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ENHANCING PRACTICAL LEARNING IN AUTOMOTIVE ELECTRICAL DIAGNOSTICS USING THE EZFUSE TESTER

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Abstract

EZFuse Tester is an innovative teaching aid designed to assist students during practical sessions involving vehicle electrical systems. This tool simplifies the fuse inspection process by providing visual (light) and auditory (beep) signals to indicate whether a fuse is functioning properly. Checking fuses is a crucial step in identifying faults in vehicle electronic components such as audio systems, lights, or other accessories. The tool addresses common challenges faced by users, particularly older mechanics with vision problems and students who find multimeters difficult to use. Its simple and user-friendly design allows students to connect the alligator clip to the battery terminal and touch the device tip to the fuse terminal-triggering a light and sound if the fuse is functional. A quantitative study involving 41 respondents (38 students and 3 lecturers) from the Department of Mechanical Engineering, Politeknik Kuching Sarawak, showed strong agreement regarding the tool's effectiveness. 85% agreed it simplifies inspections, 88% found the beeping sound engaging, and 83% stated that it enables faster diagnostics with minimal supervision. Additionally, 81% agreed that it promotes a safer, more organized workspace, while 83% recognized its role in improving problem detection and diagnostic efficiency. Overall, EZFuse Tester enhances learning outcomes, reduces inspection time, increases productivity, and supports an inclusive, efficient workshop environment.

Keywords: Automotive Education, Electrical System Diagnostics, Fuse Tester, Teaching Aid.

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INTRODUCTION

The Malaysian education system has evolved significantly with the integration of Information and Communication Technology (ICT), particularly in Technical and Vocational Education and Training (TVET). Advancements in science and technology have not only transformed the overall education landscape but also reflect the government's commitment to producing a more advanced and competitive generation. Interestingly, the use of educational technology in Malaysia began informally as early as the 1940s, showing a longstanding integration of technology that has evolved in tandem with modern progress.

In the context of TVET, especially in automotive education, teaching methods have been reshaped to emphasize practical, hands-on learning. Students in this field engage in various tasks related to vehicle maintenance, particularly the inspection of electrical systems. Through these activities, they are able to apply theoretical concepts and gain a deeper understanding of how automotive electrical components function—such as the battery, alternator, charging system, ignition system, and fuel injection system. In doing so, students are also exposed to the importance of regular maintenance and the ability to implement preventive measures to ensure the vehicle's electrical systems operate at optimal levels and to avoid potential faults.

However, traditional diagnostic tools such as multimeters and test lamps often present usability challenges, including calibration complexity, visual strain, and the need for user precision—especially among novice learners (Namun et al., 2019). These limitations can hinder the learning process, especially for students with limited technical experience or visual impairments. To overcome these issues, the EZFuse Tester was developed as an innovative teaching aid that offers immediate visual and auditory feedback. This user-friendly solution allows students to inspect fuses quickly and accurately, with minimal supervision, thus enhancing their understanding of automotive diagnostics and supporting more effective, engaging, and inclusive learning experiences (Abdullah & Samad, 2021).

1. PROBLEM STATEMENT

In the field of automotive education, diagnosing vehicle electrical systems typically involves the use of tools such as multimeters, test lamps, and visual inspection. A multimeter is generally used to measure voltage, current, and resistance, while a test lamp detects the presence of voltage by producing light or sound when a circuit is complete.

However, these conventional tools present significant challenges. The multimeter, for instance, requires precise calibration and accurate scale settings, which can be time-consuming and difficult for beginners. As noted by Namun et al. (2019), calibration alone may take between 5 to 30 minutes depending on user skill. Moreover, multimeters must often be positioned precisely for accurate reading, particularly when integrated with digital measurement systems (Lima et al., 2008). Zaini et al. (2017) further observed that analog multimeters depend heavily on visual interpretation, which may cause user fatigue during extended tasks.

Recent studies confirm that many TVET students struggle with the complexity of multimeter usage, especially in mastering settings and interpreting results under pressure (Ismail & Zulkefli, 2020). Improper handling of such tools may lead to misdiagnoses or even damage to sensitive electronic components (Chen & Wang, 2018). These barriers often result in reduced learning outcomes and longer diagnostic time in workshops (Hassan et al., 2023).

Likewise, test lamps are prone to causing glare and difficulty in identifying signal colours, particularly in

brightly lit environments. This can be problematic for older users or individuals with visual impairments (Kader & Alam, 2018). These challenges become more critical in fast-paced learning environments where time efficiency, clarity, and safety are priorities.

As Malaysia transitions toward Industry 4.0, the integration of user-friendly and accessible technology in TVET education is more important than ever (Norazah, 2022). The limitations of traditional diagnostic tools underline the urgent need for innovative alternatives that simplify the inspection process while enhancing accuracy, safety, and inclusivity.

In response to these challenges, the EZFuse Tester was developed as a Teaching Assistance Tool (TAT). This innovation incorporates both visual (LED) and auditory (beep) indicators in a compact form, enabling students and technicians to detect functioning fuses quickly and confidently. The device not only simplifies the diagnostic process but also improves workshop efficiency, supports inclusive learning, and aligns with current demands for modernized technical education (Mokhtar et al., 2021).

2. RESERACH INQUIRY

The research questions are aligned with the study's objectives and are as follows:

i. How effective is the EZFuse Tester in facilitating the examination of vehicle electrical systems?

ii. To what extent can the EZFuse Tester reduce the time required for inspecting vehicle electrical systems?

iii. What level of cost savings can be achieved using the EZFuse Tester?

iv. How effectively does the EZFuse Tester contribute to promoting a safe and organized workshop environment?

3. RESEARCH OBJECTIVE

This study aims to:

i. Evaluate the effectiveness of the EZFuse Tester in improving the accuracy and reliability of vehicle electrical system inspections.

ii. Quantify the time saved during practical vehicle electrical system diagnostics using the EZFuse Tester.

iii. Analyze the cost reduction achieved through the implementation of the EZFuse Tester in workshop operations.

iv. Assess the impact of the EZFuse Tester on maintaining a clean, organized, and safe working environment

4. STUDY FOCUS

This study was conducted with participants comprising students from the Department of Mechanical Engineering at Politeknik Kuching Sarawak. A quantitative research approach was employed, utilizing questionnaires as the primary data collection instrument. The data collection process involved the preparation and distribution of online questionnaires, which were then shared with the respondents for completion.

5. FINDING ANALYSIS

5.1. Background of Respondents

Data analysis was carried out on questionnaire responses collected from a random sample of 41 respondents, comprising both students and lecturers from the Department of Mechanical Engineering (Automotive) at Politeknik Kuching Sarawak. The demographic profiles of the respondents participating in this study are presented in Table 1.

Table 1. Demographic profile

Question	Category	Total
Status	Student	38
	Lecturer	3
Gender	Male	39
	Female	2
Age	18-23 years old	38
	24 years and above	3
Race	Malay	15
	Chinese	5
	Bumiputera	17
	Others	4
Semester	Semester 2	20
	Semester 3	1
	Semester 4	10
	Semester 5	10

A total of 41 respondents participated in the survey, comprising 38 students and 3 lecturers from the Department of Mechanical Engineering (Automotive) at Politeknik Kuching Sarawak. The majority of respondents were male (39), with only 2 female participants. In terms of age, 38 respondents were between 18 and 23 years old, while 3 were 24 years old and above. The ethnic breakdown included 15 Malay, 5 Chinese, 17 Bumiputera, and 4 from other ethnic backgrounds. Among the student respondents, 20 were in Semester 2, 10 in Semester 4, 10 in Semester 5, and 1 in Semester 3.

5.2. Analysis of Research Findings

Part II of the questionnaire focuses on specific aspects of the study, including users' perceptions of the EZFuse Tester, its ergonomic design, user experience, and its effectiveness in meeting user needs. The following section presents the findings for Part A, which addresses users' perceptions of the EZFuse Tester. Table 2 below outlines the question items related to this aspect.

Table 2. Question Items for Users' Perceptions of EZFuse Tester

Question Code	Item	% Agree	% Disagree
S1	The use of EZFuse Tester ensures that inspections can be conducted with ease.	85	15
S2	The beeping sound produced by EZFuse Tester captures students' interest in performing inspections	88	12
S3	The use of EZFuse Tester facilitates students in analyzing the condition of vehicle fuses	83	17
S4	Using EZFuse Tester assists students in conducting inspections more quickly compared to using a multimeter	85	15
S5	The use of EZFuse Tester provides a clear result of the vehicle fuse condition	83	17
S6	Utilizing EZFuse Tester helps students carry out practical inspections with minimal supervision from instructors	83	17

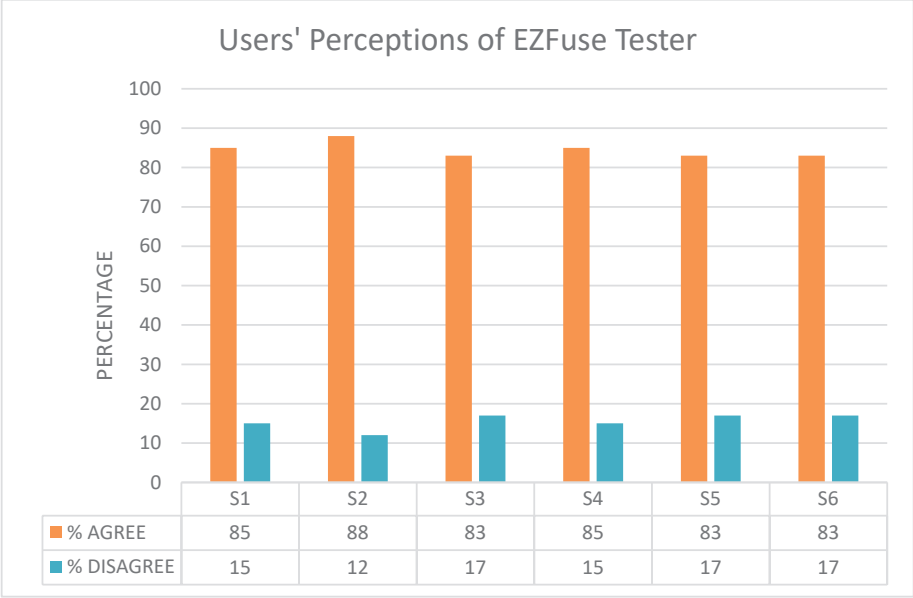

Fig. 1. Users' Perceptions of EZFuse Tester

The analysis of the questionnaire responses reveals a strong positive reception of the EZFuse Tester among both students and lecturers. According to Table 2 and Figure 1, 85% of respondents agreed that the device ensures ease of inspection (S1), and 88% acknowledged that the beeping sound engages students during diagnostic tasks (S2), which supports its function as an interactive and engaging tool in practical sessions (Hassan et al., 2023).

In terms of effectiveness in assisting diagnostics, 83% of respondents agreed that EZFuse Tester helps analyze fuse conditions (S3), provides clear results (S5), and enables students to carry out inspections with minimal supervision (S6). This shows that the tool empowers student independence and aids in comprehension, aligning with experiential learning approaches and reducing instructor workload (Mokhtar et al., 2021).

The next section, Part B of the questionnaire, focuses on ergonomic innovation and user experience, with the corresponding items listed in Table 3.

Table 2. Question Items for ergonomic innovation and user experience

Question Code	Item	% Agree	% Disagree
S7	Equipment for conducting fuse inspections is well organized	81	19
S8	The use of tools is easily accessible on the worktable	81	19
S9	The workshop arrangement is neater and saves storage space	85	15
S10	Accidents in the workshop can be reduced through the use of EZFuse Tester	80	20
S11	The use of EZFuse Tester can prevent glare issues during inspections	78	22
S12	Using EZFuse Tester enables students to perform practical work safely.	81	19
S13	The use of EZFuse Tester can simplify the process for students to calibrate a multimeter before conducting inspections	83	17

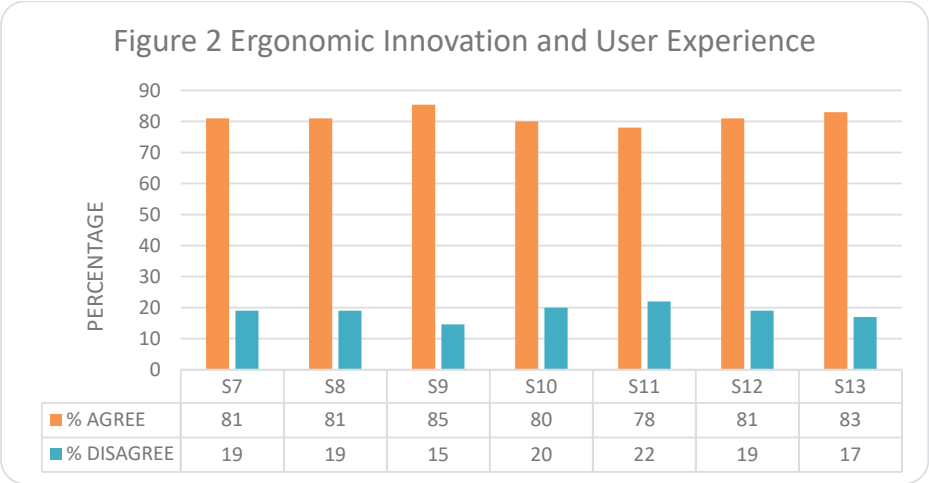

Fig. 2. Ergonomic innovation and user experience

Time efficiency was a significant theme throughout the data. Respondents indicated that the device allows quicker inspections than a multimeter (S4, 85%) and simplifies multimeter calibration (S13, 83%). This matches previous findings on the complexities students face when using traditional tools (Ismail & Zulkefli, 2020).

From an ergonomic and safety perspective (Table 3), 85% of participants noted that the device contributes to neater workshop arrangements (S9), while 81% felt that tools are easier to access (S8) and well-organized (S7). Safety benefits were also highlighted 81% believed it supported safer practical work (S12), and 80% stated it reduces accidents (S10). Additionally, 78% agreed that the device reduces glare issues during inspections (S11), which is particularly helpful for users with vision sensitivity (Kader & Alam, 2018).

Table 3. Question items related to the effectiveness of EZFuse Tester in fulfilling user needs

Question Code	Item	% Agree	% Disagree
S14	The use of EZFuse Tester saves more time for vehicle electrical system inspection tasks	85	15
S15	Using EZFuse Tester is more cost-effective compared to equipment like multimeters available in the market	81	19
S16	The use of EZFuse Tester enhances the efficiency of vehicle electrical system maintenance	80	20
S17	Using EZFuse Tester increases productivity in vehicle electrical system maintenance	81	19
S18	The use of EZFuse Tester helps mechanics improve their ability to understand and diagnose vehicle electrical system issues	81	19
S19	Using EZFuse Tester provides valuable and detailed information about the condition of the vehicle's electrical system quickly	81	19
S20	The use of EZFuse Tester helps efficiently detect problems or defects in the vehicle's electrical system	83	17
S21	Using EZFuse Tester simplifies and accelerates the process of inspecting the vehicle's electrical system	83	17

Table 4 and Figure 3 further emphasize the tool's overall effectiveness. Time-saving during inspections (S14) was confirmed by 85% of respondents. The device was also recognized for improving maintenance efficiency (S16, 80%), boosting productivity (S17, 81%), and aiding problem diagnosis (S18, 81%). Respondents found it valuable in detecting defects (S20, 83%) and accelerating inspections (S21, 83%), showing its utility in enhancing task speed and clarity.

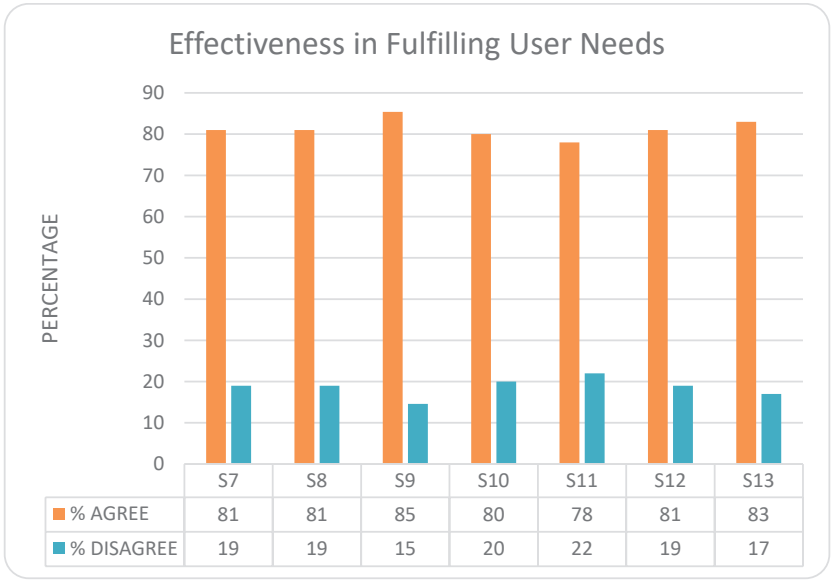

Fig. 3. Effectiveness of EZFuse Tester in fulfilling user needs

These findings collectively reinforce the EZFuse Tester's role as a practical, inclusive, and efficient educational tool. It simplifies complex diagnostic tasks, supports safer and more organized workspaces, and aligns well with the pedagogical needs of modern TVET education aiming to prepare students for Industry 4.0 (Norazah, 2022; Hassan et al., 2023; Mokhtar et al., 2021). The myIntelligent BuzzLamp

significantly enhances practical learning in automotive diagnostics. It improves student engagement, reduces inspection time, and promotes a safer working environment. As education adapts to Industry 4.0, such tools play a crucial role in empowering TVET students (Norazah, 2022).

6. DISCUSSION AND CONCLUSION

The analysis of the questionnaire responses reveals a strong positive reception of the EZFuse Tester among both students and lecturers. Approximately 85% of respondents agreed that the device simplifies the inspection process for vehicle electrical systems. Furthermore, 88% acknowledged that the auditory feedback (beeping) feature helps engage students and maintain their focus during diagnostic tasks (Hassan et al., 2023).

The device was found to improve efficiency, with 83% of users reporting that it enables faster diagnostic procedures compared to traditional tools such as multimeters. This time-saving feature directly addresses the limitations reported in prior studies, where students experienced delays due to the complexity of setting up and interpreting multimeter readings (Ismail & Zulkefli, 2020).

Additionally, 83% of respondents agreed that the EZFuse Tester reduced the need for close supervision during practical work. This supports the idea that user-friendly tools empower students to work more independently, which is crucial in fostering confidence and self-directed learning (Rahman et al., 2022). The device also contributes to workshop safety and organization, with 81% stating that it promotes a cleaner and more structured work environment.

From a pedagogical perspective, the EZFuse Tester aligns with principles of active and experiential learning, where students benefit from immediate feedback and clear results. The inclusion of both visual and auditory cues makes the device inclusive for students with varying learning preferences and abilities (Hassan et al., 2023). The integration of such assistive technologies is particularly important in TVET programs that aim to produce graduates equipped for Industry 4.0 (Norazah, 2022).

CONCLUSION

The findings of this study demonstrate that the EZFuse Tester significantly enhances practical learning in automotive diagnostics within the TVET context. With 85% of respondents affirming easier inspection, 88% finding the tool engaging, and over 80% recognizing improvements in safety, speed, and accuracy, the tool delivers quantifiable benefits in educational settings. It simplifies the diagnostic process, reduces reliance on traditional tools like multimeters, and allows students to conduct inspections more independently. Importantly, the study shows that the EZFuse Tester increases workshop efficiency, cuts inspection time, and minimizes the need for instructor supervision—leading to improved learning outcomes and higher productivity. The device's intuitive design promotes safety, reduces errors, and accommodates diverse learning styles through its visual and auditory feedback, supporting inclusive education practices. These results validate the tool's value as a strategic asset in modern TVET environments. By aligning with Industry 4.0 educational priorities and enhancing student competency in diagnostics, the EZFuse Tester contributes meaningfully to preparing a skilled, tech-savvy workforce. Its effectiveness as a cost-efficient, accessible, and pedagogically sound teaching aid underscores its relevance in transforming automotive training and elevating practical learning experiences.

REFERENCES

Abdullah, N., & Samad, N. A. (2021). Development of smart test lamp using IoT technology.

Chen, Y. S., & Wang, J. Y. (2018). Computer vision-based approach for reading analog multimeter. Applied Sciences, 8(8), 1268.

Hassan, N. S., Rahman, S. A., & Kamal, M. F. (2023). Evaluation of assistive diagnostic tools for automotive education in Malaysian TVET. Malaysian Journal of Technical Education, 10(1), 15–25.

Henderson, R., Selwyn, N., & Aston, R. (2017). What works and why? Student perceptions of useful digital technology in university teaching and learning. Learning, Media and Technology, 42(1), 1–15.

Ismail, M. H., & Zulkefli, N. (2020). TVET students' challenges in using conventional electrical testing tools. TVET Journal, 9(2), 21–30.

Kader, M. A., & Alam, M. M. (2018). Pembangunan sistem pengesanan kerosakan elektrik automotif menggunakan Arduino. International Journal of Research in Engineering, IT and Social Sciences, 8(8), 101–112.

Lima, D. A. D., Pereira, G. A. S., & Vasconcelos, F. H. D. (2008). A computer vision system to read meter displays. In Proceedings of the 16th IMEKO TC4 Symposium, Prague, Czech Republic.

Mokhtar, S. F. M., et al. (2021). Design and development of a simplified automotive circuit diagnostic tool. Journal of Technical Education and Training, 13(2), 56–62.

Namun, S. S., Rahim, N. A., & Harun, H. (2019). A study on automotive electrical system fault diagnosis by using multimeter. International Journal of Innovative Technology and Exploring Engineering, 8(9S2), 295–299.

Norazah, M. N. (2022). TVET curriculum reform for Industry 4.0: Integrating digital tools and sensors. TVET Journal of Education and Training, 14(1), 33–42.

Yusof, H. M., et al. (2018). Effectiveness of teaching aids in technical and vocational education. Asian Journal of University Education, 14(4), 77–85.

Zaini, M. H. M., Mohd Nawi, M. N., & Abdul Aziz, A. (2017). Development of a low-cost smart fuse tester for automotive applications. Journal of Telecommunication, Electronic and Computer Engineering, 9(3-5), 41–45.

Zhou, M., & Brown, D. (2015). Educational learning theories (2nd ed.). Education Publishing.