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Development and validation of an ADDIE-based jobsheet as procedural scaffolding for vocational electrical practice

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ABSTRACT

Vocational electrical learning requires students to transform technical concepts into safe, ordered, and assessable workshop performance. This study developed and validated an ADDIE-based electrical lighting installation jobsheet as a form of procedural scaffolding for Grade XI students at an Indonesian vocational school. A research-and-development design was implemented using the ADDIE stages of analysis, design, development, implementation, and evaluation, with a one-group development trial. Data were collected through classroom observation, a teacher interview, expert validation, student-response questionnaires, and diagnostic, formative, and summative assessments. Three media experts, three material experts, and 23 students participated. The jobsheet was produced in printed and digital formats and covered five practice units: single-switch installation, series-switch installation, two-way switch installation, distribution-board lighting installation for a simple building, and light-sensor-based lighting installation. Expert validation indicated high feasibility in terms of media quality (M = 3.83/4.00) and material quality (M = 3.84/4.00), while the student response was positive (M = 3.49/4.00). Learning scores increased from diagnostic assessment (M = 47.61) to summative assessment (M = 85.65), with high normalised gain (g = 0.73), a very large paired effect size (Cohen's dz = 3.02), and 82.61% summative mastery. The findings indicate that a systematically designed jobsheet can connect curriculum outcomes, occupational safety, practical procedures, and assessment evidence. Because the implementation employed a one-group development trial, the findings should be interpreted as evidence of instructional feasibility and associated learning improvement rather than causal effectiveness. The study contributes a low-cost, competency-aligned practical learning resource for vocational electrical education; however, further controlled and multi-site studies are required to verify retention and practical-skill transfer.

INTRODUCTION

Vocational education has a distinctive role in helping learners translate concepts into workplace-like performance. In general academic subjects, achievement may be judged mainly through explanation or written recall. In vocational workshops, however, learning is judged through the ability to plan, perform, check, and justify a sequence of actions under practical constraints. This requirement is especially evident in electrical installation training because incorrect wiring, poor attention to safety, or skipped procedures can damage equipment and endanger learners. Therefore, vocational electrical education requires instructional resources that structure practical actions rather than merely summarise theoretical content.

Recent vocational education research has emphasized the alignment of curriculum, teaching materials, assessment, and workplace-oriented competence. Vocational skill packages are more

effective when technical knowledge, digital competence, and workplace safety practices are taught as interconnected requirements rather than as isolated content (Kiener et al., 2022). In Indonesia, laboratory instruction must also be deliberately designed to meet professional competency standards and improve quality assurance in vocational learning (Suartini, 2019). Similar international evidence suggests that TVET-based instruction can strengthen applied competence, learning-resource production, collaboration, and 21st-century skills when learning outcomes are made explicit (Silor & Silor, 2025). Work-project integration in vocational pharmaceutical education has also been shown to reduce the gap between theoretical education and workplace requirements (Guo et al., 2024).

The Indonesian Merdeka Curriculum intensifies this demand by requiring schools to translate learning outcomes into locally meaningful, student-centered learning activities. Curriculum documents, learning objectives, and learning-objective sequences must be coherently aligned before classroom activities can effectively support competency attainment (Afif & Siregar, 2024; Fauzi & Mustika, 2022; Sari et al., 2024; Tuerah & Tuerah, 2023). However, curriculum flexibility does not automatically produce student autonomy. Schools and prospective educators may still have difficulty preparing practical learning devices, particularly when new curricular language must be translated into concrete workshop procedures (Putri & Zakir, 2023).

The empirical context of the present study illustrates this problem. Preliminary observations and a teacher interview in the electrical power installation engineering program at SMK Negeri 4 Kota Serang indicated that the grade XI Electrical Lighting Installation course did not yet have a dedicated jobsheet for practical learning. In this article, a jobsheet denotes a structured practice-guidance document that explains learning objectives, tools, materials, occupational safety, work steps, circuit diagrams, observation tasks, and assessment evidence for a specific workshop activity. Without such a guide, students learned mainly from teachers' oral explanations, practical activities depended heavily on repeated immediate guidance, and approximately half of the students were reported to score below the minimum mastery criterion of 75.

This problem extends beyond a shortage of instructional materials. It indicates a procedural gap between what the curriculum expects and what students can independently perform in the workshop. Prior literature describes jobsheets as learning materials that support investigation, problem-solving, cognitive development, and psychomotor practice (Nurhasanah et al., 2017; Wilujeng & Joko, 2021). Research on jobsheets also shows that structured practical materials can support vocational high school instruction when they are aligned with specific tasks (Nuryanto et al., 2020). In electrical installations, this alignment is critical because safe and efficient lighting practices must adhere to installation principles and technical regulations (Nawawi, 2017; Sinaga, 2019).

The present manuscript conceptualizes the jobsheet as procedural scaffolding. In line with Vygotsky's (1978) concept of the zone of proximal development, scaffolding is understood as temporary support that helps learners perform tasks they cannot yet complete independently. Wood et al. (1976) further describe scaffolding as expert support that controls task complexity, maintains direction, and enables learners to progress toward independent problem solving. This means that the jobsheet does not replace the teacher, the demonstration, or the practice task. Instead, it provides a consistent sequence of actions that students can consult before, during, and after practice. Evidence from construction-work teaching shows that know-how is built through demonstrations that guide students' attention to tools, materials, and expected outcomes (Härmävaara & Schümchen-Schram, 2025). A jobsheet extends this pedagogical guidance into a reusable written and visual structure. It reduces procedural ambiguity while allowing the teacher to focus on feedback, safety monitoring, and diagnostic questioning.

This scaffolding argument is consistent with broader evidence on structured learning materials. Well-designed materials can reduce student passivity, consolidate support, and make learning activities more manageable (Inayat et al., 2013; Lochner et al., 2016; Teresevičienė et al., 2017). Studies in professional and vocational learning have reported benefits from digital courses, multimedia resources, online platforms, and structured modules when objectives, activities, and feedback are aligned (Avelino et al., 2016; Chen et al., 2018; Jackson et al., 2019; Larson et al., 2016; Wells et al., 2012; Yanto et al., 2023; Zhang et al., 2025). At the same time, research on simulation, video, and immersive learning warns that technological novelty alone does not guarantee learning

unless technology is orchestrated around the curriculum and task (Alinier, 2007; Hekele et al., 2022; Peterson & Mlynarczyk, 2016; Spangenberger et al., 2025).

A research gap remains regarding how the development of vocational teaching materials is evaluated. Several studies report that modules, trainers, or job sheets are valid and useful in technical subjects (Habibu & Malado, 2023; Indriyanto et al., 2020). ADDIE-based and design-development studies have also been used to validate professional modules, vocational platforms, and competency-oriented curricula (Cahyadi, 2019; Friadi et al., 2020; Ganganahalli & Udgir, 2024; Lee et al., 2024; Rossydi et al., 2026; Tegeh & Jampel, 2014). However, many development studies still provide limited integrated evidence regarding the relationships among product design, expert judgment, student usability, safety integration, and diagnostic, formative, and summative learning outcomes in authentic practical classrooms. This study presents an empirically evaluated procedural scaffolding model for vocational electrical practice that integrates curriculum mapping, safety-embedded practice steps, expert validation, student usability responses, and assessment evidence.

Accordingly, the study addressed three research questions. First, how can an electrical lighting installation jobsheet be developed as a procedural scaffold for vocational practical learning? Second, how feasible is the jobsheet according to media experts, material experts, and student users? Third, what learning improvement is associated with its implementation in a one-group classroom trial? The central argument is that a systematically designed jobsheet can help convert a teacher-dependent practical lesson into a more structured, student-accessible, and assessable learning process.

METHOD

This study employed a research-and-development design to produce, validate, and evaluate a practical learning resource. The product was an electrical lighting installation jobsheet for Grade XI students in the Electrical Power Installation Engineering program at SMK Negeri 4 Kota Serang, Indonesia. The study followed the ADDIE model, consisting of analysis, design, development, implementation, and evaluation. In this study, ADDIE was used not only as a product-development sequence but also as a framework for generating evidence on need, design, feasibility, use, and learning outcomes.

The participants represented the instructional context in which the product was developed and evaluated. Product validation involved three media experts and three material experts from vocational electrical education. The classroom trial involved 23 (twenty-three) Grade XI students who used the jobsheet during practical learning. The site was selected because the electrical lighting installation course had a clear instructional problem: practical learning was being conducted without a dedicated jobsheet. The study used a one-group development trial, and the findings are therefore interpreted as learning improvement associated with implementation rather than as isolated causal effects of the jobsheet.

Purposive sampling was employed. The school was selected because it provided a relevant vocational electrical installation context and lacked a dedicated jobsheet for the targeted practice course. The validator group was selected based on expertise in vocational electrical education and instructional media, while the student group comprised the intact Grade XI class assigned to the course during implementation. The validators were selected for their relevant expertise in vocational electrical education, instructional media design, electrical installation practice, and occupational safety.

The research procedure followed five operational steps. In the analysis stage, the researchers reviewed curriculum documents, observed practical learning, interviewed the teacher, and identified student difficulties. In the design stage, learning outcomes were mapped into jobsheet components and five lighting-installation units. During the development stage, the printed and digital jobsheets and validation instruments were prepared. In the implementation stage, the jobsheet was used during classroom practice, accompanied by diagnostic, formative, and summative assessments. In the evaluation stage, expert validation, student response, and learning outcome data were synthesized to refine the product and judge feasibility.

The analysis stage identified a gap between the subject's practical nature and the available learning resources. Data were collected through classroom observations, teacher interviews, and preliminary student responses. The analysis focused on the school's curriculum, expected learning outcomes, teaching and learning processes, availability of learning resources, and students' difficulties during practice. Observation showed that the teacher remained the primary source of procedural explanations, while students lacked a consistent written guide for carrying out practice steps, checking tools and materials, and interpreting completed circuits.

The design stage translated this need into a structured jobsheet. The product contained learning outcomes, learning objectives, basic theory, tools and materials, occupational safety and health procedures, work steps, experimental circuit diagrams, discussion prompts, conclusion activities, observation sheets, scoring rubrics, and references. The content was organized into five practice units: single-switch installation, series-switch installation, two-way switch installation for controlling one lamp from two locations, distribution-board lighting installation for a simple building, and lighting installation using a light sensor or photocontrol. The units were sequenced from simple control circuits to more complex lighting-system arrangements.

The development stage produced the jobsheet in printed and digital formats. The printed format was intended for direct use in workshop practice, while the digital format allowed students to review procedures before and after class. The digital version was treated as a complement to workshop learning rather than as a stand-alone technology. This decision reflected a design-first orientation: the central mechanism was procedural organization, while the medium of access supported flexibility. Multimedia and blended-learning studies indicate that technology is most effective when it is aligned with learning objectives, learner interaction, and supporting materials rather than being used merely for novelty (Lou, 2017; Razali & Bin Ismail, 2019; Shum et al., 2025).

Three instruments were used to evaluate the product. The media-validation instrument consisted of 20 items covering display, ease of use, consistency, and format or graphics. The material-validation instrument consisted of 25 items covering content feasibility, language, presentation feasibility, and usefulness. The student-response instrument consisted of 25 items covering the presentation of material, language, graphics, and usefulness. All instruments used a four-point scale, where 4 indicated the highest level of agreement. Sample validation indicators included the clarity of instructions, the consistency of layout, the relevance of the material to learning objectives, the readability of the language, the availability of safety procedures, the clarity of the work steps, and the usefulness for independent practice.

The instruments were constructed from explicit measurement domains. The media-validation instrument measured display quality, ease of use, consistency, and format or graphics. The material-validation instrument measured content feasibility, language, presentation feasibility, usefulness, and the suitability of occupational-safety and procedural content. The student-response questionnaire assessed the presentation of material, language, graphics, and usefulness for independent practice. Validity was addressed through expert judgment of item relevance to the intended constructs. Reliability or consistency was addressed through common rating scales and standardized scoring rubrics. To avoid implying a formal reliability coefficient, validator consistency was reported as a descriptive category-agreement proportion across raters; no separate reliability coefficient was calculated for the small expert-validation panels.

Learning outcomes were assessed through diagnostic, formative, and summative assessments. The diagnostic assessment measured initial readiness and prior understanding before implementation. The formative assessment measured learning progress during jobsheet-supported practice. The summative assessment measured achievement after implementation. These assessments focused mainly on conceptual and procedural learning outcomes rather than on direct measures of wiring accuracy, task-completion time, or long-term workplace transfer. This distinction is important because the study evaluates learning evidence associated with the jobsheet, not full practical competence in all occupational dimensions.

The data-collection tools consisted of a classroom observation sheet, a semi-structured teacher interview guide, a media validation sheet, a material validation sheet, a student response questionnaire, a diagnostic test, a formative assessment, a summative assessment, and documentation of the jobsheet product and practice activities.

Data were analysed using descriptive and inferential procedures. Expert validation and student-response data were summarised as means and interpreted using the four-point criteria used in the original study. Learning scores were summarised using mean, standard deviation, median, range, confidence interval, and mastery percentage based on the minimum criterion of 75. Learning improvement was estimated using normalized gain. A paired-samples t-test compared diagnostic and summative scores, Cohen's dz estimated the paired effect size, a Wilcoxon signed-rank test was used as a non-parametric robustness check, and the Shapiro–Wilk test examined the distribution of paired differences. Student identities were anonymized for reporting purposes, and the study was conducted with school permission and in accordance with informed-consent procedures appropriate for classroom-based educational research. Normalized gain was calculated from diagnostic and summative means using the standard gain formula relative to the maximum score of 100, and mastery was interpreted against the school criterion of 75.

The research design is summarised in Table 1. The table shows how the study connected instructional need, product design, expert validation, user acceptance, and evidence of learning outcomes. This chain of evidence was developed to address a common limitation in instructional-development research: products are often judged solely by feasibility scores, with insufficient attention to use and learning data.

Table 1. Research Design, Evidence Sources, and Analytic Function

Evidence layer	Data source	Analysis	Function
Instructional need	Observation, teacher interview, preliminary student responses	Qualitative diagnosis	Establishes the empirical problem and product rationale
Product design	Curriculum outcomes, practical units, safety procedures, circuit tasks	ADDIE-based design synthesis	Shows how the jobsheet translates curriculum into practice
Expert validation	Three media experts and three material experts	Mean scores and descriptive category-agreement proportion	Tests media quality, content accuracy, presentation, and usefulness
User acceptance	Twenty-three grade XI students	Mean scores by aspect	Tests usability from the learner's perspective
Learning outcomes	Diagnostic, formative, and summative assessments	Descriptive statistics, mastery rate, n-gain, t-test, effect size, and Wilcoxon test	Tests improvement associated with implementation

RESULTS AND DISCUSSION

Results

The analysis stage confirmed a direct instructional need. Students were required to perform electrical lighting installation practice, but they did not have a dedicated jobsheet. The absence of a jobsheet had three main consequences. First, students depended heavily on the teacher's explanations during practice. Second, the learning process was not fully student-centered because students lacked a resource for independent action. Third, initial achievement was weak, with a diagnostic mean score of 47.61 and no student reaching the mastery threshold. These findings supported the development of a structured procedural scaffold rather than a minor revision of classroom explanation.

Figure 1 illustrates the theoretical mechanism underlying the study. The mechanism begins with a learning-resource gap, continues through ADDIE-based design, becomes operational through a procedural scaffold, and is examined through validation, student response, and assessment evidence. This model clarifies that the jobsheet was not treated as a decorative teaching medium. It was developed as a boundary object that connects curriculum outcomes, workshop procedures, teacher facilitation, and evidence of student performance.

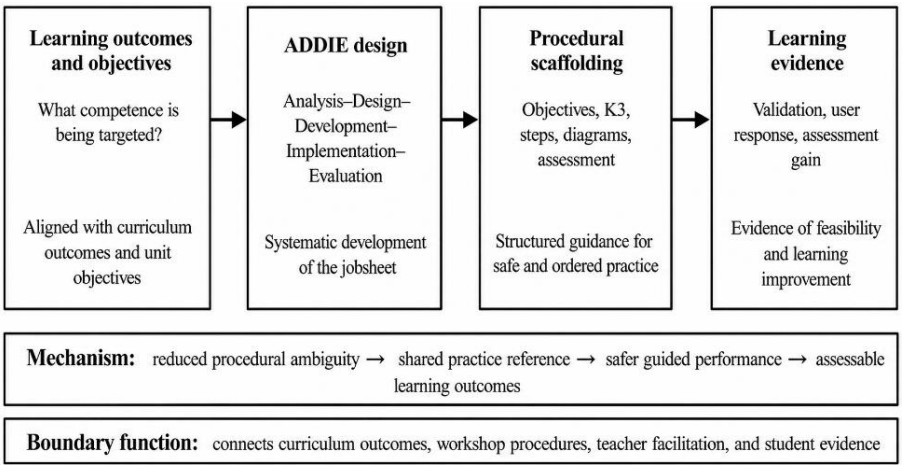

Figure 1. Mechanism of the ADDIE-based Jobsheet as Procedural Scaffolding

The final product connected curriculum outcomes and learning objectives to five practical units. Each unit contained basic theory, tools and materials, occupational safety procedures, work steps, circuit diagrams, discussion prompts, and conclusion activities. The safety component was embedded within the practice sequence because electrical installation requires safety to be enacted as part of work, not remembered as an isolated rule. The discussion and conclusion components were included so that the jobsheet did not become a mere checklist. Students were expected to complete wiring tasks and articulate what they observed, how the circuit functioned, and the evidence supporting the accuracy of the results.

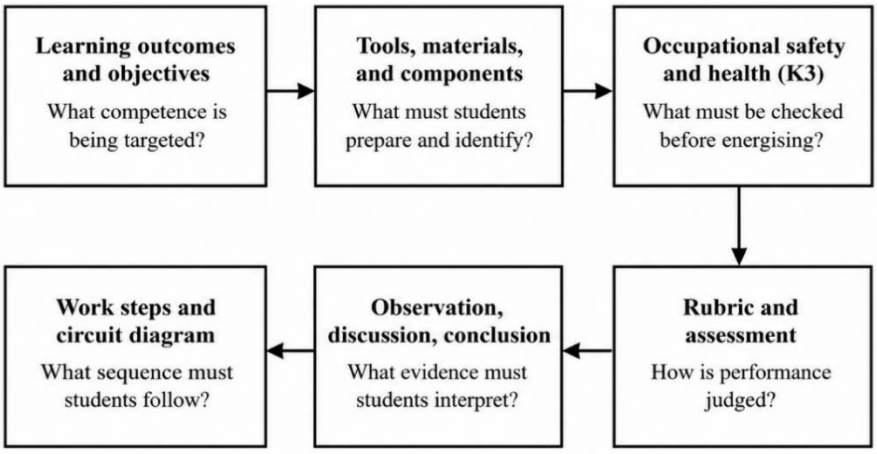

Figure 2. Representative Architecture of One Electrical Lighting Installation Jobsheet Unit

Product Feasibility and User Response

Expert validation indicated that the jobsheet was feasible. Media experts gave an overall mean score of 3.83 out of 4.00. This result indicates that the jobsheet had appropriate display quality, layout, consistency, readability, and visual presentation. Material experts gave an overall mean score of 3.84 out of 4.00, indicating alignment with learning outcomes, learning objectives, electrical practice needs, language clarity, and safety requirements. The descriptive category-agreement proportion was 0.60 for media validation and 0.76 for material validation, suggesting moderate-to-substantial convergence in validator ratings rather than a separate formal reliability coefficient.

Student responses also supported the usability of the product. The overall student-response mean was 3.49 out of 4.00. Aspect means were 3.53 for material presentation, 3.52 for language, 3.58 for graphics, and 3.38 for usefulness. Although usefulness was the lowest-rated aspect, it

remained within the high category. This pattern indicates that students perceived the jobsheet as readable, visually acceptable, and helpful for understanding practice steps. The lower usefulness score also suggests areas for design improvement: future versions could include more detailed troubleshooting prompts, wider measurement and observation spaces, and possibly QR-linked demonstrations for difficult procedures.

Table 2. Product Feasibility and User-Response Summary

Assessment source	Aspects covered	Overall mean	Interpretation
Media experts	Display, ease of use, consistency, format/graphics	3.83/4.00	High feasibility
Material experts	Content, language, presentation, usefulness	3.84/4.00	High feasibility
Student users	Presentation, language, graphics, usefulness	3.49/4.00	Positive response

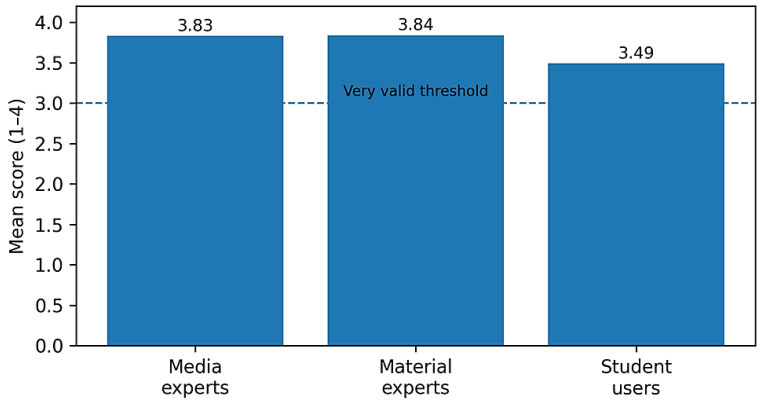

Figure 3. Product Feasibility and User-Response Scores

Learning Outcomes Associated with Implementation

Learning outcomes provided the strongest evidence of meaningful learning improvement associated with jobsheet implementation in the classroom trial. Diagnostic scores were low, with a mean of 47.61, a standard deviation of 7.52, and a range of 35 to 60. No student reached the mastery threshold at this stage. After jobsheet-supported learning, formative scores increased to a mean of 88.00, with 95.65% of students reaching the threshold. Summative scores remained high, with a mean of 85.65 and 82.61% mastery. The decrease from formative to summative mastery suggests that supported practice yielded very strong immediate performance, whereas independent consolidation still varied among students.

Table 3 reports the descriptive and inferential learning statistics. The aggregate normalized gain from diagnostic to summative assessment was 0.73, which falls within the high-gain category. The paired mean difference was 38.04 points. The paired-samples t-test showed a statistically significant increase from diagnostic to summative scores, $t(22) = 14.49$, $p < .001$, with a very large paired effect size, Cohen's $dz = 3.02$. A Wilcoxon signed-rank test supported the same conclusion, $W = 0.00$, $p < .001$. The Shapiro–Wilk test on paired differences was not significant, $W = 0.967$, $p = .622$, indicating that the paired-difference distribution did not strongly violate the normality assumption.

Table 3. Descriptive and Inferential Summary of Student Learning Outcomes

Assessment stage	Mean ± SD	Median (range)	Mastery ≥75
Diagnostic	47.61 ± 7.52	45 (35–60)	0.00%
Formative	88.00 ± 5.26	88 (68–92)	95.65%
Summative	85.65 ± 11.21	90 (60–100)	82.61%
Paired diagnostic–summative	Mean difference = 38.04	$t(22) = 14.49$; $p < .001$	$dz = 3.02$; $g = 0.73$

Note. The Wilcoxon signed-rank test confirmed the increase (W = 0.00, p < .001). The Shapiro–Wilk test did not reject normality of paired differences (W = 0.967, p = .622)

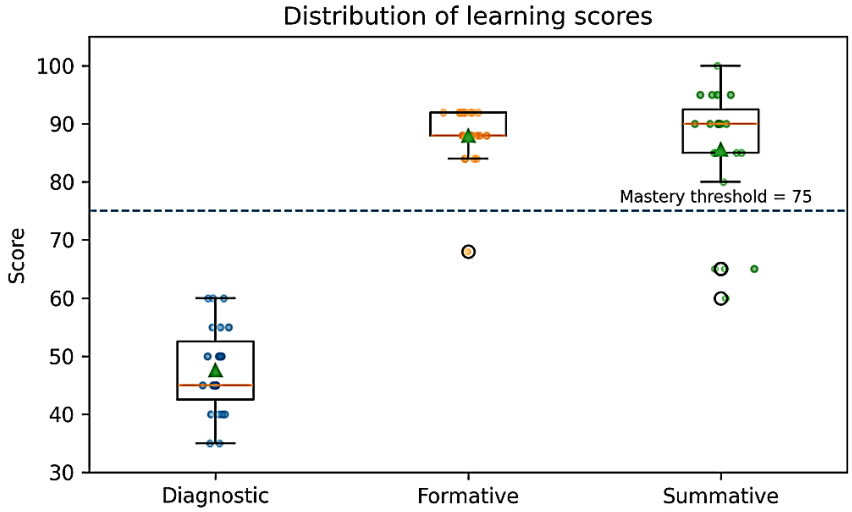

Figure 4. Distribution of Diagnostic, Formative, and Summative Scores

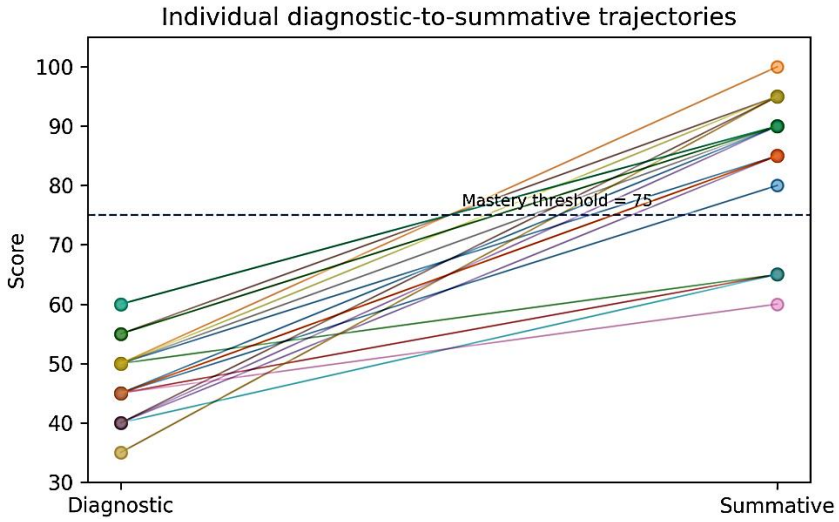

Figure 5. Individual Diagnostic-to-Summative Learning Trajectories

Discussion

The findings reframe the jobsheet as more than a worksheet. It served as a boundary object connecting curriculum policy, workshop procedures, teacher facilitation, and student performance evidence. In boundary-object theory, an artifact can be shared across communities because it is stable enough to coordinate work but flexible enough to support local interpretation (Star & Griesemer, 1989). In educational settings, boundary objects can support boundary crossing by connecting practices, language, and evidence across activity systems (Akkerman & Bakker, 2011). It translated learning outcomes into visible practice steps, safety rules into repeated action requirements, teacher knowledge into a reusable document, and practical performance into assessment evidence. This explains why the product could support a shift from teacher-centered explanation toward more student-accessible practical learning.

This interpretation is consistent with the broader logic of vocational education. Practical competence is not produced through exposure to theory alone. It requires repeated engagement with tools, standards, feedback, and workplace-like tasks. Research on vocational learning indicates that teaching quality, learner goal orientation, and applied skill packages influence outcomes and career-related development (Mahfud et al., 2019). Expansive apprenticeship research also argues that

learning is stronger when participants are supported to move beyond narrow task completion toward broader capability (Safford et al., 2013). The jobsheet developed here supports this movement at the micro-instructional level by giving students a structure for understanding, performing, and reflecting on electrical installation tasks.

The results also support a design-first rather than a technology-first approach. Many studies show that digital resources, multimedia, serious games, video feedback, and web platforms can improve satisfaction, motivation, access, or learning outcomes when they are well designed (Avelino et al., 2016; Chen et al., 2018; Eeckhout et al., 2016; Jackson et al., 2019; Shum et al., 2025; Yanto et al., 2023). However, the present study suggests that the central value of the jobsheet lies not in its digital format but in its capacity to make practical procedures visible, sequential, and assessable. The printed format supports direct workshop use, while the digital format expands access and repeated review. This hybrid approach is feasible for schools with limited resources because it improves the organization of practice without requiring costly simulation infrastructure.

Safety integration is another important contribution. Vocational safety research shows that classroom safety instruction can improve knowledge, but work practices require integration into routines, attitudes, and learning environments (Bejan et al., 2020). E-module research on occupational safety and health also indicates that well-designed learning resources can improve safety knowledge when embedded in the learning process (Nurlaela et al., 2025). The jobsheet in this study embedded safety within tools, procedures, and work steps. Safety was therefore presented as a recurring procedural requirement rather than as isolated information detached from practice.

The assessment structure strengthens the study's argument. Diagnostic, formative, and summative assessments provided evidence of learning as a developmental trajectory. Diagnostic assessment revealed initial weakness, formative assessment showed strong performance during supported learning, and summative assessment showed that most students reached mastery after implementation. This sequence is consistent with the assessment role proposed in the Merdeka Curriculum, in which diagnostic and formative assessments support learning adjustments rather than merely recording final performance (Purwati et al., 2023; Putri & Zakir, 2023). It also aligns with the testing-effect argument that assessment can support learning by requiring retrieval and consolidation (Seidel et al., 2008).

The magnitude of improvement should be interpreted cautiously. Similar pretest–posttest improvements have been reported in vocational studies using Android-based courseware, product-based teaching factory models, experimental demonstrations, and creative teaching approaches (Friadi et al., 2020; Li et al., 2022; Ragadhita et al., 2023; Yanto et al., 2023). However, because this study used one class without a control group, the gains cannot be attributed exclusively to the jobsheet. Teacher explanation, repeated practice, student familiarity with assessments, and classroom interaction may also have contributed. The most appropriate interpretation is that the jobsheet formed a validated scaffold within an improved learning environment and was associated with strong learning gains.

The study also clarifies the difference between assessed learning outcomes and practical competence. The results show improvement in diagnostic, formative, and summative assessment scores. They do not yet prove long-term competence in wiring accuracy, time efficiency, troubleshooting, safety compliance, or workplace transfer. This distinction is important because vocational competence is multidimensional. Future studies should combine assessment scores with direct observation rubrics, practical-performance video analysis, and delayed retention tests. Faculty development research in technical-vocational education also indicates that contextualized materials and targeted capacity building are needed when institutions seek systemic improvement (Lugo, 2025).

The implications for teachers are practical. When procedures are documented, teachers can spend less time repeating basic steps and more time asking diagnostic questions: Why is this conductor placed here? What happens if the switch is connected incorrectly? How was safety checked before energizing the circuit? What evidence shows that the circuit works as intended? This shift supports higher-level reasoning beyond task completion. It also resonates with research on tutor support and in-practice training, where guidance remains necessary even when structured materials are available (Davydenko & Chebrovskaya, 2025; Tran et al., 2023).

The study also has implications for educational equity. When instructions are delivered only orally, students with stronger prior knowledge, confidence, or proximity to the teacher may benefit more. A written jobsheet gives all students access to the same procedural information. This does not eliminate differences in ability, but it reduces avoidable barriers stemming from unequal access to guidance. This argument is consistent with inclusive-education literature, which emphasizes reducing barriers to participation through accessible learning support (Ainscow, 2020), and with workplace-learning theory, which treats access to guidance and learning affordances as a condition for participation and capability development (Billett, 2004). Research on academic support shows that structured support matters when students enter learning with varying levels of preparedness (Bettinger et al., 2013). In the present study, four students remained below summative mastery, indicating that written scaffolding was helpful at the class level but insufficient for every learner.

Some references in the broader instructional-design literature come from professional education, health education, or general technology-enhanced learning. They are used in this manuscript only to support general principles regarding outcomes-based curricula, simulation, structured modules, multimedia support, and learning resource design (Al Shehri, 2004; Alinier, 2007; Ganganahalli & Udgir, 2024). The specific contribution remains located in vocational electrical education. This distinction prevents overgeneralization and clarifies that evidence from distant fields functions as methodological support, not as a substitute for TVET literature.

The study has limitations. The sample was small and limited to one vocational school. The absence of a comparison group limits causal inference. Student-response data relied on self-report and may be influenced by novelty or social desirability. The study measured immediate learning outcomes rather than long-term retention, practical skill transfer, or safety behavior in subsequent tasks. Future studies should compare jobsheet-supported learning with conventional instruction or alternative media, involve multiple schools, and examine practical-performance indicators such as wiring accuracy, time efficiency, troubleshooting ability, safety compliance, and student confidence. Future work can address these limitations through pretest–posttest control-group designs, quasi-experimental matching across comparable classes, blinded external assessment of wiring products, objective safety-compliance checklists, task-completion-time measures, and delayed retention or transfer tests.

CONCLUSION

This study developed and validated an ADDIE-based jobsheet for electrical lighting installation practice in Indonesian vocational education. The product was designed in printed and digital formats and aligned with learning outcomes, learning objectives, occupational safety, circuit-based practical tasks, and assessment activities. Expert validation indicated high feasibility in terms of both media and material quality, while student responses indicated positive usability and acceptance. Learning outcomes increased substantially from diagnostic to summative assessment, with high normalized gain, a very large paired effect size, and high summative mastery. The main strengths of the product include its integrated procedural structure, low-cost printed and digital accessibility, explicit safety integration, alignment between practical circuit tasks and assessment evidence, and support for more independent student learning.

The study's main contribution is the argument that a jobsheet can serve as a comprehensive procedural scaffold for vocational practice. Theoretically, this study extends the concept of procedural scaffolding in vocational practical instruction by demonstrating how structured jobsheets can bridge the gap between curriculum expectations and authentic workshop practice. It is not merely a worksheet or handout; it is a structured pedagogical device that translates curriculum requirements into practical action, reduces dependence on repeated teacher explanation, embeds safety into work procedures, and produces evidence for assessment. In electrical lighting installation, this function is important because learning requires conceptual understanding, procedural accuracy, safety awareness, and increased independence.

The findings support further refinement and broader testing of ADDIE-based jobsheets in vocational electrical education. Future iterations should strengthen troubleshooting guidance, reflective prompts, digital interactivity, and performance rubrics. Future research should also adopt

multi-site or comparison-group designs to test retention, transfer, and the quality of practical skills. Within its methodological boundaries, the study shows that systematic instructional design can produce a feasible, accepted, and instructionally useful learning resource for competency-based vocational practice.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial or non-financial interests that could have appeared to influence the work reported in this paper.

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