JVCE 10 (2) (2025) : 124-128

Journal of Vocational Career Education

https://journal.unnes.ac.id/nju/index.php/jvce

Nozzle Tester Teaching Tool to Enhance Learning Outcomes in Conventional Diesel Engine System for Light Vehicles

Choirul Fatah Hidayatulloh[1]✉, Muhammad Khumaedi[2], Samsudin Anis[2]

[1]SMK Negeri 1 Kedungwuni, Jawa Tengah, Indonesia
[2]Universitas Negeri Semarang, Indonesia

Article Info

Article History :
Received
June 2025
Accepted
August 2025
Published
December 2025

Keywords:
Development; teaching aids; nozzle tester; light vehicle diesel engine system

Abstract

The nozzle tester, which is commonly used in the automotive engineering program at SMK N 1 Kedungwuni, is in a leaking condition, limiting its effectiveness in supporting learning and consequently affecting student learning outcomes. This issue is the main reason for conducting research on the development of a nozzle tester using a recycled jack, aimed at enhancing the learning of conventional diesel engine systems. This study employs a Research and Development (R&D) approach with the ADDIE model for development. The research method used is a pretest-posttest group design. The findings of the study include: (1) the developed teaching tool was considered feasible by media and subject matter experts, with content validity ratio (CVR), content validity index (CVI), and percentage of agreement (PA) analyses; (2) product trials showed a high level of effectiveness, demonstrated by the Independent Sample t-Test, where the N Gain Score resulted in a significant (2-tailed) value; and (3) the reproducibility coefficient (Kr) and scalability coefficient (Ks) both indicate that the application of the nozzle tester in the conventional diesel engine system learning process is very practical. The conclusion of this study is that the nozzle tester can significantly improve the learning outcomes of conventional diesel engine systems.

✉ Correspondence:
Jl. Paesan Utara, Podo Lor, Kedungwuni Bar., Kec. Kedungwuni, Kabupaten Pekalongan, Jawa Tengah 51173, Indonesia
E-mail: bravo92patah@gmail.com

p-ISSN 2339-0344
e-ISSN 2503-2305

INTRODUCTION

Quality learning has a significant impact on the success of educational programs in schools, particularly focusing on improving education quality through the teaching and learning process. The role of the teacher as a facilitator is key in this process. According to a study by Irma (2024), the teacher's role in facilitating learning should include designing digital-based learning environments that encourage students to be more active, think creatively, and improve their learning outcomes.

Learning outcomes, as defined by Arikunto (2023), involve the process of evaluation, which is essentially the assessment of student achievements. To evaluate and measure the learning outcomes of students, proper evaluation tools are necessary. In vocational schools, these outcomes can be achieved through a combination of theoretical and practical learning, which helps improve student skills. Teaching tools play an important role in this process. For instance, in the automotive engineering program at vocational schools, practical tools enhance cognitive abilities and motor skills, which is supported by the research of Abdul Azis et al. (2025).

Educational tools are vital in stimulating student emotions, attention, thoughts, skills, and abilities, ultimately promoting the learning process. In vocational schools, these tools are especially valuable for helping students understand concepts and develop skills during practical exercises. For example, in the Light Vehicle Engineering program, students do not simply watch videos or read manuals; they engage directly with hands-on tools, which helps sharpen their skills.

The nozzle tester developed in this study introduces an innovative approach by using a 5-ton jack, making it far sturdier than existing nozzle testers and significantly reducing the risk of leakage. Additionally, the pressure gauge is equipped with a digital manometer, and the entire device is coated with an anti-corrosion protective layer. To enhance stability during the spraying process, the base is reinforced with a metal plate.

This research aligns with the knowledge transfer theory proposed by Edward Lee Thorndike (1924), which suggests that "learning is essentially the formation of connections or bonds between situations and responses." Learning involves associating sensory experiences with the impulses to act. Therefore, providing adequate facilities, such as the nozzle tester, is essential for supporting knowledge transfer in learning. By using practical tools, students are expected to achieve effective and high-quality learning, with the potential for further testing and development.

METHODOLOGY

This study uses a Research and Development (R&D) approach, where the researcher develops a product and tests its feasibility, effectiveness, and practicality. The development process follows the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation, as outlined by Alodwan (2018).

The approach used in this research is qualitative, with a focus on how the development of the teaching tool and its implementation in practical learning on conventional light vehicle engine systems is carried out. The data collection methods used in this study are observation, questionnaires, and interviews.

Observation is used to assess the feasibility of the teaching tool, with an observation sheet instrument provided to experts from academia and professional technicians from PT Global Carfix Pekalongan branch, as well as colleagues. According to Sugiono (2021), questionnaires are a data collection technique that involves providing a set of written questions or statements to respondents for them to answer. The analysis phase involves identifying needs and characteristics, as well as reviewing the curriculum and technology (Nurrokhman et al., 2025). The questionnaire, in the form of a survey, is used to test the practicality of the tool, and it is directed to the productive teachers. Furthermore, to test the effectiveness, a pretest is conducted, followed by the intervention, and then a posttest is administered to the students.

RESULTS AND DISCUSSION

Research Results

The feasibility test of the nozzle tester teaching tool was conducted by 8 experts or Subject Matter Experts (SMEs). The results showed values for maintainability, usability, reusability, communicativeness, and sensitivity with a CVR of 1. The indicators for compatibility, visualization, operation, durability, and strength showed a CVR value of 0.75. The CVI value was 0.87, which indicates validity, as both CVR and CVI values are greater than 0.75. Further analysis of the consistency of these values was carried out using the percentage of agreement (PA), which resulted in 0.87, greater than 0.80. Therefore, it can be concluded that all indicators of the nozzle tester feasibility instrument are valid and reliable.

The implementation of the developed nozzle tester teaching tool was conducted in a limited trial after the media was confirmed as valid and reliable by validators from media and subject matter experts. At this stage, the nozzle tester tool was applied in a limited trial with 36 students from Class XI TKR 2 as the experimental group, while Class XI TKR 1, also with 36 students, served as the control group. The experimental group received the nozzle tester tool as part of their learning process, while the control group followed regular lessons. Both groups were then given a post-test. The results of the post-test underwent normality and homogeneity tests.

The practicality test results for the developed nozzle tester tool showed that the reproducibility coefficient (Kr) for users was 0.94, indicating that the tool is highly practical for use, as it meets the practicality requirement of being greater than 0.90. The scalability coefficient (Ks) yielded a score of 0.81, which exceeds the practicality threshold of 0.60. Based on the values of both the reproducibility and scalability coefficients, it can be concluded that the nozzle tester teaching tool for learning conventional diesel engine systems for light vehicles is considered "practical."

The effectiveness test for the developed nozzle tester teaching tool was conducted using a two-tailed t-test through an independent sample t-test on SPSS. The mean score for the experimental group was 59.03, while the control group had a mean of 60.69. The t-value was -0.8279, and the Sig. (2-tailed) value was 0.617, which is greater than 0.05. This suggests that there was no significant difference between the pre-test results of the experimental group and the control group.

For the post-test, the experimental group had a mean score of 83.61, with a minimum score of 65 and a maximum score of 100, while the control group had a mean score of 73.75, with a minimum score of 55 and a maximum score of 95. The normality test using the Kolmogorov-Smirnov test for the experimental group showed a statistic value of 0.140 with a significance of 0.070 (greater than 0.05). For the control group, the statistic value was 0.135 with a significance of 0.096 (greater than 0.05), indicating that the learning outcomes of both groups were normally distributed. The homogeneity test using Levene's statistic showed a value of 0.160 with a Sig. value of 0.691 (greater than 0.05), indicating that both the experimental and control groups were homogeneous.

A one-tailed t-test revealed a Sig. (2-tailed) value of 0.014 (less than 0.05), indicating a significant difference between the post-test results of the experimental and control groups. The t-value was 4.028, and the t-table value was 1.669, leading to the rejection of Ho and the acceptance of Ha. Therefore, it can be concluded that the use of the nozzle tester teaching tool effectively enhances the learning outcomes of conventional diesel engine systems for light vehicles.

Finally, the N-Gain Score for the experimental group was 0.64, which falls within the moderate category. The N-Gain percentage was 64.94%, indicating that the intervention provided to the experimental group had a significant impact compared to the control group.

Discussion

The development of the nozzle tester teaching tool was evaluated as suitable for implementation in the learning process by both media and subject matter experts. The validation process for the nozzle tester tool involved at least eight media experts and eight subject matter experts. Based on the validation results from the media experts, the feasibility instrument for the nozzle tester tool was deemed "appropriate" through the analysis of the Content Validity Ratio

(CVR), Content Validity Index (CVI), and Percentage of Agreement (PA).

The CVR results indicated that all indicators in the instrument validated by media experts had a CVR value ranging from 0.75 to 1. The CVI value was 0.87, suggesting that all aspects or indicators for the media development instrument of the nozzle tester tool are valid because both the CVR and CVI values exceeded 0.75. To ensure that the valid CVR and CVI values were consistent with the experts agreement, the Percentage of Agreement was calculated, yielding a value of 87%, which is greater than the 80% threshold. Therefore, the experts agreed that the media instrument for the nozzle tester tool is both valid and reliable.

Similarly, the CVR, CVI, and Percentage of Agreement results from the subject matter experts showed a CVR range of 0.75 to 1, and the CVI was 0.92. These results indicate that all aspects or indicators of the subject matter instrument for the development of the nozzle tester tool for teaching conventional diesel engine systems are valid, as both the CVR and CVI values are above 0.75. The Percentage of Agreement for the subject matter experts was 92%, which is also above the 80% threshold, further confirming that the instrument is valid and reliable. These findings align with the research by Hendri L (2023), which stated that the nozzle tester teaching tool is deemed suitable for use in teaching diesel engine systems. The results of this media feasibility assessment suggest that the developed nozzle tester tool is ready for implementation.

The nozzle tester tool is considered effective if there is a significant improvement in student learning outcomes. The effectiveness of the nozzle tester tool was analyzed using an independent sample t-test on the post-test results. Before conducting the t-test, normality and homogeneity tests were performed.

The normality test using the Kolmogorov-Smirnov test showed that the experimental class had a significance value of 0.070 (greater than 0.05), and the control class had a significance value of 0.096 (greater than 0.05), indicating that the learning outcomes for both classes were normally distributed. The homogeneity test using Levene's statistic showed a significance value of 0.691 (greater than 0.05), indicating that the variances of the learning outcomes for both classes were homogeneous.

After conducting the normality and homogeneity tests, an independent sample t-test was used to compare the learning outcomes of students in the experimental and control groups. The effectiveness of the nozzle tester tool was tested using this t-test. The results showed a t-value of 4.028, with a significance value of 0.014 (less than 0.05). Since the calculated t-value (4.028) is greater than the t-table value (1.669), it can be concluded that there is a significant difference in the learning outcomes between the experimental and control groups. Therefore, the null hypothesis (Ho) is rejected, and the alternative hypothesis (Ha) is accepted, confirming that the use of the nozzle tester teaching tool significantly improves student learning outcomes.

Additionally, the N-Gain score for the experimental group was 0.8, which indicates a high improvement in student learning outcomes in comparison to the control group that used a regular teaching module. The N-Gain score of 0.8 falls into the high improvement category, as values greater than 0.7 indicate significant learning gains.

The nozzle tester teaching tool was also categorized as practical, as indicated by the analysis of the reproducibility coefficient (Kr) and the scalability coefficient (Ks). The Kr for users was 0.94, and the Ks was 0.81, both of which meet the criteria for practicality set by Usman Rianse (2008:99), which require Kr > 0.90 and Ks > 0.60.

CONCLUSION

Based on the discussion above, it can be concluded that the developed nozzle tester teaching tool is suitable for use and can be effectively applied as a media to enhance learning on the topic of conventional diesel engine systems for light vehicles.

The developed nozzle tester teaching tool has proven to be significantly effective in improving student learning outcomes in the conventional diesel engine system course. This is evidenced by a notable difference in the effectiveness between the average learning outcomes of the experimental group compared to the control group.

REFERENCES

Azis. A., Khumaedi, M., & Anis, S. (2025). Development of Practical Tools Using Computer Power Supply for Light Vehicle Electrical System learning. *Journal of Vocational and Career Education* Vol. 10 No. 2 (2025) https://doi.org/10.15294/jvce.v9i1.23623

Alodwan, T., & Almosa, M. (2018). (2018). *The Effect of a Computer Program Based on Analysis, Design, Development, Implementation and Evaluation (ADDIE) in Improving Ninth Graders' Listening and Reading Comprehension Skills in English in Jordan. English Language Teaching, 11(4),* , 43.

Arikunto, Suharsimi. (2023). *Prosedur Penelitian : Suatu Pendekatan Praktis.* Jakarta : Rineka Cipta.

Irma. O.R., Khumaedi, M., & Anis, S. (2024). Development of a Flipbook-Based E-Module to Enhance Learning Outcomes in Manufacturing Design for Vocational High School Students. *Journal of Vocational and Career Education* Vol. 9 No. 1 (2024) https://doi.org/10.15294/jvce.v9i1.23623

Hendri L, Muhammad Agung R, Muhammad Reyhan A.J. (2023). Rancang Bangun Alat Fuel *Nozzle Tester* Menggunakan Media Bantu Pneumatic Sebagai Media Pembelajaran Gas Turbine. Journal of Aircraft Maintenance *Engine*ering & Aviation Technologies (JAMETS) Vol.02. No.02.

Nurrokhman, T., Khumaedi, M., & Sutopo, Y. (2025). Application of Android-Based E-Module in Occupational Health, Safety, and Environmental Protection and Industrial Work Culture Material. *Journal of Vocational and Career Education*, *50124*(121). https://doi.org/10.15294/jvce.v9i2.29047

Sugiono. 2021. Metode Penelitian Kuantitatif Kualitatis dan R&D. Bandung : Alfabeta.