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MOCK-UP OF VEHICLE WIPER AND WASHER SYSTEM: IT'S ACCEPTABILITY AND EFFECT ON STUDENT PERFORMANCE

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ABSTRACT

This study investigates whether there is a significant difference in the written test gain scores between students who received traditional instruction (control group) and those who received enhanced instruction using a mock-up (experimental group), focused on the automotive wiper and washer system. The results reveal that the experimental group showed significantly higher gains, indicating the effectiveness of the new instructional method.

KEYWORDS: Instructional Method, Mock-up, Wiper and Washer System, Written Test

INTRODUCTION

A clear windshield is crucial for driver safety, especially in adverse weather conditions. Without functional wiper and washer systems, visibility is compromised, increasing the risk of accidents (Kaur et al., 2022). In the Philippines, road accidents have been linked to vehicle defects, including malfunctioning wipers (Herrera-Dy, 2019).

To address this, the Agusan del Sur School of Arts and Trades, under TESDA, includes wiper and washer systems in its Automotive Technology program. The 2020 TESDA update to the Automotive Servicing NC II curriculum emphasized hands-on competencies in wiper and washer operation, reinforcing both theoretical and practical training.

This study developed and evaluated a mock-up trainer for the wiper and washer system to enhance student competency. It also investigated whether there is a significant difference in written test gain scores between students using the traditional vehicle system and those trained with the mock-up. The research

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supports curriculum modernization and practical skill development aligned with industry standards (Zeng & Zhou, 2024).

2. METHODOLOGY

This chapter outlines how the research methodology will be done in the study. Particularly, this chapter presents the research design, research locale, respondents, instrument to be used, the sampling procedures, materials, the data gathering procedure, and the statistical tools for data analysis.

2.1 Research Design:

This study used a quasi-experimental design with a pre-test–post-test control group setup to assess the effectiveness of a mock-up wiper and washer system trainer. Students were divided into two groups: the experimental group, which used the mock-up during instruction, and the control group, which received traditional instruction.

Both groups took a pre-test and post-test. Gain scores were calculated and analyzed to measure learning improvement. As the data was not normally distributed (based on the Kolmogorov-Smirnov and Shapiro-Wilk tests), the Mann-Whitney U test was used to determine if there was a significant difference between the groups' scores.

2.2 Participant:

The study involved 60 Automotive Technology students from the Agusan del Sur School of Arts and Trades. These participants were randomly assigned into two groups: 30 students in the experimental group, who received instruction using the mock-up wiper and washer system trainer, and 30 students in the control group, who received traditional instruction without the mock-up. This grouping enabled a clear comparison of learning outcomes and the evaluation of the mock-up's effectiveness in improving student performance.

2.3 Instructional Materials:

The primary instrument used in the study is to evaluated the gain scores of the control and experimental groups in the written test. The gain scores were measured by comparing the pre- and post-assessment results, allowing for a comparison of the students' performance before and after using the newly designed mock-up trainer. This evaluation aimed to determine the effectiveness of the mock-up in enhancing students' knowledge and skills by assessing the improvement in their test scores, reflecting the impact of the new mock-up on their learning outcomes.

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Data Collection:

The development of the mock-up trainer for the wiper and washer system followed several important steps. In the initial phase, the researcher submitted formal letters requesting permission to conduct the research. These were addressed to the Administrator of the Agusan del Sur School of Arts and Trades (ASSAT) and the Office of Research and Development at North Eastern Mindanao State University - Cantilan Campus, outlining the study's objectives and seeking approval for project implementation.

Upon approval, essential components such as wiper and washer parts were sourced from an actual vehicle and assembled into a fabricated framework that closely simulated real-world systems. A windshield was added for realism, and electrical components—including wires, relays, fuses, and banana clips—were installed to replicate actual system functions. This setup provided students with practical, hands-on experience in diagnosing and repairing the system.

To assess the effectiveness of the mock-up trainer, second-year Automotive Technology students were randomly assigned to control and experimental groups. Both groups took a pre-test before instruction. The experimental group used the mock-up during instruction, while the control group followed traditional methods. Afterward, both groups completed a post-test. The difference between the pre- and post-test scores (gain scores) was analyzed to evaluate the instructional impact of the mock-up trainer.

All participants were given confidentiality forms in compliance with the Data Privacy Act, ensuring voluntary and anonymous participation. Test results were collected, verified, and submitted to a statistician for analysis and interpretation.

3. RESULT AND DISCUSSION

Table 3.1 Test of Normality of written test gain scores

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Group	Statistic	Df	Sig.	Statistic	Df	Sig.
1.00	1.00	.162	30	.044	.912	30
2.00	2.00	.145	30	.111	.934	30

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Table 3.1 resent the results from the Shapiro-Wilk and Kolmogorov-Smirnov tests indicate that the control group's data significantly deviates from a normal distribution (p = .016 and p = .044, respectively), while the experimental group's data does not (p = .063 and p = .111). Because the control group's data violates the assumption of normality, a non-parametric test specifically, the Mann-Whitney U test was used to ensure appropriate and valid comparison between the two groups. This reinforces the importance of checking data distribution before selecting statistical tests to avoid misleading results. = .111). because the control group's data did not meet the assumption of normality, as confirmed by the Shapiro-Wilk and Kolmogorov-Smirnov tests. Mann- Whitney Test were used to test the written test gain scores.

Table. 3.2 Mann- Whitney Test Rank Result for Written Test Gained Scores

	Group	N	Mean Rank	Sum of Ranks
Written	Control	30	22.00	660.00
	Experimental	30	39.00	1170.00
	Total	30		

Mann- Whitney U = 195.0
Z = -3.784
P value = 0.000

Table 3.2 present the Mann- Whitney test was use to compare the gain scores written test between the control group and experimental group as the assumption of normality was violated for the control group based on the Shapiro-Wilk and Kolmogorov-Smirnov tests. The result shows a Mann-Whitney U value of 195.0 and a Z-value of -3.784, with a corresponding p-value of 0.000. Since the p-value is less than 0.05, this indicates a statistically significant difference in the written test gain scores between the control and experimental groups.

In addition, the data also shows the mean rank for the experimental group (39.00) is higher than that of the control group (22.00), suggesting that the experimental group performed significantly better in the written test gain scores compared to the control group.

The Constructivist Learning Theory, developed by Jean Piaget and Lev Vygotsky, emphasizes that knowledge is actively constructed by learners through social interaction, meaningful experiences, and engagement with content. Learning is not a passive process; instead, students must actively interact with new information, resources, and environments to form connections and deepen their

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understanding. Without interactive learning tools such as learning materials, activities, or mock-ups learners lack the cognitive foundation necessary to build new knowledge.

Complementing this, Kolb's Experiential Learning Theory highlights that knowledge is created through the transformation of experience. Learning is most effective when it involves a cyclical process of grasping and reflecting on experiences. This theory underscores the value of hands-on activities and active participation, which enhance learning outcomes by allowing learners to engage with real-world applications and concepts. Thus, incorporating mock-up trainers and practical exercises into instruction provides essential opportunities for learners to connect theory with practice. Supporting these theories, the results of the Mann-Whitney test reveal a statistically significant difference in written test gain scores between the control and experimental groups, with the experimental group showing better performance. The higher mean rank of the experimental group suggests that students benefited more from the instructional approach used, indicating meaningful improvement in their learning outcomes compared to the control group. This implies that the teaching strategy applied to the experimental group was more effective in enhancing student understanding and academic achievement.

4. CONCLUSION

The findings of this quasi-experimental study, supported by the Mann-Whitney U test, indicate that the use of a mock-up wiper and washer system as an instructional tool significantly improved student learning outcome. Students in the experimental group demonstrated higher written test gain scores compared to those who received traditional instruction. This suggests that the integration of the mock-up not only enhanced cognitive understanding but also supported the development of practical skills, making it an effective approach for teaching automotive systems within technical education programs.

5. RECOMMENDATION

Based on the findings and conclusions of the study, the following recommendations have been made:
1. It is recommended that automotive education programs formally adopt and integrate the mock-up vehicle wiper and washer system as a standard instructional tool. This study provides a more effective and hands-on teaching method. The mock-up system simplifies complex concepts, enhances lesson delivery, and encourages interactive learning making instruction more engaging and aligned with TESDA's updated standards.

2. For the aspiring automotive students use the mock-up trainer for the wiper and washer system as part of their learning. This tool provides a clear and practical way to understand the system, helping

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students build both confidence and hands-on skills. Incorporating the mock-up into automotive electrical courses will better prepare students to perform real-world servicing tasks effectively and safely.

3. Furthermore, the adoption of the mock-up can reduce instructional costs. Instead of investing in costly, full-scale vehicles, the school can use the mock-up to meet student learning needs effectively and sustainably. Moreover, governing and accrediting bodies such as TESDA, CHED, and DOST may find the insights from this study valuable when shaping future educational policies and frameworks. The findings support a shift toward competency-based, cost-efficient training models that align with national objectives for high-quality and accessible technical education.

4. Lastly, for the future researchers and are encouraged to build upon this study by exploring the application of mock-up trainers for other automotive systems beyond the wiper and washer system. Investigating their effectiveness in enhancing both theoretical understanding and hands-on skills in areas such as engine management, braking systems, or air conditioning could provide a broader foundation for skills-based learning in automotive education.

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