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# Utilization of Electric Bicycle Trainers as Learning Media to Support the Challenges of the Industrial Revolution 4.0 at SMK N 2 Probolinggo

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**Abstract**

In the contemporary era marked by the beginning of the Fourth Industrial Revolution (4.0), the world of education faces unprecedented challenges in preparing students to face the demands of a rapidly evolving technological and industrial environment. In response, educational institutions, especially vocational schools such as SMK N 2 Probolinggo, strive to improve the competencies of their students so that they can effectively navigate and contribute to the demands of the Industrial Revolution 4.0. This research initiative stems from the awareness of the critical need to align educational practices with emerging trends and the requirements of the contemporary industrial landscape. SMK N 2 Probolinggo recognizes the importance of equipping its students with relevant skills and competencies that will enable them to thrive in an industry marked by automation, digitalization, and technological advancement. The use of electric bicycle trainers as a new learning medium signifies a proactive approach in integrating innovative pedagogical methods with real-world technology applications. By utilizing electric bicycle trainers, students are provided with hands-on experiences that simulate real-world scenarios, enabling them to develop technical proficiency, problem-solving skills, and adaptability that are essential for success in the Industrial Revolution 4.0.

**Keywords**: SMKN 2 Probolinggo, Electric Motorcycle Trainer, Industrial Revolution 4.0

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## INTRODUCTION

SMK N 2 Probolinggo is a vocational school that recognizes the urgent need to prepare its students to face the challenges of the Fourth Industrial Revolution (4.0). Understanding the dynamics of today's industry characterized by automation and technological advancement, Through this initiative, SMK N 2 Probolinggo aims to integrate innovative pedagogical methods with real-world work applications by utilizing electric bicycle trainers as a direct learning medium. By actively engaging students in practical experiments and collaborative learning experiences, the school seeks to equip its students with the technical expertise, problem-solving skills, and adaptability needed to thrive in the ever-evolving industrial landscape of the 4.0 era(Kurniawan dkk., 2021; Sasmito & Wijayanto, 2020; Sitorus dkk., 2020; Sugiarto dkk., 2022; Sulistyanto dkk., 2021).

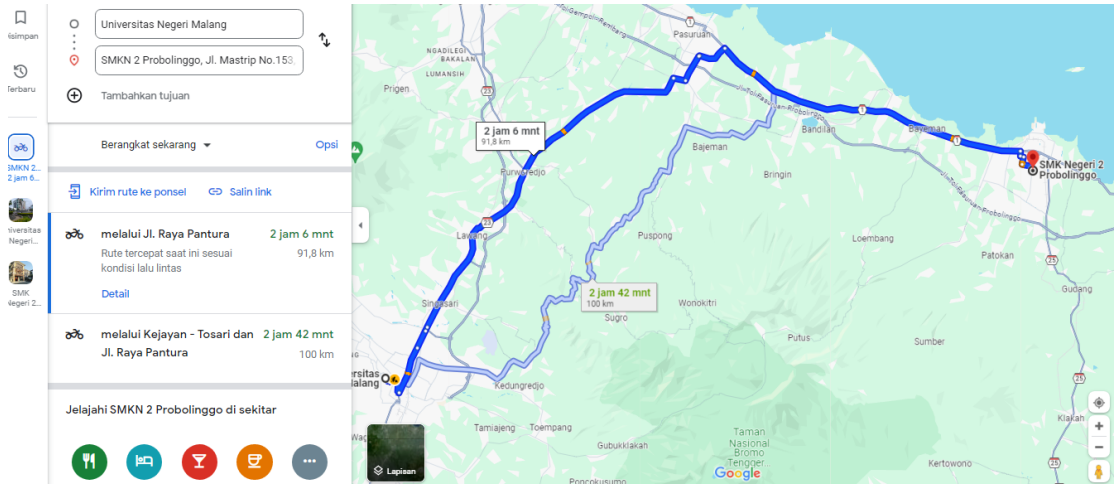


**Figure 1** Location of Partners

In the contemporary era marked by the beginning of the Fourth Industrial Revolution (4.0), the world of education faces unprecedented challenges in preparing students to face the demands of a rapidly evolving technological and industrial environment(Faiz dkk., 2022; Falah dkk., 2023). In response, educational institutions, especially vocational schools such as SMK N 2 Probolinggo, strive to improve the competencies of their students so that they can effectively navigate and contribute to the demands of the Industrial Revolution 4.0.

This research initiative stems from the awareness of the critical need to align educational practices with emerging trends and the requirements of the contemporary industrial landscape. SMK N 2 Probolinggo recognizes the importance of equipping its students with relevant skills and competencies that will enable them to thrive in an industry marked by automation, digitalization, and technological advancement(Handoko dkk., 2023; Sujito dkk., 2022).

The use of electric bicycle trainers as a new learning medium signifies a proactive approach in integrating innovative pedagogical methods with real-world technology applications(Ariza & Olatunde-Aiyedun, 2023; Badilla-Quintana & Sandoval-Henríquez, 2021; Carella & Colombo, 2024; Costa dkk., 2022; Ibrahim, 2021). By utilizing electric bicycle trainers, students are provided with hands-on experiences that simulate real-world scenarios, enabling them to develop technical proficiency, problem-solving skills, and adaptability that are essential for success in the Industrial Revolution 4.0(Benis dkk., 2021; Garcés & Peña, 2022; Gwangwava, 2021; Hernandez-de-Menendez dkk., 2020; Singhaphandu & Pannakkong, 2024).

In addition, this study seeks to explore the efficacy of using an electric bicycle trainer as a means to actively engage students in the learning process, fostering a dynamic and interactive educational environment conducive to skill acquisition and knowledge retention.(Laurens dkk., 2021; Maulana, 2023; Misbahudin, 2023; Setyanto dkk., 2023; Widianto, 2023). Through hands-on experiments and collaborative learning experiences facilitated by electric bike coaches, students are encouraged to explore concepts related to engineering, mechanics, and sustainable transportation, thereby fostering multidisciplinary learning outcomes essential to addressing the complexities of the Industrial Revolution 4.0.


(a)

(b)

**Figure 2 (a) and (b)** Learning Process of SMK N 2 Probolinggo

In summary, this research initiative seeks to address the needs of educational institutions to adapt and innovate in response to the ever-growing demands of the Industrial Revolution 4.0. By integrating electric bicycle trainers as a learning medium, SMK N 2 Probolinggo aims to empower its students with the competencies and skills needed to excel in the dynamic landscape of the contemporary industrial era.

## METHOD

The methodology of this research and community service activity includes several main steps:

1. Needs Assessment and Objective Definition: Conduct a comprehensive needs assessment to identify the current competencies of SMK N 2 Probolinggo students and ensure the specific skills needed to face the challenges of the Industrial Revolution 4.0. Set clear research objectives, describe the competencies and learning outcomes desired by students.
2. Literature Review and Development of Pedagogical Framework: Review existing literature on Industry 4.0, vocational education, and innovative teaching methodologies. Develop a pedagogical framework that integrates the use of electric bicycle trainers as a

learning medium with the principles of experiential learning, direct experiments, and problem-based learning

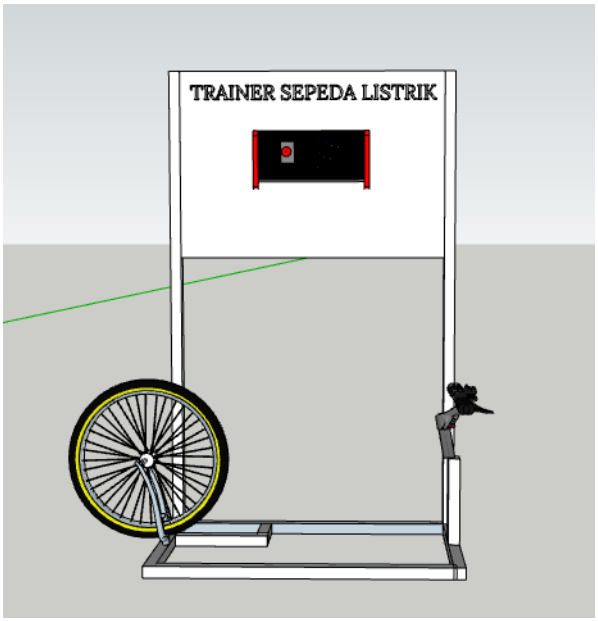


**Figure 3** Electric Bicycle Trainer Design and Plan

3. Selection and Acquisition of Electric Bike Trainers: Identify electric bike trainers that are in line with the curriculum objectives and learning needs of SMK N 2 Probolinggo students. Procure or develop necessary equipment, ensuring compliance with school infrastructure and safety standards.
4. Curriculum Integration and Learning Planning: Integrate the use of electric bike trainers into the existing curriculum of relevant subjects, such as electrical engineering, mechanics, and sustainable transportation. Develop detailed lesson plans and teaching materials that incorporate hands-on activities, simulations, and practical exercises using the trainers.
5. Training for Educators and Students: Provide training sessions for educators to familiarize them with the operation, maintenance, and teaching strategies associated with electric bike trainers. Equip students with the knowledge and skills necessary to utilize the trainers effectively, emphasizing safety protocols, troubleshooting techniques, and data interpretation.
6. Implementation and Data Collection: Implement integrated curriculum and learning activities using electric bike trainers in the classroom environment. Collect quantitative and qualitative data on student engagement, learning outcomes, skill development, and overall satisfaction with the learning experience.
7. Assessment and Evaluation: Assess student performance and progress using a variety of assessment methods, including quizzes, hands-on demonstrations, project presentations, and reflective journals. Evaluate the effectiveness of the intervention in enhancing student competencies and addressing the challenges of the Industrial Revolution 4.0.
8. Feedback and Iterative Improvement: Collect feedback from educators, students, and other stakeholders on their experiences in utilizing the electric bicycle prop as a learning medium. Identify areas for improvement and make necessary adjustments to the curriculum, teaching methods, and training protocols based on the feedback received.
9. Documentation and Dissemination: Document research findings, including best practices, lessons learned, and recommendations for future implementation. Disseminate results through academic publications, conference presentations, workshops, and other

relevant channels to share insights and contribute to the broader discourse on vocational education and Industry 4.0 readiness.

**RESULT AND DISCUSSION**

This activity begins with the design and design process to be implemented in SMK N 2 Probolinggo partners. The stages in this activity are:

1. Electric Bicycle Trainer Tool Making Stage

• Design and Planning:

In the initial stage, the design and planning of the electric bicycle trainer components that will be used as learning media are carried out. This tool is designed so that students can use it to learn the working principles of electric bicycles, their components (battery, electric motor, drive system), and installation.

• Tool Making

The tool making process involves assembling components according to the design that has been made. Some of the main parts of the trainer include the bicycle frame, electric motor, battery, control system, and digital display to show operational data (speed and power). The manufacture of this tool is carried out by a team that is an expert in electric vehicle technology and automation.


**Figure 4** Tool Design

• Tool Testing

After the tool is finished, a series of tests are carried out to ensure that all components are working properly. This testing includes testing the function of the electric motor, battery charging system, and simulation of repair and maintenance scenarios that will be used during student training.

2. Tool Use Socialization Stage

• Teacher and Instructor Training

Before the tool is handed over to the school, socialization and training are carried out for teachers and instructors of SMK N 2 Probolinggo. This training includes how to use an electric bicycle trainer, teaching methods based on this tool, and how to guide students in understanding electric bicycle technology.

• Socialization to Students

Socialization to students is carried out in the form of presentations and live demonstrations. Students are introduced to the main components of an electric bicycle, how it works, and how the trainer tool can be used for interactive learning. They are also taught basic maintenance and repair methods.


(a)

(b)

**Figure 5 (a) & (b)** Tool Socialization

3. Signing Stage of Handover Documents

• Preparation of Handover Documents

The handover document is prepared by the activity implementation team containing details of the submitted tools, the purpose of use, and the commitment of both parties (school and implementation team) to utilize the tools to support student learning. This document also includes a guarantee that the tools provided are functioning properly and will be used according to their purpose.

• Signing of Documents

After the documents are prepared, they are signed by both parties, namely representatives from the activity implementation team and the school (principal or vice principal). This signing takes place in a formal event attended by teachers, students, and several invited guests.

(a)


(b)

**Gambar 5 (a) & (b)** Penandatangan Berkas Serah Terima Alat

4. Equipment Handover Stage

• Symbolic Handover

After signing the handover documents, a symbolic handover of the electric bicycle trainer equipment was carried out from the implementing team to SMK N 2 Probolinggo. This handover signifies that the equipment is officially part of the school inventory and can be used as a learning medium.

• Use of Equipment by Students

After the handover process, the trainer equipment began to be actively used in learning at school. Students were divided into several groups to take part in practical sessions guided by teachers who had received training. In this practice, students will learn about assembly, maintenance, and simulation of electric bicycle repair directly.

• Evaluation of Equipment Utilization

After the equipment has been used in several learning sessions, an evaluation is carried out to ensure that the equipment provides optimal benefits in improving student competence. This evaluation is carried out through direct observation, student surveys, and skills tests.


**Gambar 6** Penerapan Kegiatan

**Table 1** Benefits of the Program Before and After Activities

| Aspects | Before Activity | After Activity | Positive Impact/Benefits |
|---|---|---|---|
| **Conceptual Understanding of Electric Bicycle Technology** | Limited understanding of electric bicycle concepts | Understanding significantly increased | Students have a stronger knowledge base regarding the components and working principles of electric bicycles. |

| | | | |
|---|---|---|---|
| **Installation and Maintenance Technical Skills** | Students lack practical skills related to electric bicycle installation | 90% of students are able to perform basic electric bicycle installation and maintenance | Students gain technical skills that are ready to be applied in the industrial world and real jobs. |
| **Problem Solving Skills** | Students have difficulty diagnosing technical problems related to new technologies | 75% of students can solve common technical problems independently | Improved critical skills in identifying and solving problems with electric bicycle technology. |
| **Interest and Motivation for Technology Learning** | Students' interest in electric bicycle technology is relatively low | 85% of students expressed higher interest in new technologies | Increased student interest in innovation and technology helps them be better prepared for industry 4.0. |
| **Soft Skills (Teamwork and Communication)** | Students tend to work individually with little interaction in groups | 80% of students are actively involved in discussions and teamwork | Enhances teamwork, communication, and collaboration required in technical work and joint projects. |
| **Mastery of New Learning Media** | Students are not yet familiar with learning media based on electric bicycle technology | Students master the use of electric bicycle trainers in practice | Helping students become familiar with the use of new technology in learning that is relevant to future industries. |
| **Readiness to Face the Challenges of the Industrial Revolution 4.0** | Student competencies are less in line with the needs of future industries | Student competencies are increasing and relevant to industrial technology 4.0 | Students are better prepared to face industrial challenges that require an understanding of renewable energy technology. |

**CONCLUSION**

This community service activity improves students' competency in the field of electric bicycle technology. By using an electric bicycle trainer, students gain a better understanding of the concept of electric vehicles, component installation, maintenance, and technical problem solving relevant to the challenges of the industrial revolution 4.0. The evaluation results showed a significant increase in students' technical abilities and conceptual understanding, with an average post-test score higher than the pre-test. In addition, the hands-on learning method has been shown to improve students' skills in solving technical problems independently, increasing motivation, and interest in technology-based learning. The electric bicycle trainer also supports a curriculum based on renewable technology, allowing students to learn innovations that are relevant to the

needs of the future industry. This program not only prepares students for the development of green technology and automation, but also strengthens cooperation between schools, industry, and the implementation team in ensuring the use of sustainable technology in the educational environment. The handover of the electric bicycle trainer to SMK N 2 Probolinggo is expected to provide long-term benefits, helping schools prepare competent students who are ready to compete in the modern technology-based job market. Overall, this activity provides a real contribution to the development of quality human resources that are relevant to the demands of the industrial era 4.0, which increasingly demands a workforce that understands technology and is able to adapt to continuously developing innovations.

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