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Fabrication of a Car Starter System Learning Media for Vocational High School Practicum at SMK Muhammadiyah Seputih Raman

Lukito Dwi Yuono[1,*], Eko Budiyanto[2]

[1,2] Department of Mechanical Engineering, Faculty of Engineering, Universitas Muhammadiyah Metro, Jl. KH Dewantara 115 Kota Metro, Lampung, Indonesia

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ABSTRACT

SMK Muhammadiyah Seputih Raman, located in Central Lampung Regency, Lampung Province, offers an Automotive Engineering program that focuses on motor vehicle engines such as cars and motorcycles. In vocational learning, practicum activities are essential to train students' technical skills. One important component in automotive electrical systems is the starter system, yet practical training tools for this system are currently unavailable at the school. To address this gap, a community service program was carried out involving training on the vehicle starter system and the development of a starter system trainer as a practicum medium. The outcomes of this program are: (1) the addition of new learning media, specifically a practicum tool for the automotive electrical starter system at SMK Muhammadiyah Seputih Raman; (2) improvement of students' knowledge and skills in automotive electrical systems, particularly the car starter system; and (3) the creation of a practicum module as a guide to facilitate starter system practicum activities.

1. Introduction

The rapid development of the automotive industry, particularly in motorcycles and cars, has led to increased competition among manufacturers to offer superior products in terms of both performance and design. A crucial component in operating motor vehicles is the starter system, which provides the initial rotational power needed to start the engine's working cycle. Starter systems are generally categorized into two types: manual starter systems (kick starter) and electric starter systems [1]. While manual starters are now mainly found in motorcycles, cars exclusively use electric starter systems, which rely on a battery-powered electric motor to generate sufficient torque to rotate the crankshaft.

Despite their importance, starter systems often encounter problems that require knowledge and technical competence to repair. This highlights the need for effective teaching methods and practical learning tools in vocational education, particularly for students in automotive engineering programs. SMK Muhammadiyah Seputih Raman, located in Central Lampung Regency, offers an Automotive Engineering program that covers both theoretical principles of two-stroke and four-stroke engines as well as practical training in areas such as engine tune-up, overhaul, ignition systems, and electrical systems. One of

* *Corresponding author. Lukito Dwi Yuono*
E-mail address: lukitody@ummetro.ac.id

the key practical areas in automotive electrical training is the starter system.

However, based on observations, SMK Muhammadiyah Seputih Raman currently lacks practical training media for the starter system, which makes it challenging for teachers to effectively deliver the material and for students to develop practical skills. Previous studies have shown that learning media such as starter system trainers significantly improve student learning outcomes. For example, research at SMK Cipta Karya Prembun demonstrated that the use of a starter system trainer achieved an 82.95% feasibility rating, indicating that it is valid and effective for learning. Students who used the trainer also showed higher achievement compared to those taught only through lectures [2]. Similarly, Fatah (2015) found that starter system trainers are suitable for classroom use and significantly enhance student learning outcomes [3], while Susanto (2020) and Wijaya (2016) concluded that conventional starter trainers, even when audio-based, are highly feasible as teaching media for developing competencies in starter system maintenance [4,5].

Considering these findings and the current limitations at SMK Muhammadiyah Seputih Raman, this community service activity was initiated to design and develop a car starter system trainer as a practical learning medium for automotive electrical systems. In addition, a practicum module will be created to serve as a guide, making it easier for both teachers and students to conduct practical activities related to vehicle starter systems.

2. Method

This study employed a combination of theoretical instruction, demonstration, and practical training to support the development and application of a car starter system trainer as a learning medium. The methods are outlined as follows:

2.1. Participants

The participants of this activity were students of the Automotive Engineering program at SMK Muhammadiyah Seputih Raman, Central Lampung. The students were directly involved in both theoretical sessions and hands-on training.

2.2. Tools and Materials

The primary tool used was a specially designed car starter system trainer, developed by the community service team. Supporting materials included automotive starter system components, hand tools for disassembly and assembly, and a practicum module as a learning guide.

2.3. Procedures

Lecture Sessions: Students received theoretical instruction on the principles, functions, and procedures of the vehicle starter system.

Demonstration: The trainer was used to demonstrate key components of the starter system and the process of disassembly and reassembly.

Hands-on Training: Students practiced assembly, maintenance, and troubleshooting of the starter system directly on the trainer under supervision. Each participant was actively engaged in the learning process to reinforce both knowledge and practical skills.

2.4. Implementation Approach

A participatory learning model was applied, in which students were not only observers but also active practitioners in each stage of the practicum. This approach was designed to strengthen competence in automotive electrical systems, particularly the starter system.

3. Result and Discussion

The community service activities carried out at SMK Muhammadiyah Seputih Raman were evaluated through observation of students' knowledge and practical skills. The outcomes of these observations are summarized in Tables 1 and 2.

Table 1. Improvement of Students' Knowledge

Assessment Indicator	Before Activity	After Activity
Understanding Electrical Measuring Tools		
1. Voltmeter	1	3
2. Ammeter	1	3
3. Test Pen (DC Tester)	1	3
Understanding Vehicle Electrical Components		
1. Cable Bolt	2	3
2. Starter Motor	2	3
3. Starter Switch	2	3
4. Relay	2	3
5. Fuse	2	3
6. Ignition Key	2	3
7. Indicator Light	2	3
8. Battery	2	3
9. Connector	2	3
Understanding Starter Motor Components		
1. Armature	1	3
2. Magnet Motor	2	3
3. Carbon Brush	1	3
4. Motor Bushing	1	3
5. Commutator	1	3
6. Field Coil	1	3
7. Plunger	1	3
8. Drive Lever	1	3
9. Pinion Gear	2	3
10. Starter Switch	2	3

Notes:
1 = Do not recognize and do not know the function
2 = Recognize but do not know the function
3 = Recognize and know the function

Table 2. Improvement of Students' Skills

Assessment Indicator	Before Activity	After Activity
Using Electrical Measuring Tools		
Voltmeter	1	3
Ammeter	1	3
Test Pen (DC Tester)	2	3
Practical Skills		
Assembling Starter System	2	3
Overhauling Starter Motor	2	3
Repairing Starter Motor	1	3

Notes:
1 = Unable
2 = Able but requires guidance/using a manual
3 = Able independently

The results, summarized in Tables 1 and 2, indicate clear improvements in both the availability of learning media and student competence.

3.1. Addition of Learning Media

The car starter system trainer developed through this program successfully provided SMK Muhammadiyah Seputih Raman with new practicum media in automotive electrical systems. This directly addressed the previous lack of practical tools for the starter system and supported the learning process. These findings are consistent with prior research who reported that the use of a starter system trainer significantly improved student learning outcomes compared to conventional lecture-based methods [2]. Similarly, Fatah (2015) concluded that such trainers are not only feasible but also highly effective in enhancing student learning achievement [3].

3.2. Improvement in Student Knowledge and Skills

Observations demonstrated that students' understanding and technical competence in automotive electrical systems, particularly the starter system, improved considerably after engaging in practicum activities. Through direct

involvement in assembly, maintenance, and troubleshooting, students developed both conceptual knowledge and hands-on skills. This aligns with the findings of Susanto (2020) and Wijaya (2016), who highlighted that starter system trainers, even in conventional or audio-assisted forms, were deemed very suitable as learning media and significantly contributed to students' skill development in maintenance competencies [4,5].

3.3. Availability of a Practicum Module

Alongside the trainer, a practicum module was created as a structured guide. This module facilitated the practicum process by providing step-by-step instructions, thereby supporting both teachers and students in conducting systematic and efficient learning activities. Prior research has also emphasized the importance of structured learning aids, as they enhance student independence and improve the effectiveness of practicum sessions [2].

The results of this activity confirm the findings of previous studies: starter system trainers are valid, feasible, and effective for vocational learning. While earlier research demonstrated their effectiveness in improving test results, this study further highlights their role in bridging gaps where schools lack sufficient practicum facilities [2,3]. Additionally, the integration of a practicum module complements earlier models by ensuring consistent learning outcomes across different practicum sessions.

Based on these outcomes and discussions with partner institutions, several directions are recommended for future development:

1. Designing new trainer models that follow technological advancements in modern vehicles, such as smart ignition and hybrid starter systems.
2. Expanding the range of trainers to cover other automotive and mechanical systems, thereby broadening students' practical exposure.
3. Building partnerships with more schools and institutions to strengthen collaboration networks, ensuring wider dissemination of knowledge and benefits for vocational education.

Overall, the results of this program confirm that the provision of practicum media, particularly a starter system trainer and supporting module, substantially enhances vocational students' knowledge and skills. These findings reinforce earlier research while also addressing practical gaps in partner schools, thus contributing to the continuous improvement of vocational education in line with industry needs and technological developments.

Figure 1. Students' Participation in the Community Service Activity

Figure 2. Community Service Activity on Starter System Practice at SMK Muhammadiyah Seputih Raman

4. Conclusion

The implementation of community service activities at SMK Muhammadiyah Seputih Raman has produced several significant outcomes. First, the development of a car starter system trainer successfully added new practicum media in the field of automotive

electrical systems, particularly the starter system, which had previously been unavailable at the school. Second, the program effectively enhanced students' knowledge and skills in understanding, assembling, maintaining, and troubleshooting vehicle starter systems. Third, the creation of a practicum module provided a structured guide that facilitated the implementation of practicum activities, making the learning process more systematic and efficient.

Overall, the integration of practical learning media and supporting modules has strengthened the quality of vocational education at SMK Muhammadiyah Seputih Raman and contributed to preparing students with relevant technical competencies in line with the demands of the automotive industry.

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