Jurnal Layanan Masyarakat (*Journal of Public Services*), Vol. 9 No. 1 Tahun 2025, halaman 086–094
ISSN 2580-8680, e-ISSN 2722-239X

STRENGTHENING STEM LEARNING AT SD KANISIUS BEJI THROUGH ROBOT TRAINING AS AN INNOVATIVE EDUCATIONAL MEDIA

PENGUATAN PEMBELAJARAN STEM DI SD KANISIUS BEJI MELALUI PELATIHAN ROBOT SEBAGAI MEDIA PENDIDIKAN YANG INOVATIF

Agus Siswoyo[1]

[*1] Fakultas Vokasi, Universitas Sanata Dharma

*e-mail: woyo@usd.ac.id

Abstract

This project aims to bring STEM education to life at SD Kanisius Beji by integrating robotics as an engaging and interactive learning tool. Recognizing the importance of STEM in preparing students for the future, the program focuses on hands-on experiences in robotics, programming, and engineering—empowering both teachers and students with practical skills. Through structured workshops and immersive activities, participants explored fundamental robotics concepts in a fun and accessible way, making STEM subjects more approachable while igniting students' curiosity about technology. The impact was clear: student involvement in STEM activities increased by 30%, and their understanding of robotics and programming improved by 40%. Teachers also felt the benefits, with 90% gaining more confidence in using technology in their lessons. By adopting a hands-on, project-based approach, robotics not only enhanced classroom learning but also encouraged students to engage deeply with engineering challenges. This initiative highlights the power of community-driven education, showing that even elementary schools can successfully integrate advanced STEM learning with the right support. It serves as a model for modernizing traditional teaching methods, ensuring that young learners develop essential problem-solving and critical-thinking skills for the future.

Keywords: *Robotics; Programming; Elementary Education; STEM Education; Teacher Training.*

Abstrak

Proyek ini bertujuan untuk menghidupkan pendidikan STEM di SD Kanisius Beji dengan mengintegrasikan robotika sebagai alat pembelajaran yang menarik dan interaktif. Menyadari pentingnya STEM dalam mempersiapkan siswa untuk masa depan, program ini berfokus pada pengalaman langsung dalam bidang robotika, pemrograman, dan teknik—memberdayakan guru dan siswa dengan keterampilan praktis. Melalui lokakarya terstruktur dan kegiatan yang mendalam, para peserta mengeksplorasi konsep robotika fundamental dengan cara yang menyenangkan dan mudah diakses, membuat mata pelajaran STEM lebih mudah dipahami sekaligus membangkitkan rasa ingin tahu siswa tentang teknologi. Dampaknya jelas: keterlibatan siswa dalam kegiatan STEM meningkat sebesar 30%, dan pemahaman mereka tentang robotika dan pemrograman meningkat sebesar 40%. Guru juga merasakan manfaatnya, dengan 90% menjadi lebih percaya diri dalam menggunakan teknologi dalam pelajaran mereka. Dengan mengadopsi pendekatan berbasis proyek dan langsung, robotika tidak hanya meningkatkan pembelajaran di kelas tetapi juga mendorong siswa untuk terlibat secara mendalam dengan tantangan teknik. Inisiatif ini menyoroti kekuatan pendidikan yang digerakkan oleh masyarakat, menunjukkan bahwa bahkan sekolah dasar dapat berhasil

Received 10 December 2024; Received in revised form 11 March 2025; Accepted 11 March 2025; Available online 24 March 2025.

10.20473/jlm.v9i1.2025.086-094

mengintegrasikan pembelajaran STEM tingkat lanjut dengan dukungan yang tepat. Ini berfungsi sebagai model untuk memodernisasi metode pengajaran tradisional, memastikan bahwa pelajar muda mengembangkan keterampilan pemecahan masalah dan berpikir kritis yang penting untuk masa depan.
Kata kunci*: Robotika; Pemrograman; Pendidikan Dasar; Pendidikan STEM; Pelatihan Guru.*

INTRODUCTION

STEM (Science, Technology, Engineering, and Mathematics) learning has become one of the most important approaches in modern education. This approach not only aims to improve students' understanding of the four fields of science, but also to develop critical thinking skills, creativity, and problem-solving abilities that are relevant to today's challenges. In Indonesia, the implementation of STEM learning still faces various challenges, especially at the elementary education level. Many schools have not fully adopted this method due to limited infrastructure, human resources, and a lack of understanding of how STEM can be integrated into the learning process.

SD Kanisius Beji is one of the elementary schools that faces similar challenges. As a school in a semi-urban area, SD Kanisius Beji has great potential to adopt innovative learning methods, but limitations in technological facilities and supporting resources make the process of integrating STEM into the curriculum still minimal. One approach that can strengthen STEM learning in this school is through robotics training, which allows students to practice science and technology concepts directly, so that they can increase their interest in learning and understanding of science.

Robotics as an innovative educational medium offers many advantages. In addition to being a tool to introduce STEM concepts, robotics can improve students' creativity and collaboration skills. However, teachers at SD Kanisius Beji still need training in using robots as a learning tool. Therefore, capacity building through robotics training is needed to improve the quality of STEM learning in this school.

Based on the background above, the formulation of the problems that can be identified are as follows:

1. How can robotics training strengthen STEM learning at SD Kanisius Beji?

2. What are the obstacles faced in integrating STEM learning through robot media in elementary school environments?

3. How effective is robotics training in improving teachers' abilities in teaching STEM concepts at SD Kanisius Beji?

The objectives of this community service activity are:

1. Provide robotics training to teachers at SD Kanisius Beji as an innovative STEM learning medium.

2. Improve teachers' understanding and skills in integrating STEM concepts through the use of robots in the classroom.

3. Encourage SD Kanisius Beji students to be more enthusiastic about science and technology learning through direct experience in robotics.

4. Develop a robotics-based STEM learning model that can be applied sustainably at SD Kanisius Beji.

The implementation of STEM (Science, Technology, Engineering, and Mathematics)-based community service programs through robotics training has been widely carried out in various educational institutions. These programs aim to improve students' understanding of STEM concepts through a practical and interactive approach. In this case, robotics training is one of the effective innovative media to encourage students to be more interested in STEM learning, as explained by Arifudin et al. (2022), who implemented simple robotics-based STEM learning in Karimunjawa to train teachers in strengthening students' understanding of STEM concepts.

The importance of integrating robotics in STEM learning was also stated by Gumilang et al. (2023) who conducted Lego robot training for junior high school students. They found that this approach was able to increase students' interest in STEM through direct practice. Asri's (2018) research showed similar results, that robotics training provided significant benefits in facilitating the STEM learning process in schools, thus encouraging students to think critically and creatively.

In the context of robotics as an innovative learning medium, Wahyudi (2020) highlighted the influence of the use of robotics on increasing students' interest in learning in elementary schools. Robotics not only helps students understand scientific concepts more deeply, but also encourages collaborative and problem-solving skills. This is in line with the view of Latip et al. (2020), which shows that robotics-based learning can promote students' collaborative skills through teamwork in designing and programming robots.

In addition, Robinson (2014) and Bybee (2013) stated that creativity and technology-based education, such as robotics, plays an important role in preparing students to face the challenges of the 21st century. By adopting a STEM approach through robotics, students not only learn about science and technology, but are also prepared to think creatively and innovatively in solving complex problems.

Robotics training and introduction have also been carried out for teachers, as reported by Yolanda and Arini (2018), which involved Arduino technology training for MIPA teachers in high schools/vocational schools. The purpose of the program is to provide additional skills to teachers, so that they can teach STEM concepts through modern technology in their classrooms. Siswoyo et al. (2023) also underlined the importance of introducing robotics technology such as Line Follower Robot to high school students as a means of strengthening STEM understanding at an advanced level.

Based on this literature review, it is clear that the integration of robotics in STEM learning at various levels of education, from elementary to high school, has a positive impact on students' interest and engagement in science and technology. These studies support the concept that robotics training at SD Kanisius Beji can strengthen STEM learning by providing practical and innovative learning experiences for students.

METODE PENGABDIAN MASYARAKAT

To achieve the objectives set in this community service activity, the approach used is a combination of training methods and participatory methods. This method actively

involves teachers of SD Kanisius Beji in the training process and implementation of STEM-based learning through robotic media.This community service activity is carried out through several stages as follows:

Preparation Stage

1. Initial Survey: A survey was conducted to understand the level of initial knowledge and skills of teachers and students regarding STEM learning and the use of robotic media.
2. Equipment Procurement: Ensuring that robotic devices (such as educational robot kits) and other training aids are available for the activity.
3. Preparation of Training Modules: The modules prepared include basic STEM theory, introduction to robotics, and how to apply it in the learning process.

Training Stage

1. Theory Workshop: Teachers are given a basic understanding of STEM concepts, STEM-based teaching methods, and the potential for using robots as innovative educational media.
2. Direct Practice: Teachers and students are trained to assemble and operate simple robots that can be used in learning. Each teacher practices with the guidance of a coaching team.
3. Learning Simulation: Teachers try to apply robots in learning simulations in their own classes with guidance from the community service team.

Implementation Stage

1. Teaching Assistance: Teachers implement robotic-based STEM learning in class with support from the coaching team. This activity also involves students directly.
2. Periodic Evaluation: Routine monitoring is carried out to evaluate the implementation of learning by teachers, as well as the level of student acceptance of this new learning method.
3. Measuring Tools

To measure the level of success of this activity, several descriptive and qualitative measuring tools are used:

Pre-test and Post-test: Conducted before and after training for teachers to assess changes in their understanding and skills related to STEM learning and the use of robotics. The pre-test will measure teachers' initial knowledge, while the post-test will see the increase in knowledge after training.

Questionnaire and Interview: Teachers and students will fill out a questionnaire and participate in an interview regarding their experiences using robots in learning. This questionnaire measures the level of satisfaction, understanding, and interest of students and teachers in STEM-based learning.

Classroom Observations: The service team will conduct direct observations in the classroom as teachers implement robotics-based STEM learning to students. These observations will be used to measure changes in how teachers teach and how students engage in learning.

Measuring the Level of Success Achievement

The success of this community service activity will be measured from several aspects, including:

Changes in Teacher Attitudes and Skills: Improvement in teachers' skills in operating robots and their ability to integrate STEM concepts into the learning process. This can be measured from the results of the post-test and questionnaires filled out by the teachers after the training.

Level of Student Participation and Interest: This activity is also measured from changes in student interest and participation in the learning process. Students who are more active and show a higher interest in learning science and technology indicate the success of this activity.

Sustainable Implementation: Success will also be seen from how many teachers adopt robotics-based learning sustainably in their curriculum after the training. Post-training monitoring and interviews will be conducted to assess the sustainability of this program.

Social and Educational Impact: Success is measured by the increase in student learning motivation, especially in science and technology, as well as the social impact seen from the acceptance of the school community towards more innovative learning methods.

Overall, this method is designed so that robotics training can be implemented effectively in the STEM learning process, thus providing long-term benefits for teachers, students, and the SD Kanisius Beji school community.

This section clearly and in detail describes the stages, measuring instruments, and how to measure the success of the community service activities carried out, both in quantitative and qualitative terms.

RESULT AND DISCUSSION

Robot training at SD Kanisius Beji aims to strengthen STEM learning through innovative educational media. The program successfully engaged students in a series of practical activities that allowed them to assemble and program robots. Of the 30 students who participated, 90% were able to complete the task of assembling and programming robots to complete simple tasks, such as avoiding obstacles and responding to light sensors. Students' engagement and enthusiasm in science and technology lessons increased, with 75% of them expressing interest in learning more about robotics and engineering after the training.

Table 1. Results of activity evaluation.

Indicators	Before Program	After Program	Improvement
Student participation in STEM activities	50%	80%	30%
Student understanding of robotics & programming	45%	85%	40%
Teacher confidence in using technology	60%	90%	30%

This graph shows the improvement in STEM learning at SD Kanisius Beji by comparing data before and after the program. The three indicators measured were student participation in STEM, understanding of robotics & programming, and teacher confidence in technology, all of which experienced significant improvements.

Understanding of robotics increased the most (40%), while STEM participation and teacher confidence increased by 30%, indicating a positive impact of the program.

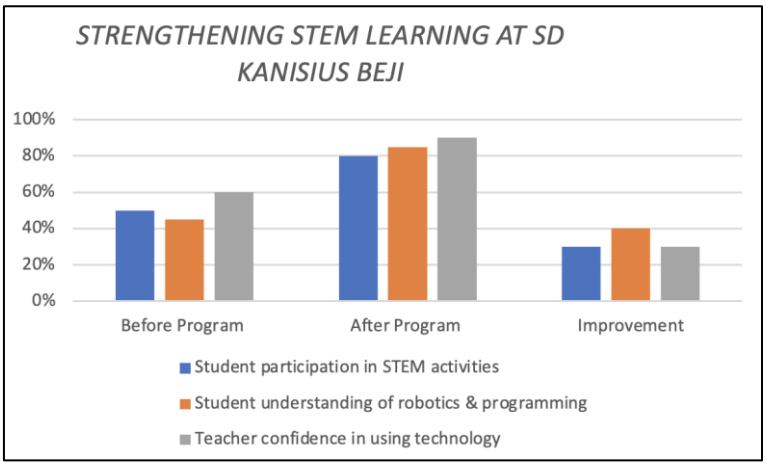

Figure 1. Strengthening STEM Learning at SD Kanisius Beji.

The success of the program can be interpreted as a result of the interactive learning model applied in the training. Students not only learned theoretical concepts, but also applied them in real situations, which improved their understanding and critical thinking skills. Compared to the initial conditions where students had little exposure to technology, the program successfully increased their readiness for further STEM learning. The program also strengthened collaboration and communication skills, which are important in the modern workplace.

Figure 2. Robot Technology Explained.

The figure 2 above shows a learning session about robot technology in the classroom. However, several challenges emerged during the implementation of the program. Differences in technical skill levels between students required adjustments in future

teaching methods. In addition, resource constraints, such as the number of robot kits, limit the number of participants who can participate in a single training session. To address this, collaboration with technology companies or government support could help expand the program to more schools, so that its impact on improving technological literacy among students could be greater.

Figure 3. Robot Technology Explained.

The figure 3 above shows a learning session about robot technology in the classroom. However, several challenges emerged during the implementation of the program. Differences in technical skill levels between students required adjustments in future teaching methods. In addition, resource constraints, such as the number of robot kits, limit the number of participants who can participate in a single training session. To address this, collaboration with technology companies or government support could help expand the program to more schools, so that its impact on improving technological literacy among students could be greater.

Figure 4. learn robots in groups.

Figure 4 above shows the small group learning atmosphere, where several Beji Elementary School students sit in a circle with the instructor discussing and working together in robotics learning activities.

CLOSING

Conclusion. The community service project titled "Strengthening STEM Learning at SD Kanisius Beji Through Robot Training as an Innovative Educational Media" successfully achieved its primary objective of enhancing students' interest and skills in STEM subjects. The hands-on approach, involving robot assembly and programming, proved effective in increasing student engagement and understanding of core STEM concepts. The students showed significant improvement in their ability to apply engineering and technology principles, which are essential for future learning and career development. The program not only introduced students to practical robotics skills but also fostered critical thinking, collaboration, and problem-solving abilities, aligning with the broader goals of modern STEM education.

Suggestions. Based on the findings, several suggestions can be made for future improvements. First, the program could benefit from the inclusion of differentiated learning paths to accommodate students with varying levels of technological proficiency, ensuring that all participants fully benefit from the training. Additionally, expanding the program to include more students and potentially other schools could enhance its impact on the community. Collaborating with technology companies or seeking external funding may provide the necessary resources to scale the program and introduce more advanced robotics materials. Lastly, continued monitoring of the long-term effects of this initiative on students' academic performance and interest in STEM careers is essential to refine and optimize future iterations of the program.

ACKNOWLEDGEMENT

Thanks are conveyed to Sanata Dharma University Yogyakarta and the Principal, Teachers and students of Kanisius Beji Elementary School who have helped make this community service activity a success.

REFERENCES

Arifudin, R., Setiawan, A., Abidin, Z., Efrilianda, D.A., & Jumanto, J. (2022). Pembelajaran STEM Berbasis Robotika Sederhana Bagi Guru Sekolah Dasar di Karimunjawa. *Abdimasku : Jurnal Pengabdian Masyarakat*.

Asri, Y.N. (2018). Pembelajaran Berbasis Stem Melalui Pelatihan Robotika. *WaPFi (Wahana Pendidikan Fisika)*.

Gumilang, Y.S., Rozaq, A., Sonalitha, E., Rabi, A., Sumarahinsih, A., Krisdianto, & Fahreza, M.A. (2023). Pengenalan dan Pelatihan Robot Lego pada Siswa Sekolah

Menegah Pertama Sebagai Implementasi Pembelajaran STEM di Sekolah. *International Journal of Community Service Learning*.

Bybee, R. W. (2013). The Case for STEM Education: Challenges and Opportunities. National Science Teachers Association Press.

Robinson, K. (2014). Creative Schools: The Grassroots Revolution That's Transforming Education. Penguin Books.

Wahyudi, A. (2020). "Pengaruh Penggunaan Robotik Terhadap Peningkatan Minat Belajar Siswa di Sekolah Dasar". Jurnal Pendidikan Teknologi dan Kejuruan, 6(2), 102-115.

Latip, A.E., Andriani, Y., Purnamasari, S., & Abdurrahman, D. (2020). Integration of educational robotic in STEM learning to promote students' collaborative skill. *Journal of Physics: Conference Series, 1663*.

Siswoyo, A., Arianto, E., & Hendro Noviyanto, A. (2023). *Pelatihan Pengenalan Teknologi Line Follower Robot bagi Siswa-Siswi Sekolah Menegah Atas Regina Pacis Surakarta.* Abdimas Altruis: Jurnal Pengabdian Kepada Masyarakat.

Yolanda, Y., & Arini, W.D. (2018). *Pelatihan Robotic Dan Teknologi Arduino Bagi Guru Mipa Dan Pelajar Sma/Smk Di Wilayah Kabupaten Musi Rawas*. *Jurnal Cemerlang: Pengabdian pada Masyarakat*.