***Community Service Journal* (CSJ)**
Poltek Mardira Indonesia
Volume. 1 Nomor. 2, November 2025
ISSN: 3090-7691

Software Engineering Competency Enhancement Program to Support Digital Transformation in the era of Industry 4.0

Ihsan Doni Irawan[1*], Faisal Yusuf Fadhilah[2], Zainal Arifin[3]
[1]Politeknik Negeri Indramayu, S1 Terapan Rekayasa Perangkat Lunak
[2]Politeknik Negeri Indramayu, D3 Teknik Pendingan dan Tata Udara
[3]Politeknik Negeri Indramayu, S1 Terapan Teknologi Rekayasa Elektro-medis
*E-mail: ihsandoniirawan@polindra.ac.id[1], fyfadhilah@polindra.ac.id[2], zend45@polindra.ac.id[3]

ABSTRACT

This community service program was initiated in response to the low level of literacy and limited understanding of Cloud Computing, Artificial Intelligence (AI), and the Internet of Things (IoT) among Software Engineering (RPL) students at SMK PGRI Kandanghaur. This condition has created a competency gap between the school curriculum and industry requirements in the era of digital transformation and Industry 4.0. The purpose of this activity is to enhance students' basic understanding, technological awareness, and learning motivation regarding these emerging technologies, thereby improving their readiness to meet modern industry demands.

The implementation method consisted of several stages, including needsassessment, coordination with the partner school, development of seminar materials, technical preparation, interactive seminar delivery, and program evaluation. The material was delivered through expert presentations, case-based discussions, and visual demonstrations illustrating the application of Cloud, AI, and IoT in industry and software development.

The results indicate a significant improvement in students' comprehension of current technologies, increased motivation for independent learning, and strengthened collaboration between the polytechnic and the partner school. Overall, this program successfully addressed the initial problem and provided a positive impact by enhancing students' readiness for digital transformation in the workplace.

Keywords: Cloud Computing, Artificial Intelligence, Internet of Things, Industry 4.0.

INTRODUCTION

The rapid advancement of digital technologies has fundamentally transformed industrial ecosystems and reshaped competency demands in the era of the Industrial Revolution 4.0. Key enabling technologies such as Cloud Computing, Artificial Intelligence (AI), and the Internet of Things (IoT) have become essential components in modern software engineering practices and global digital infrastructures. Cloud services provide scalable and cost-efficient computing resources that support modern application deployment (Bahga & Madisetti, 2014; Buyya et al., 2013), AI enables intelligent automation and data-driven decision-making processes (Russell & Norvig, 2021; He & Yan, 2021), while IoT facilitates seamless connectivity and smart data exchange across devices and environments (Elahi, 2022; Al-Fuqaha et al., 2015; Ray, 2018). Together, these technologies drive innovation and operational efficiency across various sectors including manufacturing, education, logistics, and public services (Lee et al., 2014; Xu et al., 2018).

Despite the widespread adoption of these technologies, vocational students—particularly those in Software Engineering (RPL) programs—often face difficulties in accessing and understanding emerging digital tools. Curriculum limitations, insufficient exposure to real-world technological

Volume. 1 Nomor. 2, November 2025
ISSN: 3090-7691

applications, and the lack of structured training contribute to low digital literacy among vocational learners (Sudira, 2018; Sari & Prasetyo, 2020; Kurniawan & Wibowo, 2020). This misalignment between school learning and industry needs reduces students' readiness to engage in a technology-driven workforce, which is particularly concerning as vocational schools are expected to produce job-ready graduates with practical skills relevant to digital transformation (Suryani & Wilantara, 2021).

To address these gaps, structured community service programs play a strategic role in bridging the knowledge divide and increasing students' awareness of Industry 4.0 technologies. Seminars, workshops, and applied learning activities have been shown to significantly enhance students' technological competencies, motivation, and preparedness for industry engagement (Marr, 2020; Huda et al., 2021). Therefore, this community service initiative aims to introduce fundamental concepts, practical use cases, and future career opportunities related to Cloud Computing, AI, and IoT to RPL students at SMK PGRI Kandanghaur. Through this activity, students are expected to improve their literacy, strengthen their digital competency foundation, and become more prepared to face the challenges of modern industrial transformation.

METHOD

The implementation of this community service program followed a comprehensive methodological framework designed to ensure that the seminar effectively improved students' understanding and awareness of Cloud Computing, Artificial Intelligence (AI), and the Internet of Things (IoT). The method consisted of several interconnected stages, each playing a critical role in achieving the program objectives.

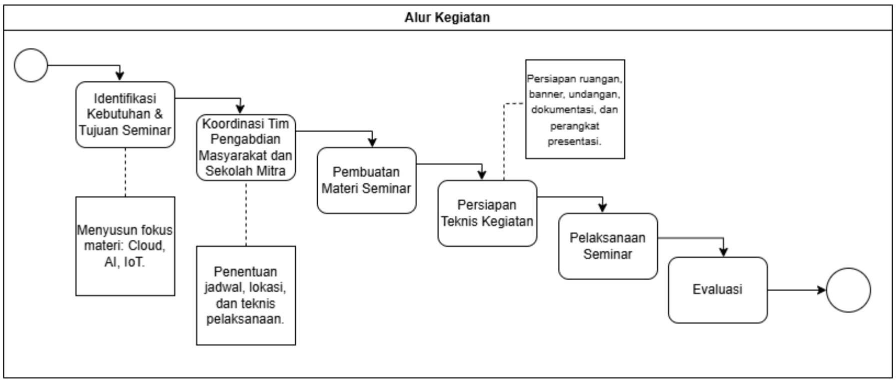

Figure 1. Implementation Method

1. Needs Identification and Determination of Program Objectives

The first stage involved conducting a systematic identification of learning needs among Software Engineering (RPL) students at SMK PGRI Kandanghaur. This process aimed to understand the current

Volume. 1 Nomor. 2, November 2025
ISSN: 3090-7691

level of technological literacy and the specific challenges faced by students and teachers. Activities included:

1. Analyzing gaps between curriculum content and technological demands of Industry 4.0,
2. Identifying limitations in access to Cloud platforms, AI tools, and iot devices,
3. Determining priority topics that must be introduced to enhance students' readiness for modern digital industries.

The results of this assessment were used to formulate specific seminar objectives, such as improving conceptual understanding, strengthening digital awareness, and motivating students to pursue independent learning in emerging technologies.

2. Coordination with the Partner School

This stage focused on establishing an effective collaboration between the community service team and SMK PGRI Kandanghaur. Coordination activities included:

1. Selecting the seminar date and duration,
2. Determining the number of participants and the target student group,
3. Identifying the required facilities such as projector, sound system, and internet connectivity,
4. Preparing administrative documents such as approval letters, schedules, and organizational roles.

This coordination ensured that the seminar was logistically feasible and aligned with the school's academic calendar, allowing maximum student participation.

3. Development of Seminar Materials

The preparation of seminar materials was a crucial step to ensure that the content delivered was accurate, relevant, and understandable for vocational students. The team designed materials with a pedagogical approach that combined theoretical concepts and practical illustrations. The content included:

1. **Introduction to Cloud Computing:** basic concepts, examples of cloud services, and relevance to software deployment.
2. **Foundations of Artificial Intelligence:** core ideas, simple machine learning concepts, everyday applications, and industry use cases.
3. **Internet of Things Overview:** understanding sensors, connectivity, data flow, and simple IoT project examples.
4. **Software Engineering Integration:** how Cloud, AI, and IoT technologies influence modern software development.

The materials were presented in multiple formats slides, infographics, diagrams, and scenario-based explanations—to enhance clarity and engagement.

4. Technical Preparation

Technical preparation ensured the program could run smoothly and professionally. Activities included:

1. Arranging the seminar room layout to support interaction,
2. Preparing equipment such as laptops, projectors, microphones, and speakers,
3. Designing and printing banners, posters, and evaluation forms,
4. Preparing digital documents such as attendance sheets, e-materials, and documentation folders,
5. Testing the internet connection and device compatibility prior to the seminar.

This stage minimized potential disruptions and ensured a conducive environment for the learning process.

5. Seminar Implementation

The seminar served as the core activity of the program. The implementation involved several structured steps:

1. **Opening Session**
   The seminar began with introductions by the school representative and the community service team, followed by an explanation of the seminar objectives and expected outcomes.
2. **Material Delivery**
   The speaker presented the seminar content using an interactive lecture method. The delivery emphasized real-world applications and technological trends to help students connect theoretical concepts with practical contexts.
3. **Demonstration and Visualization**
   Simple demonstrations (such as showing AI tools, IoT dashboards, or cloud interfaces) were integrated to make abstract concepts more tangible.
4. **Interactive Discussion and Q&A Session**
   Students were encouraged to ask questions, explore problem scenarios, and discuss future career opportunities related to the technologies introduced.

This session was designed to promote active participation and foster a deeper understanding of the subject matter.

6. Evaluation and Follow-Up Recommendations

The final stage involved evaluating the impact and effectiveness of the seminar. Evaluation activities included:

1. Distributing feedback forms to gather students' perceptions on seminar clarity, relevance, and usefulness,
2. Assessing students' self-reported understanding before and after the seminar,

3. Documenting the entire activity through photos and videos,
4. Reviewing suggestions from participants for future training needs.

Based on the evaluation results, the team formulated follow-up recommendations such as hands-on workshops for IoT projects, introductory machine learning classes, or cloud deployment practice sessions. These recommendations aim to support continuous competency development and strengthen the long-term collaboration between the polytechnic and the partner school.

RESULTS AND DISCUSSION

Commented [FA1]: Hasil dari kegiatan mohon untuk ditambahkan min 6 bukti kegiatan

The community service program produced several measurable outcomes that demonstrated its effectiveness in improving students understanding of Industry 4.0 technologies.

Figure 2. Visual media utilized during the Program session.

Figure 3 Visual Media

The seminar was attended by Software Engineering (RPL) students who actively participated throughout the session.

Figure 4. Speaker delivering material on Cloud, AI, and IoT to RPL students.

Figure 5. Program session

Figure 6. Program session.

Figure 7. Program session.

Volume. 1 Nomor. 2, November 2025
ISSN: 3090-7691

Figure 8. Program session

The main results are as follows:

1. **Increased Understanding of Emerging Technologies**
   Students showed a notable improvement in their comprehension of Cloud Computing, Artificial Intelligence, and the Internet of Things. Based on feedback collected through evaluation forms, most participants reported that the seminar clarified concepts that were previously unfamiliar or difficult to understand.
2. **Higher Learning Motivation**
   The seminar successfully stimulated students' interest in exploring digital technologies. Many participants expressed enthusiasm to continue learning through online platforms and hands-on practice, particularly in areas such as cloud platforms, IoT devices, and basic AI applications.
3. **Enhanced School–Polytechnic Engagement**
   The activity strengthened the collaboration between Politeknik Negeri Indramayu and SMK PGRI Kandanghaur. The partner school expressed interest in holding follow-up training sessions focusing on practical implementation to further support student competency development.
4. **Achievement of Program Outputs**
   The program generated several documented outputs, including seminar presentation materials, photographs and video documentation, an online news publication, and a statement letter from the school partner acknowledging the program's impact.

DISCUSSION

The results indicate that the seminar effectively addressed the initial problem of low technological literacy among RPL students. The combination of interactive explanations, contextual examples, and opportunities for discussion created a learning environment that made complex technologies more accessible and relevant.

The increased motivation among students suggests that introducing emerging technologies in an engaging and structured manner can significantly influence their interest and readiness to learn. This motivation forms an important foundation for future competency development, particularly for students preparing to enter technology-driven industries.

Furthermore, the strengthened collaboration with the partner school demonstrates that community service activities can serve as a strategic bridge between vocational education and current industry demands. Sustaining this partnership will allow continuous knowledge transfer and the possibility of developing more advanced training programs, such as hands-on IoT workshops or introductory AI project sessions.

Overall, the program successfully achieved its objectives by enhancing students' technological awareness, improving their learning motivation, and laying the groundwork for continued capacity building in digital competency development.

CONCLUSION

This Community Service Program (PKM) successfully addressed the low level of literacy and limited understanding of Cloud Computing, Artificial Intelligence (AI), and the Internet of Things (IoT) among Software Engineering (RPL) students at SMK PGRI Kandanghaur. Through a structured series of activities—including needs assessment, material development, technical preparation, and an interactive seminar—the program effectively enhanced students' foundational knowledge, technological awareness, and motivation to explore emerging digital technologies.

Evaluation results indicate a significant improvement in students' comprehension of key Industry 4.0 technologies, accompanied by a noticeable increase in their interest to continue learning through practical activities and independent study. Furthermore, this program strengthened the partnership between Politeknik Negeri Indramayu and SMK PGRI Kandanghaur, creating opportunities for sustainable collaboration in future competency development initiatives.

Overall, the PKM achieved its primary goals by reinforcing students' technological competencies and supporting their readiness to engage with the digital transformation occurring in modern industrial environments.

Commented [FA2]: Simpulan berisi dari ringkasan uraian dari hasil tujuan PKM serta saran disusun berdasarkan temuan yang telah di uraikan dalam pembahasan

BIBLIOGRAPHY

Commented [FA3]: Silahkan tambahkan daftar pustaka min 15 yang sesaui dengan topik yang di kaji

Bahga, A., & Madisetti, V. (2014). *Cloud computing: A hands-on approach*. VPT.

Buyya, R., Vecchiola, C., & Selvi, S. T. (2013). *Mastering cloud computing: Foundations and applications programming*. Morgan Kaufmann.

Elahi, H. (2022). *Internet of things: Concepts and applications*. Springer.

Huda, M., et al. (2021). Enhancing digital literacy in vocational education through technology-based training. *Journal of Technical Education and Training*. https://doi.org/10.30880/jtet

Marr, B. (2020). *Tech trends in practice: The 25 technologies driving the 4th industrial revolution*. Wiley.

Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.

Sari, D., & Prasetyo, Y. (2020). The readiness of vocational students toward Industrial Revolution 4.0. *Journal of Vocational Education Studies*. https://journal.uny.ac.id/index.php/joves/article/view/29863

Sudira, P. (2018). *TVET: Konsep, praktik, dan tantangan pendidikan vokasi di era digital*. UNY Press.

Al-Fuqaha, A., Guizani, M., Mohammadi, M., Aledhari, M., & Ayyash, M. (2015). Internet of Things: A survey on enabling technologies, protocols, and applications. *IEEE Communications Surveys & Tutorials, 17*(4), 2347–2376.

Volume. 1 Nomor. 2, November 2025
ISSN: 3090-7691

He, W., & Yan, G. (2021). *Applied artificial intelligence: A handbook for business leaders*. Springer.

Kurniawan, H., & Wibowo, A. (2020). Digital skills readiness of vocational students toward Industry 4.0. *Journal of Vocational and Learning Studies, 4*(2), 112–120.

Lee, J., Kao, H. A., & Yang, S. (2014). Service innovation and smart analytics for Industry 4.0 and smart manufacturing. *Procedia CIRP, 16*, 3–8.

Ray, P. P. (2018). A survey of IoT cloud platforms. *Future Computing and Informatics Journal, 3*(1), 35–46.

Suryani, T., & Wilantara, R. (2021). Enhancing vocational students' competence through technology-based training in the digital era. *International Journal of Emerging Technologies in Learning, 16*(11), 45–58.

Xu, L. D., Xu, E. L., & Li, L. (2018). Industry 4.0: State of the art and future trends. *International Journal of Production Research, 56*(8), 2941–2962.