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Development of an Integrated Electric Vehicle Learning Simulator (EVLIS) with Industry-Based Learning to Accelerate Work Readiness of Vocational School Students

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Abstract

Technological developments in this modern era require changes in educational approaches to ensure that students have skills that are relevant to the needs of industry, especially electric vehicles. The research aims to develop an industrial integrated electric vehicle learning tool and test its feasibility. This research design adopts Richey and Klein's research and development (R&D) stages with development and internal validation stages. The research objects were carried out at four vocational schools in the Special Region of Yogyakarta and the Automotive Jogjakarta Center (OJC) with research subjects being teachers, experts and industrial practitioners. The resulting research is the competency aspects needed by the electric vehicle industry and the design of electric vehicle learning aids/Electric Vehicle Learning Simulator (EVLIS) that are feasible and ready to be made into product prototypes. EVLIS can help improve the attitude competency, knowledge and skills of electric vehicle technology for vocational school students. Not only that, the development of EVLIS involving the electric vehicle industry can strengthen collaboration/partnership between the industrial world and vocational schools.

Keywords: Electric Vehicle Learning Simulator (EVLIS), Industry Based Learning, Work Readiness, Vocational High Schools (SMK)

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INTRODUCTION

Technological developments in this modern era require changes in educational approaches to ensure that students have skills that are relevant to industry needs[1][2].

[1] Ahmad Fathoni et al., "Increased Competitiveness and Work Readiness of Four Year Vocational High School (VHS) Students," Indonesian Journal of Learning Education and Counseling 1, no. 2 (2019): 186–94, https://doi.org/10.31960/ijolec.v1i2.114.

[2] Luthfi Indana and Soenarto Soenarto, "Vocational Career Center as the Bridge between Industry and Vocational High School Graduates," Journal of Technology and Vocational Education 25, no. 2 (2019): 219–28, https://doi.org/10.21831/jptk.v25i2.19817.

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Electric vehicles are one of the innovations that increasingly dominate the transportation sector, driving significant changes in the automotive industry. Therefore, vocational education, especially at Vocational High Schools (SMK), needs to continue to adapt to these developments. Vocational education at vocational schools is the main key in preparing the young generation to enter the world of work[3]. In recent years, technological developments in the automotive industry, especially electric vehicles, have brought significant changes[4]. Electric vehicles are increasingly becoming the main choice in the transportation sector, replacing conventional fossil fuel vehicles. However, challenges arise when vocational education in vocational schools is not aligned with industrial developments, causing a skills gap between graduates and the needs of the electric vehicle industry which continues to grow[5].

Electric vehicles are not only a technological innovation, but also bring about a paradigm shift in the skills required of automotive technicians. Without learning tools that reflect the realities of the workforce, vocational school students may have difficulty applying the knowledge and skills they learn in school when they enter industry[6]. Successful integration of the educational curriculum with industry needs is very important to ensure that vocational school graduates have skills that are relevant and can be directly applied in the workforce[7]. In this context, the lack of well-integrated learning tools in teaching vocational school students about electric vehicles and combining theoretical concepts with practical applications is a major obstacle.[8]. Therefore, the development of electric vehicle learning tools that adopt an industry-based learning approach needs to be the focus of attention to increase vocational school students' work readiness[9].

An industry-based learning approach is recognized as an effective method in increasing the relevance of student skills to industry needs[10]. By designing learning tools that not only provide theoretical understanding but also emphasize practical application in the field, we can ensure that vocational school students are truly ready to face the world of work.[11]. The electric vehicle learning tools proposed in this article are designed to

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[3] Bambang Sudarsono and Thomas Sukardi, "Developing A Model Of Industry-Based Practicum Learning," Journal of Vocational Education 7, no. 1 (2017): 43, https://doi.org/10.21831/jpv.v7i1.12886.

[4] Bambang Sudarsono, "The Application Of Rotated Practice Method To Improve Practice Learning Achievement In Vocational School," Vanos Journal Of Mechanical Engineering Education 5, no. 1 (2020): 1–8.

[5] Bambang Sudarsono, "Development of Shielded Metal Arc Welding (SMAW) Model of Welding Learning Media for Vocational School Students. The Development of Shielded Metal Arc Welding (SMAW) Welding Learning Media for Vocational High Schools Students," Journal of Vocational Park 8, no. 2 (2020): 17–24.

[6] Bambang Sudarsono et al., "Development of Integrated Project-Based (PjBL-T) Model to Improve Work Readiness of Vocational High School Students," Journal of Vocational Education 12, no. 3 (2022): 222–35, https://doi.org/10.21831/jpv.v12i3.53158.

[7] Germán A. Cadenas et al., "A Programmatic Intervention to Promote Entrepreneurial Self-Efficacy, Critical Behavior, and Technology Readiness among Underrepresented College Students," Journal of Vocational Behavior 116 (2020): 103350, https://doi.org/ 10.1016/j.jvb.2019.103350.

[8] Tianyi Wang, Janet Ramdeo, and Colleen McLaughlin, "Experiencing and Experimenting: An Exploration of Teacher Agency in an International Collaborative Teacher Professional Development Program Using Experiential Learning," Teaching and Teacher Education 104 (2021): 103389, https://doi.org/10.1016/j.tate.2021.103389.

[9] Genevieve Mc Pherson-Geyser, Rian de Villiers, and Portia Kavai, "The Use of Experiential Learning as a Teaching Strategy in Life Sciences," International Journal of Instruction 13, no. 3 (2020): 877–94, https://doi.org/10.29333/iji.2020.13358a.

[10] Hiromi Arakawa and Tokie Anme, "The Effect of an Experiential Learning Program on Motivations and Activity Involvement among Dementia Supporters in Japan," PLoS ONE 15, no. 12 December (2020): 1–12, https://doi.org/10.1371/journal.pone.0244337.

[11] A. Mustikawanto et al., "Effect of Competency, Work Motivation, Industrial Work Experience and Facilities on the Readiness of Work for Senior High School Graduates in Electro Expertise

provide a holistic learning experience, covering the technical and practical aspects required in the maintenance and repair of electric vehicles.

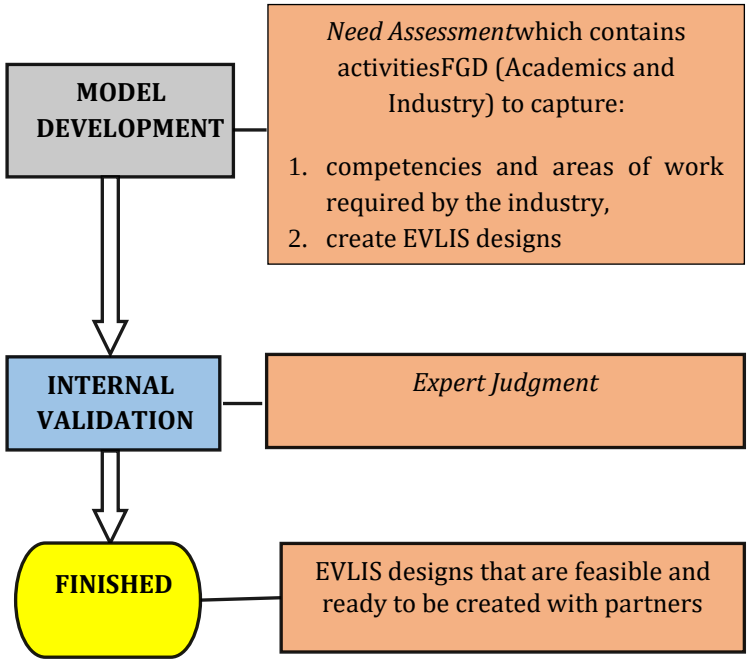
In this context, this journal article will discuss the concrete steps taken in the development of electric vehicle learning tools[12]. The focus is not only on technical aspects, but also on how this learning tool can be integrated effectively with the industry-based curriculum in vocational schools. In addition, this research will also evaluate the impact of using integrated learning tools on students' work readiness, by measuring the increase in their skills, knowledge and attitudes towards electric vehicles.

By combining an industry-based learning approach with the development of electric vehicle learning tools, it is hoped that this article can make a positive contribution to increasing vocational school students' work readiness[13]. A deep understanding of electric vehicles and their application in industrial settings will give students a competitive edge, helping them enter the workforce with relevant and up-to-date skills.

RESEARCH METHODS

This research adopts the Research and Development model of Richey and Klein (2009:8) which consists of two development stages, namely model development and internal validation. The stages of this research can be seen in Figure 1.

Figure 1. Research Design[14]



The research was carried out at four vocational schools in the Special Region of Yogyakarta and the Automotive Jogjakarta Center (OJC). The research subjects consisted of

Programs," Sciences and Technology (GCSST) 2, no. 1 (2019): 433–47, https://doi.org/10.17509/invotec.v15i1.16045.

[12] Fanani Arief Ghozali et al., "Development of a Conveyor-Based Practice Performance Assessment Tool with Android Control to Improve Vocational High School Students' Work Readiness," ELINVO (Electronics, Informatics, and Vocational Education) 8, no. 1 (2023): 38–43.

[13] Bambang Sudarsono et al., "Development of Android-Based Student Performance Tool (Tunersindro) to Improve Work Readiness of Vocational High School Students," Iqra' Journal: Educational Science Review 7, no. 2 (2022): 271–85.

[14] Bambang Sudarsono, "Development of Work-Based Learning Models Based on Work Readiness (WBL-WoRe)," Iqra' Journal 7, no. 1 (2022): 44–62.

5 Automotive Engineering Vocational School teachers, 4 experts, and 5 industrial practitioners. The initial stage is the development stage which aims to formulate the competencies needed to increase students' work readiness and create EVLIS designs that suit vocational and industrial needs. Respondents in the development stage consisted of Automotive Engineering Vocational School teachers and practitioners in the electric vehicle repair industry. This development was carried out through an interview method designed in a focus group discussion (FGD) activity format. In the second stage, namely internal validation, testing the feasibility of the EVLIS design from learning experts, automotive teachers and automotive industry practitioners. The data collection techniques used were in the form of interviews and questionnaires with instruments in the form of FGD activity interview questions and learning media feasibility questionnaires.

RESULTS AND DISCUSSION

Development Stage

The development stage aims to explore information related to the needs of industry and vocational schools in facing the demands of the development of the electric vehicle industry as well as competency aspects needed by the electric vehicle industry for vocational school graduates. The respondents used to dig up information consisted of Automotive Engineering Vocational School teachers and industrial practitioners. The results of the development stages can be seen in Table 1-3.

Table 1. Analysis of Electric Vehicle Industry Needs (input from Automotive Engineering Vocational School teachers)

Indicator	Response
The effectiveness of the vocational school curriculum in covering subjects related to electric vehicles.	Evaluation of the vocational school curriculum shows the integration of subjects relevant to the development of the electric vehicle industry.
The level of industry involvement in the development of vocational school training programs	There is active collaboration between vocational schools and the electric vehicle industry to ensure a match between the curriculum and the practical needs of the industry
Availability of supporting facilities and equipment at vocational schools to support learning related to electric vehicles	Vocational Schools are equipped with the latest laboratories, software and equipment that support student learning related to electric vehicles.
Student involvement in internships or collaborative programs with the electric vehicle industry	Students have the opportunity to apply their knowledge and skills through internships or direct collaboration with the electric vehicle industry
The success rate of vocational school graduates in meeting the workforce needs of the electric vehicle industry	Evaluation of the performance of vocational school graduates in entering the world of work shows a high level of success in accordance with the needs of the electric vehicle industry.

Table 2. Analysis of Electric Vehicle Industry Needs (input from electric vehicle industry practitioners)

Indicator	Response
Students' ability to identify current trends in the electric vehicle industry.	Students can recognize and analyze the latest developments in electric vehicle technology and design

Student understanding of electric vehicle industry safety standards and regulations.	Students understand and are able to apply safety standards and regulations that apply in the electric vehicle industry.
Student involvement in internships or collaborative programs with the electric vehicle industry	Students have the opportunity to apply their knowledge and skills through internships or direct collaboration with the electric vehicle industry
The success rate of vocational school graduates in meeting the workforce needs of the electric vehicle industry	Evaluation of the performance of vocational school graduates in entering the world of work shows a high level of success in accordance with the needs of the electric vehicle industry.
Students' skills in designing technical solutions to respond to changes in the electric vehicle industry.	Students are able to develop innovative ideas and technical solutions according to the needs and changes in the electric vehicle industry.

Exploring information related to aspects of electric vehicle mechanical competency is very important in an era of transportation that is increasingly developing towards sustainable mobility. Competence in electric vehicle mechanics allows mechanics to efficiently and effectively carry out maintenance, repair and maintenance of electric vehicles[15]. This competency is key in ensuring optimal performance and reliability of electric vehicles. In addition, by exploring information related to mechanical competence in electric vehicles, the automotive industry can increase its readiness for technological change. Technological developments in electric vehicles continue, and mechanics skilled in this aspect can play a role in dealing with repair and maintenance challenges that may arise over time[16].

An in-depth understanding of mechanical competency in electric vehicles can also support energy efficiency and environmental sustainability[17]. Competent mechanics can help identify and repair potential problems that could affect the energy efficiency of electric vehicles, thereby supporting the global goal of reducing greenhouse gas emissions and adopting environmentally friendly technologies. Aspects of competency required by electric vehicle mechanics can be seen in the following tables.

Table 3. Indicators of Initiative Attitude

Attitude Aspect Indicators	Description
Initiative	a. Proactive: Mechanics who have an initiative attitude tend to be proactive. They don't just wait for orders or directions, but actively find out about the latest technology, updates, and developments in the electric vehicle industry. b. Quickly Identify Problems: Proactive mechanics are able to identify potential problems or needed

[15] Boban Melovic et al., "Attitudes and Perceptions of Employees toward Corporate Social Responsibility in Western Balkan Countries: Importance and Relevance for Sustainable Development," Sustainability (Switzerland) 11, no. 23 (2019), https://doi.org/10.3390/su11236763.

[16] Thao Quoc Tran and Tu Ngoc Phan Tran, "Attitudes toward the Use of Project-Based Learning: A Case Study of Vietnamese High School Students," Journal of Language and Education 6, no. 3 (2020): 140–52, https://doi.org/10.17323/jle.2020.10109.

[17] Muh. Juandi Arif Baitullah and Wagiran Wagiran, "Cooperation between Vocational High Schools and World of Work: A Case Study at SMK Taman Karya Madya Tamansiswa," Journal of Vocational Education 9, no. 3 (2019): 280–93, https://doi.org/10.21831/jpv.v9i3.27719.

	repairs on electric vehicles without having to wait for complaints from customers. They have a sensitivity to signs of damage or abnormalities. c. Independent Learning: An initiative attitude includes the ability to learn independently. Proactive electric vehicle mechanics will seek out additional information, tutorials and training to continuously improve their knowledge and skills. d. Offering Innovative Solutions: The initiative also includes the ability to offer innovative solutions to electric vehicle problems. Proactive mechanics can develop creative ideas to improve the efficiency, performance or safety of electric vehicles. e. Work Efficiently: An initiative attitude also includes the ability to work efficiently. Proactive mechanics can manage time and resources well, so they can complete work quickly without sacrificing work quality.

By combining this attitude of initiative, an electric vehicle mechanic can become an effective and qualified professional, able to meet the challenges that arise in the ever-evolving world of electric vehicles[18].

Table 4. Disciplinary Attitude Indicators

Attitude Aspect Indicators	Description
Discipline	a. Punctuality: A disciplined electric vehicle mechanic always arrives on time at work. Discipline in this case is important to maintain workshop operational efficiency and ensure that maintenance or repair work on electric vehicles is carried out according to a predetermined schedule. b. Compliance with Procedures: Disciplined mechanics always follow established work procedures. They comply with applicable security protocols, company guidelines, and industry standards. This is important in the context of electric vehicles because safety and security are a top priority. c. Accuracy and Regularity: Discipline is also reflected in thoroughness and regularity when carrying out tasks. Disciplined mechanics ensure that each maintenance or repair step is carried out carefully and in the correct order. They also maintain order in the workplace, including proper storage of equipment and spare parts. d. Responsibility towards Duties: A disciplined electric vehicle mechanic takes full responsibility towards his duties. They complete the work

[18] Xavier Castañer and Nuno Oliveira, "Collaboration, Coordination, and Cooperation Among Organizations: Establishing the Distinctive Meanings of These Terms Through a Systematic Literature Review," Journal of Management 46, no. 6 (2020): 965–1001, https://doi.org/10.1177/0149206320901565.

	according to established quality standards and ensure that the repaired electric vehicle meets the manufacturer's specifications as well as applicable regulations. e. Time Management: Discipline also includes good time management. A disciplined mechanic can manage time efficiently, prioritize urgent tasks, and avoid wasting time. This ensures that electric vehicle repair or maintenance work can be completed quickly and without compromising quality.

With this disciplinary competency attitude, an electric vehicle mechanic can make a positive contribution to the smooth operation of the workshop and increase customer confidence in the services provided.[19][20].

Table 5. Indicators of Independence Attitude

Attitude Aspect Indicators	Description
Independence	a. Independent Problem Solving: An independent mechanic is able to identify and solve problems independently. They have enough technical knowledge to analyze the symptoms of problems in electric vehicles, determine the causes, and design appropriate repair solutions. b. Understanding of Latest Technology: Independence also includes the ability to continuously learn and understand the latest developments in electric vehicle technology. Independent mechanics will seek out the latest information, take training, and develop their skills to stay relevant in an ever-evolving field. c. Personal Project Management: Independent electric vehicle mechanics can manage repair or maintenance projects independently. They can plan work steps, manage time efficiently, and ensure that tasks are completed according to a set schedule.

By having an attitude of independent competence, electric vehicle mechanics can become a valuable asset in this ever-growing industry. The ability to work independently makes a positive contribution to workshop efficiency, service quality and customer satisfaction[21].

Table 6. Responsible Attitude Indicators

Attitude Aspect Indicators	Description

[19] Mukta Goyal, Chetna Gupta, and Varun Gupta, "Heliyon A Meta-Analysis Approach to Measure the Impact of Project-Based Learning Outcomes with Program Attainment on Student Learning Using Fuzzy Inference Systems," Heliyon 8, no. December 2021 (2022): e10248, https://doi.org/10.1016/j.heliyon.2022.e10248.

[20] Nizwardi Jalinus, Rahmat Azis Nabawi, and Aznil Mardin, "The Seven Steps of Project Based Learning Model to Enhance Productive Competences of Vocational Students," Advances in Social Science, Education and Humanities Research, 102, no. May 2018 (2017): 251–26, https://doi.org/10.2991/ictvt-17.2017.43.

[21] Simon McGrath et al., "Vocational Education and Training for African Development: A Literature Review," Journal of Vocational Education and Training 72, no. 4 (2020): 465–87, https://doi.org/10.1080/13636820.2019.1679969.

Responsibility	a. Knowledge Update: Continuously develop the latest knowledge and skills in electric vehicle technology. Undertake training and courses to understand the latest developments in the industry and ensure that they remain competent. b. Manage Time Efficiently: Plan and manage time well to complete work according to the set schedule. Prioritize work based on level of urgency and complexity. c. Responsible for Sustainability: Understand and implement practices that support sustainability in electric vehicle maintenance and repair, such as component recycling, use of environmentally friendly parts, and energy efficiency.

By assuming these responsibilities, an electric vehicle mechanic can make a significant contribution to the success of the repair shop, customer safety, and the progress of the electric vehicle industry as a whole[22].

Table 7. Responsible Attitude Indicators

Attitude Aspect Indicators	Description
Cooperation	a. Collaborative Work Teams: Electric vehicle mechanics need to work as a team to handle complex maintenance or repair projects. Good teamwork enables the exchange of ideas, experiences, and knowledge, which can improve efficiency and quality of work. b. Effective Communication: Clear and effective communication between mechanics, shop management and customers is essential. Mechanics need to communicate information regarding diagnosis, estimated costs and work times to workshop management and customers in a transparent manner. c. Joint Training and Development: Workshop management is responsible for providing training and development for mechanics. Mechanics can collaborate with management to plan training programs that align with the latest developments in electric vehicle technology. d. Collaboration with Electric Vehicle Suppliers and Manufacturers: Mechanics need to establish good cooperation with spare parts suppliers and electric vehicle manufacturers. This helps in getting quick access to high-quality spare parts and better understanding of the latest technology. e. Conflict Management: In situations of disagreement or conflict, it is important to handle issues in a professional and collaborative manner. Mechanics, workshop management and other related parties need to work together to find fair

[22] Khasan Setiaji, Nina Farliana, and Muhammad Feriady, "Contribution of 21st Century Skills to Work Readiness in Industry 4.0," International Journal of Advanced Science and Technology 29, no. 5 (2020): 5947–55, https://www.researchgate.net/publication/341598843.

	solutions and build harmonious relationships. f. Understanding Customer Needs: Collaboration with customers is essential in gaining a deep understanding of their needs and expectations. Mechanics need to communicate well to provide services that suit customer needs, as well as provide useful suggestions and recommendations. g. Common Quality Standards: Mechanics and management need to agree on common quality standards that must be followed when performing maintenance and repairs on electric vehicles. This is important to ensure that every vehicle that leaves the workshop meets established safety and performance standards.

By prioritizing cooperation in these various aspects, electric vehicle mechanic workshops can achieve higher operational efficiency, provide better service to customers, and contribute to positive developments in the electric vehicle industry[23][24].

Table 7. Honesty Attitude Indicators

Attitude Aspect Indicators	Description
Honesty	a. Providing Honest Information: An electric vehicle mechanic must provide honest information to workshop management and customers. This includes accurate diagnosis, transparent cost estimates, and realistic turnaround time estimates. b. Transparency in Services: Honesty is reflected in transparency regarding the work that has been done. Mechanics need to provide clear reports regarding maintenance or repairs that have been carried out, as well as provide information about the spare parts used. c. Openness to Limitations and Risks: Mechanics need to be honest about the limitations of their knowledge or skills in dealing with a particular problem. If there are additional risks or complications that may arise during repairs, they need to be honestly informed to the customer. d. Honesty in Time Management: Providing honest time estimates and ensuring that work is completed according to the promised schedule. If there is an unexpected delay, honesty in notifying customers will build trust.

Honesty creates a strong foundation for healthy business relationships and builds trust both among colleagues and with customers. Electric vehicle mechanics who are

[23] Febrika Yogie Hermanto and Mar Sholikah, "The Need of Practical Teaching in Vocational High," Journal of Vocational Education 9, no. 3 (2019): 238–48.

[24] Purificación Parrado-Martínez and Sonia Sánchez-Andújar, "Development of Competences in Postgraduate Studies of Finance: A Project-Based Learning (PBL) Case Study," International Review of Economics Education 35, no. March (2020), https://doi.org/10.1016/j.iree.2020.100192.

committed to acting with honesty not only build a good reputation, but also contribute to the positive growth of the repair shop and the industry as a whole[2526].

Table 8. Indicators of Knowledge of Measuring Instruments and Safety

Knowledge Aspect Indicators	Description
Measuring and Safety Equipment	In electric vehicle mechanic work, the use of measuring tools and adhering to safety procedures is key to maintaining work quality and work safety. Below are some common measuring tools and safety measures that are relevant in the context of electric vehicle mechanics

When electric vehicle mechanics understand the proper use of measuring tools and follow proper safety procedures, they can work efficiently and reduce the risk of accidents, thereby creating a safe and productive work environment.

Table 9. Indicators of Job Field Knowledge

Knowledge Aspect Indicators	Description
Field of work	The field of work in electric vehicle mechanics involves a variety of roles that include maintenance, repair, and upkeep of vehicles that use electric technology.

The role of an electric vehicle mechanic continues to evolve as technology advances. Technical skills and in-depth knowledge of electrical and electronic systems are essential in these areas of work[27].

Table 10. Indicators of Job Field Knowledge

Skill Aspect Indicators	Description
Work preparation	Job preparation in an electric vehicle mechanic includes several important steps to ensure success and safety in carrying out maintenance and repair tasks.

By preparing well, electric vehicle mechanics can provide reliable service and increase customer confidence, while maintaining safety and security in the workplace[28].

Table 11. Job Skills Indicators

Skill Aspect Indicators	Description

[25] Ryan Hidayat Rafiola et al., "The Effect of Learning Motivation, Self-Efficacy, and Blended Learning on Students' Achievement in the Industrial Revolution 4.0," International Journal of Emerging Technologies in Learning 15, no. 8 (2020): 71–82, https://doi.org/10.3991/ijet.v15i08.12525.

[26] Zainun Misbah et al., "Evaluating Competence-Based Vocational Education in Indonesia," Journal of Vocational Education and Training 72, no. 4 (2020): 488–515, https://doi.org/10.1080/13636820.2019.1635634.

[27] Ibeawuchi K. Enwereuzor et al., "Perceived Leader Integrity as a Mediator between Ethical Leadership and Ethical Climate in a Teaching Context," BMC Psychology 8, no. 1 (2020): 1–11, https://doi.org/10.1186/s40359-020-00420-6.

[28] Dwi Agus Sudjimat, Amat Nyoto, and Maftuchin Romlie, "Implementation of Project-Based Learning Model and Workforce Character Development for the 21st Century in Vocational High School," International Journal of Instruction 14, no. 1 (2020): 181–98, https://doi.org/10.29333/IJI.2021.14111A.

Field of work	Skills in completing work in accordance with Standard Operating Procedures (SOP) are very important in maintaining work quality, consistency and safety. Here are some of the skills needed to successfully complete work according to SOPs in electric vehicle mechanics: a. Understanding SOP: • Ability to read, understand, and follow established SOPs for various types of electric vehicle maintenance or repair. • Awareness of possible SOP changes and ability to update knowledge accordingly. b. Compliance with Procedures: • Discipline in complying with every step and instruction in the SOP, including the safety protocols and quality measures described. • Able to identify relevant SOPs for the type of work being carried out. c. Ability to Understand and Use Tools: • Understand the tools and equipment used in accordance with SOP. • Use tools properly and comply with associated safety procedures. d. Diagnosis and Troubleshooting Capabilities: • Able to carry out diagnosis according to SOP to identify problems with electric vehicles. • Ability to plan and implement corrective solutions in accordance with established procedures. e. Technical Skills: • Master the technical skills needed to complete work according to SOP. • Continue to develop technical skills in accordance with developments in electric vehicle technology.

These skills will help electric vehicle mechanics to remain consistent, efficient, and ensure that the work they perform meets the highest standards set by SOPs. This will also give confidence to customers and workshop management regarding the quality of the services provided[29][30].

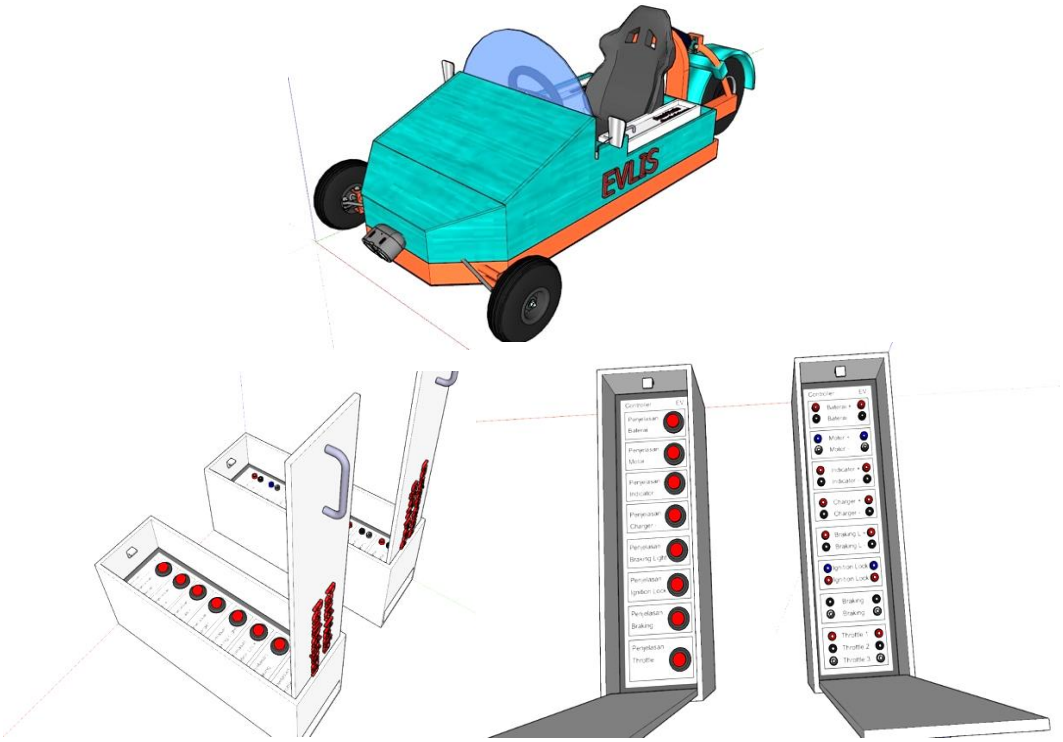
[29] Ramil D Evangelista, "24-Volts Automotive Charging System Trainer and Tester Bench," United International Journal for Research & Technology 03, no. 06 (2022): 49–53.

[30] S Titik Dwiyati et al., "Development of Automotive Vocational Homeschooling Education Based on Technopreneurship in Jakarta, Indonesia," KnE Social Sciences 3, no. 12 (2019): 544, https://doi.org/10.18502/kss.v3i12.4124.

Internal Validation

Internal validation aims to test the feasibility of the EVLIS design by experts. A feasible EVLIS design is then used as a guide for making EVLIS prototypes/products. The results of the EVLIS design can be seen in Figure 2.

Figure 2. Final EVLIS Product Design



The development of industry-based electric vehicle learning media (EVLIS) makes a significant contribution in preparing the automotive industry workforce to face the change towards electric cars[31]. By utilizing an industry-based approach, students can engage in simulations of real-life situations in the world of work, thereby enhancing their practical skills and understanding of electric vehicle technology. The results of expert evaluations show an increase in students' abilities in designing, developing and maintaining electric vehicles, in line with the demands of an industry that is increasingly focusing on sustainable cars[32].

Discussion of research results highlights the importance of integrating industry-based learning media in technical and vocational education programs[33]. It was found that this learning method not only increased students' technical knowledge, but also provided a broader perspective regarding the work environment of the electric vehicle industry[34]. Students can learn about safety standards, regulations, and best practices in the industry,

[31] Kotha Raj Kumar Reddy et al., "Developing a Blockchain Framework for the Automotive Supply Chain: A Systematic Review," Computers and Industrial Engineering 157 (2021): 107334, https://doi.org/10.1016/j.cie.2021.107334 .

[32] Muslim et al., "Project-Based Learning Tools for Light Vehicle Engines," Journal of Vocational Education 10, no. 1 (2020): 22–33.

[33] I Gede Diva et al., "Development of Automotive Basics Learning Module Sub-Subject Special Service Tools (SST) Based on Augmented Reality," Journal of Technology and Vocational Education 28, no. 2 (2022): 213–24.

[34] Pantelis Linardatos, Vasilis Papastefanopoulos, and Sotiris Kotsiantis, "Explainable AI: A Review of Machine Learning Interpretability Methods," Entropy 23, no. 1 (2021): 1–45, https://doi.org/10.3390/e23010018.

all of which are important to prepare them to be workforce ready.[35]. These results provide the basis for developing a curriculum that is more integrated with industry needs, ensuring graduates have the skills that are relevant and needed in the electric vehicle industry.

CONCLUSION

EVLIS, which was developed by utilizing industrial aspects, provides a more contextual and in-depth learning experience. The results of research data collection show that by using EVLIS students can more easily understand the technical concepts and production processes of electric vehicles through the application of industry-based learning methods. By gaining a better understanding of the practical and industrial aspects of electric vehicles, students can be better prepared to face the challenges in an automotive industry increasingly focused on sustainability.

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