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TRAINING ON THE CONVERSION TECHNIQUES OF GASOLINE MOTORCYCLES TO ELECTRIC FOR AUTOMOTIVE COMMUNITIES

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Abstract

Vehicles powered by gasoline still dominate the roads in Jakarta and its surrounding areas. This has led to uncontrollable levels of pollution in Jakarta. Electric vehicles are one solution to reduce the pollution levels in the city. Since it is not feasible to eliminate all gasoline-powered vehicles to switch to electric vehicles, converting these vehicles into electric ones is a viable solution to address this issue. One of the most widely used gasoline-powered vehicles is the motorcycle. The large number of gasoline motorcycles in Jakarta presents an opportunity for automotive communities, such as conventional vehicle workshops, to participate in the transition to electric vehicles. However, the automotive community must be skilled in converting gasoline motorcycles to electric ones. Training on converting gasoline motorcycles to electric has been conducted for the automotive community in Jakarta. Training participants come from various educational backgrounds, ranging from high school/vocational school to university graduates. As a result, the training participants have been able to increase their knowledge and skills in converting gasoline motorcycles to electric ones by up to 20.54%.

Keywords: ***Training, Conversion, Electric Motorcycles.***

INTRODUCTION

Pollution levels in Jakarta and its surrounding areas have reached alarming levels. This increase is largely driven by the growing number of motorized vehicles (Paradizsa, 2023). The heavy traffic in the capital city, caused by the high number of both private and public vehicles, generates significant exhaust emissions, including carbon monoxide (CO), nitrogen dioxide (NO_2), and fine particulate matter (PM2.5) (Aziz et al., 2021). These pollutants contribute to poor air quality, which not only harms the environment but also negatively affects public health, increasing the risk of respiratory and cardiovascular diseases (Anandari et al., 2024). Efforts to address these issues include promoting the use of public transportation, implementing green vehicle technologies, and enforcing stricter emission regulations.

The urgency for electric vehicles (EVs) in Jakarta is growing in response to the city's severe pollution levels. EVs, which produce no exhaust emissions, offer a more environmentally friendly alternative to fossil fuel-powered vehicles. Their adoption is expected to significantly reduce the emission of harmful pollutants that contribute to Jakarta's air pollution (Sudjoko, 2021). Furthermore, electric vehicles can lessen dependence on fossil fuels (Sugiyono et al., 2022) and support the government's goals for reducing greenhouse gas emissions. Implementing policies that encourage the use of electric vehicles such as tax incentives, charging infrastructure development, and public education is a crucial step toward achieving a cleaner and healthier environment in Jakarta.

Given the large number of gasoline-powered vehicles already in use, converting these vehicles to electric is increasingly important. Since it is not feasible to eliminate all fossil fuel vehicles, conversion presents a realistic and effective solution for reducing air pollution. This approach minimizes exhaust emissions from existing vehicles (Parinduri et al., 2018), extends their operational lifespan, and reduces reliance on costly and environmentally harmful fossil fuels. A successful conversion program requires comprehensive support from government policies, financial incentives, and the development of adequate infrastructure and technology. Such a program would significantly contribute to creating a cleaner and healthier environment in Jakarta and its surrounding areas. Converting gasoline motorcycles to electric offers significant benefits, one of which is access to government incentives. These incentives may come in the form of tax breaks, subsidies, or other financial assistance that helps

reduce the cost of conversion. Additionally, converting an existing motorcycle is often more economical than purchasing a new, high-quality electric motorcycle. With lower costs, motorcycle owners can save money while contributing to efforts to reduce air pollution. Beyond the financial advantages, the conversion also supports government initiatives to accelerate the adoption of green vehicles and meet emission reduction targets. Therefore, converting gasoline motorcycles to electric not only benefits the environment but also provides direct advantages to vehicle owners through more affordable costs and appealing incentives.

Conventional workshops must now develop the capability to perform gasoline-to-electric motorcycle conversions, as demand for this service is expected to grow in line with increasing environmental awareness and supportive government policies (Rahmadina et al., 2024). By offering conversion services, workshops can expand their customer base and attract individuals seeking environmentally friendly transportation alternatives. This capability can also enhance a workshop's competitiveness in the dynamic and evolving automotive industry. Investing in training and electric conversion equipment opens new opportunities for workshops to participate in sustainable environmental solutions. Thus, conventional workshops capable of converting gasoline motorcycles to electric not only increase their profitability but also contribute to pollution reduction and the improvement of air quality in Jakarta and surrounding areas.

To become capable of performing such conversions, mechanics and owners of conventional workshops must understand how to convert gasoline motorcycles to electric in accordance with applicable government regulations. Since the systems of gasoline and electric motorcycles differ significantly (Boulanger et al., 2011), this knowledge is essential to ensure that each conversion is carried out safely, efficiently, and in compliance with established quality standards and legal requirements (Jondra & Sugiarta, 2021). Adhering to regulations also helps workshops avoid legal issues and ensures that the converted vehicles remain roadworthy and environmentally friendly. Moreover, a strong understanding of these standards allows mechanics and workshop owners to provide high-quality services, building trust and loyalty among customers. Through proper training and certification, conventional workshops can position themselves as pioneers in the transition to electric vehicles.

METHOD

The target participants for the gasoline-to-electric motorcycle conversion training are members of the automotive community, including micro and small-scale workshop owners, workshop mechanics, and individuals with a hobby or interest in the automotive field particularly in motorcycle modification.

The training utilizes three main methods:

1. Lecture and Question-and-Answer Method
   The lecture and question-and-answer method is an effective approach for delivering theoretical knowledge on converting gasoline motorcycles to electric. Through lectures, the instructor provides structured and comprehensive information on the components and working principles of electric systems, such as electric motors, batteries, and controllers. The session also includes a detailed explanation of the conversion steps from disassembling gasoline engine components to installing and testing the electric components.
   Following the lecture, a Q&A session allows participants to ask specific, in-depth questions and discuss various technical and practical issues that may not have been fully understood. This interactive format helps clarify important concepts and ensures that all participants have a solid theoretical foundation before progressing to the practical phase.
2. Demonstration Method
   The demonstration method provides participants with the opportunity to observe each step of the conversion process performed by an experienced instructor. During the demonstration, the instructor shows how to disassemble gasoline engine components, install the electric motor, set up and connect the control system, and install the battery and charger.
   Each stage is explained thoroughly, with an emphasis on proper techniques, correct tool usage, and essential safety procedures. This hands-on observation enables participants to see how theoretical knowledge is applied in practice, grasp technical details that may be difficult to convey through lectures alone, and develop the practical skills necessary to carry out the conversion independently.
   This method also allows participants to ask real-time questions and receive immediate clarification from the instructor, thereby enhancing their understanding and building their confidence in performing conversions.
3. Practical Method
   The practicum method in gasoline to electric motorcycle conversion allows participants to directly apply the theoretical knowledge they have learned in a real situation. In the practicum session, participants are given

the opportunity to work hands-on by dismantling the gasoline engine, installing the electric motor, battery, and control system under the guidance of the instructor. Each participant will be involved in every step of the conversion, from planning, component selection, to final testing. This practicum not only helps participants better understand and remember the conversion process, but also hones the necessary technical and problem-solving skills. With this hands-on experience, participants can learn to face and overcome various practical challenges that may arise during the conversion process, ensuring that they are ready and confident to carry out gasoline-to-electric motorcycle conversions independently in accordance with applicable procedures and regulations (Jusnita et al., 2018). The evaluation method used is by giving a pre-test, post-test, and practical test to the participants to find out how far the training participants understand the material provided by the speaker. The pre-test and post-test questions given are questions about the conversion of electric vehicles and their components, while the practical test is assessed based on how the participants' attitudes are when practicing the conversion of gasoline motorbikes to electricity.

RESULTS AND DISCUSSION

Participants who took part in the gasoline-to-electric motorcycle conversion training came from the automotive community in Jakarta and surrounding areas. The number of participants who participated in this training was 15 people, as can be seen in Table 1. The educational background of the participants was very diverse, covering various levels and types of education, as shown in Figure 1. Participants with a high school/vocational school educational background were the largest group in this training, reaching 73% of the total participants. This diversity of educational backgrounds shows the broad enthusiasm of various groups for electric vehicle conversion technology. Other participants came from a variety of other educational backgrounds, including diplomas and degrees, which added dynamism and diversity to the teaching and learning process during the training. This provided an opportunity for the participants to exchange knowledge and experiences, thus enriching their understanding of electric motorcycle conversion technology more comprehensively.

Table 1. List of participants in the gasoline to electric motorcycle conversion training

No.	Participant Name	Education
1	Dwi Jatmiko	SMA/SMK
2	Maulana Fahriansyah	SMA/SMK
3	Ficky Robbiyanshah	SMA/SMK
4	Abdul Malik	SMA/SMK
5	Syaifullah	SMA/SMK
6	Adi Arya Pradana	D3
7	Taupik Hidayat	SMA/SMK
8	Rizqi Fadhilah	D3
9	Bani Halim	SMA/SMK
10	Aziz	D3
11	Muhammad Rizky	SMA/SMK
12	Rifki	SMA/SMK
13	Siswanto	SMA/SMK
14	Syahrul	S1
15	Fikri Syukron	SMA/SMK

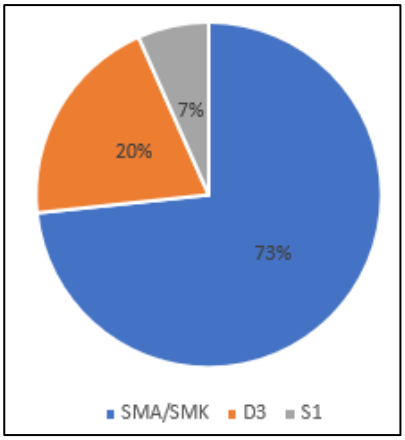

Figure 1. Number of trainees by education level

The gasoline to electric motorcycle conversion training consisted of five main sessions detailed in Table 2. Each session was designed to provide a comprehensive understanding of the conversion process, from the basics to advanced techniques. In sessions 1, 2 and 3, trainees took a pre-test to gauge their initial understanding of the material to be delivered. This pre-test is important to determine the participants' level of knowledge before they receive further explanation. After the pre-test, the speaker provided an in-depth explanation of the introduction of electric vehicles, electric vehicle conversion, and regulations governing electric vehicles in Indonesia. This explanation was delivered through lectures that were arranged systematically and equipped with interesting visualizations to make the material easy to understand. In addition to the lecture, the speaker also provided a question and answer session for the trainees. This question and answer session aimed to make the training more interactive and ensure that participants could ask questions and get a more in-depth explanation of things they did not understand. The organization of these sessions was also supported by various visual aids as shown in Figure 2, which helped participants in understanding complex concepts regarding the current trend of electric vehicles in Indonesia, especially in Jakarta and its surroundings.

Table 2. List of materials for each training session

Nama Sesi	Materi	Metode
Sesi 1	Perkenalan konversi sepeda motor menjadi listrik	Ceramah dan Tanya Jawab
Sesi 2	Pengenalan konverter *Kit and Tools*	Ceramah dan Tanya Jawab
Sesi 3	Pengujian baterai, listirk, dan performa sepeda motor listrik	Ceramah dan Tanya Jawab
Sesi 4	Pembongkaran mesin sepeda motor bensin dan instalasi koverter *kit*	Demonstrasi dan Praktikum
Sesi 5	Setting controller dan pengujian sepeda motor listrik konversi	Demonstrasi dan Praktikum

Figure 2. Explanation of session 1 material by the speaker

After the material was explained by the speaker, a post-test was conducted to assess how far the participants understood the material after getting an explanation of the material on the introduction of electric vehicles in session 1. In Figure 3, it can be seen that the training participants experienced an increase in test scores during the post-test when compared to the pre-test in session 1. In the pre-test session 1, the average value of the participants was 62.3, while in the post-test session 1, the average value of the participants was 80. This shows that there is an increase in

the average value of participants by 28.34% after getting material in session 1 regarding the introduction of electric vehicles.

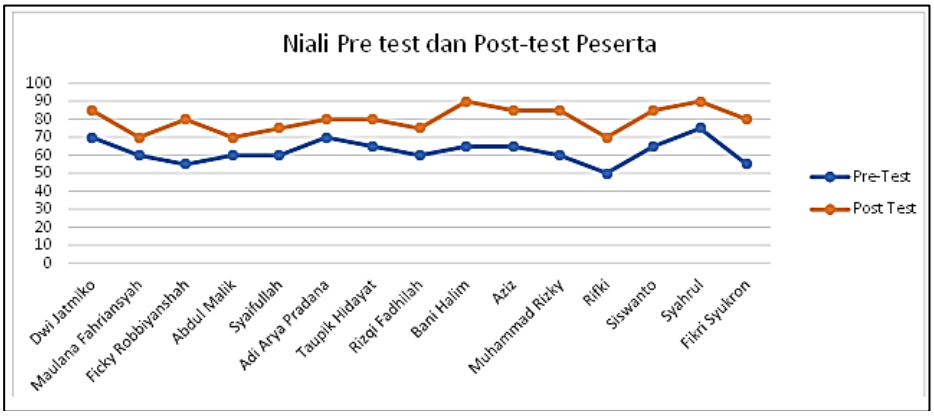

Figure 3. Pre-test and post-test scores of training participants in session 1

In session 2, the material provided to participants was about the introduction of converter kits and tools used to convert gasoline motorcycles to electricity. The trainer gave a detailed explanation of how to use the various tools and converter kits, while showing a practical demonstration which can be seen in Figure 4. At the end of the session, a post-test was conducted to measure the extent to which participants' understanding had improved after receiving the material. From Figure 5, it can be seen that the post-test scores of all participants increased when compared to the pre-test scores. The average pre-test score of participants in session 2 was 64.33% while the average post-test score of participants in session 2 was 74.67%. The increase in the average value between the pre-test and post-test participants in session 2 amounted to 16.06%.

Figure 4. Explanation of session 2 material by the speaker

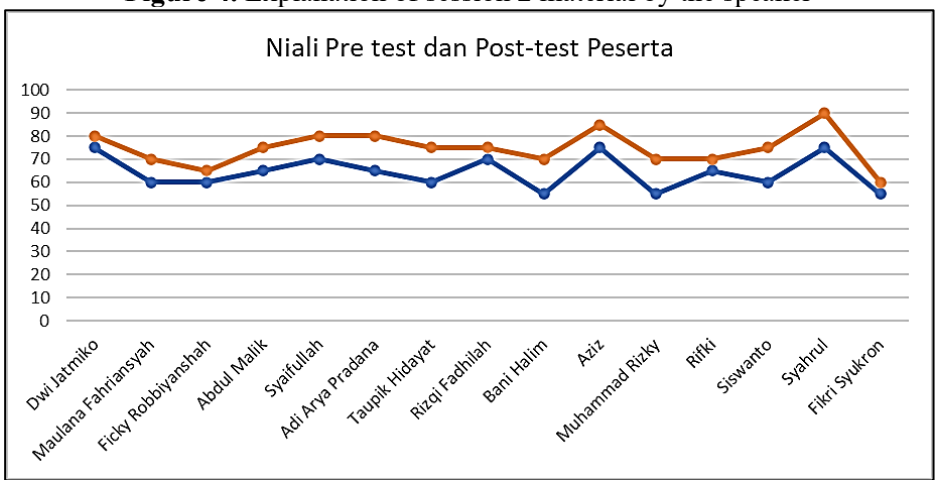

Figure 5. Pre-test and post-test scores of training participants in session 2

Just like in sessions 1 and 2, in session 3 participants were also given a pre-test and post-test to measure their understanding of the material provided. The material in session 3 discussed in depth about battery testing, electrical

systems, and electric motorcycle performance. Participants were explained in detail about how to use various test equipment, such as multimeters, ampmeters, and other relevant measuring devices. In addition, they were also given practical demonstrations on how to operate these tools in a real context. During the pre-test, participants scored an average of 60, reflecting their initial understanding before the training session began. After following the entire set of materials and practices provided in this session, the participants' average score increased to 70.33 in the post-test. Based on these results, all participants managed to improve their understanding significantly, with an average score increase of 17.22%, as can be seen in Figure 6. These results demonstrate the effectiveness of the teaching methods used, as well as the participants' ability to absorb and apply the knowledge they have gained during the training.

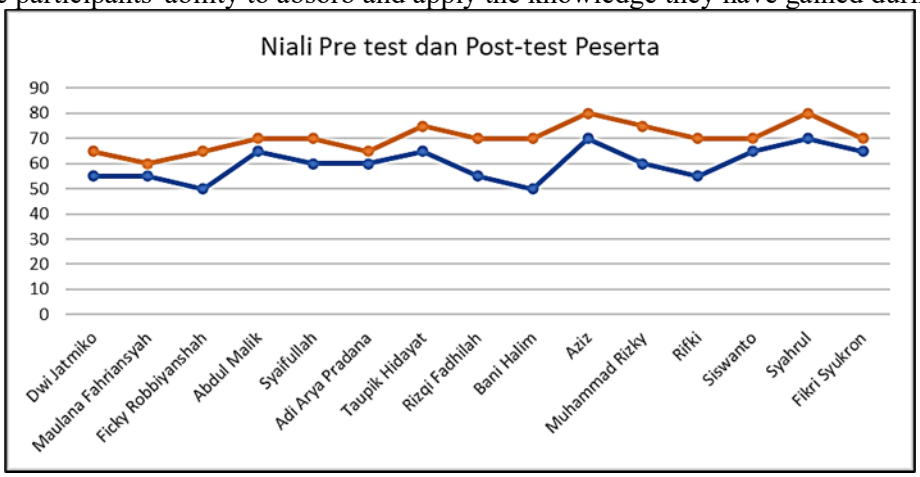

Figure 6. Pre-test and post-test scores of training participants in session 3

Based on the data from the participants' pre-test and post-test values in each session, there was an increase in the value of the post-test conducted after the provision of material when compared to the value of the pre-test given before providing material to participants as can be seen in Figure 7, where the average increase in value that occurred was 20.54%. This shows that there is an increase in knowledge in participants regarding the conversion of electric vehicles, especially the conversion of gasoline motorbikes to electricity.

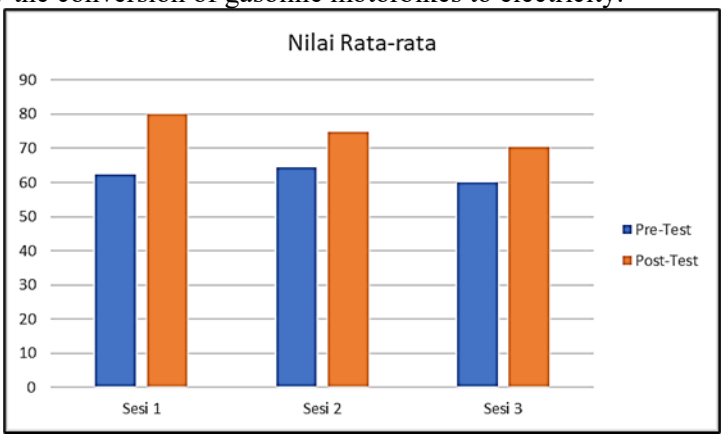

Figure 7. Average pre-test and post-test scores of trainees in all sessions

In session 4, participants were shown how to properly disassemble a gasoline motorcycle engine as shown in Figure 8, starting from removing the main components such as the fuel tank, carburetor, exhaust, and the engine itself. Each disassembly step was explained in detail to ensure participants understood the function and position of each part. Once the gasoline engine is successfully disassembled, the session continues with the installation of the converter kit, which is the core of the motorcycle conversion to electricity. Participants will learn how to install the electric motor, controller, battery, and other electronic components. Instructors will provide detailed explanations on how to connect each component so that the system can function properly and safely. In addition, they will guide participants in the wiring process and placement of components to comply with safety and efficiency standards.

Figure 8. Gasoline Motorcycle Engine Disassembly and Converter Kit Installation Session

During the practical sessions, participants are given the opportunity to directly engage in disassembly and installation under the supervision of instructors, allowing them to overcome various technical challenges that may arise. With this hands-on approach, participants not only gain theoretical knowledge, but also invaluable practical skills. The training aims to provide participants with a comprehensive understanding and technical capabilities, so that they are ready to carry out gasoline to electric motorcycle conversions independently, both for personal and commercial use in the future.

Figure 9. Controller Setting and Testing Session for Convertible Electric Motorcycle

In session 5, participants will learn how to set up the controller, which is a critical component in controlling the performance of an electric motorcycle. Experienced instructors will provide step-by-step guidance on how to calibrate the controller to suit the specifications of the electric motor and the needs of the rider, including adjustments to parameters such as maximum speed, acceleration, and energy efficiency as can be seen in figure 9. Once the controller setting is complete, participants will proceed to the testing phase of the convertible electric motorcycle. This testing includes checking the functionality of all components, ensuring safe electrical connections, and testing the motorcycle's performance under various conditions. Participants will learn how to diagnose and resolve any issues that may arise during testing, ensuring the electric motorcycle performs optimally. This session provides participants with practical skills and in-depth technical understanding, preparing them to successfully perform electric motorcycle conversions and setups independently.

Participants of the gasoline to electric motorcycle conversion training are now well-versed after going through a comprehensive series of training, consisting of theory, demonstration, and practical sessions. They not only understand the basic concepts and theories behind this conversion technology, but have also seen firsthand how the process is carried out through detailed demonstrations. Moreover, participants have gained practical experience by performing the conversion themselves under the guidance of experienced instructors, so they are now ready to apply this knowledge and skills independently.

CONCLUSION

The conclusion obtained at the gasoline to electric motorcycle conversion training for the automotive community is that participants have increased knowledge about electric vehicles and electric vehicle conversion. The average post-test score of participants increased by 20.54% when compared to the pre-test. Participants have been able to practice converting gasoline motorbikes to electricity.

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