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INTRODUCTION OF MOBILE ROBOTIC TECHNOLOGY TO SUPPORT STEM LEARNING IN SMKN 1 KAMAL STUDENTS

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Abstract

The background of this program is the importance of mastering mobile robotic technology in creating young people who are ready to face the challenges of the modern world of work and support mastery of STEM competencies.

The implementation method includes preparing materials and robotic devices, delivering materials through interactive presentations and demonstrations, and hands-on practice sessions by students. The program was also filled with discussions and motivational sessions to encourage students to understand better the importance of technology in everyday life and career opportunities in this field. An evaluation was conducted to measure the activity's success, followed by initiating an MoU between Politeknik NSC Surabaya and SMKN 1 KAMAL as a follow-up for further training.

The results showed high enthusiasm from the students, especially in the hands-on and discussion sessions. The students could understand the basic concepts of mobile robotics and showed great interest in learning more. However, time and device limitations were identified as challenges. In conclusion, this activity gave students a fundamental understanding of mobile robotics and an essential first step in developing STEM-based technology at SMKN 1 KAMAL.

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1. INTRODUCTION

Mobile robotic learning at the Vocational High School (SMK) level is increasingly becoming an essential need along with the rapid development of technology in the digital era (Setiawan, 2024). This technology plays a vital role in creating a workforce ready to face future challenges, especially in the era of the Industrial Revolution 4.0 (Tahar, Setiadi & Rahayu, 2022). Modern industries rely heavily on automation (Rozak et al., 2024), artificial intelligence (Siska, 2023), and the integration of other advanced technologies (Pratiwi et al., 2024). Therefore, mastering mobile robotic technology is not only an option but has become an urgent need for SMK students (Putra et al., 2023).

Mobile robotics provides a foundation of technical knowledge and helps students develop applicable practical skills. In this course, students are trained to understand the basic principles of robot programming, design, and operation. It is essential to hone the ability to think critically and creatively when solving various problems. This ability is one of the main

competencies needed in the 21st century, where innovation and efficiency determine success (Rahayu, Iskandar, & Abidin, 2022).

In addition to the technical skills aspect, mobile robotic learning also opens up opportunities to foster curiosity and exploration in students. By creating, programming, and operating robots, students have the opportunity to design innovative solutions to various challenges. This experience positively impacts the development of technical skills and strengthens students' confidence in facing the dynamic world of technology. In the long run, students can contribute to the innovation of products or services relevant to society's needs (Sambas, Gundara, & Ula, 2019).

Furthermore, mobile robotics is an effective tool to increase students' interest in STEM (Science, Technology, Engineering, and Mathematics) fields (Suwardi, 2021; Davidi, Sennen, & Supardi, 2021). Interactive, practice-based, and innovative project-based learning approaches motivate students to understand and explore science and technology. This is a strategic step in forming a young generation that not only masters technology but can also create innovations that support sustainable development.

Mobile robotic technology also impacts the development of students' social skills. In this learning process, students are often invited to work in teams, complete projects together, and discuss to find the best solution. This improves communication and collaboration skills and builds leadership and responsibility. With these skills, students are better prepared to face the challenges of the world of work that demands cooperation across disciplines.

However, the challenges in introducing mobile robotic technology to SMK students cannot be ignored. One of the main obstacles is the lack of access to facilities that support robotic learning, such as the necessary hardware and software (Siagian et al., 2023). In addition, the lack of structured and sustainable training for students and teachers is also an obstacle (Faridawati, 2023). To overcome this, a comprehensive and collaborative approach is needed. The government, educational institutions, and the private sector must work together to provide facilities, training, and funding that support the optimal implementation of robotics learning.

Based on these benefits and challenges, we conduct a community service program entitled "Introduction to Mobile Robotic Technology" at SMKN 1 KAMAL. This program aims to introduce mobile robotic technology to students to support innovative and relevant STEM learning. Through this activity, we hope to positively contribute to improving the quality of education at SMKN 1 KAMAL while building a strong foundation for a wider implementation of robotic technology in the future.

This activity aims to introduce SMKN 1 KAMAL students to mobile robotic technology, open their minds to STEM learning, and provide innovative and engaging learning experiences. The targets of this activity are students in grades XI and XII of SMKN 1 KAMAL who already have basic knowledge of Information and Communication Technology (ICT).

2. METHOD

The method of implementing community service activities with the theme "Introduction to Mobile Robotic Technology" at SMKN 1 KAMAL is structured to ensure the program's

effectiveness and efficiency. The following are the steps taken in the implementation of this activity:

1. **Preparation Stage**

Preparation begins with submitting a letter of permission to the school to obtain approval for the activity. After receiving authorization, the community service team coordinated with the Public Relations of SMKN 1 KAMAL to arrange schedules, locations, and other technical needs. Learning materials covering basic theory and practical applications of mobile robotics are prepared by involving experts in their fields. Mobile robotic devices and supporting tools such as laptops, projectors, and robotic kits were also prepared. Before the implementation day, the team conducted simulations and device trials to ensure everything went smoothly.

Figure 1. Preparation Stage

2. **Implementation Stage**

The activity began with an opening session conducted by the Public Relations of SMKN 1 KAMAL. This speech aimed to explain the program's purpose and motivate the students. After that, a team of lecturers briefly introduced NSC Polytechnic Surabaya, providing an overview of the educational institution and its technological contribution.

Figure 2. Implementation Stage

Competent lecturers delivered the primary material using visual media such as presentation slides and demonstration videos. This approach attracts student interest and provides in-depth knowledge of the basic concepts, applications, and potential of mobile robotic technology in the real world. A live robot operation demo followed this. This demo gave students a visual and interactive experience, helping them understand how the introduced technology works.

Students were also allowed to try operating the robot. In this session, a team of lecturers guided students to run the robot based on a simple program prepared beforehand. This hands-on approach aims to provide practical experience that strengthens students' understanding.

Question-and-answer sessions and discussions are essential parts of this activity. Students were invited to ask questions, share opinions, and discuss with the speakers. This aims to deepen students' understanding and satisfy their curiosity about mobile robotic technology. As a form of appreciation, door prizes were given to students who actively asked questions or gave interesting responses.

Next, a motivational session was delivered by a lecturer from NSC Polytechnic Surabaya. This motivational material was designed to inspire students to continue learning and exploring technology, especially when facing the challenges of the Industry 4.0 era. Students were given insights into the importance of technological skills in the modern world of work and the opportunities they can achieve through mastery of these technologies.

3. **Evaluation Stage**

At the end of the activity, an evaluation was conducted to measure the program's success. The review was conducted through observations of student participation, short interviews, and questionnaires. The information obtained was used to identify the activities' strengths and weaknesses and future improvement opportunities.

Figure 3. Evaluation Stage

The community service team initiated a Memorandum of Understanding (MoU) with SMKN 1 KAMAL as a follow-up. This cooperation includes plans for further training, such as robot assembly and programming activities, to support students' mastery of technology in more depth. With this MoU, it is hoped that the collaboration between Politeknik NSC

Surabaya and SMKN 1 KAMAL can provide sustainable benefits for students and related institutions.

3. RESULT DAN DISCUSSION

The community service program "Introduction to Mobile Robotic Technology," which was held at SMKN 1 KAMAL on November 18, 2024, was successful. Thirty students in grades XI and XII with a basic knowledge of Information and Communication Technology (ICT) attended this activity. The program was designed to provide students with insights into mobile robotic technology, support STEM learning, and introduce career opportunities in technology. The primary outcomes of this activity include:

1. **Improved Student Understanding**
   The material presented interactively covers the basics of robotic technology, practical applications of mobile robotics, and the potential for technological development in the era of the Industrial Revolution 4.0. Delivering material using visual media such as presentation slides, demonstration videos, and robotic devices helps students understand concepts more clearly.
2. **Practical Experience**
   The hands-on session was the highlight of the activity. Students watched the robotics demo and tried their hand at operating the robot. Under the guidance of a team of lecturers, they learn how to program simple commands and see how the robot responds to them. This provided an engaging learning experience and boosted students' confidence in learning new technologies.
3. **Interaction and Discussion**
   The students' enthusiasm was reflected in the question-and-answer session. The questions asked showed great interest in how robotic technology works, its role in the world of work, and the potential development of technology for daily needs. Some students also proposed creative ideas relevant to robotic applications.
4. **Motivation and Inspiration**
   The motivational material presented at the end of the event provided essential insights for students regarding the importance of mastering technology in the digital era. Inspirational messages about career opportunities in the STEM field encouraged students to prepare themselves more seriously for future challenges.
5. **Initiation of Cooperation**
   As a follow-up, the community service team initiated a Memorandum of Understanding (MoU) with SMKN 1 KAMAL for further training. This cooperation plan includes activities such as robot assembly training, advanced programming, and IoT (Internet of Things) applications to expand the scope of technology learning for students.

   This activity succeeded in having a positive impact on students' understanding and motivation regarding mobile robotic technology. Some of the discussion points include:

   1. **Effectiveness of Interactive Approach**
      Hands-on learning proved to be more effective in capturing students' attention. Demo and hands-on sessions help students understand the concept and practice the technology application directly. This aligns with the STEM approach, which emphasizes project-based learning and collaboration.

2. **Enthusiasm and Curiosity**
   The high participation of students during the question and answer session and discussion shows that they have a great interest in mobile robotic technology. This factor opens up opportunities to develop more in-depth training programs.
3. **Limitations Encountered**
   Although the program ran smoothly, there were some obstacles, such as:
   - Time constraints meant that some concepts could not be explained in detail.
   - The limited number of robotic devices meant students had to take turns trying them out. This reduced the duration of practical experience for each student.

   Further training with a longer duration and additional robotic devices should be considered to overcome this obstacle.
4. **Potential Program Sustainability**
   The initiation of the MoU is a strategic step to ensure the program's sustainability. Students can improve their technical understanding with more structured training, particularly in assembling and programming robots. It also allows the school to integrate mobile robotic technology into its curriculum.
5. **Opportunities for Teacher Competency Development**
   Special training for teachers must also be designed to support the program's sustainability. Thus, teachers can become competent facilitators of technology learning in schools.

4. CONCLUSION

The community service activity, "Introduction to Mobile Robotic Technology," at SMKN 1 KAMAL successfully achieved the main objective: introducing students to mobile robotic technology as part of STEM learning. This program not only improves students' technical understanding but also motivates them to delve deeper into technology in the era of Industrial Revolution 4.0.

This activity positively impacted and encouraged the students, especially during the hands-on and Q&A sessions. Students got hands-on experience operating the robot, strengthening their understanding of technology concepts. In addition, the motivational session encouraged them to continue learning and exploring the potential of technology in their future careers.

Some challenges, such as limited time and the number of robotic devices, hindered further deepening of the material. However, initiating a Memorandum of Understanding (MoU) with SMKN 1 KAMAL opens up opportunities for additional training and long-term cooperation, which is expected to strengthen students' technological competencies.

Overall, this activity is a significant first step in building a competent young generation in the STEM field and supporting the integration mobile robotic technology in learning at the SMK level.

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