**CHAPTER 1**

**PROBLEM AND ITS SCOPE**

**INTRODUCTION**

**Rationale**

Electronic fuel injection (EFI) is a fuel delivery system used in modern automotive engine to inject fuel into the combustion chambers. It replaces the traditional carburetor system and offers several advantages in terms of fuel efficiency, performance, and emissions control. In an electronically fuel injected system, fuel is delivered to the engine through electronically controlled fuel injectors. These injectors are precisely controlled by an electronic control unit (ECU) or engine control module (ECM) based on various input signals, such as engine speed, throttle position, air temperature, and oxygen content in the exhaust.

During the last 30 years of or so, reductions in tailpipe exhaust emission of more than 90% have been demanded of, and achieved by the automobile industry (Kunjam et al., 2015). In addition to reduced exhaust emission, EFI has also introduced other benefits such as reduced brake specific fuel consumption, increased full-load output and improved drive ability. According to Kunjam et al., (2015) advanced fuel injection system for small vehicles which have recently become commercially available system have been designed and developed.

EFI systems have been widely adopted in developed countries such as the United States, European nations, Japan, South Korea, and Australia. These regions have stringent emissions regulations, and EFI helps vehicles meet these standards by providing better control over the air-fuel mixture and increase the automotive technology advancements and progress.

The use of EFI systems has become a global standard in the automotive industry due to their benefits in fuel efficiency, performance, and emissions control. From developed nations to emerging economics, EFI technology has been widely adopted to meet emissions standards and deliver more efficient vehicles across various segments.

In most diesel-powered vehicles in the Philippines, mechanical injection systems are still being used, which are not only less efficient in terms of fuel economy and engine performance but are also harmful to the environment (Garcia et al., 2006). However, Electronic fuel injection systems have been developed that are efficient, clean burning, reliable and cost effective enough to sell to the general public in production vehicles and had been proven to be successfully used on automobile engines (Amber, 1995).

Continually improve innovations on the engine decrease discharges that contaminate nature and increment the quantity of engines utilizing fuel. According to Singh, D. (2018) enhancements and use of present-day innovations profoundly affect engines, expanding limit, effectiveness, and natural benevolence. The use of new innovation arrangements on fuel supply system for diesel engines will make leaps forward to avow the extraordinary job and aggressiveness of current diesel engines.

Creating an accurate mock-up of an Electronic Fuel Injection (EFI) system involves careful consideration of key factors. These include selecting fuel injectors with appropriate flow rates and spray patterns, choosing a fuel pump that meets the engine's demands in terms of flow rate and pressure, and incorporating a fuel pressure regulator to maintain optimal pressure. The design should also include a fuel rail that ensures even fuel distribution to each injector. Sensors such as throttle position, manifold absolute pressure, engine coolant temperature, and oxygen sensors play a crucial role in providing feedback for the EFI system. The Engine Control Unit (ECU) must be programmed to process sensor inputs and adjust injector pulse width accordingly. Accurate wiring and connectors, along with realistic simulation of various engine conditions, are essential for comprehensive testing. Additionally, incorporating data logging capabilities and safety measures, such as preventing fuel leaks, ensures a thorough and secure evaluation of the EFI system mock-up.

It is within this premise that the researchers wanted to know the learning effectiveness of automotive students in utilizing the Electronically Fuel Injection (EFI) fuel delivery system mock-up. The ability to provide hands-on, realistic, and safe learning experiences and how the students enhance understanding, skills, and readiness for automotive industry.

**Theoretical Background**

This research is anchored on the one theory: Experiential learning theory of David Kolb as cited by McCarthy (2015).

The first theory proposed by David Kolb (1984) known as "Experiential Learning Theory". This theory suggests that students learn best through a cycle of concrete experience, reflective observation, abstract conceptualization, and active experimentation. In the context of automotive education, students can engage in hands on activities with an EFI mock up, reflect on their experience, conceptualize the underlying principles, and experiment with different scenarios.

The study of Mainenelis et al. (2014) view that the experiential learning theory provides a holistic model of the learning process and a multilinear model of adult development, both of which are consistent with what we know about how people learn, grow, and develop.

Experiential learning encourages learners to actively participate in relevant tasks, such as assembling, operating, and troubleshooting the EFI fuel delivery system mock-up. By directly interacting with the system, students can practical skills and develop a deeper understanding of how it works.

Additionally, the reason why this theory is called experiential it’s because of its intellectual origins in the experiential works of Dewey, Lewin, and Piaget. Taken together - Dewey's philosophical pragmatism, Lewin's social psychology, and Piaget's cognitive-developmental genetic epistemology-form a unique

**Experiential learning theory of David Kolb as cited by McCarthy (2015)**

**LEARNING EFFECTIVENESS OF UTILIZING AUTOMOTIVE EFI FUEL DELIVERY SYSTEM MOCK-UP**

**INNOVATION OF EFI DELIVERY MOCK UP**

Figure 1.

**Theoretical Framework of the Study**

perspective on learning and development (Kolb, 1984). As they encounter challenges or malfunctions with the EFI mock-up, students can apply their knowledge to diagnose and solve problems. This process enhances their critical thinking and troubleshooting abilities, preparing them for real-world scenarios in the automotive industry.

In a virtual setting, learners can engage in simulations, virtual labs, or real-world scenarios through immersive technologies. This provides a platform for direct experiences, allowing participants to encounter and interact with concepts in a practical environment.

Following the concrete experience, learners reflect on their virtual experiences. This reflection can take the form of discussions, written reflections, or online forums where participants share insights gained from the virtual activities.

Learners then derive general principles and concepts from their reflections. This stage can be supported through online lectures, readings, or multimedia presentations that help participants connect their experiences to broader theoretical frameworks.

Virtual learning environments can facilitate active experimentation by encouraging learners to apply what they've learned in new situations. This could involve virtual projects, case studies, or problem-solving activities that challenge participants to use their newly acquired knowledge and skills.

Based on the study of Roberts T.G (2006) the process is cyclical in nature and requires an initial focus of the learner, followed by interaction with the phenomenon being studied, reflecting on the experience, developing generalizations, and then testing those generalizations. The context in which experiential learning occurs is defined by four dimensions: the level, the duration, the intended outcome, and the setting.

Kolb's Experiential Learning Theory by incorporating a variety of activities and assessments to cater to different learning styles. This might include virtual labs, group discussions, reflective journals, and collaborative projects that encourage active participation and application of knowledge in a virtual context.

Additionally, incorporating experiential theory principles into the automotive curriculum, it fosters practical skills, deepens understanding, improves problem-solving abilities, and enhance overall learning outcomes in the field of automotive technology.

Alice Y Kolb (2009) cited that building on the foundational works of Kurt Lewin, John Dewey and others, experiential learning theory offers a dynamic theory based on a learning cycle driven by the resolution of the dual dialectics of action/reflection and experience/abstraction. Describe how ELT can serve as a useful framework to design and implement management education programs in higher education and management training and development.

**THE PROBLEM**

**Statement of the problem**

This study evaluated the learning effectiveness of utilizing Automotive EFI Fuel Delivery System Mock-Ups in CTU-Argao Campus for the Academic year 2023-2024 as basis in making Operational Manual for Automotive EFI Fuel Delivery System Mock-Up.

Specifically, it sought to answer the following questions:

1. What was the profile of the respondents in terms of:

1.1 age and gender; and

1.2 civil status?

2. What was the level of understanding of the respondents in the EFI fuel delivery system without and with EFI mock-up as to:

2.1 EFI System Operation; and

2.2 EFI Construction?

3. Is there a significant difference on the level of understanding on EFI fuel delivery system on utilizing EFI fuel delivery mock-up?

4. Based on the findings, what EFI fuel delivery system operations manual can be crafted?

**Hypothesis of the Study**

Ho: There is no significant difference in learning effectiveness between automotive students who utilize the EFI fuel delivery system mock-up and those who do not utilize it.

**Significance of the Study**

The findings of this study have great value to the following:

**Educational Institutions.** Incorporating EFI fuel delivery system mock-ups into the curriculum demonstrates the commitment of educational institutions to providing relevant and practical training to students. These institutions can enhance their reputation by utilizing advanced teaching aids and offering hands-on experiences, attracting prospective students who value comprehensive automotive education.

**Automotive Industry.** The automotive industry benefits indirectly from the learning effectiveness of automotive students using EFI fuel delivery system mock-ups. Well-trained students contribute to a skilled workforce, reducing the skills gap and meeting industry demands. This ensures that technicians and mechanics possess the necessary knowledge to diagnose, repair, and maintain modern vehicles equipped with EFI systems.

**Instructors.** Teachers and instructors can effectively teach automotive students about EFI fuel delivery systems using mock-ups. These visual aids provide a tangible representation of the system, facilitating effective instruction. Instructors can demonstrate various concepts, functions, and maintenance procedures, ensuring that students grasp the theoretical and practical aspects of EFI technology.

**Students.** Automotive students will benefit significantly from this hands-on learning experience. They will gain practical knowledge and skills related to automotive fuel systems, specifically the EFI system. Working with a mock-up allows them to understand the systems components, functions, and troubleshooting techniques in a controlled environment. This experience enhances their understanding of EFI technology and prepares them for real-world scenarios.

**Future Researcher.** The result of this study will serve as a new knowledge. The ideas presented may be used as a reference data in conducting their research that is related to the study. This will be a great inspiration for them to continuously improve their capabilities as researchers.

**RESEARCH METHODOLOGY**

This section discuss the method of research being use, sources of data and research procedures that would utilize in this study.

**Design**

In accordance with study nature, to investigate the learning effectiveness of automotive students utilizing EFI fuel delivery system mock-up, the researcher utilized a quasi-experimental research method. Quasi-experimental studies involve the collection and analysis of numerical data to draw conclusions about the relationship between variables. This method follows a structured and systematic approach, employing statistical techniques to analyze the data and make inferences about the effects of the independent variable on the dependent variable. Designing surveys or questionnaires to collect quantitative data on participants' perceptions of the learning effectiveness, their confidence levels, and satisfaction with the training involving EFI fuel delivery system mock-ups.

**Flow of the Study**

This study was composed of three phases as presented in figure 2.

**Input.** This included the profile of the respondents of the following: age and gender; year and section; civil status; the level of understanding of the respondents in the EFI fuel delivery system without using EFI mock-up, the level of understanding of respondents in utilizing EFI fuel delivery system mock-up, and significant difference of understanding the EFI fuel delivery system on utilizing EFI fuel delivery mock-up.

**Process.** This began through sending a transmittal letter to the dean. After receiving the approval, the researchers will proceed to a face-to-face data gathering from the identified respondents through an adopted questionnaire. After retrieving the answered questionnaires, the responses were tabulated, analyzed, and interpreted using statistical treatment.

**Output.** The output of this study was a proposed of Operation Manual for Automotive EFI Fuel Delivery System Mock-Up.

**INPUT**

1. What was the profile of the respondents in terms of:

1.1 age and gender;

1.2 year and section; and

1.3 civil status?

2. What was the level of understanding of the respondents in the EFI fuel delivery system without and with EFI mock-up as to:

2.1 EFI System Operation; and

2.2 EFI Construction?

3. Is there a significant difference on the level of understanding on EFI fuel delivery system on utilizing EFI fuel delivery mock-up?

1. Sending Transmittal Letter
2. Data Gathering
3. Tabulating of Data
4. Analysis of Data using Statistical Treatment
5. Interpretation of the Data
6. Drawing out Conclusion

**PROCESS**

**OUTPUT**

Operation

Manual for Automotive EFI Fuel Delivery System Mock-Up

Figure 2.

**Flow of the Study**

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**A screenshot of a computer

Description automatically generated**

Figure 3.

**Spot Map of the Study**

**Research Environment**

This study was be conducted at Cebu Technological University – Argao Campus. one of the campuses under the Cebu Technological University (CTU) system. CTU-Argao currently offers various undergraduate courses in Teacher Education, Liberal Arts, Industrial Technology, Agriculture, Forestry, Hospitality Management, and Information Technology. Cebu Technological University (CTU) is a well-known university in the Philippines with multiple campuses. The Argao Campus is likely part of the CTU system. Additionally, it has a Graduate School department with programs in Education, Public Administration, and Technology Management. In a remarkable achievement, Cebu Technological University’s Argao Campus once again proved its academic prowess by clinching top positions in the September 2023 Licensure Examination for Teachers (LET). The campus not only produced three topnotchers but also secured the coveted title of the number one performing school for the Elementary level. Beyond individual triumphs, CTU-Argao emerged as the top-performing school for the Elementary level, solidifying its reputation for academic excellence. Impressively, all 55 first-time takers from the campus successfully passed the LET, achieving a perfect 100% passing rate. The triumphant results of CTU-Argao in the September 2023 LET underscore its position as a trailblazer in education, setting new benchmarks for excellence and fostering a culture of academic achievement. As the campus continues to produce top-tier graduates, its impact on the education landscape remains undeniable, solidifying its reputation as a hub for cultivating future leaders and educators.

**Respondents**

The respondents of the study were 50 3rd year BIT Automotive Technology students in Cebu Technological University – Argao Campus. The respondents were selected through random sampling. The table below shows the distribution of the respondents.

Table 1

**Total Number of Respondents**

|  |  |  |
| --- | --- | --- |
| TARGET RESPONDENTS | FREQUENCY | PERCENTAGE |
| 3rd year Automotive Students | 50 | 100 |

**Instruments**

To obtain the necessary data, the researcher used the adopted questionnaire from Human Resources Manager (Jane Doe). This is fit for the statement of the problems and requested to rate and check on their answers.

**Gathering of Data**

A written consent letter was sent to the Dean of CTU-Argao Campus before conducting the study. This study was conducted through face-to-face. The instruments were adopted and modified to corresponds the statement of the problem. The researchers discussed to the respondents on how to answer the questionnaires given. Retrieve the questionnaire, tabulation, presentation, analysis, and interpretation of the data. Lastly, the researchers discussed the findings and drew conclusions and proposed recommendations.

**Statistical Treatment**

In this study, statistical tools such as percentage, weighted mean, and t-test were used to interpret the data quantitively.

1. **Percentage** will be use in profiling the respondents.

Where:

P = percentage

f = frequency of responses

n = total number of respondents

100 = constant

1. **Weighted Mean** will be use to identify the extend of understanding of the EFI of the respondents.

Where:

WM = weighted mean

= summation

F = frequency

W = assigned weight

N = total number of respondents

**Likert Scale** will be use in describing the level of understanding of EFI fuel delivery system of the respondents through their responses.

Table 2

**Description of the Respondents’ Level of Understanding in the EFI fuel delivery system.**

|  |  |  |
| --- | --- | --- |
| INTERVAL | INTERPRETATION | DESCRIPTION |
| 1 | 1.0 – 1.80 | Poor |
| 2 | 1.81 – 2.60 | Fair |
| 3 | 2.61 – 3.40 | Satisfactory |
| 4 | 3.41 – 4.20 | Good |
| 5 | 4.21 – 5.00 | Excellent |

1. **T-test** will be use to identify the significant difference in utilizing the EFI delivery system without mock and with mock-up of the respondents.

Where:

t = t-test

= mean of the first group

= mean of second group

s1 = standard deviation of first group

s2 = standard deviation of second group

n1 = number of observations in first group

n2 = number of observations in second group

**DEFINITION OF TERMS**

The following terms here were defined according to how it was operated in the study.

**Assessment tools** are methods and instruments used to evaluate and measure the learning outcomes of students, including exams, practical assessments, and project evaluations.

**Automotive students** are individuals studying in automotive technology programs or courses, focusing on the principles and practices of automotive engineering, including EFI technology.

**Batteries** is a device that stores chemical energy and converts it to electrical energy.

**Curriculum integration** is the incorporation of EFI-related content and practical exercises into the broader automotive technology curriculum to enhance the overall educational experience.

**ECU**, the signals from the ECU cause current to flow in the solenoid coil, which causes the plunger to be pulled, opening the valve to inject the fuel.

**Electronic fuel injection** is a system that manages the fuel delivery to the engine using electronic controls, enhancing efficiency and performance in comparison to traditional carburetion.

**Flasher units** are designed to control the flash rate of vehicle directional indicator.

**Fuel injector** regulated the injection of fuel into an engines internal combustion chamber where it is mixed with air and ignited.

**Fuel line** is a hose or pipe used to transfer fuel from one point in a vehicle to another.

**Fuel line hoses**, also referred to as fuel lines, are the type of flexi tube or hose used for transferring fuel from a vehicles fuel tank directly into an engine or any component in its fuel system.

**Fuel pump** is a component used in many liquid-fueled engines (such as petrol/gasoline or diesel engines) to transfer the fuel from the fuel tank to the device where it is mixed with the intake air (such as the carburetor or fuel injector).

**Fuel pump impeller** is turned by the motor to compress the fuel.

**Fuel pump filter** removes dirt and impurities from the fuel before entering the fuel pump.

**Fuel tank** is a reservoir that holds the fuel supply and helps maintain its temperature at a level below its flash point.

**Hands-on learning** is an educational activity that involve direct interaction with real or simulated objects, providing a practical and experiential approach to learning.

**Knowledge retention** is the ability of students to remember and apply information learned during the educational experience, specifically related to EFI systems in automotive technology.

**Learning effectiveness** is the degree to which students acquire and retain knowledge, skills, and understanding related to the operation and management of EFI systems in automotive technology.

**Mock-up** is a physical or virtual representation of the EFI fuel delivery system designed for educational purposes, allowing students to interact with and learn from a simulated version of the actual system.

**Skill acquisition** is a physical or virtual representation of the EFI fuel delivery system designed for educational purposes, allowing students to interact with and learn from a simulated version of the actual system.

**Pedagogical strategies** are various teaching methods and approaches employed to facilitate effective learning, such as case studies, problem-solving exercises, and collaborative projects.

**Performance improvement** is the measurable enhancement in students' ability to apply theoretical knowledge and practical skills in the context of EFI fuel delivery systems.

**CHAPTER 2**

**PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA**

This chapter incorporates the presentation, analysis, and interpretation obtained in this study that answered the specific problems. All data were scored, tabulated, and aligned to statistical procedures, analyzed, and interpreted to answer the problems indicated in the study.

The discussion of the data is categorized into three parts. Part I consists of profiling of the respondents. Part II covers the level of understanding of EFI fuel delivery system of the respondents through their responses. Part III reveals the significant difference in utilizing the EFI delivery system without mock and with mock-up of the respondents.

Table 1

**Profile of the Respondents According to Age and Gender**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Age | Gender | | | |
| Male | | Female | |
| F | % | F | % |
| 20-22 | 30 | 60 | 4 | 8 |
| 23-25 | 16 | 32 | 0 | 0 |
| Total | 46 | 92 | 4 | 8 |

Table 1 presents the profile of the respondents according to age and gender. Where in the 20-22 age group, there are 30 male respondents, which accounts for 60% of the total respondents in that age group. Similarly, there are 4 female respondents in the same age group, constituting 8% of the total respondents in that age group. In the 23-25 age group, there are 16 male respondents, representing 32% of the total respondents in that age group. There are no female respondents in this age group. In this case, there are 46 male respondents, which make up 92% of the total respondents. There are 4 female respondents, constituting 8% of the total respondents. According to Leonard, R (2016), automotive is a male-dominated field that why many male’s students choose this courses.

Table 2

**Profile of the Respondents According to Civil Status**

|  |  |  |
| --- | --- | --- |
| Civil Status | F | % |
| Single | 49 | 98 |
| Married | 1 | 2 |
| Total | 50 | 100 |

Table 2 presents the profile of the respondents according to civil status. Based on the result, majority of the respondents of 98% of them are single, and 2% are already married. Civil Status is the legal status of the person or the martial status of everyone in relation to the marriage laws and the customs of the country. According to Lawrence, E. (2021) how being single or married influences students academic and personal lives where single students generally have more flexibility in their schedules, allowing for more dedicated study time.

Table 3

**Level of Understanding in the EFI Fuel Delivery without and with mock-up in terms of EFI Fuel System Operation**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Statement** | **Without using mock-up** | | | **With mock-up** | | |
| **Mean** | **Std. Deviation** | **Verbal Description** | **Mean** | **Std. Deviation** | **Verbal Description** |
| 1. The efi injects fuel according to the sensors signal. | 3.76 | 0.91607 | Good | 4.56 | 0.50143 | Excellent |
| 2. Sensor collect data on various engine condition. | 3.72 | 0.96975 | Good | 4.52 | 0.50467 | Excellent |
| 3. The fuel injectors injects fuel coming from the fuel tank | 4.00 | 0.85714 | Good | 4.70 | 0.46291 | Excellent |
| 4. The ecu process the data to determine the optimal air fuel mixture. | 3.84 | 0.91160 | Good | 4.56 | 0.50143 | Excellent |
| 5. The injectors precisely spray the required amount of fuel into each cylinder. | 3.90 | 0.86307 | Good | 4.62 | 0.49031 | Excellent |
| 6. The tps sensor monitor the air intake of an engine. | 3.74 | 0.96489 | Good | 4.66 | 0.47852 | Excellent |
| 7. The pump creates the pressure needed to move gas from the lines to the engine | 3.86 | 0.85738 | Good | 4.54 | 0.50346 | Excellent |
| 8. The fuel tank pressure sensor reads pressure in the fuel system or to detect leaks or faulty gas cap | 3.80 | 0.90351 | Good | 4.50 | 0.50508 | Excellent |
| 9. The tps monitor the position of the throttle to determine the drivers demand for power. | 3.74 | 1.04608 | Good | 4.46 | 0.50346 | Excellent |
| 10. The IAC adjust the engine speed bye controlling the amount of air allowed into the engine while the throttle is closed. | 3.88 | 0.87225 | Good | 4.42 | 0.57463 | Excellent |
| AVERAGE | 3.824 | 0.65139 | Good | 4.554 | 0.27121 | Excellent |

The Table 3 provides an assessment of the understanding level regarding the operation of the Electronic Fuel Injection (EFI) system without using a mock-up and with mock-up. First is the level of understanding regarding the operation of the Electronic Fuel Injection (EFI) system without using a mock-up.

The mean scores range from 3.72 to 4.00, all falling under the "Good" category. This suggests that the understanding of EFI fuel system operation is generally good across all aspects evaluated. The aspect with the highest mean score (4.00) is "The fuel injectors inject fuel coming from the fuel tank", indicating this is the best-understood aspect of the EFI system operation.

The standard deviation values, which measure the dispersion or variability in the data set, range from 0.85714 to 1.04608. These relatively low standard deviations suggest that the responses are not widely spread out from the mean, indicating a consistent level of understanding across respondents. The aspect with the highest standard deviation (1.04608), "The tps monitor the position of the throttle to determine the driver's demand for power", suggests a slightly larger variability in understanding this aspect compared to others. While the lowest standard deviation (0.85714), “The fuel injectors inject fuel coming from the fuel tank “.

The overall average score of 3.824 with a standard deviation of 0.65139, categorized as "Good", suggests a generally good and consistent understanding of the EFI fuel system operation among the respondents.

The implications of these results could be used in various ways, such as identifying areas for further training or education if necessary, or for validating the effectiveness of existing training programs. Based on the article VaporWorx (2024) explains that the basics for a modern OE-type EFI engine components include a fuel tank, electric fuel pump, fuel pressure regulation system, transfer lines, direct injection pump (for DI type engines only), fuel rails, and fuel injectors. The fuel system must become much more powerful while providing long-term reliability.

Next is the presentation of level of understanding regarding the operation of the EFI (Electronic Fuel Injection) fuel system using a mock-up. The mean scores range from 4.42 to 4.70, indicating an excellent level of understanding across all aspects evaluated. The aspect with the highest mean score (4.70) is "The fuel injectors inject fuel coming from the fuel tank", suggesting that this aspect is exceptionally well understood. The lowest mean score (4.42) is for "The IAC adjusts the engine speed by controlling the amount of air allowed into the engine while the throttle is closed", indicating a slightly lower understanding compared to other aspects.

The standard deviation values range from 0.27121 to 0.57463, indicating a relatively low variability in the responses. This suggests a consistent level of understanding across the respondents for most aspects of the EFI fuel system operation. The aspect with the highest standard deviation (0.57463), " The IAC adjust the engine speed bye controlling the amount of air allowed into the engine while the throttle is closed". While the lowest standard deviation (0.46291), “The fuel injectors inject fuel coming from the fuel tank “.

The overall average score of 4.554 with a standard deviation of 0.27121, categorized as "Excellent", indicates a highly commendable and consistent understanding of the EFI fuel system operation among the respondents.

The results suggest that the respondents have an excellent understanding of the operation of the EFI fuel system using a mock-up. This indicates a high level of knowledge and comprehension of the various components and their functions within the system. The implications of these results could be used to validate the effectiveness of training programs or educational materials related to EFI fuel system operation.

Koehler, K (2024), discussed that the benefits of EFI are easier starting, automatic altitude adjustments, more consistent power, better fuel efficiency, fewer emissions, and reduced maintenance.

The comparison between understanding the Electronic Fuel Injection (EFI) system operation with and without a mock-up demonstrates a significant difference in comprehension levels. Without the mock-up, respondents generally exhibit a good understanding, as indicated by mean scores falling within the "Good" category. However, there is some variability in comprehension across aspects, as reflected by standard deviation values. In contrast, the use of a mock-up greatly enhances understanding, leading to an excellent level of comprehension across all evaluated aspects. The consistent and commendable understanding observed with the mock-up suggests its effectiveness as an educational tool for teaching EFI system operation.

Table 4

**Level of Understanding in the EFI Fuel Delivery System without and with mock-up in terms of EFI Fuel System Construction**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Statement** | **Without using mock-up** | | | **With mock-up** | | |
| **Mean** | **Std. Deviation** | **Verbal Description** | **Mean** | **Std. Deviation** | **Verbal Description** |
| 1. The EFI composed of ecu. | 3.76 | 1.09842 | Good | 4.46 | 0.50346 | Excellent |
| 2. The tps typically located on the throttle body it sense the position of the throttle valve. | 3.88 | 0.84853 | Good | 4.46 | 0.50346 | Excellent |
| 3. The fuel injectors mounted on the intake manifold or directly into combustion chamber. | 4.00 | 0.85714 | Good | 4.50 | 0.50508 | Excellent |
| 4. The fuel pump typically located in the fuel tank and it pressurized and deliver fuel to the injectors. | 3.92 | 0.89989 | Good | 4.64 | 0.48487 | Excellent |
| 5. The throttle body positioned in the intake system and regulates the air flow into the engine. | 3.84 | 0.88893 | Good | 4.64 | 0.48487 | Excellent |
| 6. The fuel line run along the vehicle chassis, and it made up of metal or high pressure rubber. | 3.90 | 0.83910 | Good | 4.62 | 0.49031 | Excellent |
| 7. The fuel filters located between the fuel pump and the injectors. | 3.92 | 0.92229 | Good | 4.66 | 0.47852 | Excellent |
| 8. The ecu is the brain of the efi system | 4.1 | 0.99488 | Good | 4.58 | 0.49857 | Excellent |
| 9. The IAC Valve (Idle Air Control) located near the throttle body that adjusts the engine idle speed. | 3.80 | 0.94761 | Good | 4.62 | 0.49031 | Excellent |
| 10. The fuel rail mounted at the top of the injector. | 4.12 | 0.82413 | Good | 4.68 | 0.47121 | Excellent |
| AVERAGE | 3.9240 | 0.65202 | Good | 4.58 | 0.27405 | Excellent |

The Table 4 reveals the level of understanding regarding the construction of the EFI (Electronic Fuel Injection) fuel system without using a mock-up and with mock-up. First is the level of understanding regarding the construction of the EFI (Electronic Fuel Injection) fuel system without using a mock-up.

The mean scores range from 3.76 to 4.12, indicating a good level of understanding across all aspects evaluated. The aspect with the highest mean score (4.12) is "The fuel rail mounted at the top of the injector", suggesting that this aspect is well understood. The lowest mean score (3.76) is for "The EFI composed of ECU", indicating a slightly lower understanding compared to other aspects.

The standard deviation values range from 0.82413 to 1.09842, suggesting a relatively low variability in the responses. This indicates a consistent level of understanding across the respondents for most aspects of the EFI fuel system construction. The aspect with the highest standard deviation (1.09842), " The EFI composed of ecu". While the lowest standard deviation (0.82413), “The tps typically located on the throttle body it sense the position of the throttle valve“.

The overall average score of 3.9240 with a standard deviation of 0.65202, categorized as "Good", indicates a generally good and consistent understanding of the EFI fuel system construction among the respondents.

The results suggest that the respondents have a good understanding of the construction of the EFI fuel system. This indicates that they have knowledge of the key components and their functions within the system. The implications of these results could be used to identify areas of strength and areas that may require further training or education. It can also serve as a basis for validating the effectiveness of existing training programs or identifying areas for improvement in educational materials related to EFI fuel system construction. According to Smith, J (2006) that the components of an EFI system, are the electronic control unit (ECU), sensors (e.g., throttle position sensor, manifold absolute pressure sensor), fuel injectors, and spark control to function successfully.

Second is the level of understanding regarding the construction of the EFI (Electronic Fuel Injection) fuel system using a mock-up. The mean scores range from 4.46 to 4.68, indicating an excellent level of understanding across all aspects evaluated. The aspects with the highest mean scores (4.64, 4.64, and 4.68) are "The fuel pump typically located in the fuel tank and pressurized and delivers fuel to the injectors", "The throttle body positioned in the intake system and regulates the airflow into the engine", and "The fuel rail mounted at the top of the injector". These aspects are particularly well understood by the respondents.

The standard deviation values range from 0.27405 to 0.50508, indicating a relatively low variability in the responses. This suggests a consistent level of understanding across the respondents for most aspects of the EFI fuel system construction. The aspect with the highest standard deviation (0.50508), "The fuel injectors mounted on the intake manifold or directly into combustion chamber.". While the lowest standard deviation (0.47121s), “The fuel rail mounted at the top of the injector. “.

The overall average score of 4.58 with a standard deviation of 0.27405, categorized as "Excellent", indicates a highly commendable and consistent understanding of the EFI fuel system construction among the respondents.

The results suggest that the respondents have an excellent understanding of the construction of the EFI fuel system using a mock-up. These implications of this study can be utilized in various ways, such as identifying areas of strength and areas that may require further training or education. It can also serve as a basis for validating the effectiveness of existing training programs or identifying areas for improvement in educational materials related to EFI fuel system construction.

According to Heywood (1988), the EFI system is a complex integration of various components working together to deliver precise fuel quantities to the engine. Key components include the fuel pump, throttle body, fuel injectors, and fuel rail. Each part plays a vital role in the efficient functioning of the engine by regulating the fuel-air mixture that enters the combustion chamber.

The comparison of understanding the construction of the EFI fuel system with and without a mock-up reveals notable disparities in comprehension levels and their implications. When no mock-up is used, respondents demonstrate a good understanding, as reflected in mean scores falling within the "Good" category. However, there is some variability across aspects, indicating potential areas for improvement. Conversely, employing a mock-up significantly enhances understanding, resulting in excellent mean scores across all evaluated aspects. This suggests that practical demonstrations play a pivotal role in bolstering comprehension and knowledge retention regarding EFI fuel system construction. Moreover, the consistent understanding observed with the mock-up underscores its efficacy as an educational tool. These findings highlight the importance of integrating hands-on learning experiences, such as using mock-ups, to optimize technical education outcomes. Overall, the use of mock-ups not only facilitates a deeper understanding of EFI system construction but also serves as a basis for refining training programs and educational materials, ultimately fostering more effective learning environments in the field of automotive engineering.

Table 5

**Significant difference of learning effectiveness in utilizing the EFI delivery system without and with mock-up of the respondents**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Test Value = 0 | | | | | | Interpretation |
| t | df | p-value | Mean Difference | 95% Confidence Interval of the Difference | |
| Lower | Upper |
| Operation Without mock-up | 41.511 | 49 | 0.000 | 3.82400 | 3.6389 | 4.0091 | Reject |
| Construction Without mock-up | 42.555 | 49 | 0.000 | 3.92400 | 3.7387 | 4.1093 | Reject |
| Operation With mock-up | 118.733 | 49 | 0.000 | 4.55400 | 4.4769 | 4.6311 | Reject |
| Construction With mock-up | 118.326 | 49 | 0.000 | 4.58600 | 4.5081 | 4.6639 | Reject |

The Table 5 shows the results of a statistical analysis comparing the utilization of the EFI delivery system with and without a mock-up. The utilization of the EFI delivery system without the mock-up showed a significant difference in understanding the operation of the EFI. The mean difference in utilization was 3.82400, with a 95% confidence interval of 3.6389 to 4.0091, while in the construction without the mock-up of the EFI, the 3.92400, with a 95% confidence interval of 3.37387 to 4.1093. The utilization of the EFI delivery system with the mock-up showed a significant difference in understanding the operation of the EFI. The mean difference in utilization was 4.55400, with a 95% confidence interval of 4.4769 to 4.6311, while in the construction without the mock-up of the EFI, the 4.58600, with a 95% confidence interval of 4.5081 to 4.6639.

The table indicates that there is a significant difference in the utilization of the EFI delivery system between the used of mock-up and did not use the mock-up. The p-values or the Sig. (2-tailed) for all variables (Operation without mock-up, Construction without mock-up, Operation with mock-up, and Construction with mock-up) are 0.000, which is less than the conventional threshold for statistical significance (usually set at 0.05). This suggests that the observed differences in utilization are highly unlikely to occur by chance alone. The presence of the mock-up has a noticeable impact on the utilization of the EFI delivery system.

This implies that the presence of the mock-up in the learning process significantly enhances the utilization of the EFI delivery system. This suggests that incorporating mock-ups can be an effective educational tool for improving understanding and engagement with the operation and construction of the EFI system. Allows for a more hands-on and interactive learning experience. By physically engaging with the mock-up, learners can gain practical skills and knowledge, leading to a deeper understanding of the system's operation and construction.

According to Castillo, C (2019), through mock-up instruction, students were able to disassemble engines/assemble engines, remove gas engines, repaired diesel engines, replaced timing belts, water pumps, can serve brake systems and power steering, replaced horns, changed oil, extracted engines, diagnosed engine effects and engine overhauling. Mock-up instructional innovation serves as developing tools that enhance students' technical skills to align with the requirements of the industry.

**CHAPTER 3**

**SUMMARY, FINDINGS CONCLUSIONS AND RECOMMENDATIONS**

This chapter discusses the summary, findings, conclusions, and recommendation of this study The Learning Effectiveness of Utilizing Automotive EFI Fuel Delivery System Mock-Up.

**SUMMARY**

This study was conducted to determine the effectiveness of utilizing automotive EFI fuel delivery system mock-up.

This chapter warps up the overall outcome of the analyzed quantitative data, which has undergone a series of tabulations and interpretations, to come up with conclusions. This study was conceptualized to find out the level of understanding of EFI delivery system with mock-up and without mock-up as to EFI system operation and EFI construction, and to determine the significant difference in utilizing the EFI delivery system without mock up and with mock-up of the respondents among male and female automotive students.

The study was conducted at Cebu Technological University Argao Campus. The respondents were fifty (50) automotive students under 3rd year. The researchers utilize the quasi-experimental research method and a researchers-made questionnaire to gather the data needed for this study. The statistical tools used were percentage, weighted mean, and t-test.

**FINDINGS**

The study investigated the understanding of the EFI fuel delivery system among automotive students at Cebu Technological University - Argao Campus, focusing on the effectiveness of using an EFI mock-up. The respondents, totaling 50 individuals, were predominantly single (98%) and predominantly male across age groups, with 60% in the 20-22 age bracket and 32% in the 23-25 range. The study found that without the mock-up, respondents displayed a good level of understanding in EFI system operation (average weighted mean of 3.824) and construction (average weighted mean of 3.9240). However, when utilizing the EFI mock-up, their understanding significantly improved, rated as excellent for both operation (average weighted mean of 4.554) and construction (average weighted mean of 4.58). Statistical analysis revealed a significant difference in understanding between scenarios, suggesting the effectiveness of using the mock-up in enhancing comprehension of the EFI fuel delivery system among male and female automotive students.

Base on the constructed answers from our questionnaire we find that the Idle Air Control (IAC) valve is a critical component in modern engines, tasked with maintaining stable engine idle speed by controlling the amount of air that enters the engine when the throttle is closed. If the IAC valve were not present or malfunctioning, the engine would face several operational challenges. Firstly, without the IAC valve adjusting the air intake, the engine would struggle to maintain a consistent idle speed, often resulting in frequent stalling, particularly when coming to a stop or idling. Additionally, the engine might experience rough or erratic idling as the air-fuel mixture would not be properly balanced at low speeds. Acceleration and overall engine performance could suffer, as the engine may not receive enough air when transitioning from idle to higher RPMs, impacting both power output and drivability. Furthermore, starting the engine, especially when cold, would become more difficult due to insufficient air intake regulation. Lastly, the lack of proper air intake control could lead to increased emissions, as the engine would not be operating efficiently, potentially causing environmental and regulatory issues.

In conclusion, the Idle Air Control valve plays a crucial role in ensuring the smooth and efficient operation of the engine at idle and low speeds. Its function is essential for maintaining stable idle speed, optimizing engine performance, and reducing emissions, highlighting its importance in modern automotive engineering.

In the efi construction we found out that the if fuel injectors are not mounted on the intake manifold or directly into the combustion chamber, several significant issues can arise with engine performance and efficiency. Injectors are typically designed to spray fuel directly into the intake manifold or combustion chamber to ensure optimal fuel atomization and mixing with the incoming air. When injectors are placed elsewhere, such as further down the intake path or in a different location, several problems can occur. Improper injector placement can cause drivability issues. The engine may experience rough idling, hesitation, or misfires because the fuel is not being delivered optimally. Fuel distribution among the cylinders may also be uneven, causing some cylinders to run too rich or too lean, which can affect overall engine balance and performance.

In conclusion, the placement of fuel injectors directly impacts engine performance, fuel efficiency, and emissions. Injecting fuel into the intake manifold or combustion chamber is essential because it ensures proper fuel atomization, optimal combustion, and cleaner engine operation. Any deviation from this standard can result in a variety of issues that compromise the overall performance and efficiency of the engine.

**CONCLUSION**

The study found that automotive students at Cebu Technological University's Argao Campus had a significantly better understanding of the EFI fuel delivery system when they used an EFI mock-up. Understanding was "good" prior to the use of the mock-up, but it improved to "excellent" after it was. The statistical significance of the difference suggests that practical, hands-on teaching aids are effective in technical education.

**RECOMMENDATION**

In line of the findings of the study, the following recommendations are offered:

1. Include Practical Teaching Aids: It is strongly advised that these kinds of practical teaching aids be included in the curriculum. These resources give students practical experience in a real-world setting, which can aid in their understanding of difficult concepts.

2. Extend Mock-up Use: Mock-ups should be used for more than just the EFI fuel delivery system. The application of physical models or mock-ups could also be advantageous for other intricate automotive technology systems and components.

3. Teachers should receive training on how to use these teaching aids effectively to get the most out of using them. This could involve teaching methods for incorporating these resources into their classes and assisting students with their use.

4. For Further Research, additional research should be conducted to explore the impact of practical teaching aids on other areas of automotive education and in other educational settings. This will help to generalize the findings and further validate the effectiveness of this teaching method.

5. For Student Feedback: Regular feedback from students should be sought to continuously improve the use of these teaching aids. Feedback can provide valuable insights into what is working well and where improvements can be made.

6. For the Future Researchers, it is important to benchmark as a respect to the legal owner of the current research and improve the mock-up for better performance.

**CHAPTER 4**

**OUTPUT OF THE STUDY**

This chapter contains the proposal for an Operation Manual of the EFI mock-up that will provide comprehensive guidance for users operating the Electronic Fuel Injection (EFI) fuel delivery system mock-up. It will encompass detailed instructions, safety protocols, component descriptions, troubleshooting procedures, maintenance guidelines, technical specifications, and operating tips.

**Rationale**

The study operation manual of the Electronic Fuel Injection (EFI) system mock-up is a significant resource that provides comprehensive information about the workings of the EFI system. It offers detailed insights into how this system operates, the components involved, and the troubleshooting techniques for common problems.

According to IC Engine (2023), Electronic Fuel Injection (EFI) is a fuel delivery system that has become the standard in modern vehicles, replacing carburetors in most gasoline-powered engines. EFI offers precise control over fuel delivery, resulting in improved performance, efficiency, and emissions control.

The manual also offers a comprehensive look at the various components of the injection system, including the pumping element, metering element, mixing element, metering control, mixture control, distributing element, timing control, and ambient control. Each of these components plays a crucial role in the functioning of the EFI system, and understanding their roles can help in troubleshooting and maintaining the system.

The study operation manual of the EFI system mock-up is an invaluable resource for anyone working with or interested in EFI systems. It provides a thorough understanding of the system's operation, components, and troubleshooting techniques, making it a must-have reference for professionals in the field.

**Objectives**

The proposed Operation Manual of the EFI fuel delivery system mock-up for Automotive students in CTU-Argao Campus aims to:

1. to ensure safe and efficient operation of the EFI mock-up.

2. to familiarize users with the components and functionality of the EFI system.

3. to provide step-by-step instructions for starting, stopping, and adjusting the system.

4. to offer troubleshooting guidance for identifying and resolving common issues.

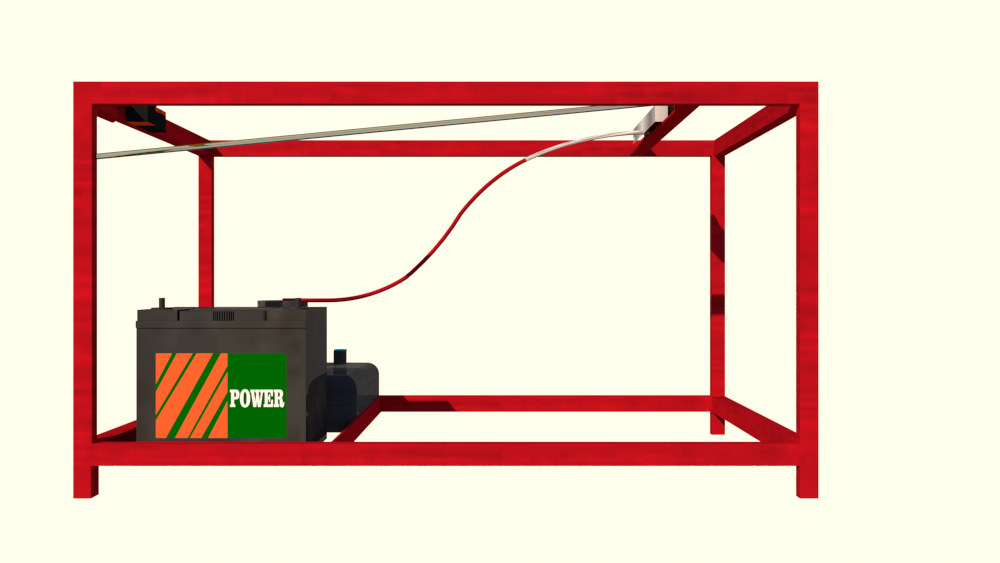
5. to outline maintenance procedures for preserving the system's performance.

6. to present technical specifications for reference during operation.

7. to offer operating tips and best practices for optimal performance.

8. to address regulatory requirements and compliance standards.

**ARCHITECTURE DESIGN OF EFI SYSTEM MOCK-UP**



Switch

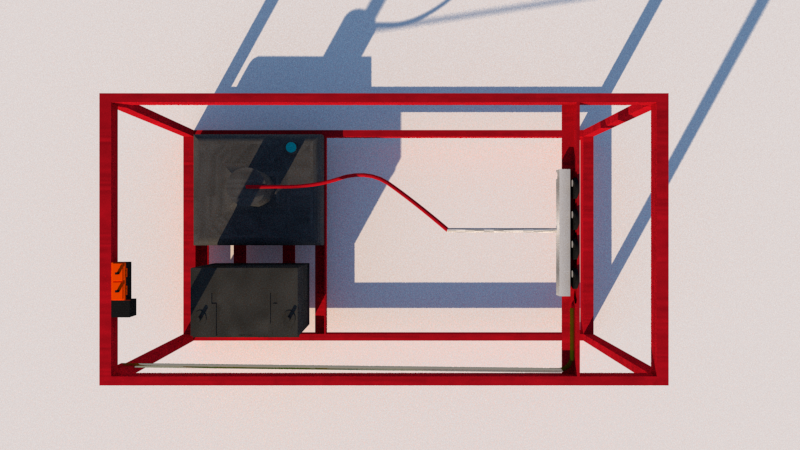
Fuel Tank

Flasher Relay

Fuel Injector

Fuel Line/ Fuel Hose

Battery



Switch

Flasher Relay

Fuel Line/ Fuel Hose

Fuel Injector

Fuel Pump

Fuel Tank

Battery

The functions of EFI are fuel injection management and ignition management, which is by the following parts:

1. A **fuel pump** is a component used in many liquid-fueled engines (such as petrol/gasoline or diesel engines) to transfer the fuel from the fuel tank to the device where it is mixed with the intake air (such as the carburetor or fuel injector).

2. A **fuel injector** regulated the injection of fuel into an engines internal combustion chamber where it is mixed with air and ignited.

3. A **batteries** is a device that stores chemical energy and converts it to electrical energy. Batteries and similar devices accept, store, and release electricity on demand.

4. **Flasher units** are designed to control the flash rate of vehicle directional indicator.

5. A **fuel line** is a hose or pipe used to transfer fuel from one point in a vehicle to another.

6. **Fuel pump impeller** is turned by the motor to compress the fuel.

7. **ECU**, the signals from the ECU cause current to flow in the solenoid coil, which causes the plunger to be pulled, opening the valve to inject the fuel.

8. The **fuel pump filter** removes dirt and impurities from the fuel before entering the fuel pump.

9. **Fuel line hoses**, also referred to as fuel lines, are the type of flexi tube or hose used for transferring fuel from a vehicles fuel tank directly into an engine or any component in its fuel system.

10. **The fuel tank** is a reservoir that holds the fuel supply and helps maintain its temperature at a level below its flash point.

**PROCEDURE ON MOCK-UP CONSTRUCTION**

Step 1. Assemble the frame of the mock using the square tube.

Step 2. Place the fuel tank in the mock-up.

Step 3. Then next the fuel pump. Where fuel pump pressurizes the fuel and sends it through the fuel lines to the fuel injectors.

Step 4. Install the fuel rails. These will deliver fuel to the injectors.

Step 5. Install the efi injector. These injectors will spray fuel into the intake ports.

Step 6. Connect the fuel lines. Fuel lines generally refer to the hoses that carry fuel from the fuel tank to the engine of an automobile or other machinery.

Step 7. Electrical connection. Use a 12V power supply to simulate the electrical signals needed to activate the injectors.

**PROCEDURE ON MOCK-UP OPERATION**

Step 1. Plug the battery.

Step 2. Put the gasoline in fuel tank.

Step 3. Turn on the flasher switch.

Step 4. Turn on the main switch.

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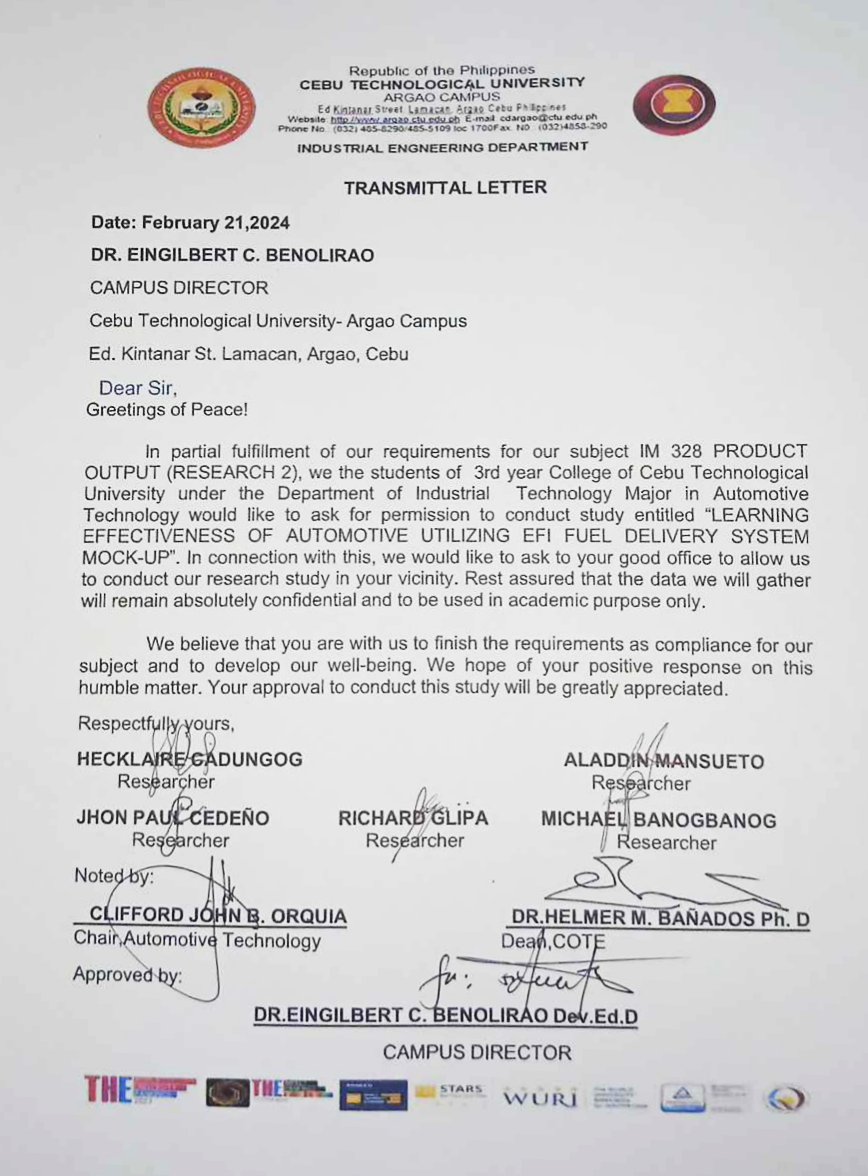
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**APPENDICES**

**APPENDIX A**

**TRANSMITTAL LETTER DEAN**



**APPENDIX B**

**QUESTIONNAIRE**

**Direction:** Please read the following statement below and put a check mark (/) on the column that corresponds your answer.

**Part I.**

Age: 20 – 22

23 – 25

26 – 28

29 – above

Gender: Male

Female

Gay

Lesbian

Bisexual

Transgender

Civil: Single

Married

Separated

Widowed

**Part II.** The level of understanding of the respondents in the EFI fuel delivery system without using EFI mock-up.

**Legend:**

**Poor (1)** - Signifies the lowest level of quality or performance.

**Fair (2)** - Moderate level of satisfaction.

**Satisfactory (3)** - Indicates that the quality or performance meets the expected standard.

**Good (4)** - Represents a high level of quality or performance.

**Excellent (5)** - Signifies the highest level of quality or performance.

1. **EFI System Operation**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **STATEMENTS** | **1** | **2** | **3** | **4** | **5** |
| 1. The efi injects fuel according to the sensors signal. |  |  |  |  |  |
| 2. Sensor collect data on various engine condition. |  |  |  |  |  |
| 3. The fuel injectors injects fuel coming from the fuel tank |  |  |  |  |  |
| 4. The ecu process the data to determine the optimal air fuel mixture. |  |  |  |  |  |
| 5. The injectors precisely spray the required amount of fuel into each cylinder. |  |  |  |  |  |
| 6. The tps sensor monitor the air intake of an engine. |  |  |  |  |  |
| 7. The pump creates the pressure needed to move gas from the lines to the engine |  |  |  |  |  |
| 8. The fuel tank pressure sensor reads pressure in the fuel system or to detect leaks or faulty gas cap |  |  |  |  |  |
| 9. The tps monitor the position of the throttle to determine the drivers demand for power. |  |  |  |  |  |
| 10. The IAC adjust the engine speed bye controlling the amount of air allowed into the engine while the throttle is closed. |  |  |  |  |  |

1. **EFI Construction**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **STATEMENTS** | **1** | **2** | **3** | **4** | **5** |
| 1. The EFI composed of ecu. |  |  |  |  |  |
| 2. The tps typically located on the throttle body it sense the position of the throttle valve. |  |  |  |  |  |
| 3. The fuel injectors mounted on the intake manifold or directly into combustion chamber. |  |  |  |  |  |
| 4. The fuel pump typically located in the fuel tank and it pressurized and deliver fuel to the injectors. |  |  |  |  |  |
| 5. The throttle body positioned in the intake system and regulates the air flow into the engine. |  |  |  |  |  |
| 6. The fuel line run along the vehicle chassis, and it made up of metal or high pressure rubber. |  |  |  |  |  |
| 7. The fuel filters located between the fuel pump and the injectors. |  |  |  |  |  |
| 8. The ecu is the brain of the efi system |  |  |  |  |  |
| 9. The IAC Valve (Idle Air Control) located near the throttle body that adjusts the engine idle speed. |  |  |  |  |  |
| 10. The fuel rail mounted at the top of the injector. |  |  |  |  |  |

**CURRICULUM VITAE**

**CURRICULUM VITAE**



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**Civil Status:** Single

**Motto: “**Don’t stop if the light is green.”

**EDUCATIONAL BACKGROUND**

Senior High School Bulasa National High School 2018-2019

Bulasa, Argao, Cebu

Junior High School Argao Central for Science Learning INC 2015-2016

Elementary School Mandilikit Elementary School 2011-2012

Mandilikit, Argao, Cebu

**CURRICULUM VITAE**

A person in a suit and tie

Description automatically generated

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**Civil Status:** Single

**Motto:** “Do all things with love.”

**EDUCATIONAL BACKGROUND**

Senior High School Cawayan National High School 2020-2021

Cawayan, Dalaguete , Cebu

Junior High School Cawayan National High School 2014-2015

Cawayan, Dalaguete , Cebu

Elementary School Sanicolas Elementary School 2010-2011

**CURRICULUM VITAE**



**Hecklaire F. Cadungog**

Canbantug, Argao, Cebu

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**Gender:** Male

**Nationality:** Filipino

**Religion:** Roman Catholic

**Civil Status:** Single

**Motto:** ‘’Theres no elevator to success, you have to take the stairs’’

**EDUCATIONAL BACKGROUND**

Senior High School Calagasan National High School 2020-2021

Calagasan, Argao, Cebu

Junior High School Calagasan National High School 2018-2019

Calagasan, Argao, Cebu

Elementary School Canbantug, Elementary School 2014-2015

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**CURRICULUM VITAE**



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**Religion:** Roman Catholic

**Civil Status:** Single

**Motto:** “Believe in yourself, conquer your dreams.”

**EDUCATIONAL BACKGROUND**

Senior High School Teodoro Dela Vega Memorial 2020-2021

National High School

Papan, Sibonga, Cebu

Junior High School Teodoro Dela Vega Memorial 2018-2019

National High School

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**CURRICULUM VITAE**



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**Motto:** “Life is too short to stay stock.”

**EDUCATIONAL BACKGROUND**

Senior High School Cawayan National High School 2020-2021

Cawayan, Dalaguete, Cebu

Junior High School Cawayan National High School 2014-2015

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Elementary School Malones Elementary School 2010-2011

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A person in a suit and tie

Description automatically generated

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**EDUCATIONAL BACKGROUND**

Senior High School Bulasa National High School 2020-2021

Bulasa, Argao, Cebu

Junior High School Bulasa National High School 2018-2019

Bulasa, Argao, Cebu

Elementary School Binlod Elementary School 2011-2012

Binlod, Argao, Cebu