Electrical Power students from Lopburi Technical College enrolled in the Outdoor Electrical Installation subject during semester 2/2024, who were selected by cluster random sampling. The research instruments follow: 1) the learning model integrating the MIAP model with simulation-based learning, 2) an instructional package for outdoor electrical installation, which consists of a teacher's manual, instructional plans, presentation media, and activity sheets, 3) the learning achievement test, 4) an outdoor electrical installation skill assessment form, and 5) the students' satisfaction evaluation form. The statistical methods used in this study included percentage, mean, standard deviation, and t-test (dependent). The study found that: 1) The developed instructional model, which integrates the MIAP learning model with Simulation-Based Learning (SBL), was of high quality ($\bar{x}$ = 4.34, SD = 0.37), 2) students showed significantly higher learning achievement after learning through the integrated learning model ($p < .05$), 3) students who learned through the developed instructional model showed high outdoor electrical installation skills (average score was 3.15

or 78.82%) and 4) students showed a highest level of satisfaction with the developed instructional model ($\bar{x}$ = 4.51, SD. = 0.30), thus the integrated model helps vocational students develop practical skills and a deeper understanding through active learning, real-life practice, and continuous reflection.

Keywords: MIAP learning model, Simulation-based learning, Vocational certificate, Development of outdoor electrical installation skills

I. INTRODUCTION

According to the Twelfth National Economic and Social Development Plan (2023–2027), Thailand must prioritize the advancement of science, technology, research, and innovation as essential drivers for enhancing national competitiveness. At the same time, it is critical to accelerate the upskilling of the workforce, especially among new entrants to the labour market (Office of the National Economic and Social Development Council, 2023). In alignment with this direction, the Strategic Policies of the Office of the Vocational Education Commission (2012–2026) emphasize the production and development of manpower that meets national demands in industrial, economic, and social sectors. One area of focus is the development of vocational education to ensure that graduates possess the practical skills required by employers. In the field of electrical power, one critical skill is outdoor electrical installation, which requires both technical precision and hands-on experience. However, conventional teaching methods that rely mainly on lectures and demonstrations may fall short in equipping students with real-world competencies and confidence.

Several previous studies have pointed out the limitations of classroom-based instruction in vocational training. Poopamonkaipob (2019, pp. 14–21) emphasized that most vocational students have few opportunities to practice in settings that closely simulate actual workplaces, resulting in limited problem-solving skills and confidence. Similarly, Phoyen (2021, pp. 11–28) found that while students receive some technical instruction, the lack of practical exposure hampers their ability to transfer knowledge to real work conditions. These findings highlight the need for innovative instructional approaches that promote hands-on experience and engagement with real-life scenarios. To meet this demand, simulation-based learning has emerged as a valuable method for developing job-ready skills. However, additional strategies are still needed to structure such learning experiences effectively.

One such strategy is the MIAP learning model, which consists of four components: Motivation, Information, Application, and Progress. This model promotes active learning by encouraging students to participate meaningfully in each stage of the learning process (Phetjan et al., 2023, pp. 1–14). A key strength of the MIAP model lies in its structured and progressive approach, which enhances understanding and performance. When combined with simulation-based learning, it helps replicate realistic working conditions and provides learners with repeated opportunities for skill development. As Chudjuajeen et al. (2021, pp. 149–163) suggested, simulation-based approaches allow students to perform tasks in safe, practice-based environments that reflect actual job scenarios. The integration of MIAP with simulation thus serves as a promising solution to bridge the gap between theoretical instruction and practical application in vocational education.

Therefore, the objective of this research is to develop a learning management model that integrates the MIAP learning model with simulation-based learning (SBL) for vocational students in outdoor electrical installation skills. This study aims to enhance students' learning outcomes by offering experiences that combine theoretical knowledge with hands-on practice, ultimately fostering analytical thinking, problem-solving ability, and confidence to perform tasks effectively and safely in real-world environments.

II. LITERATURE REVIEW

The MIAP learning model (Tongrot & Pansri, 2022, pp. 188-201) is a student-centred approach that encourages active engagement through four key stages: 1) Motivation (M): Instructors stimulate interest using media such as videos, images, or Q&A, helping learners connect prior knowledge to new content through real-world problems, 2) Information (I): This step is to convey knowledge or the essence of the lesson. The teacher must clearly explain the scope of the content so that the learners can prepare and plan their learning appropriately, 3) Application (A): Learners practice applying knowledge through hands-on tasks, exercises, or simulations that align with learning goals, helping reinforce understanding and build skills, 4) Progress (P): Learner performance is assessed through participation and task completion. Simulation-Based Learning (SBL) (Alharbi et al., 2024, pp. 1-21) is an instructional approach that places learners in realistic environments where they take on assigned roles under specific conditions. It allows students to practice problem-solving and critical thinking through direct experience in settings that resemble real-life situations. The key outcomes of SBL include (Khumsuk & Nillapun, 2021, pp. 1-11): 1) Knowledge acquisition aligned with learning goals and hands-on experiences, 2) Learner satisfaction, which reflects how students respond to the learning process and environment, and 3) Self-confidence, which directly influences the quality of performance. Simulation-Based Learning (SBL) helps boost learners' confidence, especially in performing technical tasks and making informed decisions. The learning process is typically organized into four stages (Chubkhuntod et al., 2020, pp. 1062-1072): 1) the provision of concrete experiences, 2) reflection on those experiences, 3) the development of abstract concepts derived from observations, and 4) the application of those concepts in new situations.

To address the need for effective instructional strategies in vocational education, several studies have proposed integrating active learning with simulation-based approaches. Informed by these developments, the present study combines the MIAP learning model, comprising four stages: Motivation, Information, Application, and Progress, with Simulation-Based Learning (SBL) to design an instructional framework aimed at enhancing outdoor electrical installation skills among vocational students. The hypothesis is that innovation-based learning activities, which integrate hands-on practice with analytical thinking, can significantly improve academic achievement, vocational skill performance, and student satisfaction.

III. RESEARCH METHODOLOGY

This section outlines the research methodology employed in the study, which aimed to develop and evaluate an instructional model that integrates the MIAP learning model with simulation-based learning (SBL) to enhance vocational students' outdoor electrical installation skills. The section includes the research design, conceptual framework, participants, research instruments, model development process, data collection procedures, and statistical analysis, with the details as follows:

3.1 Conceptual Framework

The conceptual framework of this study, which focuses on developing outdoor electrical installation skills through the integration of the MIAP learning model and simulation-based learning for vocational certificate students, consists of the independent variable: MIAP learning model combined with simulation-based learning, which consists of Motivation, Information, Application, and Progress. The dependent variables: learning achievement, outdoor electrical installation skills, and learner satisfaction, as illustrated in Figure 1.

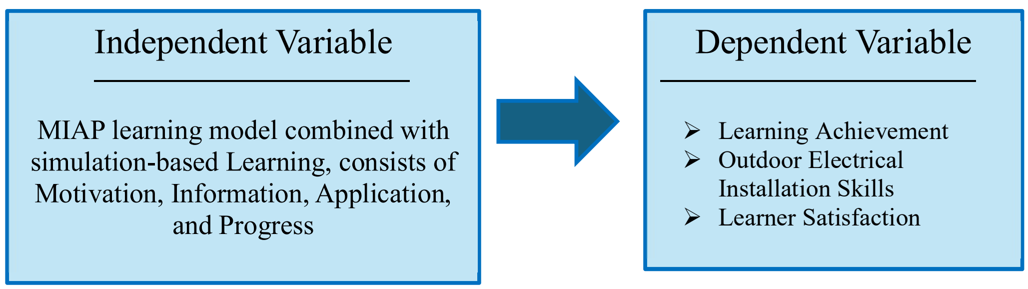

Figure 1: Independent variable and dependent variable in research

3.2 Research Design

This study employed a one-group pretest–posttest experimental design (Seetao et al., 2025, pp. 277-297), which is appropriate for evaluating the effectiveness of an instructional intervention when only a single group is available for study. In this design, participants were assessed before and after receiving instruction using the developed model to measure changes in key outcomes. The instructional model, which integrates the MIAP learning model with simulation-based learning (SBL), was applied in a real classroom setting. The design involved three main phases: 1) administering a pre-test to determine academic performance, 2) implementing the instructional model through a sequence of learning activities aligned with the MIAP learning model with simulation-based learning (SBL) principles, and 3) conducting a post-test using the same assessment instruments to evaluate improvements in academic achievement and student satisfaction.

3.3 Population and Sample

The population in this study consisted of 93 third-year vocational certificate students in the Electrical Power Program at Lopburi Technical College who were enrolled in the "Outdoor Electrical Installation" course during the second semester of the 2024 academic year. These students were distributed across five classrooms

The sample group in this study consisted of 19 third-year vocational certificate students in the Electrical Power Program at Lopburi Technical College. The students were enrolled in the Outdoor Electrical Installation course during the second semester of the 2024 academic year and were selected from a total population of 93 students distributed across five classrooms. The selection was made using cluster random sampling (Mingolo, 2025, pp. 82-98) by choosing one classroom.

3.4 Research Instruments

The research instruments used in the development of outdoor electrical installation skills through the MIAP learning model, combined with simulation-based learning for vocational certificate students, are illustrated in Figure 2 and described as follows:

1) A learning model integrating the MIAP model with simulation-based learning, designed to enhance students' skills in outdoor electrical installation,

2) An instructional package for outdoor electrical installation consists of a teacher's manual, instructional plans, presentation media, and activity sheets.

3) A learning achievement test comprising 60 multiple-choice questions with four answer choices, developed to assess students' academic performance which the content validity of the test items was evaluated using the Index of Item-Objective Congruence (IOC), with all items scoring above 0.50.

4) An outdoor electrical installation skill assessment form, which is an Analytic rubric-based assessment form with four scoring levels. (Sukmak & Klinbumrung, 2025, pp. 1-10)

5) The students' satisfaction evaluation form with the developed teaching model used a 5-point Likert scale (Yuangngoen et al., 2019, pp. 50-58).

Figure 2: Examples of research instruments

3.5 Research Procedure

3.5.1 The study began with the collection of essential data, including: 1) the course description of 20104-2012 Outdoor Electrical Installation, and 2) the instructional plans designed using the MIAP learning model integrated with simulation-based learning, focusing on practical skill development in the subject of outdoor electrical installation.

3.5.2 Development of a learning management model. The integration of the two instructional approaches enables learners to connect theoretical knowledge with practical application, while enhancing analytical thinking skills and self-confidence. This is particularly suitable for skill-based subjects such as outdoor electrical installation. The MIAP learning model consists of four stages: 1) Motivation, 2) Information, 3) Application, and 4) Progress, emphasizing active learner engagement throughout the process. Similarly, simulation-based learning comprises four key steps: 1) the provision of concrete experiences, 2) reflection on those experiences, 3) the development of abstract concepts derived from observations, and 4) the application of those concepts in new situations, as illustrated in Figure 3. Designing learning activities that combine both approaches can enhance realism in instruction and ensure alignment with real-world work environments, as shown in Table 1, which presents the instructional process based on the integrated model.

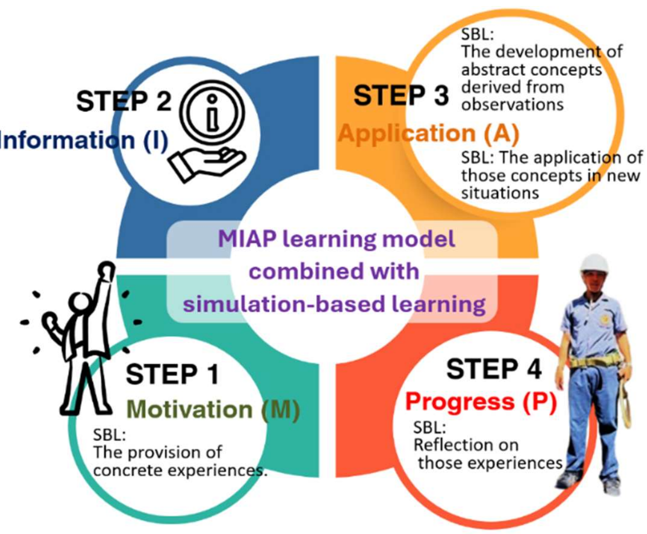

Figure 3: The developed MIAP learning model combined with Simulation-Based learning

Table 1: The instructional process based on the learning model

MIAP learning process	Simulation-based learning process	Training and learning activities
1. Motivation (M)	Step in the provision of concrete experiences.	Instructor - Provided an overview of the learning agreement and classroom expectations. - Introduced the lesson using a video that simulated a real-world scenario, such as an outdoor electrical malfunction. Students - Attentively listened to the instructor and asked clarifying questions as needed.

Table 1: (Continued) The instructional process based on the learning model

MIAP learning process	Simulation-based learning process	Training and learning activities
1. Motivation (M)	Step in the provision of concrete experiences.	Instructor - Provided an overview of the learning agreement and classroom expectations. - Introduced the lesson using a video that simulated a real-world scenario, such as an outdoor electrical malfunction. Students - Attentively listened to the instructor and asked clarifying questions as needed.
2. Information (I)		Instructor - Delivered relevant theoretical content to provide learners with foundational knowledge before engaging in practice. - Demonstrated the practical tasks based on the activity sheet. Students - Listened to the instructional content attentively.
3. Application (A)	Step in the development of abstract concepts derived from observations. Step in the application of those concepts in new situations.	Instructor - Designed challenging simulation scenarios to encourage problem-solving. - Observed students' performance during the activity. Students - Planned and applied problem-solving strategies. - Independently performed tasks within the simulated scenario.
4. Progress (P)	Step in reflection on those experiences	Instructor - Provided constructive feedback on students' performance. - Facilitated knowledge sharing and reflection based on practical experiences. Students - Engaged in peer discussion and shared insights from their practice. - Analyzed the strengths and weaknesses of their performance to enhance future learning.

3.5.3 The developed MIAP learning model, combined with simulation-based learning, was designed to improve outdoor electrical installation skills for vocational certificate students. The quality of the model was evaluated by five experts who had at least five years of teaching experience in higher education and knowledge in education or electrical-related fields. The model was then revised based on their suggestions.

3.5.4 The instructional activities were implemented based on the MIAP learning model combined with simulation-based learning, following a preliminary experimental research design. A one-group pretest–posttest design was employed with a sample of 19 students from the Electrical Power Program at Lopburi Technical College during the second semester of the 2024 academic year.

3.5.5 The students' learning achievement was compared before and after the implementation of the developed MIAP learning model combined with simulation-based learning. A 60-item multiple-choice test with four answer options was used as the assessment tool.

3.5.6 The students' outdoor electrical installation skills were assessed through practical activities based on the developed MIAP learning model with a simulation-based learning (SBL) using a four-level analytic rubric evaluation form.

3.5.7 Students' satisfaction with the developed MIAP learning model combined with simulation-based learning was assessed using a questionnaire based on a 5-point Likert scale. After that, data were collected, analyzed using appropriate educational statistics, and summarized to conclude.

3.6 Data Analysis

Data analysis in this study consisted of four parts: 1) the quality evaluation of the developed MIAP learning model combined with simulation-based learning was analyzed using mean and standard deviation, 2) the students' learning achievement before and after the implementation of the instructional model was compared using a dependent-samples t-test, 3) the outdoor electrical installation skills were analyzed by comparing percentage scores and 4) the students' satisfaction with the developed instructional model was analyzed using mean and standard deviation.

IV. RESULTS

4.1 Results of the Learning Model Quality Evaluation

The quality of the developed instructional model was evaluated by five experts in the field of electrical and electronic education, each with more than five years of teaching experience, as shown in Table 2.

Table 2: Results of the learning model quality evaluation (n=5)

Item	$\bar{x}$	SD	Interpret
1. Instructional design and structure.	4.32	0.33	high
2. Learning activities	4.52	0.46	highest
3. Applicability and practical relevance	4.36	0.48	high
4. Measurement and evaluation	4.16	0.30	high
Total average	4.34	0.37	high

For Table 2 as the results revealed that the overall quality of the learning model was rated at a high level ($\bar{x}$ = 4.34, SD = 0.37). Specifically, the mean scores for each aspect were as follows: instructional design and structure ($\bar{x}$ = 4.32, SD = 0.33), learning activities ($\bar{x}$ = 4.52, SD = 0.46), applicability and practical relevance ($\bar{x}$ = 4.36, SD = 0.48) and measurement and evaluation ($\bar{x}$ = 4.16, SD = 0.30).

In addition, the experts recommended improving the clarity of the instructional activity plans to ensure that teachers can implement them more easily, incorporating more diverse assessment tools, such as using behavioral observation forms alongside student self-assessment. All suggestions were incorporated into the model before it was implemented in the actual experiment.

4.2 Results of the comparison of students' learning achievement

To assess the effectiveness of the developed instructional model, a pre-test and post-test were administered to a sample group of 19 vocational certificate students. The test consisted of 60 multiple-choice questions as shown in Table 3.

Table 3: Results of the comparison of students' academic achievement (n=19)

Test	Score	$\bar{x}$	SD	df	t_{cal}	Sig. (1 tailed)
Pretest	60	30.79	5.34	18	12.02*	0.0000
Posttest	60	48.68	6.52			

$^*p < .05$, one-tailed

For Table 2, the mean pre-test score was 30.79 (SD = 5.34), while the mean post-test score increased to 48.68 (SD = 6.52). A paired-samples t-test indicated a statistically significant difference at the .05 level (t = 12.02, $p < .05$), confirming the effectiveness of the instructional model.

4.3 The Results of Developing Outdoor Electrical Installation Skills

To evaluate the effectiveness of the instructional model that integrated the MIAP approach with simulation-based learning, an assessment was conducted focusing on ten core competencies related to outdoor electrical installation. The evaluation measured students' performance using a 4-point rubric score, as shown in Table 4.

Table 4 : The results of outdoor electrical installation skills

Item	$\bar{x}$ value (max 4 points)	Performance (100%)	Rank
1. Wearing appropriate personal protective equipment.	3.63	90.79	1
2. Using tools and equipment for tasks on utility poles.	3.58	89.47	2
3. Climbing and performing tasks on utility poles safely.	3.53	88.16	3
4. Assessing the work environment prior to operation.	2.95	73.68	7
5. Inspecting and testing electrical systems.	3.26	81.58	5
6. Securing guy wires appropriately	3.11	77.63	6
7. Installing rack channels.	2.84	71.05	8
8. Installing low-voltage insulators	2.68	67.11	9

Table 4: (Continued) The results of outdoor electrical installation skills

Item	$\bar{x}$ value (max 4 points)	Performance (100%)	Rank
9. Installing high-voltage insulators	2.53	63.16	10
10. Working in compliance with safety standards and legal regulations	3.42	85.53	4
Total average	**3.15**	78.82	

According to Table 4, the strengths are wearing appropriate personal protective equipment, using tools and equipment for tasks on utility poles, and climbing and performing tasks on utility poles safely, respectively. The weaknesses are installing high-voltage insulators and installing low-voltage insulators, respectively. The overall mean score of students' outdoor electrical installation skills was 3.15, with a score over 70 percent interpreted as a "high" level. showing a need for further practice in these complex tasks.

4.4 Students' Satisfaction with the Learning Model

Students' satisfaction with the integrated learning model, combining the MIAP learning model with simulation-based learning, was evaluated through a structured questionnaire administered at the end of the instructional program. The questionnaire consisted of Likert-scale items covering key aspects, as shown in Table 5.

Table 5: Students' satisfaction with the learning model (n=19)

Item	$\bar{x}$	SD	Interpret	Rank
1. Activities were well-structured and easy to follow.	4.47	0.51	high	4
2. The model encouraged active teacher-student and peer interaction.	4.42	0.61	high	5
3. Content was effectively connected to real tasks.	4.37	0.50	high	6
4. Simulations increased motivation and engagement.	4.68	0.48	highest	1
5. Students applied knowledge to problem-solving.	4.58	0.69	highest	3
6. Learners practised self-monitoring and metacognition.	4.47	0.61	high	4
7. The environment boosted enthusiasm for learning.	4.58	0.51	highest	3
8. Teamwork and collaborative planning were emphasised.	4.47	0.70	high	4
9. Students developed systematic and analytical thinking.	4.42	0.77	high	5
10. Lessons reflected real-world contexts.	4.63	0.50	highest	2
Total average	4.51	0.30	highest	

According to Table 5, the strengths are simulations, increased motivation and engagement, and lessons reflect real-world contexts. The weaknesses are that the content was effectively connected to real tasks, and the overall mean score for students' satisfaction was 4.51, indicating a high level of satisfaction. A bar chart is presented in Figure 4. This figure illustrates the mean scores of 19 students' satisfaction with vocational certificate students at Lopburi Technical College for the learning management model that integrates the MIAP model with simulation-based learning, based on ten evaluation items, allowing for a more accessible interpretation of the data.

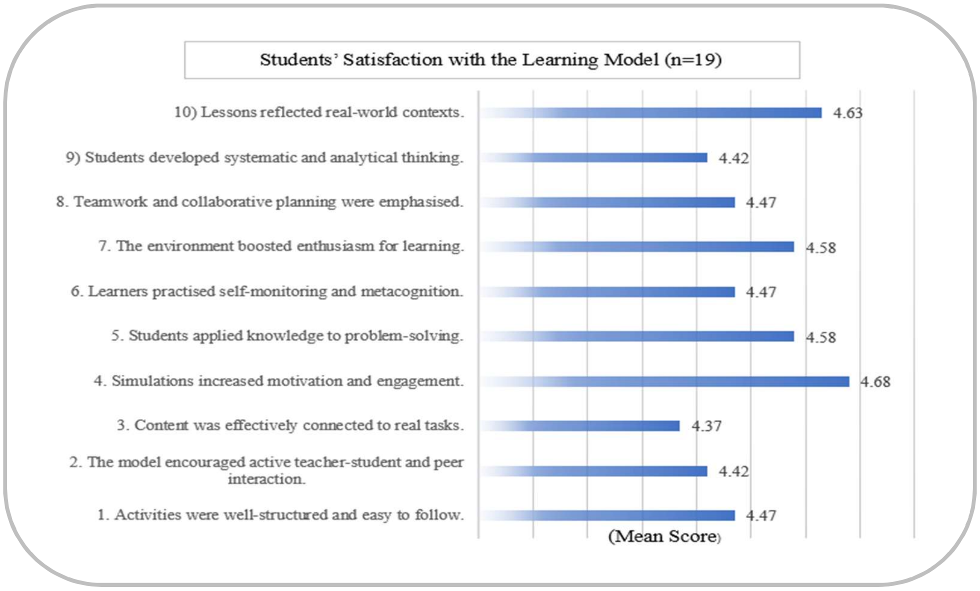

Figure 4: Students' satisfaction with the learning model presented in bar chart format

V. CONCLUSION AND DISCUSSION

This research aimed to develop outdoor electrical installation skills through an instructional model that integrates the MIAP learning model with simulation-based learning (SBL) for third-year vocational certificate students at Lopburi Technical College. The study involved 19 participants and was implemented through activities designed to promote analytical thinking and hands-on practice. The results showed that the developed instructional model was of high quality, which led to students' significantly higher learning achievement after learning through the integrated learning model ($p < .05$) and an average outdoor electrical installation skill score of over 70 percent. Furthermore, learner satisfaction was also rated high, indicating that the model effectively enhanced both vocational skills and practical learning experiences in outdoor electrical installation.

The developed instructional model, which integrates the MIAP learning model with Simulation-Based Learning (SBL), was evaluated by five experts and found to be of high quality ($\bar{x}$ = 4.34, SD = 0.37). The model underwent a rigorous validation process by educational experts before implementation. The findings are consistent with Sriudomkij et al. (2020, pp. 381-396), who developed a computer-based instructional model that employed simulations integrated with problem-solving processes, which demonstrated that a well-designed instructional model can significantly enhance learners' knowledge and skill acquisition. Furthermore, the study by Karnna and Prathoomthong (2020, pp. 12-21), who developed an MIAP-based instructional package combined with multimedia computer lessons to improve electrical measuring tool competencies among vocational students, supports these findings. Thus, learning through realistic and practical experiences combined with the structured phases of the MIAP model is deemed suitable for vocational certificate students. Students showed significantly higher academic achievement after learning through the integrated learning model (t = 12.02, $p < .05$). This indicates that the combination of the MIAP Model, which focuses on motivation, information, application, and reflection, and SBL, which emphasizes real-life experiences, can effectively enhance students' understanding and ability to apply knowledge. This result is consistent with Poopamonkaipob et al. (2020, pp. 111–118), who found that using MIAP with online lessons on condition design for vocational students significantly improved their academic performance, and Hansena and Jumrusprasert (2024, pp. 26-39) found that using inquiry-based learning together with simulation activities improved critical thinking and problem-solving skills among lower secondary school students. Therefore, integrating the MIAP model with simulation-based experiences is an effective instructional approach that helps improve academic achievement, especially for vocational certificate students. Students who learned through the developed instructional model showed high outdoor electrical installation skills (average score was 3.15 out of 4.00, or 78.82%). The results show that the learning model helped students improve their practical skills. This finding matches Pengsook (2022, pp. 103-114), who found that using simulation-based learning helped students improve their problem-solving skills. Students scored much higher after learning, showing that working in realistic situations helps with understanding and real practice and Raksapakdee and Chaipichit (2022, pp. 46-58), who used direct teaching and peer coaching to teach outdoor electrical installation, reported an average score of 78.41%, with over 80% of students passing the standard. Therefore, hands-on learning combined with simulation-based activities can effectively develop students' practical skills. Students showed a high level of satisfaction with the developed instructional model ($\bar{x}$ = 4.51, SD = 0.30) because the learning activities were clear and closely related to real working environments. The model gave students meaningful opportunities to engage with the content, which helped them understand and apply the knowledge effectively. This is consistent with Hutamarn (2022, pp. 32-43) used the MIAP learning model with demonstration kits and simulation worksheets in a course on electric drive and servo systems. His study found that students were highly satisfied with the model. Similarly, Prathoomthong and Karnna (2022, pp. 141-156) developed a lesson using MIAP and game-based learning for teaching basic programmable controllers and found that students had the highest level of satisfaction. Therefore, learning models that promote student participation, provide strong teacher support, and use suitable technologies can effectively increase student satisfaction.

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