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Acceptability of a 3-in-1 Automotive Charging System Trainer for Automotive Technology Instruction

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Abstract— *The study addressed the need for a reliable and instructionally effective trainer that could improve the teaching and learning of automotive charging systems in laboratory classes. In many technical-vocational settings, the lack of functional, safe, and durable instructional equipment limits students' opportunities for hands-on learning and practical skill development. Thus, the main objective of the study was to determine the acceptability of the developed 3-in-1 Automotive Charging System Trainer in terms of functionality, applicability, workability, durability, and safety. The study is academically and practically significant because it provides evidence on the value of localized instructional innovation in strengthening automotive technology education and improving competency-based laboratory instruction. Using a descriptive-evaluative research design, the study gathered data from 50 purposively selected respondents composed of 35 students, 10 teachers, and 5 industry experts. An adapted Likert-scale questionnaire was used as the primary instrument for data collection. Findings revealed that the trainer was rated Highly Acceptable in all five criteria, with functionality obtaining the highest mean of 4.80, followed by workability (4.75), durability (4.73), safety (4.72), and applicability (4.67), resulting in an overall grand mean of 4.734, interpreted as Highly Acceptable. The study concluded that the 3-in-1 Automotive Charging System Trainer is an effective, safe, durable, and instructionally relevant device for automotive technology instruction. Practically, the findings imply that the trainer may be adopted for wider classroom and laboratory use, replicated in similar institutions, and further enhanced to support more effective hands-on learning experiences in automotive education.*

Keywords— *Acceptability: Automotive Education.: Automotive Trainer: Functionality: Instructional Innovation: Safety.*

I. INTRODUCTION

Automotive charging system trainers play an important role in automotive technology instruction because they help learners understand battery charging, alternator operation, voltage regulation, and related diagnostic procedures through hands-on experience. In technical-vocational education, the acceptability of a trainer is a vital concern because an instructional device must not only function properly but must also be applicable to learning tasks, workable in laboratory settings, durable for repeated use, and safe for student operation. Previous studies have shown that well-designed trainer systems improve practical learning and strengthen technical competencies. Escalada et al. (2024) emphasized that trainer acceptability may be examined through functionality, applicability, workability, durability, and safety. Antifuesto and San Diego (2022) likewise found that a vehicle electrical security system trainer became more instructionally valuable when it was perceived as functional and safe by users. Lacanilao (2023) reported that portable automotive starting and charging system trainers were highly useful in improving practical engagement among students and teachers. In a related way, Chavez (2022) and Suyitno et al. (2020) highlighted that effective instructional devices in automotive education should be reliable, relevant to competencies, and supportive of meaningful laboratory learning.

At Jose Rizal Memorial State University–Dipolog Campus, the need for an acceptable 3-in-1 Automotive Charging System trainer emerged from the condition of the existing automotive laboratory, where instructional tools were described as inadequate, outdated, or limited in function. Such conditions may constrain demonstrations and practical exercises, particularly in lessons that require students to observe the interaction of several charging-system components within one operational setup. Although related studies have already established the value of trainer-based instruction in technical and vocational education, there remains a need to determine whether a localized, faculty-developed trainer is acceptable for actual use in the context of the institution. This gap is important because an innovation may be technically completed yet still require evaluation from students, teachers, and industry experts before it can be confidently adopted for instruction. Addressing this gap requires an evidence-based assessment of the trainer using clear criteria that reflect both pedagogical and operational quality.

For this reason, the study was conducted to determine the level of acceptability of the 3-in-1 Automotive Charging System trainer in terms of functionality, applicability, workability, durability, and safety. It was expected that the findings would establish whether the developed trainer is suitable for integration into automotive technology instruction and provide a basis for its wider classroom use, replication, and further improvement.

Literature Review

Acceptability is a critical measure of instructional innovation in technical-vocational education. A trainer is considered effective when it is perceived as functional, applicable, workable, durable, and safe in actual classroom

Bebbot M. Cainta, "Acceptability of a 3-in-1 Automotive Charging System Trainer for Automotive Technology Instruction," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 8, Issue 11, pp. 172-178, 2026.

and laboratory use. Instructional materials should therefore be evaluated not only for their existence as prototypes but also for their educational value and practical usability. Ornstein and Coffman (2020) emphasized that instructional materials influence learner motivation and comprehension, showing that their quality must be judged by how well they support learning and safe practice.

Several studies support these criteria in evaluating trainer systems. Escalada et al. (2024) showed that functionality, applicability, workability, durability, and safety are valid dimensions for assessing an innovated motor control trainer. Their findings suggest that highly acceptable trainers operate with minimal error, respond to learning needs, can be used repeatedly, and ensure user protection. Antifuesto and San Diego (2022) also found that a vehicle electrical security system trainer was highly acceptable because it simulated real systems and improved learner confidence and practice. Similarly, Lacanilao (2023), Evangelista (2022), and Lapada and Torres (2025) reported that trainer systems become instructionally valuable when users perceive them as safe, reliable, and relevant to laboratory competencies.

The literature also explains the meaning of the five acceptability criteria. Functionality refers to the trainer's ability to perform its intended purpose accurately. Applicability concerns its relevance to real learning tasks and competency development. Workability refers to practicality, ease of use, and availability of materials for operation or replication. Durability reflects the trainer's capacity to withstand repeated use, while safety ensures that learners can use the device without unnecessary risk. Studies by Balbin (2012, 2015), Chavez (2022), and Suyitno et al. (2020) consistently show that instructional trainers are more effective when they are stable, realistic, manageable, and safe. These ideas support the evaluation of the 3-in-1 Automotive Charging System trainer as an instructional device suitable for classroom implementation.

II. Research Methodology

This study used a descriptive research design to evaluate the acceptability of the developed 3-in-1 Automotive Charging System trainer. The evaluation focused on five criteria: functionality, applicability, workability, durability, and safety.

The respondents were 50 purposively selected participants composed of 35 students, 10 teachers, and 5 industry experts. They were chosen based on their knowledge of automotive electrical systems and their capability to assess the instructional and technical value of the trainer. This group provided perspectives from learners, instructors, and practitioners.

Data were gathered using an adapted questionnaire based on the instrument of Escalada et al. (2024). The items were revised to suit the features of the 3-in-1 Automotive Charging System trainer. The instrument measured functionality, applicability, workability, durability, and safety using a five-point Likert scale, where 5 meant Highly Acceptable and 1 meant Not Acceptable.

Before the evaluation, the respondents were oriented on the components, operation, and safety features of the trainer. A demonstration was conducted, after which the respondents observed and used the device and then answered the evaluation questionnaire. The data were tabulated and analyzed using mean scores for each criterion and the overall grand mean. Mean scores ranging from 4.21 to 5.00 were interpreted as Highly Acceptable.

III. Results and Discussions

Results

Evaluation results were based on the instrument adapted by the researcher. Each variable in the instrument reflected the developed project and its evaluation process.

TABLE 1. Acceptability of 3 in 1 Automotive Charging System based on its Functionality

Functionality	Mean	Qualitative Description
The developed 3-in-1 Automotive Charging System performs its intended function effectively.	4.48	Highly Acceptable
The system operates with minimal errors during use.	4.85	Highly Acceptable
The system responds accurately to start/stop and other control commands.	4.56	Highly Acceptable
It facilitates hands-on learning in automotive charging principles.	4.91	Highly Acceptable
All integrated components (alternator, battery, inverter, voltmeter, etc.) function properly.	4.84	Highly Acceptable
Average Mean	**4.80**	**Highly Acceptable**

The results in Table 1 reveal that the 3-in-1 Automotive Charging System attained a high level of acceptability in terms of functionality, with an overall mean rating of 4.80, interpreted as Highly Acceptable. This indicates that the system effectively meets its intended purpose and performs reliably during operation. The high scores across the functionality indicators suggest that users found the system efficient, user-friendly, and capable of supporting hands-on learning experiences in automotive technology. The findings imply that the device successfully integrates essential components, ensuring smooth performance and operational accuracy suitable for instructional and practical applications.

These results align with the findings of Escalada et al. (2024) in their study on the Design and Development of an Innovated Motor Control Trainer, which also obtained a Highly Acceptable rating (M = 4.65) for functionality. Similar to their device, the developed 3-in-1 Automotive Charging System demonstrates strong potential as an effective educational and training tool, offering minimal errors, high efficiency, and enhanced skill development opportunities for learners. This suggests that both innovations are valuable instructional technologies capable of improving technical competencies in the field of automotive and electrical systems.

Likewise, Antifuesto and San Diego (2022) reported comparable outcomes in their study on the development and evaluation of acceptability of a vehicle electrical security system trainer as an instructional tool in teaching autotronics,

Bebbot M. Cainta, "Acceptability of a 3-in-1 Automotive Charging System Trainer for Automotive Technology Instruction," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 8, Issue 11, pp. 172-178, 2026.

where the trainer achieved a Highly Acceptable rating in terms of functionality (M = 4.67). Their results underscore that well-designed instructional devices enhance the teaching-learning process by simulating real-world automotive systems, thereby improving learners' engagement, confidence, and practical competencies. The parallel findings between the present study and that of Antifuesto and San Diego (2022) further validate the importance of developing functional, interactive, and context-based trainers in technical and vocational education.

TABLE 2. Acceptability of 3 in 1 Automotive Charging System based on its Applicability

Applicability	Mean	Qualitative Description
The system is applicable for laboratory exercises in automotive electrical and charging systems.	4.87	Highly Acceptable
It meets the learning needs of students studying automotive electrical systems.	4.56	Highly Acceptable
It reflects real-world applications of automotive charging systems.	4.52	Highly Acceptable
It improves students' understanding of electrical safety and practices.	4.76	Highly Acceptable
It provides opportunities to practice troubleshooting charging system problems.	4.63	Highly Acceptable
Average Mean	**4.67**	**Highly Acceptable**

The findings in Table 2 reveal that the 3-in-1 Automotive Charging System achieved a high level of acceptability in terms of applicability, with an overall mean score of 4.67, interpreted as Highly Acceptable. This suggests that the system is highly relevant and useful for laboratory instruction, aligning well with the learning needs of students in automotive technology. Its strong applicability rating reflects its effectiveness as a practical learning tool that bridges theoretical concepts with real-world automotive applications. Moreover, the results indicate that the system enhances students' understanding of electrical safety, hands-on troubleshooting, and the overall operation of automotive charging systems, making it a valuable instructional material for both teaching and skills training.

These results are consistent with the study of Escalada et al. (2024) on the Design and Development of an Innovated Motor Control Trainer, which also recorded a Highly Acceptable rating in applicability (M = 4.78). Similar to their findings, the developed 3-in-1 Automotive Charging System proves to be an effective educational innovation that meets user needs, promotes safe laboratory use, and strengthens students' technical competence through experiential learning. Both studies highlight the significance of developing instructional devices that are not only functional but also applicable and responsive to the evolving demands of technical education and industry practice.

The results in Table 3 indicate that the 3-in-1 Automotive Charging System obtained a high level of acceptability in terms of workability, with an overall mean of 4.75, described as Highly Acceptable. This suggests that the system is practical, efficient, and easy to implement within educational settings. The results imply that the materials used are accessible and cost-effective, making the project feasible for replication in other institutions. The clarity of its operating guidelines and its user-friendly design contribute to its manageability and effectiveness in performing multiple experiments. These findings confirm that the developed training system can be efficiently operated, sustained, and utilized in technical education laboratories, making it an ideal instructional tool for developing automotive competencies.

TABLE 3. Acceptability of 3 in 1 Automotive Charging System based on its Workability

Workability	Mean	Qualitative Description
The materials used in the system are available and cost-effective.	4.85	Highly Acceptable
The system can be replicated and developed in other institutions.	4.68	Highly Acceptable
The system's instructions and operating guidelines are clear and understandable.	4.67	Highly Acceptable
The system is user-friendly and manageable.	4.84	Highly Acceptable
Multiple tasks and experiments can be performed using the system.	4.75	Highly Acceptable
Average Mean	**4.75**	**Highly Acceptable**

Similarly, Escalada et al. (2024) reported that their Innovated Motor Control Trainer achieved a Highly Acceptable rating in workability (M = 4.63), emphasizing the accessibility of materials, expertise, and fabrication resources necessary for implementation. Both studies affirm the importance of practicality and replicability in instructional device design. The comparable findings indicate that ensuring the availability of materials and technical support contributes significantly to the usability and sustainability of educational tools. Overall, the high workability ratings in both studies highlight their potential for widespread adoption in technical and vocational education.

TABLE 4. Acceptability of 3 in 1 Automotive Charging System based on its Durability

Durability	Mean	Qualitative Description
The system can withstand frequent and repeated usage.	4.59	Highly Acceptable
The components are resistant to damage during operation.	4.63	Highly Acceptable
The device does not easily deform, overheat, or wear out.	4.83	Highly Acceptable
It endures different environmental and laboratory conditions.	4.74	Highly Acceptable
It is made of durable, high-quality materials.	4.87	Highly Acceptable
Average Mean	**4.73**	**Highly Acceptable**

The results in Table 4 show that the 3-in-1 Automotive Charging System achieved a high level of acceptability in terms of durability, with an overall mean score of 4.73, described as Highly Acceptable. This indicates that the system is built with durable and high-quality materials capable of withstanding frequent use and varied laboratory conditions. The results suggest that the device performs reliably even under continuous operation, showing strong resistance to

Bebbot M. Cainta, "Acceptability of a 3-in-1 Automotive Charging System Trainer for Automotive Technology Instruction," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 8, Issue 11, pp. 172-178, 2026.

deformation, overheating, or wear. The high durability rating further implies that the system is designed for long-term educational and technical use, providing consistent performance and safety for users.

Figure 1. Automotive Charging System Trainer based on its Durability

These findings are consistent with the study of Escalada et al. (2024) on the Innovated Motor Control Trainer, which also obtained a Highly Acceptable rating in durability (M = 4.73). Their study highlighted the device's resistance to deformation, endurance under high temperatures, and resilience to environmental factors, all of which contributed to its long lifespan and reliability. Similarly, the developed 3-in-1 Automotive Charging System demonstrates strong structural integrity and endurance, making it a dependable tool for sustained instructional use. Both studies confirm that durability is a key factor in ensuring the long-term functionality and educational value of instructional training devices.

TABLE 5. Acceptability of 3 in 1 Automotive Charging System based on its Safety

Safety	Mean	Qualitative Description
The system has no sharp or hazardous edges.	4.89	Highly Acceptable
No toxic or harmful materials are used in its construction.	4.68	Highly Acceptable
It includes protective measures such as fuses, insulation, and circuit protection.	4.78	Highly Acceptable
The emergency stop or protective switch is available and functional.	4.69	Highly Acceptable
The system ensures safe operation even during prolonged use.	4.58	Highly Acceptable
Average Mean	**4.72**	**Highly Acceptable**

The results in Table 5 reveal that the 3-in-1 Automotive Charging System obtained a high level of acceptability in terms of safety, with an overall mean score of 4.72, interpreted as Highly Acceptable. This indicates that the system is designed with user protection as a priority, incorporating safety features such as proper insulation, circuit protection, and an accessible emergency stop mechanism. The absence of sharp edges and toxic materials further ensures that the device is safe to handle and operate, even during extended laboratory use. These findings imply that the system not only promotes effective learning but also upholds safety standards suitable for educational environments.

Similarly, the study conducted by Escalada et al. (2024) on the Gas Leakage Detector System yielded comparable results, with a Highly Acceptable mean rating of 4.70 for safety. Their findings emphasized the importance of structural safety, non-toxic materials, and protective features such as emergency stop mechanisms and clear safety instructions. In parallel, the 3-in-1 Automotive Charging System demonstrates the same high regard for user protection, making it a reliable and secure instructional device. Both studies underscore that safety is a fundamental criterion in the development of educational technologies, ensuring that learners can explore and apply technical knowledge without risk.

In addition, the findings are consistent with those of Antifuesto and San Diego (2022), who evaluated the Vehicle Electrical Security System Trainer and found it Highly Acceptable in terms of safety (M = 5.00). Their study emphasized that educational trainers must be constructed with user safety in mind, featuring proper insulation, stable wiring, and safe operational design to prevent accidents during laboratory use. The strong alignment of results across these studies underscores that safety is a fundamental criterion in the design of instructional technologies, ensuring that learners can engage in hands-on technical training with confidence and minimal risk.

TABLE 6. Overall Acceptability

Characteristics	Average Mean	Rank	Highly Acceptable
Functionality	4.80	1	Highly Acceptable
Applicability	4.67	5	Highly Acceptable
Workability	4.75	2	Highly Acceptable
Durability	4.73	3	Highly Acceptable
Safety	4.72	4	Highly Acceptable
Grand Mean	**4.734**		**Highly Acceptable**

The results in Table 6 show that the 3-in-1 Automotive Charging System achieved an overall high level of acceptability, with a grand mean of 4.734, interpreted as Highly Acceptable. Among the five criteria evaluated, functionality ranked first (M = 4.80), followed by workability (M = 4.75), durability (M = 4.73), safety (M = 4.72), and applicability (M = 4.67). These findings indicate that the developed system performs its intended functions effectively, is easy to operate, and is constructed using durable and safe materials suitable for educational use. The high ratings across all categories affirm that the 3-in-1 Automotive Charging System is a well-designed and reliable instructional device that meets both technical and pedagogical standards.

In comparison, Escalada et al. (2024), in their study on the Innovated Motor Control Trainer, also reported a Highly Acceptable overall mean of 4.698. Their findings emphasized the strong applicability, durability, and safety of the device, suggesting that it effectively met user needs and maintained consistent performance in laboratory settings. Similarly, the 3-in-1 Automotive Charging System demonstrates excellent overall quality and usability, showing its potential as a valuable tool in automotive education. Both studies highlight

Bebbot M. Cainta, "Acceptability of a 3-in-1 Automotive Charging System Trainer for Automotive Technology Instruction," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 8, Issue 11, pp. 172-178, 2026.

the importance of integrating functionality, safety, and durability in developing instructional technologies that enhance practical learning and technical competency.

Suggestions from the Respondents for Further Improvement

Out of the 50 respondents who evaluated the 3-in-1 Automotive Charging System, a majority or 86% (43 respondents) expressed that the device was already highly functional and effective for instructional use but still offered recommendations for enhancement. Specifically, 40% of the respondents suggested the integration of digital monitoring features such as LED indicators, ammeters, and voltmeters for more accurate measurement and performance observation.

One student remarked, "It would be better if the trainer had a digital display so we can easily see voltage readings while testing." Similarly, an instructor stated, "Adding a real-time digital monitor will help us demonstrate electrical output and system behavior more effectively."

Meanwhile, 26% of respondents proposed the installation of transparent safety covers, improved wiring insulation, and clear labeling of components to enhance user safety during laboratory operation. As one student noted, "I suggest putting a transparent cover on the wiring and moving parts for safety during class demonstrations." An industry expert also commented, "Proper labeling and protective insulation would make it safer and more suitable for long-term laboratory use."

Additionally, 20% of respondents recommended upgrading the inverter capacity and incorporating modular connectors to allow easier testing and expansion for future experiments. One instructor shared, "The system's inverter can be upgraded, and modular connectors will help perform multiple experiments using the same setup."

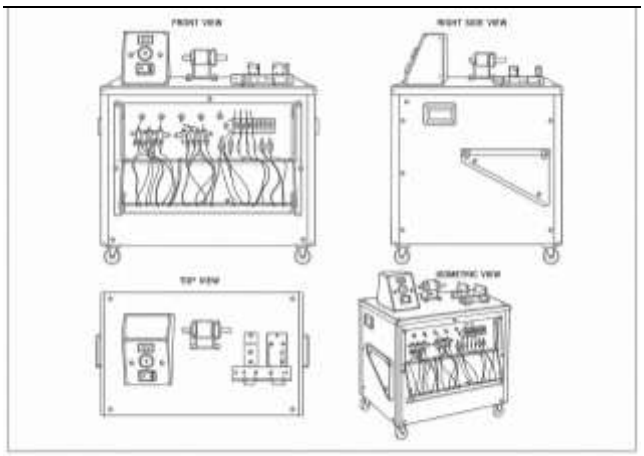

Figure 2. Isometric View of the Automotive Charging System Trainer

A smaller portion, 14%, suggested adding renewable energy options such as solar or wireless charging integration to align with emerging automotive technologies and environmental sustainability. As one industry expert explained, "Integrating solar charging would make the trainer more relevant to the future of electric vehicles."

Lastly, 10% of respondents emphasized the need for regular maintenance and calibration schedules to maintain the system's long-term reliability and accuracy. A laboratory technician advised, "The trainer should undergo regular calibration to keep voltage readings accurate and ensure its consistent performance."

Overall, the quantified feedback and qualitative remarks reveal that respondents view the 3-in-1 Automotive Charging System as a highly acceptable and innovative instructional device, while encouraging continuous improvement through digital integration, enhanced safety measures, system upgradeability, and renewable energy adaptation to ensure its sustained relevance, safety, and instructional value in automotive education.

Figure 3. The Completed Automotive Charging System Trainer

The results demonstrated a consistently strong evaluation across all five criteria. Functionality obtained the highest mean score at 4.80, indicating that the trainer effectively performed its intended functions, responded accurately to controls, and supported hands-on learning in charging-system principles. Workability followed with a mean of 4.75, suggesting that the materials, operating guidelines, manageability, and potential for replication were viewed very positively by the evaluators.

Durability received a mean of 4.73, showing confidence in the trainer's ability to withstand frequent use and diverse laboratory conditions. Safety posted a mean of 4.72, confirming that the device was perceived as properly insulated, structurally safe, and equipped with protective features suitable for educational environments. Applicability, while ranking fifth, still obtained a highly favorable mean of 4.67, indicating that the trainer was considered relevant to laboratory exercises, student learning needs, troubleshooting practice, and real-world automotive applications.

The overall grand mean of 4.734 shows that the 3-in-1 Automotive Charging System trainer was Highly Acceptable as an instructional innovation. The pattern of results suggests that the trainer was not only technically functional but also educationally meaningful, practical to use, and safe for sustained implementation in automotive technology classes.

Discussion

Bebbot M. Cainta, "Acceptability of a 3-in-1 Automotive Charging System Trainer for Automotive Technology Instruction," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 8, Issue 11, pp. 172-178, 2026.

The acceptability profile of the trainer indicates that the innovation successfully met the major criteria expected of instructional equipment in technical-vocational education. The highest score in functionality implies that respondents viewed the trainer as a credible and efficient representation of charging-system operations. This is important because functional reliability is often the first threshold that determines whether a trainer can be integrated into regular laboratory instruction.

The high rating in workability further strengthens the case for institutional adoption. A device may be technically sound but still difficult to use or replicate; however, the results here suggest that the trainer remained manageable, understandable, and feasible in an educational context. This makes the innovation particularly valuable for universities and colleges that need practical yet economical equipment for automotive instruction.

Durability and safety also emerged as strong areas, which is critical for faculty-developed laboratory devices. Equipment intended for repeated classroom use must remain stable, resistant to damage, and safe for learners. The positive evaluation in these dimensions suggests that the trainer was developed with attention not only to instructional goals but also to responsible laboratory practice. Applicability, although the lowest among the five means, remained within the Highly Acceptable range, indicating that respondents still regarded the trainer as directly useful to the competencies expected in automotive electrical instruction.

The present findings align with the comparative studies cited in the original manuscript, particularly those reporting high acceptability for trainer-type instructional devices in technical education. Taken together, the results support the claim that the 3-in-1 Automotive Charging System trainer is a pedagogically valuable innovation with strong potential for classroom integration, replication, and continued enhancement.

IV. Conclusion

The study concluded that the 3-in-1 Automotive Charging System trainer is a highly acceptable instructional device for automotive technology instruction. The evaluation showed that the trainer obtained high ratings in functionality, applicability, workability, durability, and safety, with an overall grand mean interpreted as Highly Acceptable. These findings indicate that the trainer is capable of performing its intended purpose effectively while also meeting the instructional, technical, and safety requirements of laboratory use. The results further suggest that the device is relevant to competency-based automotive instruction because it provides students with meaningful hands-on learning experiences that connect theory with actual charging system operations.

Moreover, the trainer has strong potential for integration into automotive technology classes because it is practical, reliable, and suitable for repeated instructional use. Its positive evaluation from students, teachers, and industry experts confirms its value not only as a functional device but also as a pedagogically sound innovation. As such, the 3-in-1 Automotive Charging System trainer may be adopted as a laboratory instructional material and may also serve as a model for similar innovations in technical-vocational education. Continued improvement of the trainer through additional digital features, enhanced safety measures, and future system upgrades may further strengthen its instructional effectiveness and long-term usefulness.

V. Recommendations

It is recommended that the 3-in-1 Automotive Charging System trainer be adopted and utilized in automotive technology instruction, particularly in laboratory classes involving automotive electrical and charging systems. Since the trainer was found to be highly acceptable in terms of functionality, applicability, workability, durability, and safety, instructors may use it as a supplementary instructional material to strengthen hands-on learning and improve students' practical understanding of charging system operations. Schools and technical-vocational institutions may also consider replicating the trainer as a cost-effective and localized innovation for competency-based instruction.

It is further recommended that the trainer be continuously improved to enhance its instructional value and long-term usability. Future enhancements may include the integration of digital monitoring devices such as voltmeters, ammeters, and LED indicators, the addition of protective covers and clearer component labels for safety, and the upgrading of modular features for more varied experiments. Future studies may also evaluate the effectiveness of the trainer in improving student performance, skill acquisition, and learning outcomes, as well as test its applicability in other institutions offering automotive technology programs.

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