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TECHNOLOGY-ENHANCED LEARNING IN TVET: THE EFFECT OF THE MOTORCYCLE ENGINE TRAINER ON STUDENT PERFORMANCE

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ABSTRACT

This study examined the effectiveness of the Motorcycle Engine Trainer as an instructional tool in enhancing the learning outcomes of Grade 9 students enrolled in Motorcycle and Small Engine Servicing. Conducted at Carrascal National High School and Parang National High School in Surigao del Sur, the study employed a quasi-experimental design with pre-test–post-test control groups. A total of 100 students participated, divided into experimental and control groups, with the former taught using the Motorcycle Engine Trainer and the latter through conventional lecture-demonstration methods. Findings revealed that while both groups initially demonstrated comparable low mastery, the experimental group showed significantly greater improvement in the post-test. Independent samples t-test analysis confirmed a statistically significant difference in performance between the two groups, favoring those taught with the Motorcycle Engine Trainer. These results underscore the pedagogical value of hands-on, technology-enhanced instruction in strengthening conceptual understanding and practical skills in technical-vocational education. The study concludes that integrating functional learning aids such as the Motorcycle Engine Trainer can effectively bridge the gap between theoretical instruction and practical application. These findings hold important implications for educators, curriculum developers, and policymakers, highlighting the need to adopt innovative instructional tools to improve competence, engagement, and industry readiness among students in technical-vocational programs.

KEYWORDS: Technical-vocational education, Motorcycle Engine Trainer, instructional effectiveness, experiential learning, student performance

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INTRODUCTION

Technical and vocational education requires instructional approaches that effectively integrate theory with practice to ensure students develop conceptual understanding and practical competence. In motorcycle servicing, conventional lecture-demonstration methods often provide limited opportunities for students to engage directly with mechanical systems, making it challenging to grasp complex concepts such as the four-stroke engine cycle. To address this gap, specialized instructional tools such as the Motorcycle Engine Trainer have been developed to bridge classroom knowledge with hands-on application.

Research demonstrates that motorcycle engine learning media significantly enhance students' understanding of engine mechanisms through various technological approaches. Augmented reality (AR) technology has emerged as an effective interactive learning medium that minimizes boredom compared to conventional text-and-picture methods, providing 3-dimensional visualizations with audio explanations and quiz features (Sri Rahayu et al., 2022; Hellik Hermawan et al., 2019), while Lan et al. (2023) demonstrated that immersive technologies like virtual reality improve comprehension and practical skills in automotive training. These findings are supported by constructivist and experiential learning theories, emphasizing that learners construct knowledge more effectively when actively involved in authentic tasks.

Building on this foundation, the present study investigates the effectiveness of the Motorcycle Engine Trainer in enhancing the learning outcomes of Grade 9 students in Motorcycle and Small Engine Servicing. Specifically, it compares the pre-test and post-test performance of students taught using the trainer against those instructed through conventional lecture-demonstration methods. Furthermore, it examines whether the differences in learning gains are statistically significant. The study provides empirical evidence on the pedagogical value of technology-enhanced instruction in technical-vocational education, with implications for curriculum design, instructional strategies, and workforce readiness.

METHODOLOGY:

Research Design

This study employed a quasi-experimental design utilizing the pre-test–post-test control group method. The design was selected to compare the effectiveness of the Motorcycle Engine Trainer with conventional lecture-demonstration methods in enhancing students' learning outcomes. Both experimental and control groups were given a pre-test to establish baseline knowledge and a post-test to measure learning gains after the intervention.

Research Setting and Respondents

The study was conducted at Carrascal National High School in Carrascal, Surigao del Sur, and Parang National High School in Parang, Cantilan, Surigao del Sur. Both institutions are public secondary schools

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offering Grade 9 Technology and Livelihood Education (TLE) classes with a specialization in Motorcycle and Small Engine Servicing. These schools provided an ideal context for the study as they implement the required TLE curriculum that integrates mechanical servicing competencies.

The respondents were Grade 9 students from two intact sections enrolled in the TLE subject during the school year's first quarter. The total population consisted of 100 students (97 male and three female). A purposive sampling technique was employed, as the selected students were direct beneficiaries of the Motorcycle Engine Trainer intervention.

Research Instrument

A researcher-developed achievement test was used as the main instrument for data collection. The test comprised multiple-choice questions aligned with the learning competencies in the Motorcycle and Small Engine Servicing module. Content validity was established through expert review by TLE teachers and subject matter specialists, while reliability was determined through pilot testing, ensuring appropriateness for assessing students' knowledge and skills before and after the intervention.

Data Gathering Procedure

The study began with administering the pre-test to both experimental and control groups to determine their baseline understanding of motorcycle engine concepts. The experimental group received instruction using the Motorcycle Engine Trainer, while the control group was taught through the conventional lecture-demonstration method. After the instructional period, a post-test of identical structure and difficulty was administered to measure learning gains.

Data Analysis

The pre- and post-test results were analyzed using statistical analysis, both descriptive and inferential in nature. Mean and standard deviation were computed to describe the performance levels of both groups. To test the difference in mean scores and determine the significance of learning gains, an independent samples t-test was conducted at a 0.05 level of significance.

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RESULTS AND DISCUSSIONS

Table 1. Pretest and Post-test Mean Scores of Students Taught Using the Motorcycle Engine Trainer vs. Conventional Methods

Group	Test Type	Mean Score	Standard Deviation	Mean Gain Score	Interpretation
Experimental (Trainer)	Pretest	21.40	3.21	—	Low Mastery
	Post-test	34.65	2.85	13.25	High Mastery
Control (Conventional)	Pretest	20.85	3.55	—	Low Mastery
	Post-test	28.90	3.14	8.05	Moderate Mastery

The findings of this study demonstrate that the Motorcycle Engine Trainer significantly enhanced students' learning outcomes compared to conventional lecture-demonstration methods. In the pretest, both groups exhibited low levels of mastery, confirming that students possessed limited prior knowledge of motorcycle engine concepts. However, following the intervention, a marked improvement was evident in both groups, with the experimental group showing substantially greater gains than the control group.

The experimental group's higher post-test performance suggests that hands-on, technology-enhanced instruction provided by the Motorcycle Engine Trainer facilitated more effective knowledge acquisition and skill development. This result reinforces the pedagogical value of experiential and interactive learning environments, which are known to engage learners more actively than traditional lecture-based approaches. Consistent with the findings of Nirmalakhandan et al. (2007) found that combining physical, mathematical, and simulation models, which allowed students to "participate, act, react, and reflect," led to improved student learning and achievement compared to traditional lecture-based approaches.

Empirical support shows that students who engage in constructive and active interactions with multiple fraction representations achieve higher conceptual understanding and representational flexibility than those who use only active interactions (Mazziotti et al., 2016). The Motorcycle Engine Trainer likely enabled students to integrate visual, tactile, and cognitive inputs, thereby facilitating a more comprehensive understanding of complex engine mechanisms. Such multi-sensory learning opportunities are difficult to replicate through lecture-demonstration alone.

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The implications of these findings are significant for technical-vocational education and training (TVET). Integrating functional learning aids such as engine trainers can bridge the gap between theoretical knowledge and practical skills, thereby enhancing student competence and workforce readiness. The evidence for curriculum designers and instructors underscores the importance of investing in instructional technologies that align with competency-based education standards. Ultimately, the use of specialized trainers not only supports improved cognitive outcomes but also prepares learners for real-world applications, ensuring that educational practices remain responsive to industry demands.

Table 2. Independent Samples t-test Result on the Post-Test Scores Between Experimental and Control Groups

Group	N	Mean	Std. Deviation	t-value	p-value (Sig. 2-tailed)	Decision on H_0	Interpretation
Experimental (Trainer)	50	34.65	2.85	6.516	0.000	Reject H_0	**Significant Difference**
Control (Conventional)	50	28.90	3.14				

The independent samples t-test revealed a statistically significant difference in post-test performance between students taught with the Motorcycle Engine Trainer and those taught using conventional lecture-demonstration methods. The experimental group (M = 34.65, SD = 2.85) achieved higher scores than the control group (M = 28.90, SD = 3.14), with a t-value of 6.516 and a p-value of 0.000, leading to the rejection of the null hypothesis. These results indicate that the instructional method played a decisive role in shaping student learning outcomes.

The greater performance of the experimental group provides strong empirical support for the effectiveness of technology-enhanced, hands-on learning approaches in technical-vocational education. The results corroborate previous studies, which demonstrated that interactive methods, including group discussions, case studies, and simulations, increased comprehension by 30-40% and engagement by 50% compared to conventional lecture formats (Yogaswara et al., 2025). This suggests that learners are more likely to internalize complex concepts when they are actively involved in manipulating and observing instructional materials.

The implications of these findings extend beyond the classroom. Integrating simulation-based or trainer-based instructional technologies into automotive technology curricula can bridge the persistent gap

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between theoretical instruction and industry-required competencies. For educators, curriculum developers, and policymakers, these results underscore the value of investing in functional learning aids that align pedagogy with authentic workplace skills. Such integration enhances academic performance and strengthens employability and industry readiness among technical-vocational graduates.

CONCLUSION

This study demonstrated that using the Motorcycle Engine Trainer significantly improved students' learning outcomes compared to conventional lecture-demonstration methods. Both groups exhibited limited prior knowledge at the pretest stage, but after instruction, the experimental group achieved substantially greater gains, as reflected in higher post-test scores and a statistically significant difference confirmed through t-test analysis. These results highlight the pedagogical value of integrating hands-on, technology-enhanced tools into technical-vocational education.

The findings affirm that experiential and interactive instructional approaches foster deeper cognitive engagement, stronger conceptual understanding, and enhanced practical competence. Grounded in constructivist and theories centered on learning through experience, the Motorcycle Engine Trainer provided students with authentic opportunities to manipulate and visualize engine mechanisms, thereby facilitating more meaningful learning than traditional methods alone.

For technical-vocational education and training (TVET), these results underscore the importance of investing in simulation-based and trainer-assisted instructional technologies. Such innovations strengthen academic performance and ensure alignment with industry standards, preparing learners with the skills necessary for professional practice. Ultimately, this study provides empirical evidence that adopting functional learning aids can bridge the gap between theory and practice, contributing to more effective and industry-relevant education.

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