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Strengthening Pedagogical Competence among Junior High School Teachers in Klaten through Interdisciplinary AI Workshops

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Abstract

The rapid advancement of artificial intelligence (AI) demands teacher adaptation, yet existing training remains partial and lacks interdisciplinary integration. This community service activity aimed to enhance AI understanding, technical skills, and implementation readiness among junior high school teachers. Using an Asset-Based Community Development (ABCD) approach operationalized through the 5D framework (Discovery, Dream, Design, Define, Destiny), a three-week serial workshop was conducted with 39 teachers from six subject areas at Muhammadiyah junior high schools in Klaten, Indonesia. Evaluation employed observations, questionnaires, and interviews. Results showed significant improvement in conceptual understanding across all topics, with 75-96% of participants achieving independent competency on specific AI applications. Participant satisfaction was high (mean 4.41/5). However, challenges included unstable internet and limited devices. This interdisciplinary serial workshop model proved effective as a professional development approach, with potential for replication through teacher working groups. Recommendations include improved infrastructure, extended practice time, and ongoing mentoring support.

1. Introduction

The rapid advancement of artificial intelligence (AI) has fundamentally transformed education, with generative AI enabling personalized learning, automated administrative tasks, and immersive learning experiences (Holmes & Tuomi, 2022). However, this technological revolution introduces ethical and pedagogical complexities that necessitate comprehensive teacher preparation (Wulanda et al., 2025).

Recognizing this urgency, UNESCO published the AI Competency Framework for Teachers (AI CFT), defining 15 competencies across five key dimensions (UNESCO, 2026). At the national level, Indonesia's Ministry of Primary and Secondary Education (Kemendikdasmen) issued Regulation Number 13 of 2025, mandating coding and AI be taught progressively starting in grade 5. Despite these policy developments, research reveals that more than 60% of Indonesian teachers lack advanced digital literacy (Sufyadi et al., 2026).

Figure 1. Initial observation and FGD with the Muhammadiyah Principals Working Group (K3SM).

Initial observations with the Muhammadiyah Principals Working Group (K3SM) in Klaten Regency as seen in Fig 1., revealed a significant competency gap: only approximately 20% of teachers possessed adequate digital literacy related to AI. Most training programs remain one-off, subject-specific, and theory-heavy, contradicting research showing that sustainable change requires phased, continuous, practice-based approaches (Darling-Hammond et al., 2017). This gap between policy mandates and classroom realities formed the impetus for this community service activity.

2. Methods of Implementation

2.1 Approach

This activity employed the Asset-Based Community Development (ABCD) approach, focusing on identifying and mobilizing existing community assets rather than deficiencies (Kretzmann & McKnight, 1993). The approach was operationalized through the 5D framework: Discovery, Dream, Design, Define, and Destiny.

2.2 Time, Venue, and Participants

The activity was conducted on three consecutive Saturdays: April 25, May 2, and May 9, 2026, at Muhammadiyah 1 Klaten Junior High School. A total of 39 teachers participated, representing Science (6), Mathematics (5), English (4), Informatics (3), and other subjects (6 initial), with additional participants joining voluntarily in subsequent sessions. Selection criteria included subject relevance to AI integration, interest in technology-enhanced learning, and willingness to participate fully (Celik et al., 2022; Miao, 2024). Recent studies emphasize that teacher AI competence is influenced by professional learning, institutional support, individual beliefs, and contextual factors (Zhou et al., 2026). In this context, professional development programs that integrate AI with pedagogical practices are increasingly important for strengthening teachers' capacity to design innovative and meaningful learning experiences (Khalid et al., 2026; Tan et al., 2024; Aravantinos, et al., 2026)

2.3 ABCD 5D Implementation

The community empowerment program was implemented following the five stages of the Asset-Based Community Development (ABCD) framework (Hawking & Simon, 2018): Discovery, Dream, Design, Define, and Destiny. This approach emphasized identifying and leveraging existing community strengths while collaboratively designing sustainable professional development activities, as seen in Fig 2.

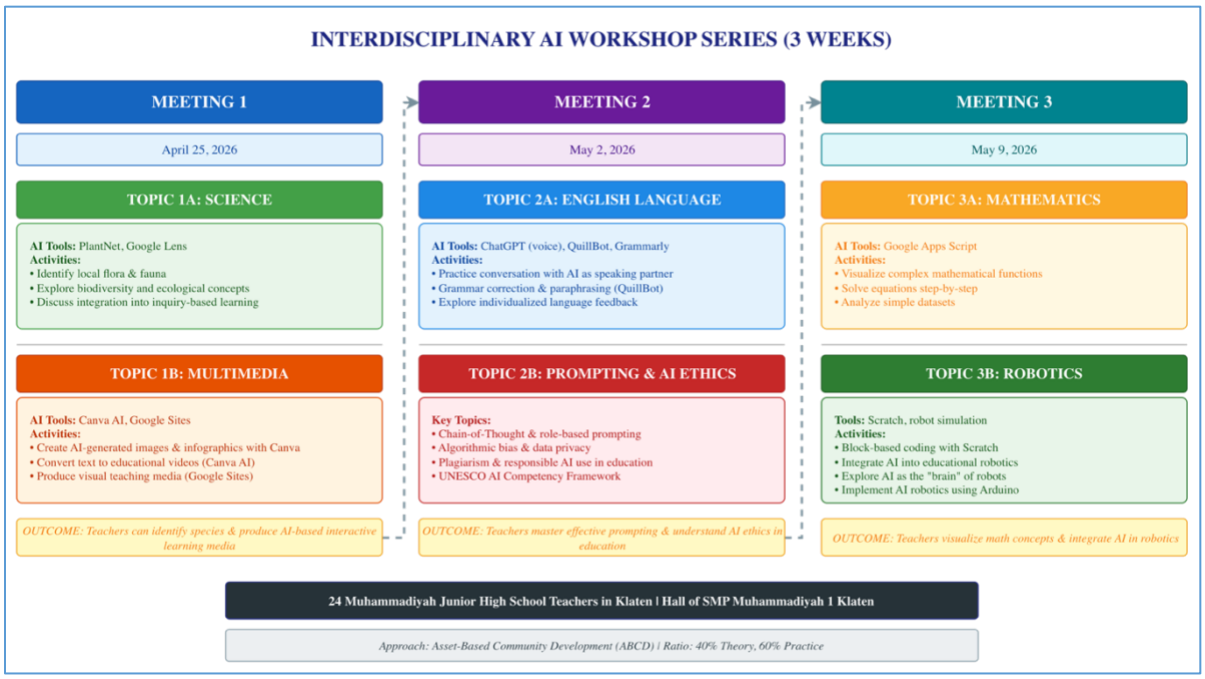

Figure 2. The 5D Appreciative Inquiry Framework

The Discovery stage was conducted from 11–18 April 2026 to identify the assets, needs, and readiness of the participating teacher community. Data were collected through coordination meetings with the *Kelompok Kerja Kepala Sekolah Muhammadiyah* (K3SM), a pre-workshop questionnaire completed by 26 teachers, and a Focus Group Discussion involving 12 teacher representatives from different subject areas. The asset mapping revealed several enabling factors, including strong teacher motivation (approximately 90% expressed interest in learning AI), diverse disciplinary expertise, institutional support from K3SM, and an established culture of collaboration among Muhammadiyah schools. At the same time, the baseline assessment indicated that only 20% of participants possessed adequate AI literacy, highlighting the need for structured capacity-building activities.

During the Dream stage on 18 April 2026, participants engaged in a collaborative visioning workshop to define the desired role of AI in their educational practice. Through facilitated discussions, teachers formulated a shared vision that positioned AI as a pedagogical partner capable of enhancing learning effectiveness, supporting differentiated instruction, and reducing teachers' administrative workload while ensuring ethical and responsible use. This shared vision subsequently guided the design of the workshop curriculum and learning activities.

Figure 3. AI training session in robotics implementation on May 9, 2026.

The Design stage, conducted between 19 and 23 April 2026, translated the collective vision into a structured professional development program. A three-week serial workshop was developed with learning topics arranged from introductory to more advanced levels, allowing participants to progressively build their competencies. Consistent with principles of experiential learning, approximately 60% of each session was devoted to hands-on practice, while the remaining 40% focused on conceptual foundations. Participants were also organized into interdisciplinary learning groups to encourage cross-subject collaboration and the exchange of pedagogical ideas. The workshop topics and AI applications introduced during each meeting are summarized in Table 1.

Table 1. Topics and Materials for the Interdisciplinary AI Serial Workshop

Meeting	Date	Topic 1	Topic 2	AI Applications
1	Apr 25	Science	Multimedia	PlantNet, Google Lens, Canva AI, Google Sites
2	May 2	English	Prompting & Ethics	ChatGPT, Grammarly, QuillBot, Perplexity
3	May 9	Mathematics	Robotics (Figure 3)	Google Apps Script, Arduino, Scratch

Source: (UNESCO, 2026)

2.4 Evaluation Methods

The effectiveness of the workshop series was evaluated using a mixed-methods approach comprising three complementary instruments to capture participants' cognitive, behavioral, and affective outcomes.

First, semi-structured interviews were conducted with a purposive sample of 15 participants following the completion of the workshops. The interviews explored teachers' conceptual understanding of AI, perceived pedagogical value, ethical awareness, and anticipated classroom applications. Interview transcripts were analyzed using inductive thematic analysis to identify recurring patterns and emerging themes related to changes in participants' perceptions and instructional planning.

Second, participants' practical competencies were assessed through direct observation using a structured skills checklist completed during the hands-on workshop activities. The instrument evaluated five core competencies related to AI use in educational settings: accessing AI applications, formulating effective prompts, generating AI-assisted outputs, documenting results, and adapting AI tools to subject-specific teaching contexts. Each competency was rated on a three-point performance scale (1 = unable to perform, 2 = able with assistance, and 3 = able independently). To ensure scoring consistency, two observers independently assessed participant performance, yielding an inter-observer reliability of 92%.

Third, all participants (n = 39) completed a post-workshop questionnaire consisting of 18 five-point Likert-scale items that measured overall satisfaction with the workshop, perceived readiness to implement AI in classroom practice, and perceptions of the workshop design and delivery. The instrument demonstrated excellent internal consistency (Cronbach's $\alpha = 0.92$). In addition, the questionnaire included several open-ended questions to capture participants' reflections, perceived implementation barriers, and recommendations for improving future professional development programs. These qualitative responses were analyzed thematically to complement the quantitative findings and provide a richer understanding of teachers' experiences. Ethical approval obtained (Protocol No. 4041/P2M/UMS/IV/2026); all participants provided informed consent.

3. Results and Implementation

The implementation of the interdisciplinary AI workshop series over three weeks produced significant outcomes across all measured indicators. This section presents the results of the evaluation, organized according to the four primary outcomes: (1) conceptual understanding, (2) technical skills mastery, (3) participant satisfaction, and (4) readiness for implementation. Each subsection is followed by a discussion that connects the findings to the existing literature and the broader context of teacher professional development in the AI era.

3.1 Implementation Fidelity

The workshop series successfully engaged 39 unique teachers, exceeding the initial recruitment target of 24 participants. Attendance rates were 91.7% (22/24) for Meeting 1, 70.8% (17/24) for Meeting 2, and 45.8% (11/24) for Meeting 3. Although attendance decreased over successive sessions, this pattern is not uncommon in voluntary professional development programs. The reduction was primarily associated with competing school responsibilities, the non-mandatory nature of the program, and the increasing technical complexity of the workshop content, which required greater participant commitment.

3.2 Conceptual Understanding

Thematic analysis revealed substantial changes in teachers' perceptions and pedagogical thinking following the workshop series. Participants progressed from perceiving AI as a general-purpose digital tool to recognizing its discipline-specific pedagogical value and the ethical considerations associated with its use. Three major themes emerged.

From Generic to Discipline-Specific Understanding. Initially, many teachers, particularly those teaching Science and Mathematics, viewed AI as having limited educational relevance beyond basic information retrieval. As the workshops progressed, however, they began to recognize its potential to support subject-specific teaching and learning. One science teacher remarked, "I thought AI was only useful for searching images, but it turns out it can also be used for plant identification."

Growing Awareness of AI Ethics and Critical Use. Participants demonstrated increased awareness of ethical issues surrounding AI, including algorithmic bias, data privacy, and the importance of effective prompt engineering (Abdy et al., 2025). Rather than accepting AI-generated outputs uncritically, teachers emphasized the need to verify information before using it in the classroom. As one English teacher reflected, "I just realized that AI can be biased. Not all of the information it provides is accurate."

From *Conceptual Understanding to Instructional Planning*, beyond acquiring theoretical knowledge, teachers translated their learning into practical instructional strategies. They proposed integrating AI-generated infographics as lesson starters, using AI-powered chatbots to provide after-class learning support, and employing image-recognition tools for species identification in project-based learning. These examples indicate a shift from abstract awareness to concrete pedagogical planning, suggesting that participants had begun to integrate AI meaningfully into their instructional practice rather than viewing it solely as a technological novelty.

3.3 Technical Skills Mastery

Table 2. Independent Competency per Topic

Topic	AI Application	Independent (%)
Science	PlantNet / Google Lens	95.8
Multimedia	Canva AI	91.7
English	ChatGPT	87.5
Prompting	Perplexity / Advanced prompting	79.2
Mathematics	Google Apps Script	83.3
Robotics	Scratch + AI simulation	75.0

In a nutshell, 90% of participants (35 of 39 teachers) demonstrated independent competency across all practical workshop activities. Competency levels varied by disciplinary context, with the highest performance observed among Science teachers (95.8%) and the lowest among Robotics teachers (75.0%) as seen in **Table 2**. A disaggregated analysis of practical competencies showed that participants performed strongest in accessing AI applications (93%) and generating AI-assisted outputs (88%), followed by documenting their work (84%). Lower proficiency was observed in formulating effective prompts (79%) and adapting AI tools to discipline-specific instructional contexts

(76%), suggesting that higher-order pedagogical integration remained more challenging than basic operational skills.

3.4 Participant Satisfaction

Across the workshop series, mean satisfaction (as seen in **Fig 4**): 4.41/5 (SD=0.75), categorized as "Very Good." Highest indicators: presenters' openness to questions (4.62), presenter mastery (4.59), and real benefits (4.59). Lowest: facilities & infrastructure (3.85), time management (4.18), and program organization (4.21).

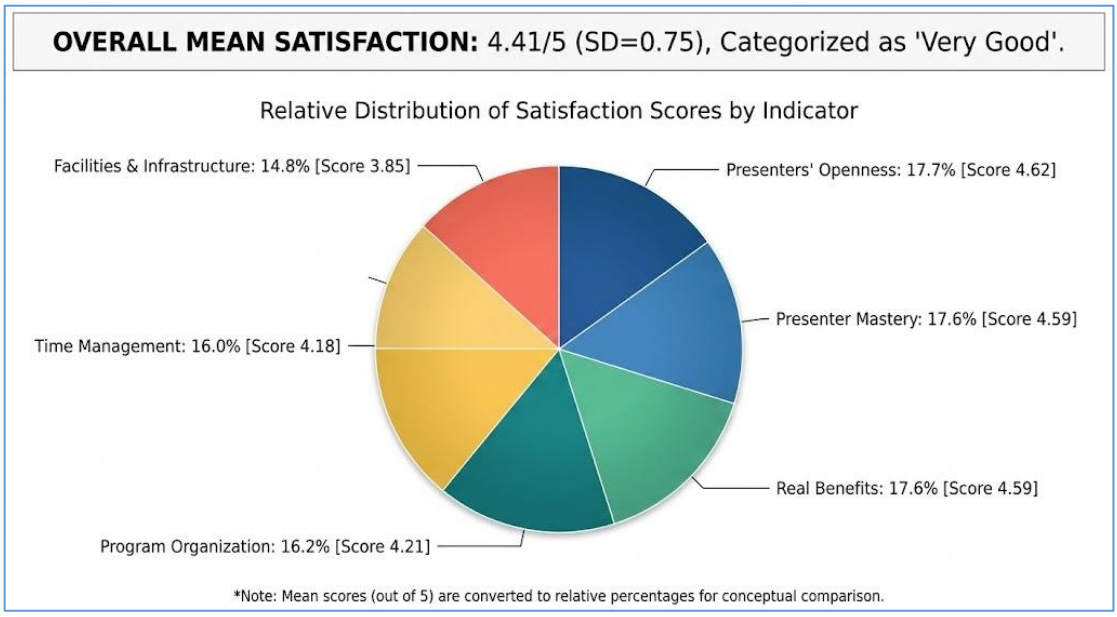

Figure 4. Participant Satisfaction Indicators

Implementation readiness: Mean 4.00/5 (SD=0.89), with 90% expressing confidence (scores 4-5) in implementing AI tools. Confidence increased across meetings: Meeting 1(3.86), Meeting 2 (4.12), Meeting 3 (4.18).

3.5 Preferred AI Applications

Table 3. Teacher's Preferred AI Applications

Application Category	Frequency (n=39)	%
Content creation (image/text generation)	32	82.1
Personalized learning (adaptive platforms)	23	59.0
Assessment & feedback (grading tools)	18	46.2
Administrative efficiency	15	38.5
AI ethics and challenges	13	33.3
Robotics, coding, Arduino	6	15.4

The data presented in Table 3 reveal participants' strongest preference for AI applications that offer immediate, practical classroom utility. Content creation tools (image and text generation) were the most favored, selected by 82.1% of teachers (n=32), reflecting the pressing need for efficient instructional material development. Personalized learning platforms followed at 59.0% (n=23), indicating teachers' interest in addressing diverse student needs through adaptive technologies. Assessment and feedback tools (46.2%, n=18) and administrative efficiency applications (38.5%, n=15) were also highly valued, suggesting that teachers view AI as a means to reduce workload burdens. Conversely, AI ethics and challenges received relatively lower interest (33.3%, n=13), while robotics and coding attracted the fewest responses (15.4%, n=6), likely due to perceived complexity and limited relevance to participants' subject areas. These findings underscore the importance of prioritizing practical, discipline-relevant AI applications in future professional development programs.

3.6 Ideal Duration

Participants expressed a preference for workshop sessions lasting approximately 4–5 hours, with a mean preferred duration of 4 hours and 31 minutes (median = 4 hours 15 minutes; mode = 4 hours). This suggests that participants considered a half-day format sufficient to balance content coverage with sustained engagement.

3.7 Barriers to Implementation

Thematic analysis of the open-ended responses identified several anticipated barriers to implementing AI in classroom practice. The most frequently reported challenges were limited access to devices in venue (n = 8), unstable internet connectivity (n = 7), insufficient time to prepare AI-supported lessons (n = 6), the need for ready-to-use instructional modules (n = 5), and concerns about students misusing AI tools (n = 3). These findings indicate that both infrastructural constraints and pedagogical support remain critical factors influencing teachers’ readiness to integrate AI into their instructional practice.

4. Conclusion

The interdisciplinary serial workshop series, grounded in the Asset-Based Community Development (ABCD) approach and operationalized through the 5D framework, successfully addressed low AI literacy, fragmented training, and limited interdisciplinary collaboration among Muhammadiyah junior high school teachers in Klaten. Through the five stages, Discovery, Dream, Design, Define, and Destiny, 39 teachers from six subject areas transformed their understanding of AI from a generic technology into a contextualized pedagogical partner. Evaluation demonstrated significant outcomes: 75-96% independent competency across AI applications, high satisfaction (mean 4.41/5), and 90% confidence in classroom implementation. Teachers developed critical awareness of algorithmic bias and responsible AI use while translating learning into concrete instructional strategies. Despite persistent challenges including unstable internet and limited devices, the program's replicable model offers a blueprint for scaling AI literacy through teacher working groups (MGMP). The program demonstrates that meaningful change begins by mobilizing existing assets: teachers' passion, creativity, and collaborative spirit. With improved infrastructure, extended practice time, and ongoing mentoring support, this ABCD-based interdisciplinary workshop model holds strong potential for sustainable professional development in the AI era.

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