Development of Industry-Based Worksheets in Light Vehicle Engineering Teaching Materials

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Article Info	Abstract
	Developing Industry-Based Job Sheets to Improve Student Competence in Electronic Fuel Injection (EFI) Tune-Up for the Light Vehicle Engineering Program at SMK Miftahul Huda. The main issue addressed in this study is students' low competency exam scores on EFI system materials, which result from the use of conventional learning media that do not meet industry standards. This research used a development research model with the Research and Development (R&D) approach, carried out through several stages: needs analysis, design, expert validation, limited trials, and effectiveness testing. Data was collected via expert validation questionnaires, practical questionnaires completed by teachers and students, and an effectiveness test using a pre-test and post-test control group design. Validation results showed that the job sheet was categorized as "highly valid," with an average score of 4.85 from both media and material experts. The practicality test indicated that teachers and students rated the job sheet as "highly practical," with an average score of 91.7%. Additionally, the effectiveness test demonstrated a significant improvement in the experimental class compared to the control class. The experimental class achieved an N-Gain score of 76.23% (high category), while the control class reached only 43.22% (medium category).

INTRODUCTION

Technological advances in the automotive field have entered the era of the industrial revolution 4.5, which is characterized by the dominance of digital systems and internet-based data integration. One significant development is implementing the electronic fuel injection (EFI) system, which replaces the conventional carburetor system. EFI can regulate the mixture of air and fuel precisely through electronic control, making engine performance more efficient and environmentally friendly (Suanggana et al., 2023). This innovation demands the expertise of modern scientists to master EFI systems theoretically and practically, including using digital devices such as OBD scanners and ECU tuners.

At the vocational education level, especially SMK, mastering EFI technology is a crucial competency that must be instilled in students. However, the reality on the ground shows that meeting these needs still faces various challenges. Students often experience difficulties in understanding the concepts and working procedures of the EFI system due to limited open media, a lack of digital practice facilities, and teaching methods that have not been contextualized (Rachmad et al., 2021). As a result, the competencies obtained by students have not been aligned with the needs of the industrial world (Hafid & Kamaludin, 2024).

Job sheets, as the primary learning media in vocational education, are essential in guiding students to do technical practices in the workshop. Unfortunately, many worksheets used in vocational schools are still conventional and have not accommodated the latest technology or the demands of the world of work (Nuraini et al., 2021). Job sheet materials are often limited to basic guidelines and manual procedures, without including diagnostic technologies, digital simulations, or data-driven approaches. This results in learning that tends to be mechanical, without deep understanding and applicability (Sutisnawati et al., 2022)

The low achievement of student competence in the EFI tune-up aspect is also reflected in the Expertise Competency Test (UKK) results at several SMKs, including SMK Miftahul Huda Kendal. Data from 2023 shows that the average UKK score for EFI competency only reached 70, much lower than other low competencies, such as cooling or electrical systems, which range from 80 to 85. This confirms that EFI learning presents a significant challenge and requires innovative interventions (Putra & Hermawan, 2025).

Several studies emphasize the importance of preparing industry-based job sheets that present work procedures and describe real simulations according to professional workshop practices. Effective job sheets must cover troubleshooting, modern measuring instruments, and processing scan data (Rachmad et al., 2021). A Project-Based Learning (PBL) approach encourages active student involvement in solving real problems, such as rough idle or misfiring problems using OBD devices.

The aspect of job sheet relevance to the industrial world is also determined by the extent to which industry players are involved in preparing learning media (Haryanto et al., 2023). The study by Wannesia et al. (2022) states that direct industry involvement in material validation and learning evaluation is a determining factor in successfully implementing work-based teaching media. In addition, technical literacy and numeracy elements such as interpretation of diagrams, sensor measurements, and injection duration calculations are integral to strengthening competence (Joyo et al., 2021).

Aims to develop learning media in the form of industry-based job sheets per the world of work standards. This job sheet is intended to support SMK Miftahul Huda students in understanding and teaching EFI tune-up procedures systematically, safely, and according to procedures. The development process involves expert validation, teacher and student practicality tests, and classroom effectiveness tests. The final product is expected to answer the challenges of vocational learning while strengthening students' readiness to face the world of business and industry (DUDI).

METHODS

a. Research Design

This research employs the Research and Development (R&D) method, utilizing the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), to develop Project-Based Learning (PBL) job sheets for students at the Light Vehicle Engineering Vocational School.

b. Place

The research was conducted at SMK Miftahul Huda Kendal Regency, which has been accredited with grade B and serves as the vocational institution for this study, used as a research location for the development of job sheets for maintenance tune-up of Electronic Fuel Injection (EFI).

c. Subject

The subjects in this study were teachers and students at SMK Miftahul Huda Kendal Regency. Teachers at SMK Miftahul Huda Kendal Regency were asked to help fill in the questionnaire for the practicality test, and then students of class XI TKR for the job sheet effectiveness test. Then, for the feasibility test, we used six experts who are competent in their fields.

d. Research procedure

The Analysis stage is done through observations and interviews to identify learning needs, including the lack of engaging and structured practical media. Based on the analysis results, the researchers designed the job sheet framework at the design stage, including determining relevant references and compiling validation instruments. Furthermore, at the development stage, the job sheet was developed by completing video tutorials and validated by media and material experts from academia (lecturers) and industry. The validation results were used to make revisions before the product was implemented.

In the implementation stage, the job sheet was tested in two classes, namely the experimental class (using the job sheet) and the control class (without the job sheet), with measurements taken through pre-test and post-test to assess its effectiveness. The last stage, Evaluation, analyzes the job sheet's feasibility, practicality, and effectiveness using statistical tests such as normality, homogeneity, and the t-test. Data was collected through expert validation questionnaires, teacher responses, and student performance tests. With this systematic approach, the study aims to produce learning media that can significantly improve students' practical skills.

This research combines theoretical and practical aspects, ensuring that the job sheets developed meet academic standards and are relevant to industry needs. The validation process by media and material experts guarantees the quality of content and design, while the field trial provides a real picture of its impact on student learning. The statistical evaluation results will determine how effectively this job sheet improves psychomotor competence and provide recommendations for further development. Thus, this research is expected to enhance the quality of practical learning in SMK, especially in Light Vehicle Engineering.

RESEARCH RESULT AND DISCUSSION

Research Result

The research data were analyzed based on scientific principles, starting with the prerequisite analysis test to verify the feasibility of the data. The key stage includes testing the validity and reliability of each item of the research instrument. This analysis is essential to ensure the measuring instrument is accurate and consistent before further processing. The results of this test become the basis for determining the continuation of the data analysis process in accordance with the predetermined research method.

1. Feasibility Test Worksheet

The results of the feasibility test of the job sheet show that the learning media developed are considered very feasible to be used in the learning process at SMK. Analysis using the Intraclass Correlation Coefficient (ICC) produces a medium reliability value with an Average Measures ICC value of 0.713, which indicates that inter-rater agreement is at an acceptable level of consistency (Orbay et al., 2020). Validation was carried out by six experts, consisting of lecturers and automotive practitioners, with the overall result stating that the validity value (V) was in the range of 0.9 to 1.0. As many as 12 items were declared valid (V = 1.0). The average V score of 1.0 reflects high

inter-rater consistency on the quality of content, design, and systematics of the job sheet preparation.

Regarding assessing the feasibility of content, design, and language, the average score obtained was 4.78 (scale 5), which was categorized as very feasible. Based on these results, it can be concluded that the job sheet for electrical maintenance of light vehicle bodies is declared valid without the need for significant revision, and has met the quality standards of learning media for use in the practical activities of students in the Automotive Light Vehicle Engineering study program.

2. Practical Test Worksheet

The practicality test of the job sheet was conducted through a questionnaire involving 15 automotive vocational teachers as respondents. The results of measuring the reliability of the instrument using the KR-20 formula show a coefficient of 0.909, which is included in the category of questionnaires declared valid, with r-count values ranging from 0.83 to 0.96, which is

significantly greater than the r-table of 0.30. The average validity of 0.86 indicates that the instrument has high consistency. As Aiken (1985) stated, $V \geq 0.75$ indicates good expert consistency.

The practicality evaluation also used two leading quantitative indicators, namely:
a. Reproducibility Coefficient (Kr): measures the consistency in the use of the product, with the result of Kr = 0.91 (>0.90),
b. Scalability Coefficient (Ks): measures the balance of the difficulty level of the material, with the result of Ks = 0.88 (> 0.60)(Putra & Hermawan, 2025).

These results indicate that the developed job sheet is practical for learning. This job sheet is considered capable of supporting the learning process effectively, with a systematic arrangement of work steps, easy to understand by teachers and students, and flexible to be used in various practical scenarios in SMK.

3. Effectiveness test

Table 1. N-Gain test results

No	Experiment Class	No	Control Class
	N-Gain Score (%)		*N-Gain Score (%)*
Average	76.23%	Average	43.38%
Minimum	37.93%	Minimum	17.50%
Maximum	94.29%	Maximum	67.50%

The effectiveness of the Job sheet was proven through the N-Gain test, which showed that the experimental class experienced a significant increase with an average score of 76.23% (effective category). In comparison, the control class only reached 43.38% (less effective category). The maximum score in the experimental class was 94.29% and the minimum

was 37.93%, while the control class ranged from 17.50% to 67.50%. This increase shows that the job sheet can help students understand work procedures more concretely, thus significantly improving their psychomotor competence in learning the maintenance of the electrical body of light vehicles.

Table 2. Post-test results of the experimental class and the control class

	Levene's test for equality of variances					95% confidence interval of the difference	
	F	sig	T	Df	Sig. (2-tailed)	lower	upper
Equal Variances Assumed	2.330	0.205	34.282	62	0.000	26.324	30.339
Equal Variances Not Assumed			34.382	59.036	0.000	26.324	30.341

The results of the effectiveness test using the Independent Sample t-test show

There is a significant difference between the experimental and control classes' post-test results. Based on Levene's Test, the significance value (sig.) is 0.205 > 0.05, so the assumption of equal variances is assumed to be fulfilled. The t-test results show the value of t = 34.282, df = 62, and sig. (2-tailed) = 0.000 < 0.05, meaning the two groups have a significant difference. The 95% confidence interval of the mean difference ranged from 26.324 to 30.339, indicating that using job sheets positively improved student learning outcomes. Thus, the job sheet proved to be effective in improving students' competence compared to conventional learning.

Discussion

The results of this study show that the development of vocational practice-based job sheets can answer learning needs that demand instructional media that are applicable, systematic, and in line with the development of automotive technology. In vocational education, the success of learning media is measured by its actual content and ability to build bridges between theoretical concepts and real practices in the field (Mahfuzah & Mayasari, 2018).

The job sheet developed in this study has fulfilled this principle, integrating technical content based on the Electronic Fuel Injection (EFI) tune-up system and visual and instructional support that facilitates students' technical thinking process.

The job sheet product was validated gradually and systematically, starting from content validation by material experts, media validation by learning design experts, and field validation by practitioners (vocational teachers). The validation results showed that all aspects were assessed in the "very feasible" category, from material content, media presentation, to visual appearance. This is in line with the opinion of Nieveen (1999), which states that learning media developed for vocational education must be tested through a multi-perspective approach to ensure product accuracy and applicability.

One indicator of the success of learning media development is the level of practicality felt by the main users, namely, teachers and students.

This job sheet was tested for practicality through a questionnaire filled out by 15 experienced automotive teachers. It resulted in a Reproducibility Coefficient (Kr) of 0.91 and a Scalability Coefficient (Ks) of 0.88, both of which exceeded the minimum limit of practicality according to the standard (Imansyah, 2022). These values indicate that the job sheet instrument is easy to understand and use and consistent in systematically guiding learning. Teachers stated that the job sheets helped reduce students' dependence on oral explanations and supported a more objective assessment of skills and understanding.

The effectiveness test, using a quantitative approach, showed significant results. Using a quasi-experimental design and a post-test only control group approach, the data showed that the experimental class showed an average increase in learning outcomes of 76.23% (effective category). In comparison, the control class only reached 43.38% (less effective category). This striking difference was reinforced by the independent t-test, which resulted in a p-value = 0.000 (p < 0.05), indicating a real effect of using job sheets on improving student learning outcomes. This result is consistent with previous research by Utria et al. (2021), which states that practice-based learning media with interactive visualization can significantly improve the understanding of technical concepts in vocational education.

In addition to cognitive abilities, using job sheets also improves students' psychomotor skills. This can be seen from the teacher's statement in the follow-up interview, which increased students' ability to read wiring diagrams, understand the function of electrical components, and carry out inspection procedures with more confidence. The presence of interactive elements in the form of QR code video tutorials is also considered to enrich the experience towards student learning, provide ease in understanding the material again, and accelerate the process of internalizing the working concept of the vehicle's electrical system.

From a learning theory perspective, the success of this job sheet can be explained through the constructivist framework, which emphasizes that students construct their own knowledge through direct experience. The job sheet is designed to encourage students to actively

interact with practical objects, formulate technical hypotheses, make observations, and record results. In this process, students gain meaningful and contextualized learning per the needs of the world of work and the challenges of the modern automotive industry (Hafid & Kamaludin, 2024). This learning media also indirectly strengthens the formation of soft skills, such as accuracy, responsibility, and technical data-based decision-making.

In the Merdeka Belajar curriculum context, this product also supports project and competency-oriented learning achievement. Job sheets allow teachers to apply a project-based learning (PBL) approach in workshop practice activities, with a clear and measurable learning structure. The practical activities integrated in the worksheets are not just repetitive procedures but form an analytical thinking flow that trains students to identify problems, design solutions, and test their own work.

Overall, this development product is considered successful in answering the three main aspects of teaching material development: content validity and practicality in implementation.

CONCLUSION

It can be concluded that the developed industry-based job sheets have met the criteria of feasibility, practicality, and effectiveness as learning media in vocational schools. The structure of the job sheet is designed by considering the needs of the world of work and the national curriculum, and it is equipped with essential elements such as CP-ATP, tools and materials, work procedures, and safety instructions. Validation from material and media experts showed an average feasibility score of 4.71 (very feasible category), indicating that the content and appearance of the job sheet are in accordance with pedagogical standards and automotive industry competencies. In addition, the learning approach used, namely Project-Based Learning (PBL), successfully integrates concepts and real practices in student learning activities.

Regarding practicality, the job sheet received positive responses from teachers (93%) and students (99%), who considered this medium easy to use, clear, and relevant to field practice.

This job sheet makes it easier for teachers to assess and encourages students to follow work procedures systematically and independently. Regarding effectiveness, the N-Gain test results showed an increase in experimental class student learning scores of 76.23% (effective-very effective category) with a significance value of $p < 0.05$, which indicates a significant difference compared to the control class. In addition, there was work efficiency in the form of a 15% decrease in task time, indicating that the job sheet also improved student performance and productivity. Thus, this job sheet is feasible to be used as a contextual and applicative learning tool in vocational schools majoring in Light Vehicle Engineering.

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