

A Service Work Order-Based Assessment for Learning Model to Improve Practical Competence and Work Readiness of Automotive Vocational School Students

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ABSTRACT

This study aimed to develop a Service Work Order (SWO)-based Assessment for Learning (Afl) model and examine its validity, practicality, and association with automotive students' practical competence and work readiness. Research and development comprised needs analysis, instrument design, expert validation, a limited trial with 36 students, and a quasi-experimental nonequivalent pretest-posttest comparison involving 72 students in two intact classes. The intervention involved eight periodic light-vehicle maintenance sessions. Expert validity was rated 92.53%, with teacher and student practicality ratings of 90.40% and 89.50%. Mean competence rose from 64.17 to 86.39 in the experimental group and from 63.72 to 74.11 in the control group. The reported ANCOVA indicated a baseline-adjusted difference ($F = 52.846$, $p < 0.001$, partial $\eta^2 = 0.433$), with an experimental-group N-gain of 0.62 and a between-group Cohen's d of 1.73. Experimental-group work-readiness scores increased descriptively from 65.22 to 86.11, but the supplied data did not permit an inferential work-readiness test. The model uses a traceable cycle of work evidence, safety checks, feedback, correction, verification, and reflection. Findings support its practical promise while warranting multiclass replication and fuller instrument-reliability reporting.



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A. INTRODUCTION

Vocational secondary education is expected to prepare graduates who can integrate technical knowledge, practical skills, safe work habits, and adaptability to workplace demands. In automotive education, this requires learning environments that approximate industrial service processes rather than separating theory from practice (Pradana et al., 2024; Erviana et al., 2023). Work-based learning and Teaching Factory approaches can strengthen the relevance of school learning to real work and contribute to competency development and work readiness (Pradana et al., 2024; Sari et al., 2025). However, authentic practice requires an assessment

system that captures how students perform, make decisions, comply with procedures, and improve during the task, not merely whether the final product is acceptable (Kusmini et al., 2021; Tentama et al., 2022).

Periodic light-vehicle maintenance is particularly suitable for such assessment because it combines preparation, tool use, inspection, diagnosis, maintenance procedures, quality control, documentation, and Occupational Safety and Health (K3). These activities demand procedural accuracy, technical judgment, and safe work behavior, while school workshops often operate with limited vehicles, equipment, time, and teacher supervision (Sujadi et al., 2022; Pamungkas & Gunadi, 2025). Conventional assessment can therefore obscure important aspects of individual performance, especially when group grades are based mainly on final task outcomes. It may also provide insufficient evidence of who completed particular procedures, how errors were identified, or whether corrective actions were performed (Kusmini et al., 2021; Tentama et al., 2022). Feedback is another critical issue: when it is verbal, incidental, or provided only after task completion, students have limited opportunity to use it as a traceable basis for immediate improvement. Structured formative feedback and reflection are consequently needed to connect observed performance gaps with corrective action during practical learning (Austin et al., 2024).

Existing vocational research provides complementary but incompletely connected approaches to authentic assessment. Work-based learning and Teaching Factory publications address the organization and workplace relevance of vocational learning (Erviana et al., 2023; Pradana et al., 2024; Sari et al., 2025), while competency-assessment studies address the documentation of occupational skills and individual performance (Kusmini et al., 2021; Tentama et al., 2022). Automotive workshop studies emphasize safety compliance and resource constraints (Sujadi et al., 2022; Pamungkas & Gunadi, 2025). These contributions are important, but their separate emphases do not, by themselves, establish an integrated formative assessment cycle organized around a Service Work Order (SWO). The proposed model is differentiated from a conventional job sheet and from AfL applied as a discrete feedback activity by making the authentic work document the continuous record of task requirements, individual performance evidence, safety checks, feedback, corrective action, quality verification, and reflection. The resulting research gap is therefore operational and integrative: routine workshop documentation has not been demonstrated here as a single traceable backbone for learning-oriented evaluation across an automotive maintenance task. Table 1 summarizes the distinct emphases of the research cited in this manuscript; the comparison is thematic rather than a systematic review of every existing model.

Table 1. Thematic positioning of SWO-based AfL relative to cited vocational-education research

Research strand and cited studies	Reported focus	Assessment orientation	Role of work order
Work-based learning / Teaching Factory (Pradana et al., 2024; Erviana et al., 2023)	Workplace-relevant vocational learning	Industry-aligned learning processes	Not demonstrated as a continuous AfL record in this manuscript
Occupational competency assessment (Kusmini et al., 2021; Tentama et al., 2022)	Work skills, competency tests, and performance evidence	Competency-oriented evaluation	SWO-mediated correction and re-verification not reported here
Workshop safety and resources (Sujadi et al., 2022; Pamungkas & Gunadi, 2025)	Facility constraints and occupational safety	Safety and workshop readiness	Work-order integration not established by cited titles
Proposed SWO-based AfL model (present study)	Maintenance-task evidence, safety, feedback, verification	Formative continuous process and competency outcomes	Central traceable document linking performance to corrective action

Note. This table characterizes only the thematic emphases visible from studies cited in the manuscript; it does not establish that the cited studies lack unreported procedures or effect estimates.

Accordingly, this study developed and evaluated a Service Work Order (SWO)-based Assessment for Learning (AfL) model for periodic light-vehicle maintenance in automotive vocational education. The SWO served as a continuous work record that connected authentic task criteria to individual observation, occupational safety and health (K3), diagnosis, formative feedback, corrective action, verification, and reflection. The model was designed to provide a closed evidence-to-improvement cycle within resource-constrained school workshops. Specifically, the study aimed (1) to develop an SWO-based AfL framework and associated assessment instruments; (2) to evaluate their expert-rated validity and teacher/student practicality; and (3) to examine whether practical competence following eight sessions differed between students using the model and those receiving conventional job-sheet assessment, while describing associated patterns in work readiness and safety-related performance. Because classes were not randomly allocated, effectiveness is evaluated as an association rather than definitive causal proof.

B. METHODS

Research Design and Development Procedure

This study used a Research and Development (R&D) approach to develop and evaluate a Service Work Order (SWO)-based Assessment for Learning (AfL) model for periodic light-vehicle maintenance in automotive vocational education. Drawing on the development logic of 4D and ADDIE, the process included needs analysis, design, development, validation, a limited trial, an effectiveness evaluation, and refinement (Bahora et al., 2023; Suryani et al., 2022). Needs analysis used observations, interviews, literature examination, and existing assessment documents to identify workshop processes, limitations in individual assessment, equipment availability, the use of feedback, and safety checkpoints. The model prototype comprised a learning SWO, an 11-aspect four-point performance rubric, observation sheets, an Achievement–Gap–Improvement–Verification feedback guide, a reflection sheet, a quality-inspection checklist, a K3 checkpoint SOP, and a teacher implementation guide. These complementary instruments were designed to retain evidence of both work processes and final outcomes, rather than treating the SWO as an administrative form alone.

Participants, Trial, and Intervention

Participants included experts in assessment, vocational learning, and automotive engineering, one productive Light Vehicle Engineering teacher, and eleventh-grade students. Product validation addressed content, construct, language, automotive-technical suitability, implementation, and K3 integration. A limited trial with 36 students examined practicality, readability, implementation, and user responses. Effectiveness was then tested using a quasi-experimental nonequivalent pretest–posttest control-group design with 72 students from two intact classes. The experimental group ($n = 36$) used the SWO-based AfL model, whereas the control group ($n = 36$) used conventional job sheets and regular teacher assessment. The intervention comprised eight 240-minute sessions covering periodic maintenance at 5,000 and 10,000 km, lubricant and fluid inspection, battery, brakes, tires, cooling systems, and integrated vehicle inspection. Data sources included practical-competency tests, performance rubrics, activity observations, K3-compliance instruments, diagnostic assessments, feedback records, reflection sheets, work-readiness questionnaires, and practicality questionnaires.

Data Analysis and Ethical Considerations

Validity and practicality were summarized using the reported expert/user percentage scores and feasibility categories; qualitative comments supported iterative refinement. The available validation record reports four evaluator roles and component percentages, but does not provide item-level ratings, the content-validity index or its calculation, instrument internal-consistency coefficients, or an inter-rater agreement statistic. Consequently, the reported 92.53% is presented as an aggregated expert assessment rather than proof of psychometric reliability. The original study description does not specify whether assessors were independently trained, whether parallel ratings were collected, or how discrepancies were resolved; these procedures must be documented from the original research record before stronger reliability claims can be made. Practical-competence effectiveness was summarized using paired- and independent-samples t-tests, baseline-adjusted ANCOVA, N-gain, Cohen's d , and partial eta squared. A pretest between-group comparison and Levene's variance test were reported. Because the available material contains aggregate results only, raw-data-based reanalysis, confidence intervals, reliability coefficients, and additional inferential tests cannot be reconstructed reliably. Work-readiness results are therefore reported descriptively; paired work-readiness scores, standard deviations, or covariance data would be required for valid inferential analysis. Participation was conducted with school permission, aggregate reporting was used to protect confidentiality, and workshop procedures followed K3 requirements.

C. RESULT AND DISCUSSION

1. Results

Results are organized according to the development sequence—needs analysis, model and instrument development, validation, limited trial, effectiveness testing, and final refinement—so that evidence of feasibility and effectiveness can be traced to the corresponding stage of model development.

Needs Analysis

Needs analysis involving two teachers and 36 students identified three main problems: assessment remained focused on final outcomes rather than documented work processes, individual contributions were difficult to monitor during group practice, and formative feedback was largely verbal and incidental. Only five of 18 analyzed documents contained detailed process indicators, while 27 of 36 students reported unclear assessment criteria. Facility constraints were also evident, with six groups sharing three vehicles and only 176 of the allocated 240 minutes used effectively for practice. Although the Service Work Order (SWO) was recognized as an authentic workshop document, it was rarely integrated into assessment.

These findings established six design characteristics: authentic, formative, structured, evidence-based, OHS-integrated, and practical.

Model Design and Development

The resulting model positioned the SWO as the core document linking task interpretation, diagnosis, work planning, K3 readiness, implementation, performance evidence, quality control, formative feedback, corrective action, verification, and reflection (Figure 1). Teacher and student roles were structured to enable individual assessment within group practice. The operational toolkit comprised the learning SWO, performance rubric, observation sheet, formative feedback guide, K3 checkpoint SOP, quality inspection checklist, reflection sheet, and teacher implementation guide. The final performance rubric contained 11 aspects scored on a four-point scale, while feedback followed an Achievement–Gap–Improvement–Verification sequence.

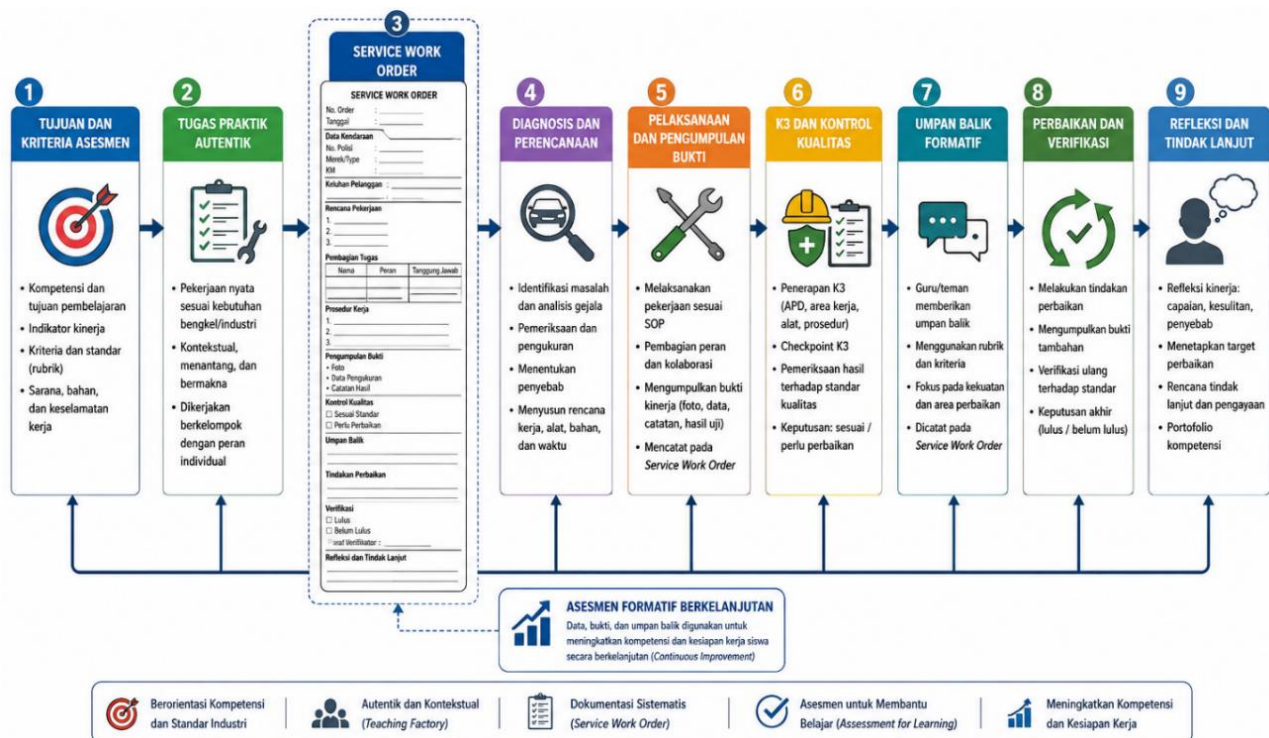


Figure 1. Conceptual Structure of the Assessment Model for Learning Based on Service Work Orders

Model Validation and Limited Trial

Overall validity reached 92.53%, and every validator classified the model as highly valid (Table 2). Component-level scores ranged from 88.50% for the teacher implementation guide to 95.40% for the K3 checkpoint SOP. Revisions concentrated on simplifying documents, specifying technical references, strengthening diagnosis verification, clarifying rubric descriptors, and refining the reflection format.

Table 2. Summary of Validation Results Based on Validator

Validator	Percentage	Category
Assessment expert	93.60	Very valid
Vocational-learning expert	93.33	Very valid
Automotive-engineering expert	92.31	Very valid
Productive teacher	90.83	Very valid
Overall	92.53	Very valid

The limited trial showed high implementation and practicality. Mean syntax implementation was 89.88%, ranging from 80.73% for reflection and competency documentation to 98.44% for tool, material, and K3 inspection. Teacher and student practicality reached 90.40% and 89.50%, respectively. Active practice time increased from 176 to 203 minutes, while activity dominance by particular students decreased from approximately 61% to 38%. Of 96 documented performance issues, 79 were corrected after formative feedback. The main implementation constraints were vehicle and equipment availability, teacher observation workload, and the time needed for feedback and reflection.

Model Effectiveness

Baseline practical competence was comparable between groups (experimental = 64.17; control = 63.72; $p = 0.777$). After eight sessions, mean practical competence reached 86.39 in the experimental group and 74.11 in the control group. Improvement was visible across the assessed competency dimensions, with particularly strong post-intervention performance in K3 compliance, work quality, procedural accuracy, and diagnostic capability (Table 3).

Table 3. Practical Competency Results Based on Aspects

Competency Aspects	Experimental Pretest	Experimental Posttest	Control Posttest
Work preparation	66.25	90.28	77.08
Use of tools and materials	65.42	87.50	75.69
Procedural accuracy	64.58	88.89	77.78
Technical skills	66.67	86.81	76.39
Diagnostic capabilities	61.39	84.72	70.83
Measurement accuracy	60.42	84.72	69.44
K3 Compliance	67.08	94.79	78.47
Quality of work results	67.36	90.97	77.78
Time efficiency	63.19	82.64	72.92
Communication and cooperation	65.28	87.50	75.69
Documentation of work results	57.64	81.25	62.50
Overall average	64.17	86.39	74.11

K3 compliance increased from 67.08 to 94.79 and diagnostic capability from 61.39 to 84.72 in the experimental group. The reported work-readiness score also rose from 65.22 to 86.11, an observed gain of 20.89 score points. However, the available research record supplies no group-specific work-readiness variance, paired observations, or control-group work-readiness outcome, so the statistical significance and effect size of this change cannot be established. At posttest, 86.11% of experimental-group students were categorized as competent or highly competent, compared with 41.67% in the control group. These categorization figures describe final status, not a separately estimated work-readiness treatment effect.

The reported homogeneity check was non-significant (Levene's $p = 0.317$); other distributional diagnostics are not supplied in the summary record. The between-group practical-competence posttest comparison was statistically significant ($t = 7.316$, $p < 0.001$), and ANCOVA reported a difference after adjusting for baseline competence ($F = 52.846$, $p < 0.001$, partial $\eta^2 = 0.433$). Experimental-group N-gain was 0.62 compared with 0.29 in the control group; the reported between-group Cohen's d was 1.73 (Table 4). These values indicate a substantial association in this sample, but their precision and sensitivity to class-level clustering cannot be checked without individual scores and model diagnostics. Effect sizes from the earlier studies cited here were not provided in the submitted source material and therefore cannot be compared numerically without retrieving their underlying outcome statistics.

Table 4. Summary of Statistical Analysis of Model Effectiveness

Analysis	Experimental Class	Control Class	Results
Pretest average	64.17	63.72	Equivalent at baseline
Posttest average	86.39	74.11	Higher in experimental group
Average increase	22.22	10.39	Larger increase in experimental group
Paired t-test	t= 18.762; p <0.001	t= 10.184; p < 0.001	Both increased significantly
Between-group posttest	-	-	t= 7.316; p < 0.001
ANCOVA	-	-	F= 52.846; p < 0.001
Partial eta squared	-	-	0.433
Average N-gain	0.62	0.29	Moderate (experimental); low (control)
Between-group Cohen's d	-	-	1.73
Decision			Model associated with a very large effect

Final SWO-Based AfL Model

The finalized SWO-based AfL model comprised eight components: learning objectives and assessment, authentic tasks, SWO documentation, performance evidence, K3 and quality checks, formative feedback, improvement and verification, and reflection and follow-up. Its ten-stage syntax was designed for a 240-minute practical session. K3 indicators were treated as non-compensatory critical requirements, meaning that students who failed these standards required remediation and re-verification before being declared competent.

2. Discussion

The findings suggest that SWO-based AfL can reposition practical assessment from an end-point judgment to a documented improvement cycle embedded in automotive work. The experimental group improved by 22.22 practical-competence score points versus 10.39 in the comparison group. The reported standardized difference was large ($d = 1.73$), but the nonequivalent-class design and lack of raw-data diagnostics constrain causal attribution. The proposed educational mechanism is observable and operational: explicit standards generate performance evidence, identified gaps prompt corrective feedback, and completion requires verification before the work order is closed. Relative to broader work-based learning and Teaching Factory practices, the conceptual distinction is the use of an individual traceable assessment loop as part of the task documentation itself rather than as an external scoring activity (Purnama & Wagiran, 2020; Perwiranegara, 2022; Tentama et al., 2022; Kusmini et al., 2021).

The model also strengthened participation by combining explicit performance criteria with individual evidence requirements during group practice. The reduction in activity dominance by particular students suggests that individual accountability can be increased without eliminating collaboration. In this configuration, the performance rubric functions not only as a scoring device but also as a learning guide that clarifies expected standards and required evidence (Firdaus et al., 2023). The SWO further increases authenticity by bringing diagnosis, work planning, procedures, measurement records, K3, quality control, feedback, corrective action, and reflection into one document. Its role therefore extends beyond workshop administration to an integrated pedagogical and assessment tool that is consistent with Teaching Factory work processes (Perwiranegara, 2022; Herliana et al., 2024).

Formative feedback is central to this architecture because identified performance gaps are followed by corrective action and verification rather than being recorded only as errors. The Achievement–Gap–Improvement–Verification sequence makes feedback specific, actionable, and traceable. Reflection is similarly embedded in the assessment cycle rather than being relegated to an isolated end-of-session exercise, encouraging students to identify performance gaps, explain their causes, and formulate subsequent improvement. Together, these processes support increasing learner responsibility and continuous competency development (Selviana & Puspasari, 2023). The integration of diagnostic reasoning, K3, and quality control also broadens the meaning of competence from task completion to technical decision-making, safe work behavior, and quality assurance, consistent with the importance of systematic K3 supervision and documentation in vocational workshops (Rizbudiani & Jaedun, 2021; Sanusi et al., 2023). The model's distinctive feature is therefore not a more detailed worksheet, but a closed improvement loop in which performance evidence is interpreted against explicit criteria, converted into feedback, acted upon, and verified.

The descriptively higher work-readiness score is compatible with the view that authentic documentation, adherence to standard operating procedures, risk control, diagnosis, and quality verification may help cultivate professional work habits. However, the available data do not support an inferential work-readiness comparison, and the observed increase should not be treated as a demonstrated between-group effect. The model connects school assessment with service-work expectations through repeated evidence generation and verification, an approach aligned with the broader relevance of vocational competencies to employment (Purnama & Wagiran, 2020). Its main theoretical proposal is a work-document-mediated AfL cycle integrating task authenticity, individual accountability, K3, quality control, feedback, remediation, and reflection. Its practical value is a potentially reproducible evidence trail that allows teachers to recognize different student contributions during shared workshop tasks. That value needs to be weighed against documentation effort, teacher observation workload, class size, and limited vehicles and tools (Aryanto et al., 2023). Numerical benchmarking against earlier studies cannot be established from this manuscript's citations alone because compatible effect-size estimates and outcomes are not available in the supplied record.

Several limitations qualify interpretation. The effectiveness evaluation involved only two intact classes within a single school; baseline comparability and ANCOVA adjustment cannot eliminate unmeasured selection or contextual confounding. Furthermore, student observations may be statistically dependent within classes; with only one class per condition, an independent class-level treatment effect cannot be established. The supplied materials do not report item-level instrument validation, internal consistency, independent double-scoring, inter-rater agreement, confidence intervals, or a distribution of work-readiness change scores. These are reporting and verification gaps, not grounds for generating post hoc coefficients. The intervention concerned periodic light-vehicle maintenance and did not evaluate retention or workplace transfer. Replication should therefore include multiple schools and classes, clear allocation and scoring protocols, independent assessors, validated instruments, a pre-registered analysis plan, and longer-term work-performance outcomes. Digitized SWO records could subsequently be assessed for their capacity to reduce the documentation and feedback burden.

D. CONCLUSION AND SUGGESTIONS

This study developed a Service Work Order (SWO)-based Assessment for Learning (AfL) model that integrates authentic automotive practice and formative assessment within one work-process structure. The model combines authentic tasks, explicit performance criteria, diagnostic reasoning, K3, quality control, formative feedback, corrective action, verification, reflection, and competency documentation. Its final form comprises eight core components and ten operational stages supported by interconnected assessment and guidance instruments.

The model received favorable expert validity ratings (92.53%) and teacher/student practicality ratings (90.40% and 89.50%), while the experimental group showed a larger increase in assessed practical competence than the control group. The reported practical-competence posttest difference remained significant after baseline adjustment; nevertheless, the observational class allocation and incomplete reliability records limit generalization and causal interpretation. The available work-readiness evidence indicates a descriptive increase, not a verified inferential effect. Overall, the results support further testing of SWO-based AfL as an authentic, documented and improvement-oriented model for periodic automotive maintenance learning.

Schools adopting the model should adapt SWO formats, K3 checkpoints, and verification standards to local workshop conditions and involve industry partners where feasible. Future studies should test the model across schools and automotive competency areas, evaluate digital SWO systems, and examine longer-term transfer to workplace performance.

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