

## **Design, fabrication, and evaluation of a dual-mode (electric and manual) automotive multipurpose worktable lifter**

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**Abstract:** Developing instructional devices in technical-vocational education enhances hands-on learning and promotes safety and efficiency in skill-based training. However, limited studies have addressed the fabrication and classroom applicability of dual-mode worktable lifters for automotive technology instruction. This study aimed to design, fabricate, and evaluate a Dual-Mode (Electric and Manual) Automotive Multipurpose Worktable Lifter as instructional equipment for technical-vocational education. Employing the Project Development Method (PDM) and descriptive-evaluative research design, the project underwent systematic design, fabrication, assembly, testing, and revision phases. The constructed lifter, equipped with an electric and manual lifting mechanism and safety features, was assessed for its acceptability in terms of design and construction, instructional applicability, cost-effectiveness, durability, functionality, and safety. A total of 78 respondents, including automotive students, instructors, and industry experts from Isabela State University–Ilagan Campus, ISAT–DepEd, and ISAT–TESDA, participated in the evaluation using validated questionnaires, interviews, and observation. Results revealed that the equipment was “very much acceptable” across most criteria, with functionality receiving slightly varied ratings. ANOVA indicated no significant difference in acceptability among respondent groups, except in terms of functionality. Based on the findings, the study recommends the integration of the dual-mode worktable lifter into automotive technology programs and encourages further enhancements based on classroom and industry feedback.

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## **INTRODUCTION**

Technology and Livelihood Education (TLE) is one of the key components of secondary education in the Philippines. Various vocational schools in the City of Ilagan, including the Isabela School of Arts and Trades (ISAT–TESDA) and Isabela State University Ilagan Campus, offer technical-vocational courses with specializations such as automotive technology. To deliver effective instruction and enhance learning outcomes, these institutions require suitable teaching aids, including trainers and mock-ups.

In view of this, the researcher was inspired to design and fabricate instructional equipment that functions as a multipurpose worktable lifter, capable of lifting automotive engines and supporting other instructional activities. It can also be used for maintenance and repair tasks

involving small engines. The researcher aimed to develop a functional and practical project utilizing readily accessible and locally available materials.

Technological advancements in both software and hardware continue to evolve rapidly, posing challenges and creating opportunities in instructional technology. As Amirault (2015) highlighted, this continuous development necessitates adaptive and innovative approaches in educational systems.

Naelga and Chavez (2017) emphasized that teaching methods and learning styles significantly influence the selection of instructional materials, suggesting that a variety of materials, such as vehicle mock-up models, can foster more effective student learning. Similarly, Pimentel et al. (2016) argued that productive education must go beyond traditional lectures and tests. Adopting an outcomes-based education (OBE) approach fosters critical skills such as analysis, problem-solving, collaboration, communication, creativity, and innovation. To simulate real-world settings, students must have access to industry-relevant equipment and apparatuses.

Moreover, cost-effectiveness is a critical consideration in the selection of instructional equipment. Hydraulic lift systems, for example, require a consistent supply of oil, while pneumatic systems incur costs from air compression maintenance. In contrast, pinion and chain systems require minimal upkeep, making them more sustainable and economically viable over time (Omar et al., 2017).

Ergonomics also plays a vital role in the application of lifting systems. The American National Standards Institute (ANSI, 2017) recommends adjustable work heights to reduce the physical strain caused by repetitive or prolonged tasks. Organizations that have implemented motorized lifting tables have reported increased productivity and reduced worker fatigue. For instance, Siemens recorded a 20% increase in productivity and a decline in employee discomfort in departments using such solutions.

According to Daramola & Daniel (2015), students taught using improvised instructional materials outperformed those who learned through conventional methods. Their study underscores the value of locally sourced instructional materials in bridging resource gaps and enhancing student performance in Basic Science and Technology education.

Grounded in these principles, the researcher set out to construct an instructional device that meets the practical and instructional needs of the institution. The equipment designed—a motorized automotive multipurpose worktable lifter—integrates a direct current (DC) motor with a screw jack and can operate in both electric and manual modes. It also features a detachable tool organizer and built-in safety mechanisms, innovations not typically found in commercially available table lifters.

The fabricated equipment will be evaluated by three groups of respondents: industry experts, automotive students, and instructors from Isabela State University, Ilagan Campus, as well as from the Technical Skills and Development Authority at ISAT–TESDA Main Campus in Ilagan, Isabela.

The researcher believes that this device will greatly aid both students and instructors in conducting activities, lectures, and demonstrations more effectively. Given that many automotive students are visual and kinesthetic learners, this hands-on instructional aid is expected to enhance comprehension. Additionally, because the equipment is locally produced, it is more cost-effective than similar commercial products. As observed by the researcher, no such instructional equipment currently exists in vocational schools in the City of Ilagan.

Thus, this study aims to design, fabricate, and evaluate the acceptability of a dual-mode (electric and manual) multipurpose worktable lifter as an instructional tool in automotive education.

### *Statement of the problem*

This study aimed to fabricate a dual-mode automotive worktable lifter and evaluate its acceptability.

Specifically, it sought to answer the following questions.

1) What are the processes involved in fabricating and evaluating a dual-mode automotive worktable lifter?

2) What is the level of acceptability of the fabricated dual-mode automotive worktable lifter based on the following criteria, as evaluated by the students, instructors, and expert respondents?

- a) design and construction
- b) instructional applicability
- c) cost- cost-effectiveness
- d) durability ( range of lifting and weight capacity )
- e) functionality, and
- f) safety.

3) Is there a significant difference in the level of acceptability of the proposed multipurpose dual-mode worktable lifter as perceived by groups of respondents?

## METHODOLOGY

### *Research design*

This study aimed to fabricate a dual-mode (electric and manual) multipurpose worktable lifter as instructional equipment. It utilized the descriptive method of research to obtain reliable, consistent, and accurate results.

The researcher employed the Project Development Method (PDM), wherein the design and specifications of the dual-mode multipurpose work table lifter were conceptualized. The PDM combines theoretical and practical knowledge by following appropriate steps aligned with the research development process, from research design to research finalization.

The dual-mode (electric and manual) multipurpose working table lifter was constructed and assembled in accordance with the proposed design. Revisions were made to address any defects, and the equipment was reassembled until it was deemed functional and acceptable.

Furthermore, the descriptive-evaluative research design was applied to assess the equipment based on its design and construction. The primary data-gathering instruments included questionnaire checklists, supported by unstructured interviews and direct observation.

### *Respondents and locale of the study*

The respondents, comprising instructors, teachers, students, and experts, were selected based on their skills and competencies in automotive technology. They were requested to complete an assessment form to evaluate the acceptability and functionality of the fabricated motorized table lifter.

### *Research instrument*

The researcher used evaluation questionnaires partly based on those developed by Cubangbang et al. (2024) and Bartolome (2019). These questionnaires aimed to assess the acceptability and functionality of the dual-mode (electric and manual) multipurpose worktable lifter. The tool consisted of thirty (30) items across six (6) evaluation criteria. All criteria were rated on a 5-point scale.

To ensure relevance and reliability, the evaluation criteria—including design and construction, functionality, and safety—were reviewed and validated by the researcher’s adviser and critic.

To verify the equipment's functionality, the researcher also developed a set of laboratory activities and experiments using the fabricated lifter. The manual of operation was presented to the respondents, who conducted the actual testing during the evaluation process.

#### *Data analyses procedure*

The following statistical tools were used to analyze the data:

Weighted Mean (WM). Used to determine the level of acceptability of the fabricated equipment in terms of design and construction, instructional applicability, cost-effectiveness, durability, functionality, and safety.

Analysis of Variance (ANOVA). Employed to determine whether there were significant differences in the evaluations of the three groups of respondents regarding the identified variables.

## DISCUSSION OF FINDINGS

### *Construction process*

This dual-mode automotive worktable lifter serves as a dynamic educational apparatus, enhancing hands-on learning in automotive workshops, vocational institutions, and engineering labs. It features a dual-mode lifting system that facilitates smooth vertical adjustments of the tabletop, accommodating various automotive tasks such as engine maintenance, component evaluation, and assembly procedures.

Constructed with a durable framework and driven by an electric motor or Manual mechanism, the lifter incorporates a scissor or linear actuator mechanism to ensure stable and precise elevation. Safety is prioritized through the inclusion of limit switches, an emergency stop function, and locking casters, promoting both user protection and mobility.

By integrating this equipment into training programs, students gain practical experience with mechanical systems, motor controls, load management, and adherence to safety protocols. Its adaptable design supports a range of instructional activities, fostering ergonomic practices by reducing the need for manual lifting.

### *Level of acceptability of the fabricated dual-mode automotive multipurpose worktable lifter*

#### *Level of acceptability of the fabricated dual-mode automotive worktable lifter in terms of design and construction*

The data reveals that the level of acceptability in terms of durability is “Very Much Acceptable” in all indicators. The overall means fell within the mean range of 4.20 – 5.00, which indicates that the level of acceptability of the trainer in terms of durability was “Very Much Acceptable”.

This implies that the respondents were consistent in their evaluation to accept the trainer as highly durable. This means that the Fabricated Dual-Mode Worktable Lifter could last long.

*Level of acceptability of the fabricated dual-mode automotive worktable lifter in terms of instructional applicability*

The data presents the level of instructional applicability of the project. From the data, it can be gleaned that the instructional applicability of the system is “Very Much Acceptable” to all the groups of respondents. The overall means fell within the mean range of 4.20 – 5.00, which indicates that the level of acceptability of the trainer in terms of Instructional applicability is Very Much Applicable. The results show high instructional value of the trainer, especially in practical and competency-based education settings.

*Level of acceptability of the fabricated dual-mode automotive worktable lifter in terms of cost effectiveness*

The data presents the level of acceptability of the project in terms of cost- cost-effectiveness. As disclosed in the table, all indicators under cost- cost-effectiveness obtained the rating “Very Much Acceptable” from the three groups of respondents. All criteria were rated “Very Much Acceptable” with means of 4.78, 4.83, and 4.56, respectively. This indicates that the trainer is highly accepted by the respondents because it is highly cost-effective.

*Level of acceptability of the fabricated dual-mode automotive worktable lifter in terms of durability*

The data reveals that the level of acceptability of the trainer in terms of durability is “Very Much Acceptable” in all indicators. The overall means fell within the mean range of 4.20 – 5.00, which indicates that the level of acceptability of the fabricated table lifter in terms of durability was “Very Much Acceptable”. This implies that the respondents were consistent in their evaluation to accept the project as highly durable. This means that the fabricated dual-mode automotive worktable lifter could last long.

Respondents agree that the table lifter is constructed with high durability in mind, especially in terms of component integrity.

*Level of acceptability of the fabricated dual-mode automotive worktable lifter in terms of functionality*

The table discloses the level of acceptability of the trainer in terms of functionality. As indicated, the functionality of the trainer is “Very Much Acceptable.” all groups found the system functional; experts gave lower ratings, especially for noise and vibration, which still fall within the "Acceptable" range.

This implies that the respondents found the fabricated lifter to be very functional. Hence, the trainer is useful in Automotive Instruction.

*Level of acceptability of the fabricated dual-mode automotive worktable lifter in terms of safety*

The table presents the level of acceptability of the project in terms of safety. As disclosed in the table, all indicators under Safety obtained the rating “Very Much Acceptable” from the three groups of respondents. All criteria were rated “Very Much Acceptable” by industry experts, TVL Teachers with means of 4.75, 4.75, and 4.64, respectively. This indicates that the trainer is highly accepted by the respondents because it is safe to use. All respondent groups confirmed

that the table lifter meets strong safety standards and is safe to use in educational and industrial environments.

*Evaluation of differences in general acceptability of the fabricated dual-mode automotive worktable lifter among groups of respondents*

*Comparison of the general level of acceptability of the fabricated dual powered automotive worktable filter across different groups of respondents based on criteria*

The only significant difference was in Functionality, where experts rated the system lower than teachers. This may be attributed to higher performance expectations from experts in terms of smooth operation and technical precision.

Based on the descriptive statistical analysis of the study titled "Fabrication and Evaluation of Dual-Mode Automotive Multipurpose Worktable Lifter", the findings reveal a generally high level of acceptability across all evaluated criteria, with specific highlights and contrasts.

The highest mean was recorded under Instructional Applicability with an average of 4.818, indicating that respondents highly agreed on the tool's educational relevance. Specifically, the indicators such as promoting active learning, enhancing mechanical understanding, and aligning with various curricular competencies were all rated exceptionally high, underscoring the learner's value as a teaching aid.

Conversely, the lowest mean appeared under Functionality, with an average score of 4.629. While still in the "very acceptable" range, this lower mean suggests that respondents saw slightly more room for improvement in operational aspects like the smoothness of the lifting mechanism, power consistency, and responsiveness to controls.

Overall, the general mean ratings across all six criteria (Design and Construction, Instructional Applicability, Cost, Durability, Functionality, and Safety) ranged from 4.629 to 4.818, reflecting a very high level of acceptability. This outcome suggests that the fabricated table lifter is not only functional and safe but also cost-effective, durable, and especially useful in instructional settings.

These results affirm the device's effectiveness and potential for educational and industrial use, while subtly pointing toward the functionality aspect as a focus area for further refinement or enhancement.

## CONCLUSION

Based on the findings of the study, it is concluded that the dual-mode automotive multipurpose worktable lifter can significantly contribute to improving instructional delivery in Automotive Technology by providing a practical, reliable, and cost-effective teaching aid. Its high level of acceptability among key stakeholders highlights its potential to enhance technical competencies and hands-on learning experiences. Furthermore, the equipment supports the broader goals of Technical-Vocational Education and Training (TVET) by promoting innovation and self-reliance through locally fabricated instructional materials. Overall, the study emphasizes the importance of integrating context-responsive tools in technical education to bridge the gaps between classroom instruction and industry practice.

In view of the findings and conclusions of the study, several recommendations are presented. First, since a significant difference was found in the functionality ratings among respondents, it is recommended that further refinement of the dual-mode mechanisms and

operational components be undertaken to ensure optimal performance and consistent functionality across different users. Technical-vocational institutions and training centers may consider adopting the fabricated dual-mode automotive multipurpose worktable lifter as instructional equipment to enhance hands-on learning in automotive servicing and other technical applications. Additionally, regular testing and upgrading of the equipment's features—such as lifting capacity, durability, and safety mechanisms—should be carried out to align with evolving industrial standards and user needs. The systematic design and fabrication process employed in this study may also serve as a model for the future development of other instructional devices, thereby promoting similar project-based research in Technology and Livelihood Education (TLE) and industrial education programs. Lastly, future researchers are encouraged to conduct longitudinal and multi-site evaluations involving a larger group of respondents to further validate the equipment's functionality and explore its broader integration into educational and industry settings.

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