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# Development of E-Learning Module for Lathe Machining Techniques with a Service-Learning Approach in Vocational High Schools

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**ABSTRACT**

This study addresses the limitations in current learning tools for vocational machining skills, which impede active engagement, independent study, and optimal learning outcomes. To address these challenges, an e-module for Lathe Machining Engineering was developed using a Service Learning approach to enhance learning effectiveness through valid, practical, and effective instructional resources. The development followed the ADDIE model, encompassing Analysis, Design, Development, Implementation, and Evaluation stages. Data were collected from teachers, subject-matter experts, and students to assess the e-module's validity, practicality, and effectiveness. Descriptive statistics were used for data analysis. The e-module was found to be valid across multiple criteria: content feasibility (0.85), presentation quality (0.86), language suitability (0.82), Work-Based Learning (WBL) alignment (0.94), and incorporation of the Service Learning approach (0.83). Practicality was high, with student and teacher responses averaging 90.8%. Effectiveness, measured by a gain score of 0.60, fell in the medium category, indicating improved learning outcomes. The findings suggest that the Service Learning-based e-module is a robust learning medium for enhancing machining competencies in vocational education. Its integration of active learning principles addresses gaps in engagement and independent study, supporting its practical application in technical education settings. The Lathe Machining Engineering e-module, grounded in a Service Learning approach, is valid, practical, and effective. Future research should explore its long-term impact on student performance and adaptability across diverse technical disciplines.



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## 1. INTRODUCTION

In vocational education, especially in fields like Machining Engineering, developing specialized competencies is critical for preparing students to meet industry demands. Previous studies highlight the necessity for integrating both theoretical and practical knowledge to build technical proficiency in students (Jalinus et al., 2018). Lathe machining, a core aspect of machining engineering, uses a single-

point cutting tool to shape rotating workpieces and is fundamental to student training in machining techniques. Conventional lathe machining, in particular, is widely taught due to its applicability across industries, from large-scale manufacturing to small precision component production (Azwinur, 2017). Research has also underscored the importance of using industry-aligned methods and tools in training students, which enables them to meet industry standards upon graduation (Suwiarta, 2020; Wijaya, 2015).

Teachers play a central role in the implementation of effective machining instruction by preparing comprehensive lesson plans that align with students' needs and industry requirements. This process includes developing a syllabus, learning plans (RPP), and instructional media that enhance student engagement and understanding (Sudiyono, 2021). Studies show that systematic planning and the use of well-designed instructional materials not only improve learning outcomes but also bridge the gap between theoretical knowledge and practical skills (Nur'alifah, 2022; Islami, 2021). However, existing research indicates that conventional approaches to teaching machining techniques, which primarily include lectures and teacher-led discussions, may limit student engagement and practical understanding (Sudarsono, 2020).

In addition to preparing instructional materials, teachers play a vital role in facilitating classroom learning and guiding students through practical sessions that simulate real-world machining tasks. They are also responsible for evaluating the learning process to assess student comprehension and skill acquisition, enabling continuous improvement in instructional strategies to meet diverse learning needs (Wijaya, 2015). Through systematic planning, active instruction, and thorough evaluation, teachers can foster a learning environment that prepares students to meet the high standards and demands of the machining industry. This comprehensive approach ensures that students not only grasp the technical skills but also understand the importance of quality, precision, and adherence to industry-specific safety protocols, further enhancing their readiness for the workforce.

Given the complexity of practical learning in lathe machining, it is essential that learning activities are carefully planned and structured to align with both the students' needs and the established standards of machining practice. Teachers play a pivotal role in this process, as they are expected to design and implement lessons that convey technical skills and inspire and engage students in a conducive learning environment. By fostering a comfortable, stimulating classroom atmosphere, teachers encourage active student participation, which is crucial for achieving successful learning outcomes. Before initiating these activities, teachers must meticulously prepare by developing effective instructional tools and materials tailored to support hands-on learning. This preparation is a strategic step toward optimizing the educational process, ensuring that each session is well-organized and capable of delivering the highest possible results (Suwiarta, 2020). Ultimately, with thorough preparation and a focus on student-centered approaches, teachers can enhance the quality of lathe machining education, enabling students to build competency and confidence in their technical skills, ready for industry challenges.

The preparation of learning tools by teachers plays a critical role in fostering conducive learning environments, particularly in practical lessons. These learning tools include implementation plans, teaching materials such as teacher's guides and modules, and job sheets containing step-by-step instructions for work processes that students must complete (Islami, 2021; Nur'alifah, 2022). Teachers utilize these teaching materials to deliver information aligned with the lesson plan (*Rencana Pelaksanaan Pembelajaran*, RPP). In vocational education, learning involves both theoretical and practical components, where students first study the theory and then apply it through hands-on activities in workshops (Pernanda, 2018).

Theoretical learning activities aim to instill foundational concepts related to the subject matter, while practical activities focus on equipping students with hands-on skills that integrate their theoretical knowledge. In turning learning activities, which are part of vocational training, students engage in productive learning that combines theory with practice. These activities are structured around Core Competencies (Kompetensi Inti, KI) and Basic Competencies (Kompetensi Dasar, KD), ensuring that concepts are taught prior to practical implementation. This approach enables students to grasp the

underlying concepts of their work before engaging in lathe practice, thereby improving their practical execution.

Improved student understanding positively influences knowledge acquisition, skill development, and attitudes, creating a strong foundation for achieving learning objectives. The integration of theoretical understanding with practical application ensures that students not only grasp essential concepts but also apply them effectively in real-world scenarios. This alignment enables students to meet the learning outcomes designed by teachers, bridging the gap between conceptual learning and hands-on experience (Hasri, 2021). Ultimately, this approach not only enhances student competence but also prepares them to meet future challenges with confidence and proficiency.

Developing learning tools encompasses the creation of teaching materials, learning resources, and instructional aids that guide teachers in effectively planning and implementing the learning process. These tools serve as essential frameworks to support teachers in delivering lessons while meeting students' needs. Well-structured learning tools are crucial for fostering an enjoyable and effective learning environment, tailored to enhance student engagement and understanding (Zaus, 2018). According to the *Kamus Besar Bahasa Indonesia* (KBBI), the term "devices" refers to means or tools, while "learning" is defined as the process or activity of acquiring knowledge. Together, learning tools are instrumental in bridging these concepts to achieve optimal educational outcomes.

The learning process continues to rely on conventional approaches, such as teacher-led questioning, answering, and discussions, which often fail to engage students. Teachers' questions frequently go unanswered, reflecting a lack of active student participation. The *Rencana Pelaksanaan Pembelajaran* (RPP) used by teachers has significant shortcomings, including the absence of detailed material, learning models, and specific instructional steps. This results in teacher-centered instruction with minimal emphasis on student engagement. Lesson planning is typically carried out by subject teachers based solely on the syllabus, without incorporating modules designed to foster independent learning in both theoretical and practical contexts.

Additionally, the learning process remains abstract, failing to effectively enhance students' knowledge and skills as expected. This gap is particularly evident in practical lessons, where students struggle to grasp the concepts and their applications. Furthermore, the current teaching approach does not clearly demonstrate the real-world benefits of learning activities, nor does it adequately prepare students to apply their knowledge in industrial or community service contexts (Sudarsono, 2020). In conclusion, the conventional, teacher-centered learning process, coupled with poorly designed lesson plans, hinders students' ability to achieve meaningful learning outcomes. A shift towards more interactive, student-centered approaches and the development of comprehensive learning modules is essential to enhance understanding and align learning with practical, real-world applications.

While previous research has established the foundational aspects of machining education in vocational settings, there is limited exploration into the development of self-guided e-learning modules tailored for practical, hands-on subjects like lathe machining. Most studies address traditional classroom setups without incorporating digital learning tools, which can provide flexibility and improve accessibility for students who lack sufficient time on physical machines due to limited resources (Hasri, 2021; Yulastri, 2018). Additionally, existing curricula often lack service-learning elements that allow students to apply their skills in real-world, community-oriented projects, a component that is increasingly recognized as vital in vocational training (Pernanda, 2018). This study addresses this gap by developing an e-learning module designed specifically for lathe machining techniques, integrating a service-learning approach that enables students to apply their technical skills within a community setting, thereby enhancing both skill acquisition and social responsibility.

The learning facilities at SMK Negeri 1 Mandau for lathe machining engineering subjects are implemented in the workshop and in the classroom. However, based on observations during practice, students still use the machines alternately. One lathe machine is used by fifteen students, this causes practical learning to be ineffective, so students feel bored waiting for their turn to carry out practice. One effort to increase students' enthusiasm and motivation for the learning material is by having media or

tools, with media that can be applied in the learning process so that it attracts students' interest in the learning material presented. Among other things, the media or tools include; Video media, visual media still or moving images and modules are part of the media that can be used in learning (Yulastri, 2018).

This study aims to explore how an e-learning module can enhance students' theoretical understanding and practical abilities in lathe machining, a critical area of competency in vocational machining education. Specifically, it seeks to determine the extent to which digital learning tools can bridge the gap in hands-on skills, especially for students with limited access to physical machines. By focusing on both theoretical and practical learning outcomes, the research investigates the potential of e-learning to effectively reinforce and expand students' machining skills, preparing them for industry standards and challenges.

Furthermore, this study examines the impact of incorporating a service-learning approach within the e-learning module on students' engagement and retention of skills. Service-learning has been recognized as a powerful pedagogical method, linking classroom knowledge with real-world applications. This approach encourages students to actively apply their learning in community or industry-related projects, fostering a deeper connection to their field and promoting essential values such as social responsibility. The research thus aims to reveal whether integrating service-learning in vocational machining education can improve students' motivation, skill retention, and readiness for professional environments.

To achieve these aims, this study sets forth several key objectives. The primary objective is to design and develop an e-learning module tailored to the specific requirements of lathe machining instruction in vocational schools. This module will not only support traditional hands-on learning but also provide a flexible, self-guided platform for skill acquisition, allowing students to progress at their own pace. Additionally, the research intends to embed a service-learning component within this module to create opportunities for students to apply their technical skills in real-world contexts, thus reinforcing both practical competencies and social awareness. Finally, this study seeks to evaluate the module's overall effectiveness in enhancing students' theoretical knowledge, practical skills, and engagement in machining engineering, providing insights that could inform broader educational practices in vocational training.

## 2. METHODS

This research employed a development research approach structured around a systematic process designed to create and refine educational materials. Given the focus on instructional events in vocational education, the study utilized the ADDIE model—a widely adopted instructional design framework encompassing five key stages: Analysis, Design, Development, Implementation, and Evaluation. Each of these stages provided a structured pathway to ensure the Lathe Machining Engineering learning module met both educational standards and practical needs. Through this model, the study aimed to produce a comprehensive e-learning module that incorporates a service-learning approach, enhancing students' knowledge, skills, and independence in the subject of lathe machining engineering.

The initial stage, Analysis, involved a thorough examination of factors relevant to developing an effective learning module. This included an analysis of student characteristics to understand their learning preferences, an evaluation of the existing curriculum to ensure alignment, a review of available teaching materials, and an assessment of community needs to incorporate practical, real-world applications. This analysis laid the groundwork for creating a module that not only aligns with academic objectives but also supports students' vocational goals and addresses industry-relevant skills. Additionally, community needs analysis helped tailor the module to include a service-learning component, promoting students' engagement with actual community or industrial projects.

Following the Analysis stage, the Design phase focused on establishing clear learning objectives and designing instructional strategies to achieve these outcomes. During this stage, learning tools were drafted, and the framework for the module was created, incorporating structured lesson plans, instructional content, and a series of assessment instruments. The design process emphasized active

learning strategies, allowing students to engage with the material in both theoretical and practical dimensions. This phase also included the creation of a test instrument grid to measure knowledge and skill acquisition, ensuring the module's effectiveness could be accurately assessed.

In the Development stage, the theoretical designs were brought to life. This included the creation of instructional materials, assessment instruments, and initial prototypes of the module. These components underwent several rounds of testing and revision based on feedback from subject matter experts and pilot testing with students. Revisions were made iteratively to refine the module, ensuring clarity, engagement, and alignment with learning objectives. Instrument testing and adjustments were essential in this stage to ensure that assessments reliably measured students' comprehension and technical skills.

The Implementation stage involved deploying the module in a real classroom setting. Here, the module's validity, practicality, and effectiveness were rigorously evaluated. Teachers and students used the module over a set period, with observations and feedback collected to assess its usability and impact. This stage included testing the module's practicality for regular use, examining how easily students and teachers could integrate it into their routines, and assessing its effectiveness in fostering student engagement and skill acquisition. The implementation phase provided critical data on how well the module met educational goals in an authentic learning environment.

Finally, the Evaluation stage assessed the overall effectiveness of the module, examining whether it met the intended learning outcomes and the requirements of a vocational education setting. Modules validated for practical use were further refined based on feedback, ensuring they were accessible, effective, and aligned with industry standards for Lathe Machining Techniques. This stage concluded with a final review, solidifying the module's value as a learning tool that is validated, practical, and effective for use in teaching Lathe Machining Engineering. Through this meticulous ADDIE-based process, the study achieved a learning module designed to enhance vocational students' technical knowledge and skills while fostering independence and community engagement.

## 3. FINDINGS AND DISCUSSION

### *3.1 Findings*

Based on the assessment and aspects contained in the validation questionnaire statement items, statistical data processing was carried out using Aiken's V. In detail, the results of the learning module validation are presented in Table 1 below.

**Table 1**. Expert Validation Results

| No | Aspect | Validator 1 | Validator 2 | Validator 3 | Average | Category |
|---|---|---|---|---|---|---|
| 1 | Feasibility of Module Content | 0.86 | 0.78 | 0.93 | 0.857 | Valid |
| 2 | Feasibility of Presentation | 0.91 | 0.80 | 0.88 | 0.863 | Valid |
| 3 | Language Eligibility | 0.80 | 0.80 | 0.88 | 0.827 | Valid |
| 4 | WBI model | `1.00 | 0.83 | 1.00 | 0.943 | Valid |
| 5 | Service Learning | 0.75 | 0.75 | 1.00 | 0.833 | Valid |

The results of the validity test analysis on expert validators obtained an average for the feasibility aspect of the module content of 0.857 > 0.60, so it can be concluded that the Lathe Machining Engineering module in the feasibility aspect of the module content is declared valid. The feasibility aspect of module presentation obtained an average of 0.863 > 0.60, so it can be concluded that the feasibility aspect of module presentation was declared valid. The language suitability aspect obtained an average of 0.827 > 0.60, so it can be concluded that the language suitability aspect is declared valid. The WBL model aspect obtained an average of 0.943 > 0.60, so it can be concluded that the WBL model

aspect is declared valid. The service learning aspect obtained an average of 0.833 > 0.60, so it can be concluded that the service learning aspect was declared valid.

Analysis of practicality test data is calculated based on the scores obtained from the questionnaire instruments distributed to students. Data was obtained after students used the Lathe Machining Engineering learning module.

**Table 2.** Analysis of Module Practicality Data by Students

| No | Assessment Aspects | Percentage (%) | Category |
|---|---|---|---|
| 1 | Performance | 81.52 | Very Practical |
| 2 | Presentation of Material | 79.45 | Very Practical |
| 3 | Benefit | 78.83 | Very Practical |
| Average Practicality of Students' Responses | | 79.93 | Very Practical |

Based on the data obtained, the average student response was 79.93%, so it can be concluded that the Lathe Machining Engineering learning module is very practical for students to use for independent learning. Practicality test data analysis is calculated based on the scores obtained from the questionnaire instrument distributed to Machining Engineering Teachers. Data was obtained after the teacher used the Lathe Machining Engineering learning module.

**Table 3.** Analysis of Module Practicality Data by Teachers

| No | Assessment Aspects | Percentage (%) | Category |
|---|---|---|---|
| 1 | Performance | 85.71 | Very Practical |
| 2 | Presentation of Material | 81.36 | Very Practical |
| 3 | Benefit | 81.25 | Very Practical |
| Average Practicality of Teachers' Responses | | 82.75 | Very Practical |

Based on the data obtained, the average teacher response was 82.75%, so it can be concluded that the Lathe Machining Engineering learning module is very practical for teachers to use in learning activities. Classical completion aims to find out the percentage of students who get a score above the KKM after using the Lathe Machining Engineering learning module. The basis for determining the effectiveness of the module is if the minimum average percentage of completeness is greater than or equal to 85%, then the Lathe Machining Engineering learning module is categorized as effective for use. On the other hand, if the minimum average percentage of completion is less than 90% then the Lathe Machining Engineering learning module will not be used effectively.

**Table 4**. Classical Completion Data

| Number of Students | The highest score | The lowest score | Value Range | | | |
|---|---|---|---|---|---|---|
| | | | <75(incomplete) | % | >75 (complete) | % |
| 29 | 93,7 | 72,4 | 2 | 6 | 27 | 93 |

The number of students who completed it based on the data above was 27 with a percentage of 93%, this shows that Classical completion has been achieved. It can be concluded that the Lathe Machining Engineering learning module is effectively used. The results of the Pretest and Posttest

were analyzed using Gain Score which aims to test the effectiveness of the treatment given to a particular group. Based on the Gain Score test carried out in the Posttest group, a Gain Score value of 0.63 was obtained with a moderate interpretation as presented in table 5

**Table 5.** Gain Score Test Results

| Total Sample | Gain Score | Interpretation |
|---|---|---|
| 29 | 0,63 | Medium |

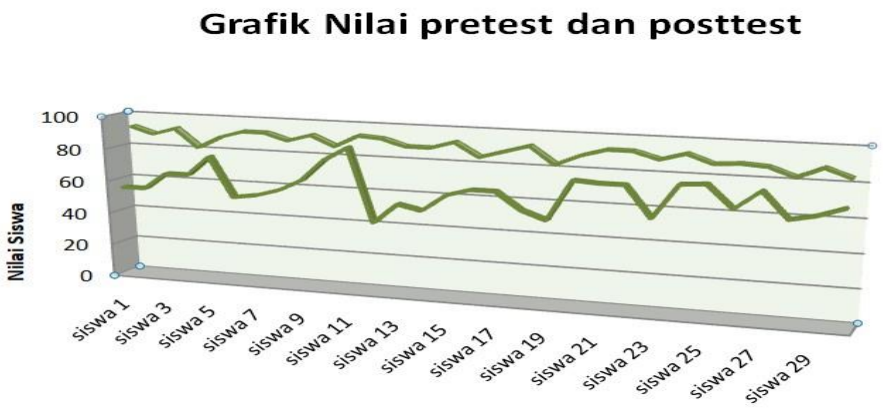


**Figure 1.** Changes in student learning outcomes

As shown in Figure 1. there was an increase in student learning outcomes before and after using the module. The effectiveness of the Lathe Machining Engineering learning module developed is in the medium category so that the module is suitable for use as a learning tool for students to use independently so that it has an impact on the Lathe Machining Engineering learning outcomes at SMKN 1 Mandau.

Testing the effectiveness of community services. The aim of testing the effectiveness of community services is to determine the average level of community satisfaction regarding service satisfaction that has been provided by students by assessing aspects of service assessment. The results of the community service effectiveness test are presented in Table 6 in detail.

**Table 6**. Community Service Effectiveness Test Results

| No | Assessment Aspects | Percentage (%) | Category |
|---|---|---|---|
| 1 | Service Procedures | 83. 07 | Satisfied |
| 2 | Completion time | 82. 67 | Satisfied |
| 3 | Service fees | 84. 73 | Satisfied |
| 4 | Service Products | 83. 07 | Satisfied |
| 5 | Means | 87. 66 | Satisfied |
| 6 | Infrastructure | 85. 65 | Satisfied |
| 7 | Competence of officers providing services | 83. 36 | Satisfied |
| | **Average** | 84.36 | Satisfied |

The effectiveness of community service carried out by class Based on the data processing carried out, the average result obtained from data processing on community response satisfaction was 84.36, which is classified as satisfied. So it can be concluded that the public is satisfied with the services provided. The product developed in this research is a Lathe Machining Engineering learning module which has been tested on class XI Machining Engineering students in the Lathe Machining Engineering Subject at SMK N 1 Mandau.

### *3.2 Discussion*

This study began with initial observations at SMK N 1 Mandau to identify specific challenges and contextual factors in the lathe machining curriculum. Observations and interviews with students and teachers highlighted several areas needing improvement, including the need for student-centered learning materials and the integration of practical, hands-on experiences in lathe operation. Through an analysis of student characteristics, it was found that students in class XI, aged 16 to 18, demonstrated problem-solving abilities and an inclination towards independent learning. These findings suggest that students are capable of engaging with more autonomous, experiential learning approaches, such as observing, operating, and troubleshooting lathe equipment themselves. Research supports that providing such opportunities not only enhances their skill acquisition but also fosters a deeper understanding of the machinery and the precision required in lathe machining (Pamungkas et al., 2016).

Curriculum analysis served as a foundation for systematically structuring the module content to align with the core and basic competencies outlined in the 2013 curriculum. The analysis, which followed the syllabus for the Lathe Machining Engineering subject at SMKN 1 Mandau, ensured that the module maintained consistency with educational objectives, including essential skills and conceptual frameworks that the curriculum aims to impart (Yunianto et al., 2021). The curriculum's focus on core competencies (KI) and basic competencies (KD) guided the development of learning indicators and objectives, establishing the core concepts that would form the basis of the module. By aligning the module with these competencies, the study reinforced the importance of adhering to standardized learning objectives, while addressing gaps in hands-on learning and student engagement.

The needs analysis conducted as part of this study provided valuable insights into the challenges faced in lathe machining instruction. Classroom observations and interviews revealed that teaching remained predominantly teacher-centered, limiting student engagement and hands-on practice. Consequently, a shift towards a more student-centered approach was deemed essential to improve learning outcomes. A Service-Learning approach was proposed as an innovative method to bridge this gap by allowing students to create community-oriented products, thereby enhancing their practical skills while contributing to the local community. This approach not only meets the students' needs for experiential learning but also aligns with broader educational goals that emphasize community service as a learning tool (Mtawa, 2021).

Following the preliminary analysis, the design phase involved formulating specific learning objectives for the lathe machining module. The objectives were crafted to enable students to systematically practice lathe operations on simple, moderately complex, and complex workpieces. This progression allowed for incremental skill-building as students learned to operate a lathe with increasing precision and complexity. To ensure optimal engagement and skill transfer, the module was developed using a Work-Based Learning (WBL) model combined with a Service-Learning approach, which research indicates can effectively link theoretical knowledge with real-world application, reinforcing students' understanding and retention (Grossman et al., 2021).

The module development underwent rigorous validation to confirm its content relevance, visual design, language clarity, and alignment with both WBL and Service-Learning models. Validation included expert evaluations through a structured questionnaire to gather feedback and suggestions for improvement. The validation results indicated high validity across all aspects, underscoring the module's appropriateness and usability in the educational setting.

Once validated, the Lathe Machining Engineering module was implemented in the classroom with class XI Mechanical Engineering students, who engaged in community service by producing JIS 10 K flanges of various diameters (2-inch, 3-inch, and 5-inch) as part of their practical learning experience. Post-implementation, a practicality assessment of the module focused on three main aspects: appearance, material presentation, and user benefits. Results showed high practicality, with scores of 90.81 for display and 83.04 for material presentation, both within the "very practical" category. This demonstrated the module's user-friendliness and effectiveness in presenting lathe machining content.

Finally, an effectiveness test was conducted using gain score analysis to evaluate the module's impact on students' learning outcomes. The gain score of 0.64, categorized as medium, indicates a significant improvement in students' knowledge and skills following the module's implementation. This medium-level gain suggests that while the module substantially benefits students, further refinements could enhance its effectiveness. Overall, the module's positive practicality and effectiveness scores support its utility in vocational education, offering a structured yet flexible approach to lathe machining education that combines technical skill development with service-based community engagement.

## 4. CONCLUSION

This study on the development of a Lathe Machining Technique learning module, designed with a service-learning approach and developed using the ADDIE model, yielded a practical and effective educational tool for class XI Machining Engineering students at SMKN 1 Mandau. The module was validated by experts, who assessed its content relevance, presentation quality, language clarity, and adherence to both Work-Based Learning and Service-Learning models, affirming its validity. Following practical testing, both students and teachers rated the module as highly practical, underscoring its usability and effectiveness in a classroom setting. The module's effectiveness was further validated through pretest and posttest comparisons, which demonstrated significant improvements in student learning outcomes.

The findings imply that integrating a service-learning approach into vocational training modules can enhance student engagement, skill acquisition, and the practical relevance of their learning. However, a limitation of this study is that it was conducted within a single school setting with a specific cohort, which may affect the generalizability of results to broader educational contexts. Future research could expand on these findings by implementing similar modules in diverse vocational schools and exploring long-term impacts on student skill retention and application in real-world settings. Additionally, further studies could investigate the integration of digital or virtual tools in the module to enhance accessibility and address limitations in machine availability.

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