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Optimizing Deep Learning: Workshop on Improving Teacher Capacity in the Application of Artificial Inteligent (AI) and Coding at SDIT Mafatih

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Abstract

The integration of Coding and Artificial Intelligence (AI) in elementary education faces significant challenges, particularly regarding teacher readiness and infrastructure. SDIT Mafatih teachers often perceive Computational Thinking (CT) solely as a programming activity, overlooking its core pillars: decomposition, pattern recognition, abstraction, and algorithms. This community service program aims to enhance teacher capacity at SDIT Mafatih through a structured four-stage approach: a basic CT workshop emphasizing unplugged activities, provision of basic digital infrastructure, development of an integrative curriculum guide, and progressive Scratch training. The program utilized a participatory method involving 23 participants, supported by the provision of tablets and projectors. Results indicated a significant improvement in teacher competency, with average initial knowledge scores reaching 79.9% of the maximum. The activities successfully produced integrative lesson plans and digital learning modules, demonstrating an effective model for digital transformation in resource-limited educational settings.

Keywords: Artificial Intelligence, Computational Thinking, Scratch, Community Service.

1. INTRODUCTION

The urgency of integrating Coding and Artificial Intelligence (CA) into primary education is increasing with the development of Industry 4.0 and 5.0. This aligns with Minister of Elementary and Secondary Education Regulation No. 13 of 2025, which mandates the integration of Coding and Artificial Intelligence (KA) into the National Curriculum. However, schools like SDIT Mafatih face serious challenges in the form of limited infrastructure and limited teacher understanding.

An initial survey at SDIT Mafatih showed that 85% of teachers had never received substantial training in Coding and Artificial Intelligence (KA). Furthermore, there is a misconception that teachers often view Computational Thinking (CT) as synonymous with coding alone, without understanding its four main pillars: decomposition, pattern recognition, abstraction, and algorithms. Infrastructure is also a constraint, with only one projector available for every six classrooms.

This community service program offers a solution through two main approaches: training CT concepts through unplugged activities (such as logic games and puzzles) and practical training using Scratch software. This program also implements the Independent Learning and Independent Campus (MBKM) policy, which involves students in addressing real-world educational challenges. The urgency of integrating Coding and Artificial Intelligence (AI) into education is increasing with the development of Industry 4.0 and 5.0, which demand superior human resources with strong digital understanding and skills [1][2]. In line with this, the Ministry of Primary and Secondary Education has taken strategic steps, through Permendikdasmen 13/2025, one of which is the integration of Coding and AI into the curriculum at various levels of education from elementary to high school [3].

On the other hand, schools, including SDIT Mafatih, face challenges in implementing Coding and AI in learning. The main problems faced by SDIT Mafatih lie in two critical aspects: limited teacher understanding and inadequate technological infrastructure. Initial surveys showed that 85% of classroom teachers had never received substantial training in Coding and AI, while supporting facilities such as projectors and digital devices were only available in 20% of classrooms. As a result, coding and computational thinking (CT) learning cannot be implemented, thus depriving students of the opportunity to develop computational thinking (CT), which is essential in the digital age [4][5].

To address this, we offer a solution based on two approaches: training in CT concepts through unplugged activities (such as logic games and puzzles) to build a foundation for

 Vol. 4, No. 1 June 2026, Page. 20-25.
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computational thinking [6], and practical training using Scratch software installed on three provided tablets. Scratch was chosen because of its visual and interactive interface, suitable for beginners, and because it allows teachers to apply CT concepts in simple projects such as creating animations or educational quizzes, even with limited devices [7].

This program is designed to help teachers integrate CT into everyday learning, both through unplugged and digital activities. We provide a practical guidance module containing examples of computer-free KA activities and basic Scratch projects, along with brief mentoring to ensure teachers can begin teaching coding independently [8]. By focusing on reinforcing basic concepts before coding practice, this solution is expected to be effective even with limited school resources.

This program is also in line with the Independent Learning and Independent Campus (MBKM) policy, which encourages collaboration between universities and the community to address real-world educational challenges [9]. Through this activity, students can participate in community service programs as a form of implementing off-campus learning, while also assisting schools in adapting the independent curriculum, particularly in digital literacy aspects. The Coding and KA training activities using Scratch also support teacher competency in implementing Coding and KA subjects according to curriculum requirements, while also serving as a tangible manifestation of knowledge transfer from universities to partner schools. Thus, this program not only addresses the needs of partners but also provides contextual learning experiences for students in accordance with the principles of MBKM.

2. METHODOLOGY

This community service activity was held on December 6, 2025, at SDIT Mafatih. The implementation phase was divided into three main stages : (1). Preparation Phase: Included classroom observations, teacher interviews, curriculum analysis, competency mapping through pre-tests, and preparation of unplugged CT modules and hardware (tablets and projectors). (2). Implementation Phase: A one-day intensive workshop with material consisting of 40% CT concepts, 30% Scratch practice, and 30% teaching simulations. (3). Evaluation Phase: Analysis of pre-test and post-test results and preparation of a report on the activity results.

Figure 1 presents the pre-test administered before the training activities began. The pre-test was conducted to assess the participants' initial knowledge and understanding of Artificial Intelligence (AI), Computational Thinking (CT), and Coding concepts. The results served as a baseline for identifying teachers' existing competencies and determining the focus of the training materials. The assessment also provided valuable information for designing learning activities that addressed participants' specific needs and knowledge gaps.

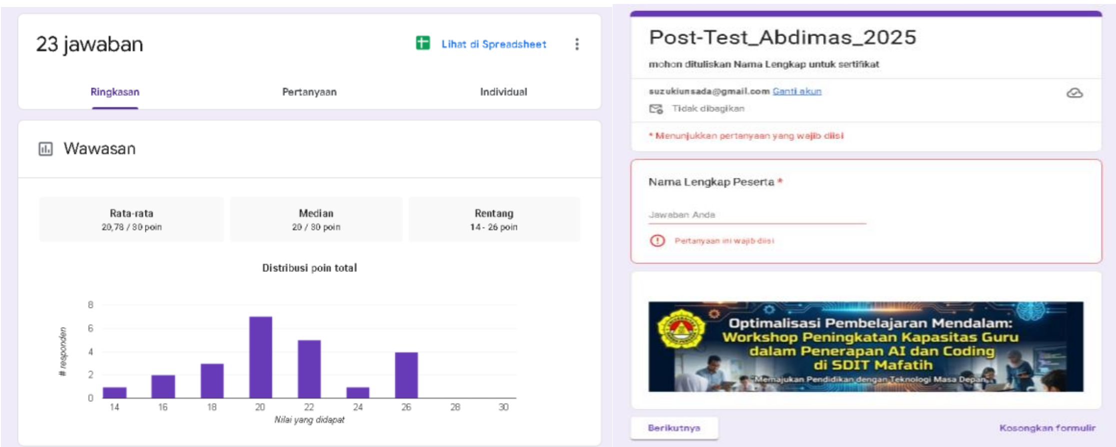

Figure 1. Respondent Pre Test & Post Test

Figure 1 presents the post-test conducted immediately after the completion of the training program. The post-test was designed to evaluate participants' learning outcomes and measure the effectiveness of the workshop in improving teachers' understanding of AI, Computational Thinking, and Coding concepts. By comparing the post-test results with the pre-test findings, the

 Vol. 4, No. 1 June 2026, Page. 20-25.
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training team was able to assess participants' cognitive improvement and evaluate the achievement of the program objectives. The post-training assessment indicated that participants demonstrated better conceptual understanding and greater confidence in applying the acquired knowledge in educational settings.

Figure 2 shows one of the instructional modules introducing the fundamental concepts of Artificial Intelligence (AI) and Computational Thinking (CT). During this session, participants were introduced to the basic principles of AI, its applications in education, and the four core pillars of Computational Thinking, namely decomposition, pattern recognition, abstraction, and algorithmic thinking. This introductory material was intended to establish a strong conceptual foundation before participants engaged in practical coding activities using Scratch.

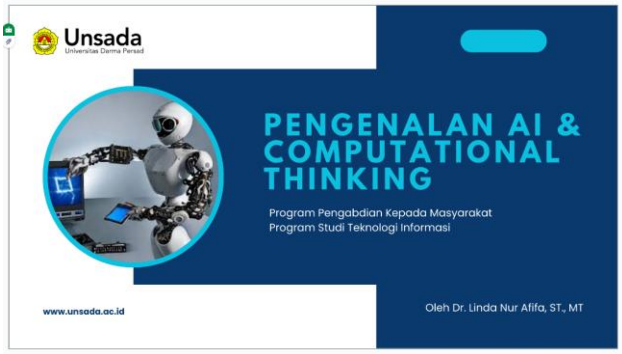

Figure 2. Introduction to AI and Computational Thinking

Figure 3 presents the learning activity on Pattern Recognition, one of the fundamental components of Computational Thinking. In this session, teachers practiced identifying similarities, differences, and recurring patterns within various problem scenarios as an essential step toward developing algorithmic solutions. The activity emphasized that pattern recognition enables learners to simplify complex problems by recognizing common structures, thereby facilitating more efficient problem-solving processes. This competency is expected to support teachers in designing classroom activities that foster logical reasoning and computational thinking among elementary school students.

Figure 3. Pattern recognition

3. RESULT AND DISCUSSION

Based on the results of the pre-test involving 23 participants, the average score reached 20.78 out of a maximum score of 30, equivalent to 79.9%. The distribution of scores indicated that 52.2% of the teachers were categorized as having moderate competency (60–79%), while 43.5% were classified as having high competency (>80%). These findings suggest that most participants already possessed a fundamental understanding of Computational Thinking (CT), Artificial Intelligence (AI), and Coding concepts before the training. Nevertheless, the relatively limited proportion of participants in the high-competency category indicates that additional capacity-building activities are still required, particularly in translating conceptual knowledge into practical classroom implementation.

Vol. 4, No. 1 June 2026, Page. 20-25.
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The perception questionnaire demonstrated highly positive responses toward the training program. Regarding material relevance, 66.7% of respondents considered the training content to be very relevant to their professional needs, indicating strong alignment between the workshop objectives and teachers' expectations. In terms of material completeness, 91.7% of participants evaluated the learning materials as either complete (50.0%) or very complete (41.7%), suggesting that the workshop successfully covered the essential concepts required for introducing AI and Coding in elementary education. The evaluation of the facilitator also produced favorable results. Approximately 66.7% of participants rated the speaker's ability to explain concepts and answer questions as "Very Good," reflecting effective knowledge transfer and interactive communication throughout the workshop. Effective facilitation is considered an important factor influencing participants' learning engagement and confidence in adopting new educational technologies.

Regarding implementation readiness, the findings indicate that 41.7% of teachers felt quite ready, while 25.0% reported being very ready to integrate AI and Coding into classroom learning. Although these results demonstrate a positive shift in teachers' confidence, they also imply that a considerable proportion of participants still require continued mentoring, classroom practice, and follow-up training before independently implementing AI-supported learning activities. This finding is consistent with previous studies emphasizing that professional development programs should combine conceptual understanding with sustained practical assistance to ensure successful classroom adoption. In addition to improving teacher competency, the program also generated tangible outputs through the provision of educational facilities. One LCD projector was donated to the partner school to reduce infrastructure limitations, while an integrated AI and Coding training module was developed as a practical reference for teachers. These supporting facilities are expected to increase the sustainability of the program by enabling teachers to repeatedly apply the acquired knowledge during classroom instruction.

Overall, the evaluation results indicate that the workshop achieved its primary objectives in improving participants' awareness, knowledge, and readiness to implement AI and Coding in elementary education. The combination of positive participant perceptions, improved readiness, and the provision of supporting infrastructure demonstrates that the community service program has the potential to accelerate digital transformation at SDIT Mafatih. However, the findings also highlight the importance of conducting follow-up mentoring and longitudinal evaluations to measure the long-term impact of the training on actual classroom practices and student learning outcomes. Figure 4 presents a group photograph of the training participants together with the community service team after the completion of the workshop activities. The documentation illustrates the active involvement of teachers throughout the program and reflects the collaborative atmosphere established between the university and the partner school. The high level of participant engagement observed during the workshop is consistent with the positive evaluation results obtained from the perception questionnaire, indicating that the training was well received and successfully facilitated knowledge sharing on Computational Thinking, Artificial Intelligence, and Coding. Furthermore, this activity strengthened institutional collaboration and fostered teachers' motivation to implement the acquired knowledge in classroom practices.

Figure 4. Group photo with the teachers participating in the training

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Figure 4 shows the official handover of one LCD projector to the school principal as part of the program's supporting facilities. The provision of this equipment represents a tangible output of the community service activity aimed at addressing the limited technological infrastructure identified during the initial needs assessment. The LCD projector is expected to support the delivery of interactive learning materials related to Artificial Intelligence and Coding, facilitate future teacher training sessions, and enhance the sustainability of digital learning implementation at SDIT Mafatih. In addition to improving classroom presentation capabilities, the donated equipment demonstrates the program's commitment to providing long-term educational benefits beyond the workshop itself.

4. RESULT

The functional evaluations confirm that the developed web application provides significant technical advantages over traditional public report workflows. By utilizing the Model-View-Controller (MVC) architectural pattern, the system maintains strict isolation between backend data processes and user presentation views, preventing unauthorized data injection or state modifications. Centralized relational database migrations in MySQL ensure structured data storage and consistent transaction records, eliminating physical paperwork loss and tracking delays.

However, several developmental constraints remain within the current application ecosystem. The platform depends entirely on standard web server requests, lacking integrated push-notification systems or automated cross-platform messaging hooks (e.g., WhatsApp API) to alert users instantly when their complaint status changes. Furthermore, the system lacks automated analytical tools to group incoming report trends or an independent file exporter engine to instantly generate PDF or Excel summaries for administrative accounting reports. These limitations highlight critical directions for future functional software updates.

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