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# Introduction to Robotics Technology for High School Students in Nganjuk Regency through Line Follower Robot Training

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**ABSTRACT**

*In the era of rapid technological advancement, mastering robotics has become crucial for the younger generation. A community service program by the Physics Study Program lecturer team of Surabaya State University introduced robotics training to high school students at SMAN 1 Nganjuk. This program aimed to foster interest in science and technology, enhance critical thinking, and develop problem-solving skills. The training included systematic steps such as needs analysis, material preparation, implementation, and evaluation. Students learned to design, assemble, and test line follower robots, integrating theory and hands-on practice to understand robotics concepts and techniques comprehensively. The program's outputs include video documentation, news articles, training modules registered as Intellectual Property Rights (IPR), and scientific articles for national journals. Supported by the Nganjuk Regency Education Office, the program aims to enhance students' technological competencies and inspire greater achievements. It also serves as a model for similar initiatives in other regions, promoting technology education development in Indonesia. Evaluation based on participant questionnaires showed positive results: understanding of material (80%), material relevance (81%), usefulness (83%), instructor quality (87%), facilities (93%), and training time adequacy (83%). Overall, the program achieved very good results, successfully engaging students and meeting its objectives.*

## INTRODUCTION

Robotics technology plays an important role in digital-era education. However, in Nganjuk Regency, East Java, high school students' understanding and skills in this technology still need to be improved due to the lack of facilities and teaching materials. In response to this challenge, a team of lecturers from the Physics Study Program at Surabaya State University implemented a community service program related to Line Follower robot-making training for high school students throughout the MGMP in Nganjuk Regency. This program aims to improve technological literacy through a hands-on approach, where students learn to assemble and operate line-follower robots. This method is expected to improve students' understanding of the basic concepts of electronics and robotics and foster their interest in the technology field. Support from the Nganjuk Regency Education Office ensures the integration of this activity into the school curriculum, providing long-term benefits for improving the quality of technology education in the region.

The main target of partners in implementing Line Follower robot-making training is to improve students' abilities and skills in technology and robotics. There needs to be more clarity between the school curriculum and the practical skills required for the technology industry. This results in low student understanding and interest in robotics technology. Through this training, students are expected to gain valuable knowledge and be directly involved in making Line Follower robots to improve their competence and prepare them for future challenges in the increasingly advanced world of technology (Sa'adah, 2020). This training also aims to motivate students to be more interested in

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science and technology and foster creativity and innovation among the younger generation (Wicaksono, 2021).

Technology and robotics learning at the high school level in Nganjuk Regency is still limited to the theory given in class and needs adequate practical implementation. The lack of facilities and practical training makes it difficult for students to understand technological concepts in depth and apply them. Meanwhile, the need for practical skills in technology and robotics is increasing along with the development of Industry 4.0. Based on research, Line Follower robot-making training can significantly improve students' robotics knowledge (Siswanto & Sigit, 2019). However, a team from Pelita Harapan University study showed that there needs to be a comprehensive training program in high schools throughout the MGMP Nganjuk Regency that integrates theoretical and practical robotics learning. Therefore, this Line Follower robot-making training is very important to fill the gap between the existing curriculum and the need for practical skills in the industrial world (Pelita Harapan University Team, 2023).

An important step in the community service activities by the UNESA Physics Study Program lecturer team is improving students' practical and theoretical competencies in robotics and technology. This activity aims to provide basic knowledge and skills in making and programming Line Follower robots and increase students' interest in science and technology through practical experience (Zacky *et al*., 2024).

## METHOD

Line Follower Robot Making Training for High School Students throughout MGMP Nganjuk Regency was conducted with a structured and participatory approach. The training method includes several main stages: (a) identification of partner needs and problems through discussion and observation, (b) preparation of training materials and creation of modules and demo robots, (c) implementation of training with lecture, demonstration, and direct practice methods, and (d) evaluation and follow-up of activities.

The work procedure begins with a site survey and needs analysis, followed by the preparation of proposals and procurement of tools and materials. The implementation of the training involves theory and practice sessions, where students actively assemble and program the Line Follower robot. Participation of partners, in this case, the Nganjuk Education Office and schools. They provide initial information regarding the needs and problems faced, as well as support the program's implementation through facilities and coordination of activities. This participation ensures that the training runs according to local needs and can provide maximum impact (Introduction to Line-Follower Robots, 2020).

The work procedures for the community service activities to be carried out are shown in Figure 1.

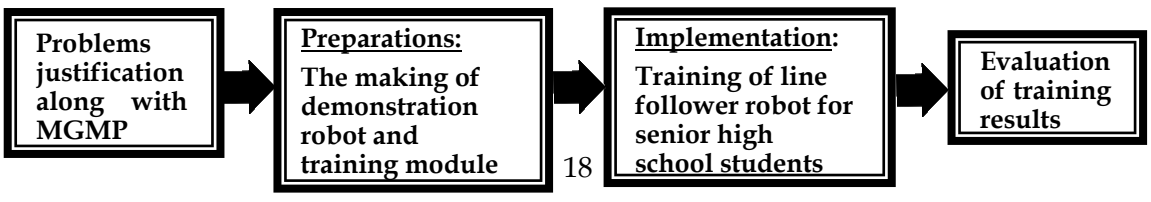

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**Figure 1.** Procedure flow for PKM activities

A response questionnaire was administered after the training to evaluate the extent of the success of the Line Follower robot-making training activity for High School Students throughout the MGMP of Nganjuk Regency who were involved in this Community Service activity.

**Table 1.** Scoring Criteria for Training Participant Response Sheets (Riduwan, 2010)

| Score | Explanation |
|---|---|
| 5 | Very Good |
| 4 | Good |
| 3 | Enough |
| 2 | Not Enough |
| 1 | Very Less |

The percentage of the training participant response sheet score is calculated using the formula:

$$Percentage\ score\ = \frac{\sum selected\ score}{\sum max\ score\ for\ each\ question} \times 100\% \qquad (1)$$

The percentage criteria for the training participant response sheet scores can be seen in Table 2.

**Table 2.** Percentage Criteria for Response Sheet Scores (Riduwan, 2010)

| Score | Explanation |
|---|---|
| 0% < x ≤ 20% | Very Less |
| 21% < x ≤ 40% | Not Enough |
| 41% < x ≤ 60% | Enough |
| 61% < x ≤ 80% | Good |
| 81% < x ≤ 100% | Very Good |

**Table 3.** Percentage Criteria for Response Sheet Scores

| No | Assessment Instrument | Description | | | | |
|---|---|---|---|---|---|---|
| | | 5 | 4 | 3 | 2 | 1 |
| 1 | Is the material delivered in the training easy to understand? | | | | | |
| 2 | Is the material delivered following your needs? | | | | | |
| 3 | How useful is the training material in improving your understanding? | | | | | |
| 4 | How do you assess the quality of the instructor's delivery of the material? | | | | | |

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| | |
|---|---|
| **5** | How do you assess the facilities and equipment used in the training? |
| **6** | Is the time required for the training sufficient? |

## RESULTS AND DISCUSSION

This program is considered successful if the PKM team of the Physics Department, FMIPA UNESA, successfully conducts "Training on Making Line Follower robots for High School Students throughout the MGMP of Nganjuk Regency". Based on the results of coordination with the principal of SMAN 1 Nganjuk as the location of the training, an agreement was reached that the implementation of the training activities would start on the day and date: Saturday, July 20, 2024. The PKM team prepared before the training activities. The preparations included modules and video tutorials on making Line Follower Robots.


**Figure 2.** Video tutorial for the Line Follower robot

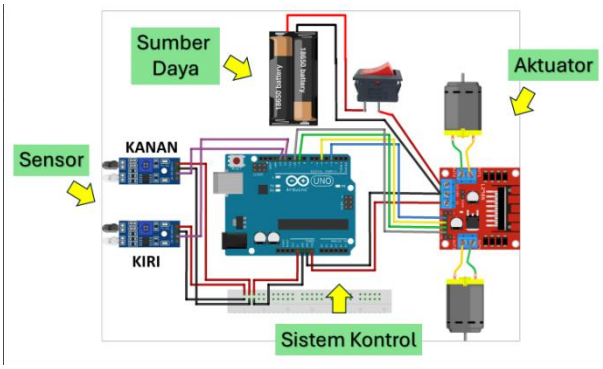


**Figure 3.** Line Follower robot tutorial module

Figures 2 and 3 show the results of making a module and video tutorial for making a Line Follower robot. Making a module and video tutorial for a line follower robot provides significant benefits, such as improving students' technical skills in electronics and programming, motivating and involving them in real projects, and developing problem-solving and collaboration skills (Hsu & Chang, 2018). In addition, this module also provides a continuous learning resource, prepares students for robotics

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competitions, and helps them understand advanced concepts in robotics and the application of the latest technology (Gómez & Fernandez, 2019).

The implementation of the training carried out by the PKM TEAM includes opening, presentation of materials, questions and answers, making robots, and robot competitions. Figure 4 shows the presentation of training materials, and Figure 5 shows the making of robots.


**Figure 4.** Presentation of Material


**Figure 5.** Making a Line Follower robot

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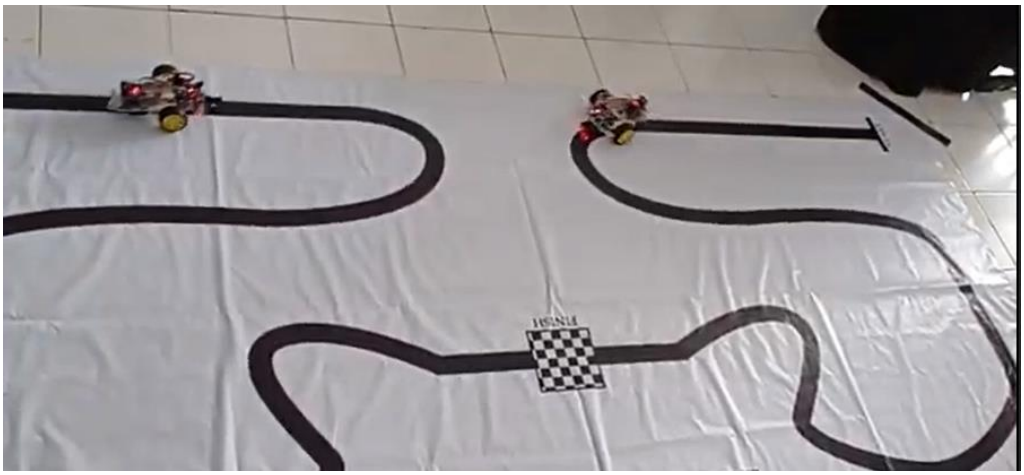

**Figure 6.** Line Follower robot competition

Figure 6 shows that after students try to make their own Line Follower robots, they continue by testing students' skills in making robots in robot competitions. This competition aims to motivate students to make good and correct robots and excel in competitions (Lindh, J, 2019).

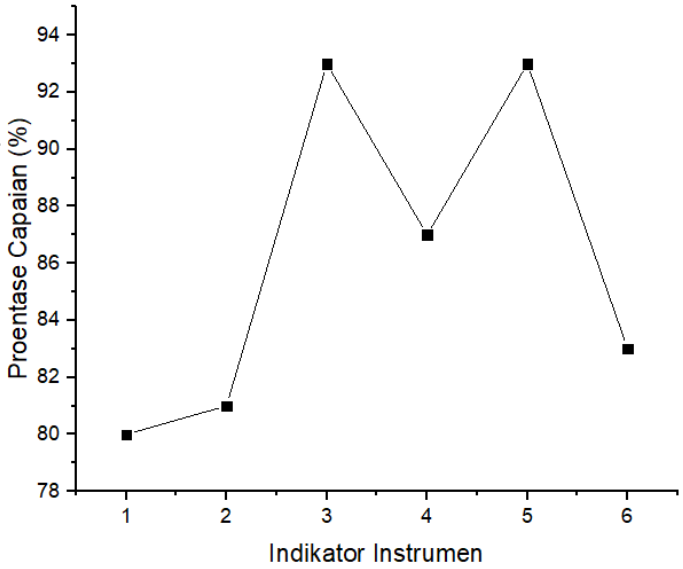


**Figure 7.** Results of the response questionnaire

After completing a series of student training activities, the students were given a questionnaire to determine their response to the PKM activity of making a Line Follower robot. Based on the results of the response questionnaire as an instrument of success in implementing PKM it can be seen in Figure 7. The results of the response questionnaire from 15 students are as follows: understanding of the material is 80% (good), suitability of the material is 81% (very good), usefulness is 83% (very good), quality of instructor delivery is 87% (very good), facilities and equipment are 93% (very good), and adequacy of training time is 83% (very good). The percentage results of the response sheet scores mostly showed very good results only in understanding the material, which showed good results. The success of this PKM activity must be connected to the availability of

modules, video tutorials, and competent instructors (Santos & Moreira, 2020). Second, the success of this PKM activity must be balanced with the accuracy of the learning method and training system (Dugger & Yoon, 2021).

## CONCLUSION

The conclusion that can be obtained from this PKM activity is the first realization of Line Follower robot-making training activities that are easy to apply and at a relatively affordable cost for students. With this activity, it is expected that students will be able to apply and participate in various competitions. The results of the questionnaire responses from 15 students are as follows: understanding of the material is 80% (good), suitability of the material is 81% (very good), usefulness is 83% (very good), quality of instructor delivery is 87% (very good), facilities and equipment are 93% (very good), and adequacy of training time is 83% (very good). The percentage of response sheet scores mostly show very good results, only in understanding the material that shows good results.

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