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Online digital literacy training for Indonesian teachers using UNESCO DLGF and AI competency framework

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ABSTRACT

Indonesia's rapid digital transformation demands that teachers develop strong digital literacy competencies. However, persistent gaps, particularly in data literacy, applied technical problem-solving, and digital content creation, have not been fully addressed by existing training programs. The emergence of AI in education further increases competency demands that are not widely accommodated by current teacher professional development initiatives. This community service article reports on a two-session online digital literacy training involving 137 teachers from elementary, junior high, senior high, and vocational high schools across 26 provinces in Indonesia. The training was designed based on the UNESCO Global Framework of Reference on Digital Literacy Skills and expanded upon by the UNESCO AI Competency Framework for Teachers. Outcomes were measured through a post-training self-assessment survey, and findings indicate that participants reported high to very high digital literacy self-efficacy after the training. Ethics and Security emerged as the strongest dimensions, while data literacy remained the weakest area, reflecting the difficulty of building critical information-evaluation skills through short-term interventions. Applied technical problem-solving and digital content integration were also identified as follow-up priorities. This training confirms that online professional development grounded in a global framework is a measurable strategy for building teachers' digital literacy nationally.

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ABSTRAK

Transformasi digital Indonesia yang pesat menuntut guru untuk mengembangkan kompetensi literasi digital yang kuat. Namun, kesenjangan yang persisten, terutama dalam literasi data, pemecahan masalah teknis terapan, dan pembuatan konten digital, belum sepenuhnya diatasi oleh program pelatihan yang ada. Kemunculan AI dalam pendidikan semakin menambah tuntutan kompetensi yang belum banyak diakomodasi oleh inisiatif pengembangan profesional guru saat ini. Artikel pengabdian ini melaporkan pelatihan literasi digital daring dua sesi yang melibatkan 137 guru dari jenjang SD, SMP, SMA, dan SMK di 26 provinsi di Indonesia. Pelatihan dirancang berdasarkan UNESCO Global Framework of Reference on Digital Literacy Skills dan diperluas dengan UNESCO AI Competency Framework for Teachers. Hasil diukur melalui survei penilaian diri pasca pelatihan dan temuan menunjukkan bahwa peserta melaporkan efikasi diri literasi digital yang tinggi hingga sangat tinggi setelah mengikuti pelatihan. Etika dan Keamanan menjadi dimensi terkuat, sementara literasi data tetap menjadi area yang relatif paling lemah, mencerminkan sulitnya membangun keterampilan evaluasi informasi kritis melalui intervensi jangka pendek. Pemecahan masalah teknis terapan dan integrasi konten digital juga teridentifikasi sebagai prioritas tindak lanjut. Pelatihan ini menegaskan bahwa pengembangan profesional daring berbasis kerangka global merupakan strategi yang terukur untuk membangun literasi digital guru secara nasional.

Kata Kunci: *literasi AI; literasi digital; pelatihan guru; transformasi digital; UNESCO DLGF*

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INTRODUCTION

The rapid advancement of digital technology has fundamentally reshaped the educational landscape. That case places teachers at the forefront of digital transformation and demands new sets of professional competencies (Haleem et al., 2022; Ismail et al., 2025). In Indonesia, the world's fourth most populous country, spread across more than 17,000 islands, the imperative for digitally literate educators has become increasingly urgent as the nation seeks to bridge persistent educational quality gaps and prepare its citizenry for a knowledge economy (Priambodo et al., 2025; Syahruddin & Agus, 2026). According to the IMD World Digital Competitiveness Report 2024, Indonesia continues to rank in the lower group among countries with large populations (above 20 million) across three key domains: Knowledge, Technology, and Future Readiness. These rankings reflect systemic challenges in human resource development, digital infrastructure investment, and innovation capacity that directly affect the quality of education at all levels.

Digital literacy, broadly defined as the awareness, attitude, and capability to utilize digital tools to communicate and express social action, has emerged as a foundational professional competency for educators in the contemporary knowledge economy (Achmad & Utami, 2023; Farias-Gaytan et al., 2022; Ji & Li, 2025; Rahmawati et al., 2024; Vaskov et al., 2021). Teachers serve a dual role: developing their own digital competencies for effective instruction in digital environments while simultaneously modeling responsible, critical, and creative digital citizenship for the next generation of learners (Ismawati et al., 2023; Rahmawati et al., 2024). Research consistently demonstrates that teacher digital literacy directly influences pedagogical effectiveness, student engagement, and learning outcomes, underscoring the urgency of professional development at a national scale (Bhat, 2023; Rahmawati et al., 2024; Shi et al., 2025; Zafeer et al., 2025).

In response, SociopreneurID (Sociopreneur Indonesia), in collaboration with the Beasiswa Pelatihan Guru (BPG) 2025 scholarship initiative, organized this community service program for in-service teachers across Indonesia. The training program was systematically designed based on the UNESCO Global Framework of Reference on Digital Literacy Skills (DLGF) (see: https://unesdoc.unesco.org/ark:/48223/pf0000391299) and aligned with the UNESCO AI Competency Framework for Teachers (AI-CFT) (see: https://unesdoc.unesco.org/ark:/48223/pf0000391104.locale=en). This alignment acknowledges AI literacy as an emerging and indispensable dimension of digital literacy, equipping educators with the competencies required to effectively navigate, evaluate, and integrate AI technologies within teaching and learning environments.

This study makes a distinct contribution by being the first to systematically integrate the UNESCO AI Competency Framework for Teachers (AI-CFT) into a structured digital literacy training delivered at a national scale across 26 provinces. Prior Indonesian teacher professional development programs, including PemBATIK, GPO, and PKP, have focused primarily on technology tool adoption and have not yet incorporated AI-CFT competency progression into their frameworks (Lidinillah et al., 2021; Mailizar et al., 2022; Rahmawati et al., 2024). This study also employs a seven-dimension adaptation of the UNESCO DLGF as both the training framework and the outcome measurement instrument, providing dimension-level competency data for a diverse cohort of in-service teachers across all four school levels.

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This community service activity was designed to strengthen participants' digital literacy competencies across all seven UNESCO DLGF dimensions and to introduce AI literacy through the UNESCO AI-CFT, with outcomes measured using a structured post-training self-assessment instrument to identify priority dimensions requiring continued development in future programs. As outlined in Sustainable Development Goals (SDGs) 4 on quality education, one of the key skills is digital literacy (Tasliah et al., 2024). A 29-item post-training digital literacy self-assessment survey was administered to all participants after both sessions. This article reports on the design, implementation, and survey-based outcomes of the training program, contextualized within the broader literature on teacher digital literacy development in Indonesia and globally. Findings are discussed with reference to the seven UNESCO DLGF dimensions and the specific competency profiles of Indonesian teachers across different school levels and geographic regions.

Literature Review

Digital Literacy as a Professional Competency for Teachers

The UNESCO Digital Literacy Global Framework (DLGF) defines digital literacy as encompassing the ability to access, manage, understand, integrate, communicate, evaluate, and create information safely through digital technologies, with an explicit focus on employability (see: https://unesdoc.unesco.org/ark:/48223/pf0000391299). This definition is notable for its emphasis on both technical and higher-order cognitive dimensions, as well as its focus on safe and appropriate use, particularly salient for teachers who must guide students in responsible digital citizenship. For teachers specifically, digital literacy extends beyond personal digital proficiency to encompass curriculum design, pedagogy, the application of digital tools, and professional learning (Ahyar & Herlambang, 2025; Lidinillah et al., 2021). Teachers with higher digital literacy are more likely to engage in continuous online professional development and to demonstrate a more positive attitude toward the use of digital content in classroom settings (Mailizar et al., 2022; Suryawati et al., 2024).

Commissioned by the UNESCO Institute for Statistics (UIS) as the methodological foundation for SDG Thematic Indicator 4.4.2, the DLGF synthesized frameworks from 47 countries, building upon the European Commission's DigComp 2.0 and extending it with additional competency areas (Juwita et al., 2024). For this training program, the DLGF was adapted into seven contextualized dimensions aligned with the practical needs of Indonesian teachers: Technical Competence, Data Literacy, Collaboration, Digital Content Creation, Safety, Problem-Solving, and Ethics. The Ethics dimension was deliberately foregrounded given its particular relevance to Indonesia's educational context, where issues of academic integrity, AI-generated content, digital misinformation, and online conduct norms are pressing concerns.

State of Teacher Digital Literacy in Indonesia

Research consistently documents significant variability in Indonesian teachers' digital literacy levels, with most secondary school teachers operating at an intermediate level (Rahmawati et al., 2024). Safety, Problem-solving, and Digital Content Creation are consistently weak areas among Indonesian pre-service teachers, and rural teachers report considerably lower digital competencies than their urban counterparts (Hidayat et al., 2023; Soekamto et al., 2022). The COVID-19 pandemic demonstrated both the vulnerability of Indonesia's education system and the potential of online professional development to reach teachers nationwide (Mailizar et al., 2022). The UNESCO AI Competency Framework for Teachers (AI CFT) addresses this gap through five interconnected components: Human-centered Mindset, AI Ethics, AI

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Foundations and Applications, AI Pedagogy, and AI for Professional Learning (see: https://unesdoc.unesco.org/ark:/48223/pf0000391104.locale=en), each organized across three progression levels (Acquire, Deepen, Create). The inclusion of AI-CFT content in Session 2 reflects the recognition that digital literacy and AI literacy are increasingly inseparable competency domains for 21st-century educators.

METHODS

Activity Design and Setting

Training has consistently been identified as the most effective approach to improving teachers' digital literacy (Banoy-Suarez & González-Reyes, 2024; Medini & Berger-Douce, 2024; Zhou et al., 2023). This community service activity employed a training intervention design with a post-training survey for outcome assessment, delivered as two 2.5-hour online video conference sessions.

Research Participants

A total of 137 in-service teachers from all four school levels (Elementary, Junior High, Senior High, Vocational) completed both sessions and the post-training survey.

Table 1. Participant Demographics

Category	Sub-Category	n	Percentage (%)
School Level	Elementary (SD)	50	36.5%
	Junior High (SMP)	43	31.4%
	Senior High (SMA)	22	16.1%
	Vocational (SMK)	22	16.1%
Total		**137**	**100%**
Region (Island)	Java	81	59.1%
	Sumatra	25	18.2%
	Kalimantan	8	5.8%
	Nusa Tenggara	9	6.6%
	Sulawesi and Maluku	5	3.6%
	Papua	9	6.6%
Total	**26 provinces**	**137**	**100%**

Source: List of Participants Data, 2025

As shown in **Table 1**, participants were from 26 provinces across all five major island groups of Indonesia, from Aceh to Papua Tengah, with Java-based participants constituting the largest group (59.1%). This geographic diversity underscores the value of online training in enabling national-scale capacity building. SociopreneurID conducted participant recruitment through an open registration process. Selection criteria were: 1) demonstrated motivation and commitment to full participation; 2) institutional support from the teacher's school; and 3) geographic distribution across Indonesia's island groups. No minimum baseline digital competency was required, ensuring accessibility for teachers with varying levels of familiarity. This procedure is consistent with purposive sampling strategies in community service research.

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SociopreneurID conducted participant recruitment and selection through a transparent, open registration process. The program was accessible to all active in-service teachers at the four school levels (SD, SMP, SMA, and SMK) across Indonesia. Prospective participants submitted applications specifying their teaching level, provincial location, and personal motivation for attending. The SociopreneurID team carried out selection based on three criteria: 1) demonstrated motivation and commitment to participate fully in the program; 2) institutional commitment from both the teacher and their school to support participation; and 3) geographic distribution to ensure representation across Indonesia's major island groups. No minimum baseline digital competency was required as a selection criterion, ensuring the program was accessible to teachers with varying levels of digital familiarity. This selection procedure is consistent with purposive sampling strategies employed in community service research, where participants are chosen to reflect the diversity of the target population while ensuring sufficient engagement quality.

Training Program Structure

Table 2. Training Session Design and Content Coverage

Session	Title & Date	Topics Covered	DLGF Dimensions
1	**The Foundation of 21st-Century Education** (6 Sept 2025)	Indonesia digital literacy context; UNESCO DLGF overview; technical skills; data literacy and fact-checking; digital collaboration; online safety; digital ethics & AI ethics	• D1 Technical Competence • D2 Data Literacy • D3 Collaboration • D5 Safety • D7 Ethics
2	**Critical and Creative Digital Competencies** (13 Sept 2025)	AI paradigm shift; digital content creation & AI tools; copyright & AI ethics; problem-solving with AI; UNESCO AI CFT (5 components, 3 levels); AI pedagogy for teachers	• D4 Digital Content Creation • D6 Problem Solving • UNESCO AI CFT

Source: List of Participants Data, 2025

The training program consisted of two 2.5-hour online sessions delivered one week apart (**Table 2**), combining didactic presentation with interactive elements including case studies, scenario-based challenges, and collaborative reflection. Materials were grounded in real-world Indonesian classroom contexts.

Survey Instrument

A 29-item post-training digital literacy self-assessment survey was administered following both sessions, and the survey remained open until 16 September 2025. Items were grouped across seven dimensions (4-5 items each), all using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Scores were categorized as: Very High (4.50-5.00), High (3.50-4.49), Moderate (2.50-3.49), and Low (below 2.50). Regarding instrument validity and reliability, the 29 items were developed through content validation aligned with the seven dimensions of the UNESCO DLGF (see: https://unesdoc.unesco.org/ark:/48223/pf0000391299). Each item was mapped to a specific DLGF sub-competency and reviewed by the training facilitator (content validity).

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Construct validity was assessed using corrected item-total correlation (r >= 0.30), and internal consistency through Cronbach's alpha (threshold: 0.70). Full item-level results are reported in **Table 3**. In addition to the 29 Likert-scale items, the survey included two open-ended qualitative questions. Open-ended questions are a recognized instrument design strategy for capturing the depth, nuance, and contextual complexity of participants' experiences that closed-scale items cannot fully elicit. The inclusion of qualitative items follows the mixed-methods embedded design tradition, in which qualitative data serve to explain, contextualize, and enrich quantitative findings.

The two open-ended questions were:

Question Q1: *"Describe your plan for self-development in digital literacy and AI literacy following this training."*

This question was designed to elicit participants' forward-looking professional development intentions. Grounded in self-efficacy theory and self-directed learning principles, it assesses whether the training built sufficient confidence in participants to articulate concrete, actionable learning plans rather than vague or passive intentions (Doanh & van Munawar, 2019; Maheshwari & Kha, 2022; Tzeng et al., 2022).

Question Q2: *"Describe your strategy for applying digital literacy and AI literacy in your school context following this training."*

This question was designed to capture participants' contextual application intentions, grounded in situated learning theory and transfer of training theory. It probes the extent to which training content was internalized as actionable professional knowledge rather than retained as declarative information. It helps identify perceived enablers and barriers within the Indonesian educational environment.

Data Analysis

Quantitative Likert-scale data were analyzed using descriptive statistics (means, standard deviations, and frequency distributions) calculated at the item, dimension, and school levels. The analysis was conducted using Python 3.x with the pandas library. Qualitative responses from the open-ended items were reviewed thematically to identify recurring patterns in participants' stated self-development plans and classroom application strategies. The thematic review was conducted by the lead trainer-researcher and validated by rereading all 137 qualitative responses. Regarding the trustworthiness of the qualitative analysis, credibility was established through member checking, transferability through thick description of participant contexts (**Table 1**), dependability through the six-phase thematic analysis, and confirmability through participant quotations anchored in the UNESCO DLGF and AI-CFT frameworks (Ahmed, 2024).

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RESULTS AND DISCUSSION

Training Participation and Implementation

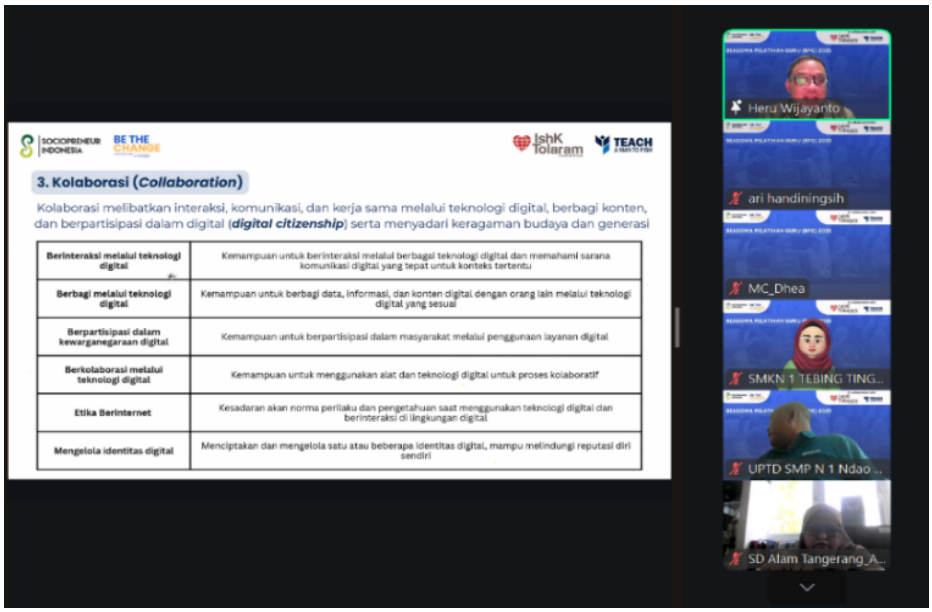

Figure 1. Online Digital Literacy Training
Source: Author Documentation, 2025

Both training sessions (shown in **Figure 1**) were conducted as planned on 6 and 13 September 2025, with active synchronous participation from 137 teachers across 26 provinces. Participants engaged with case-based discussions, scenario-based challenges, reflective questions, and real-time chat contributions.

Validity and Reliability of the Survey Instrument

Prior to reporting substantive findings, the psychometric properties of the 29-item digital literacy self-assessment instrument were evaluated to confirm its suitability as a measurement tool. Two aspects were assessed: construct validity using corrected item-total correlation analysis and internal consistency reliability using Cronbach's alpha. Construct validity was evaluated at the item level using corrected item-total correlation (r), which measures the extent to which each item correlates with the total scale score for its respective dimension after removing that item's contribution to the total. Following the criterion, items with r >= 0.30 are considered valid indicators of the underlying construct.

Table 3. Item Validity (Corrected Item-Total Correlation) and Dimension Reliability (Cronbach's Alpha)

No.	Item	r (Item-Total)	Cronbach's Alpha	Status
1.1	Understanding the functions of common digital devices	0.643		Valid
1.2	Knowing how to install software on digital devices	0.748		Valid
1.3	Activating protection software/antivirus on digital devices	0.749		Valid
1.4	Analyzing and troubleshooting simple technical problems	0.612		Valid
1.5	Willingness to learn more about how digital technology works	0.552		Valid
D1	**Dimension Average - Technical Competence (D1)**	**—**	**0.837**	**Reliable**

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No.	Item	r (Item-Total)	Cronbach's Alpha	Status
2.1	Understanding the difference between disinformation and misinformation	0.606		Valid
2.2	Awareness that many internet applications collect personal data	0.529		Valid
2.3	Knowing how to search credible information sources online	0.671		Valid
2.4	Tendency to ask critical questions to evaluate online information	0.667		Valid
D2	**Dimension Average - Data Literacy (D2)**	**—**	**0.802**	**Reliable**
3.1	Benefiting from digital technology for remote collaboration	0.590		Valid
3.2	Awareness that strong social communication skills are essential for online collaboration	0.652		Valid
3.3	Knowing how to use various features in video conferencing platforms	0.649		Valid
3.4	Familiar with digital technologies supporting team-based collaboration	0.690		Valid
D3	**Dimension Average - Collaboration (D3)**	**—**	**0.816**	**Reliable**
4.1	Knowing that AI systems can automatically generate digital content	0.608		Valid
4.2	Understanding that digital content on the internet is protected by copyright	0.710		Valid
4.3	Able to use digital tools to create accessible content for everyone	0.718		Valid
4.4	Able to combine different types of digital content to express facts or opinions	0.708		Valid
D4	**Dimension Average - Digital Content Creation (D4)**	**—**	**0.842**	**Reliable**
5.1	Knowing that strong and unique passwords reduce security risks	0.720		Valid
5.2	Awareness of signs of digital addiction and potential risks	0.788		Valid
5.3	Knowing how to activate two-factor authentication	0.593		Valid
5.4	Considering benefits and risks before allowing third parties to process personal data	0.752		Valid
D5	**Dimension Average - Safety (D5)**	**—**	**0.853**	**Reliable**
6.1	Understanding that collaborative problem-solving via digital platforms produces better solutions	0.623		Valid
6.2	Knowing that online learning helps keep up with digital technology developments	0.721		Valid
6.3	Understanding how to use digital technology to implement creative ideas	0.694		Valid
6.4	Always following technology changes, believing there is always an opportunity to learn	0.720		Valid
D6	**Dimension Average - Problem Solving (D6)**	**—**	**0.849**	**Reliable**

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No.	Item	r (Item-Total)	Cronbach's Alpha	Status
7.1	Awareness that inappropriate digital behavior has long-term negative impacts	0.637		Valid
7.2	Understanding digital ethics related to AI use in editing or manipulating content	0.822		Valid
7.3	Able to identify hostile or demeaning online activities (SARA, bullying, hate speech)	0.737		Valid
7.4	Understanding AI ethics in the educational context	0.768		Valid
D7	**Dimension Average - Ethics (D7)**	**—**	**0.878**	**Reliable**
	Overall Instrument (29 items)	**—**	**0.964**	**Excellent**

Source: Processed Data, 2025

The results presented in **Table 3** confirm that all 29 items satisfy the validity criterion, with corrected item-total correlations ranging from r = 0.529 to r = 0.822, all exceeding the minimum threshold of r = 0.30. At the dimension level, Cronbach's alpha coefficients ranged from 0.802 (D2, Data Literacy) to 0.878 (D7, Ethics), with an overall instrument alpha of 0.964, confirming that the 29-item instrument is a valid and reliable tool for measuring the seven UNESCO DLGF dimensions and supporting the interpretive confidence of all subsequent findings. The trustworthiness of the qualitative analysis was established through credibility (member checking), transferability (thick description of the participant context), dependability (six-phase thematic analysis), and confirmability (participant quotations anchored in theoretical frameworks), as detailed in the methods section.

Overall Post-Training Digital Literacy Self-Assessment

Table 4. Post-Training Digital Literacy Survey Results by Item and Dimension

No.	Survey Item	Dimension	Mean	SD	Category
1.1	Understanding the functions of common digital devices (computer, tablet, smartphone)	D1 Technical	4.75	0.51	Very High
1.2	Knowing how to install software on digital devices	D1 Technical	4.50	0.65	Very High
1.3	Activating protection software/antivirus on digital devices	D1 Technical	4.39	0.71	High
1.4	Analyzing and troubleshooting simple technical problems on digital devices	D1 Technical	4.17	0.80	High
1.5	Willingness to learn more about how digital technology works	D1 Technical	4.73	0.54	Very High
D1	**Dimension Average - Technical Competence**	**D1**	**4.51**	**0.48**	**Very High**
2.1	Understanding the difference between disinformation (fake/hoax with intent) and misinformation (false information without intent)	D2 Data	4.37	0.73	High
2.2	Awareness that many internet applications collect personal data	D2 Data	4.45	0.69	High
2.3	Knowing how to search credible information sources online	D2 Data	4.30	0.71	High

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No.	Survey Item	Dimension	Mean	SD	Category
2.4	Tendency to ask critical questions when evaluating online information quality	D2 Data	4.28	0.73	High
D2	**Dimension Average - Data Literacy**	**D2**	**4.35**	**0.52**	**High**
3.1	Benefiting from digital technology for remote collaboration processes	D3 Collab	4.53	0.65	Very High
3.2	Awareness that strong social communication skills are essential for online collaboration	D3 Collab	4.69	0.56	Very High
3.3	Knowing how to use various features in video conferencing platforms	D3 Collab	4.42	0.68	High
3.4	Familiar with using digital technologies that support team-based collaboration	D3 Collab	4.48	0.66	High
D3	**Dimension Average - Collaboration**	**D3**	**4.53**	**0.49**	**Very High**
4.1	Knowing that AI systems can be used to automatically generate digital content (text, news, images)	D4 Content	4.62	0.60	Very High
4.2	Understanding that digital content on the internet is protected by copyright	D4 Content	4.50	0.66	Very High
4.3	Able to use digital technology tools to create content accessible to everyone	D4 Content	4.43	0.72	High
4.4	Able to combine different types of digital content to express facts or opinions better	D4 Content	4.26	0.79	High
D4	**Dimension Average - Digital Content Creation**	**D4**	**4.45**	**0.53**	**High**
5.1	Knowing that strong and unique passwords for each service are an effective way to reduce security risks	D5 Safety	4.67	0.56	Very High
5.2	Awareness of signs of digital addiction and potential physical/psychological risks	D5 Safety	4.55	0.65	Very High
5.3	Knowing how to activate two-factor authentication when available	D5 Safety	4.36	0.79	High
5.4	Considering benefits and risks before allowing third parties to process personal data	D5 Safety	4.62	0.62	Very High
D5	**Dimension Average - Safety**	**D5**	**4.55**	**0.49**	**Very High**
6.1	Understanding that collaborative problem-solving via digital platforms can produce better solutions	D6 Problem	4.42	0.69	High
6.2	Knowing that online learning offers opportunities to keep up with digital technology developments	D6 Problem	4.50	0.68	Very High
6.3	Understanding how to use digital technology to implement creative ideas	D6 Problem	4.51	0.65	Very High
6.4	Always following changes and technology developments, believing there is always an opportunity to learn	D6 Problem	4.52	0.67	Very High
D6	**Dimension Average - Problem Solving**	**D6**	**4.49**	**0.50**	**High**
7.1	Awareness that inappropriate behavior in digital environments can have long-term negative social and personal impacts	D7 Ethics	4.67	0.58	Very High

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No.	Survey Item	Dimension	Mean	SD	Category
7.2	Understanding digital ethics related to AI use in editing or manipulating digital content	D7 Ethics	4.49	0.70	High
7.3	Able to identify hostile or demeaning online messages/activities (e.g., SARA, bullying, hate speech)	D7 Ethics	4.50	0.67	Very High
7.4	Understanding AI ethics, especially in the educational context	D7 Ethics	4.55	0.66	Very High
D7	**Dimension Average - Ethics**	**D7**	**4.55**	**0.50**	**Very High**
	Overall Grand Mean (All 29 Items)	**All**	**4.49**	**0.50**	**Very High**

Source: Processed Data, 2025

Table 4 presents the complete survey results across all 29 items and seven dimensions. The grand mean score across all items and all participants was 4.49 (SD = 0.50), corresponding to a 'Very High' category. This finding indicates strong self-reported digital literacy competency across the participant cohort. The proportion of participants selecting score 4 or 5 (Agree or Strongly Agree) across all items was 95.5%, with only 3.9% of all responses at the Neutral level (score 3) and fewer than 1.0% at the Disagree/Strongly Disagree level (score ≤2).

Dimension-Level Analysis: Strengths and Areas for Development

Table 5. Dimension-Level Results with Score Distribution

Dimension	Mean	SD	Score 5	Score 4	Score 3	Score ≤2	Category
D1 - Technical Competence	4.51	0.48	58.1%	36.2%	4.2%	1.5%	Very High
D2 - Data Literacy	4.35	0.52	43.6%	49.5%	5.5%	1.5%	High
D3 - Collaboration	4.53	0.49	58.4%	37.2%	3.3%	1.1%	Very High
D4 - Digital Content Creation	4.45	0.53	52.6%	41.6%	4.9%	0.9%	High
D5 - Safety	4.55	0.49	59.9%	35.8%	4.2%	0.2%	Very High
D6 - Problem Solving	4.49	0.50	53.5%	42.5%	3.6%	0.4%	High
D7 - Ethics	4.55	0.50	58.8%	38.5%	1.8%	0.9%	Very High
Grand Mean	**4.49**	**0.50**	**55.3%**	**40.2%**	**3.9%**	**0.9%**	**Very High**

Source: Processed Data, 2025

Table 5 provides a comparative overview of dimension scores, including score distributions. At the dimension level, four of the seven dimensions (Safety, Ethics, Collaboration, Technical Competence) reached the 'Very High' category (mean ≥ 4.50). In comparison, three dimensions (Data Literacy, Digital Content Creation, Problem Solving) were classified as 'High' (mean 3.50-4.49). This overall profile is encouraging, though the relative differences across dimensions reveal meaningful patterns for instructional design. Safety and Ethics were the joint highest-scoring dimensions (both M = 4.55, ~59% responses at score 5). These high scores reflect the strong emphasis on ethical and safety content throughout both sessions, which is woven into real-world Indonesian educational scenarios. The results suggest that training successfully reinforced and extended participants' existing ethical awareness and safety practices.

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Collaboration was the third-highest dimension (M = 4.53, SD = 0.49). The highest individual item was 3.2, awareness that strong social communication skills are essential for effective online collaboration (M = 4.69), reflecting participants' practical experience with remote communication challenges in the aftermath of the COVID-19 pandemic. This aligns with research, which identified social presence as a significant predictor of teachers' acceptance of online professional development (Mailizar et al., 2022). Technical Competence (M = 4.51, SD = 0.48) reached the 'Very High' category with the highest within-dimension variability. Item 1.4, troubleshooting simple technical problems (M = 4.17, SD = 0.80), was the lowest-scoring item in the entire survey, contrasting sharply with item 1.1 (understanding device functions, M = 4.75) and item 1.5 (willingness to learn, M = 4.73). This pattern, high conceptual awareness and motivation but weaker applied skills, is consistent with prior findings on troubleshooting deficiencies among Indonesian teachers (Soekamto et al., 2022).

Data Literacy was the lowest-scoring dimension (M = 4.35, SD = 0.52), the only one to remain below 4.40. Items 2.4 (critical questioning, M = 4.28) and 2.3 (credible source searching, M = 4.30) were the lowest in the dimension, corresponding to DigComp 1.2 and 1.1, respectively, which prior research has identified as persistently challenging for Indonesian teachers and students (Hidayat et al., 2023; Ilhami et al., 2021). These results are particularly concerning given Indonesia's well-documented vulnerability to digital misinformation and the central role teachers play in developing students' critical information literacy. Digital Content Creation (M = 4.45, SD = 0.53) and Problem Solving (M = 4.49, SD = 0.50) were both classified as 'High' category dimensions, sharing a consistent pattern: awareness-oriented items scored higher than applied-skills items. Item 4.4 (combining different types of digital content, M = 4.26) was the second-lowest in the entire survey, mapping to DigComp 3.2 and consistent with findings that Indonesian pre-service teachers show limited multimodal content integration skills (Ilhami et al., 2021). These results confirm that applied technical problem-solving and content integration remain priority areas for follow-up.

School Level

Table 6. Survey Results by School Level

School Level	n (%)	D1-D7 Mean	SD	Min	Max
Elementary (SD)	50 (36.5%)	4.48	0.49	3.00	5.00
Junior High (SMP)	43 (31.4%)	4.48	0.52	2.75	5.00
Senior High (SMA)	22 (16.1%)	4.55	0.46	3.25	5.00
Vocational (SMK)	22 (16.1%)	4.49	0.50	3.00	5.00
Total / Grand Mean	**137 (100%)**	**4.49**	**0.50**	**2.75**	**5.00**

Source: Processed Data, 2025

Table 6 presents the mean digital literacy by school level. Scores were consistently high to very high across all four levels, with Senior High (SMA) teachers recording the highest mean (M = 4.55, SD = 0.46) and Elementary and Junior High teachers the lowest (M = 4.48). The inter-level range was only 0.07 scale points. No inferential test was conducted, so a definitive conclusion about statistical significance cannot be made. However, the results suggest comparably high post-training self-assessed competency across all school levels. The consistency of results across varied school-level contexts supports the UNESCO DLGF's original design claim as a contextually adaptable framework (see: https://unesdoc.unesco.org/ark:/48223/pf0000391299), demonstrating that it provides a robust structure for digital literacy development across diverse institutional settings.

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Qualitative Findings: Self-Development Plans and Classroom Application Strategies

Open-ended survey responses provided rich qualitative data on participants' post-training intentions. Thematic analysis of all 137 responses to both open-ended questions identified five dominant themes for Q1 (self-development plans) and five complementary themes for Q2 (classroom application strategies), as summarised in **Table 7**. For Q1 (self-development plans), five dominant themes were identified. For Q2 (classroom application strategies), five complementary themes were identified.

Table 7. Thematic Mapping of Qualitative Findings from Open-Ended Survey Questions

No.	Theme	Representative Quotation	Freq. (%)	Theoretical Grounding
Q1 - Self-Development Plans: "Describe your plan for self-development in digital literacy and AI literacy following this training."				
T1	**Formal Professional Development**	'I will join training and workshops to deepen digital skills' (East Java)	~65%	Self-Directed Learning; Self-Efficacy by Bandura in "*Self-efficacy: The Exercise of Control*"
T2	**Self-Directed Learning**	'I commit to independent study through online courses and recent educational technology literature' (Kalimantan Selatan)	~58%	Digital literacy predicts online PD acceptance (Mailizar et al., 2022)
T3	**Professional Learning Community**	'I will join a teacher learning community to share and learn together' (Bengkulu)	~45%	Communities of Practice by Wenger in "*Communities of Practice: Learning, Meaning, and Identity*"
T4	**Classroom Experimentation**	'I will directly practice digital tools in my teaching, experimenting step by step' (DKI Jakarta)	~62%	Enactive Mastery Experience by Bandura in "*Self-efficacy: The Exercise of Control*
T5	**Student Digital Mentoring**	'I will guide students to use digital tools wisely, ethically, and critically' (Papua Tengah)	~38%	UNESCO AI-CFT Human-centered Mindset (see: https://unesdoc.unesco.org/ark:/48223/pf0000391104.locale=en)
Q2 - Classroom Application Strategies: "Describe your strategy for applying digital literacy and AI literacy in your school context."				
T6	**AI Tools for Learning Design**	'I will use AI for quiz generation, student feedback, and lesson preparation' (Jawa Tengah)	~54%	UNESCO AI-CFT AI Pedagogy component (see: https://unesdoc.unesco.org/ark:/48223/pf0000391104.locale=en)
T7	**Interactive Media Creation**	'I will create interactive digital learning media using Canva, PowerPoint, and video tools' (Sumatera Utara)	~47%	DLGF D4 Digital Content Creation (see: https://unesdoc.unesco.org/ark:/48223/pf0000265403)
T8	**Critical Media Literacy for Students**	'I will teach students how to identify hoaxes and evaluate online sources critically' (Riau)	~43%	DLGF D2 Data Literacy (Halik et al., 2023)
T9	**Digital Ethics Culture in School**	'I will build school agreements with students about responsible and ethical digital use' (Maluku)	~39%	DLGF D7 Ethics; *mendidik karakter* (national curriculum)

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No.	Theme	Representative Quotation	Freq. (%)	Theoretical Grounding
T10	**Context-Adaptive Technology Use**	'I will adapt digital tools to the internet conditions and device availability at my school' (Nusa Tenggara Barat)	~35%	DLGF Pathway Mapping Methodology (see: https://unesdoc.unesco.org/ark:/48223/pf0000265403); Situated Learning

Source: Processed Data, 2025

Table 7 presents a comprehensive mapping of the thematic findings for both questions, including theme labels, representative participant quotations, and the theoretical framework associated with each theme. For Q1, formal professional development (T1, ~65%) and classroom experimentation (T4, ~62%) were the two most prevalent themes, suggesting that participants experienced the training not as a terminal event but as a catalyst for ongoing self-directed professional growth. The professional learning community theme (T3, ~45%) reflects the collective dimension of digital literacy development, consistent with Wenger's Communities of Practice theory in "*Communities of Practice: Learning, Meaning, and Identity*". The fact that 45% of participants spontaneously articulated plans to join peer learning communities suggests that the training successfully conveyed the social and collaborative dimensions of digital literacy, rather than merely individual technical skills.

The student digital mentoring theme (T5, ~38%) indicates that participants internalized the training's ethical framing at the pedagogical level, recognizing that their own digital literacy development has direct implications for students' digital futures. This connects to the Human-centered Mindset component of the UNESCO AI-CFT and the DLGF's emphasis on digital literacy as a social and civic competency. For Q2, the AI tools for learning design theme (T6, ~54%) was the most prominent classroom application strategy, with participants citing specific tools in concrete subject-specific contexts, providing evidence of learning transfer at the intention level. Context-adaptive technology use (T10, ~35%) emerged as an important infrastructure-aware strategy among participants from eastern Indonesian provinces, consistent with situated learning principles (Giones et al., 2022).

Critical media literacy for students (T8, ~43%) and digital ethics culture in school (T9, ~39%) together indicate that participants saw themselves not merely as digital tool users, but as digital citizenship educators. This dual professional identity, as both practitioner and educator of digital literacy, is precisely the orientation that the UNESCO DLGF and AI-CFT frameworks are designed to cultivate, and its spontaneous emergence in qualitative responses constitutes evidence of training effectiveness at the dispositional level. This discussion interprets the findings by drawing on theoretical frameworks, comparisons with prior studies, and convergent evidence from both quantitative and qualitative data streams. Rather than restating the results, each sub-section below builds on them to advance analytical claims, identify novel contributions, and situate this study within the broader literature on teacher digital literacy development and online professional development in Indonesia and beyond.

Structured Online Training as an Equity-Oriented Mechanism for National-Scale Competency Development

The most significant interpretive finding is that structured, framework-aligned online professional development can generate uniformly high post-training self-efficacy across geographically, institutionally, and pedagogically diverse teacher populations. Despite prior findings documenting substantially lower digital competencies among rural and remote teachers and only intermediate levels across most secondary school teachers (Rahmawati et al., 2024; Soekamto et al., 2022). This program achieved

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comparable post-training profiles among participants from Java and provinces as distant as Papua Tengah, Maluku, and Nusa Tenggara Barat. The key enabling factor is the program's use of the UNESCO DLGF as both the curricular organizing framework and the measurement instrument across all seven dimensions, a methodological approach distinct from prior Indonesian programs such as PemBATIK, GPO, and PKP, which are anchored exclusively in the UNESCO ICT-CFT or national Kominfo pillars.

This finding suggests that framework alignment, rather than resource intensity, may be the primary determinant of equitable competency outcomes at the national scale. The persistence of Data Literacy as the lowest-scoring dimension reflects a structural rather than incidental limitation. Critical information evaluation is a higher-order skill embedded in habits of questioning and skepticism requiring prolonged, practice-intensive development (Hidayat et al., 2023; Ilhami et al., 2021). A novel finding is the conscious competence gap: participants reported the lowest scores in Data Literacy yet simultaneously identified critical media literacy as a top classroom teaching priority (T8, ~43%), reflecting professional metacognitive awareness that training designers should actively cultivate.

The within-dimension contrasts between awareness-oriented and applied-skills items in Technical Competence and Digital Content Creation are interpretable as diagnostic markers rather than training failures. Marín and Castañeda, in "Handbook of Open, Distance and Digital Education," argued that digital literacy development requires progression through the stages of awareness, integration, and critical reflection; short-term online training reliably achieves the first but inherently struggles with the second and third. The convergence of low applied-skills scores with targeted practical planning themes in the qualitative data represents a training outcome visible only when quantitative and qualitative evidence are read together and provides a clear design mandate for practice-intensive follow-up modules.

The joint highest scores in Ethics and Safety dimensions reflect genuine professional values that participants hold deeply as educators and intend to transmit institutionally. The qualitative data confirm this interpretation: participants articulated specific plans to embed ethical digital practice in student-facing school culture through classroom agreements, student mentoring in responsible AI use, and modeling of critical digital citizenship. This pattern aligns with findings that identified character formation (*mendidik karakter*) as a deeply embedded professional value among Indonesian teachers, and more research found that ethical orientation was the strongest predictor of digital literacy development in Chinese pre-service teachers (Ji & Li, 202; Suryawati et al., 2024). The present study adds that the purposeful alignment of training content with teachers' professional identity values produces a multiplier effect: teachers who internalize digital ethics as a professional value become agents of digital ethics education within their institutions.

Cross-Level Score Parity as Evidence of Framework Validity Across Institutional Contexts

The descriptive consistency of post-training scores across all four school levels (range: 0.07 scale points) challenges prior findings that document higher digital competencies among secondary than elementary teachers (Rahmawati et al., 2024; Soekamto et al., 2022). The DLGF's pathway mapping methodology appears to create measurement conditions under which participants across different institutional contexts can recognize their competencies within the same conceptual vocabulary, while qualitative data reveal distinct application trajectories (Java secondary: AI learning design; eastern Indonesian elementary: context-adaptive technology use). The divergence between moderate quantitative scores in AI literacy-adjacent dimensions and the high qualitative specificity for AI tool application reflects latent competency at the Acquire level of the UNESCO AI-CFT.

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Participants who described specific AI tools and subject-specific applications in qualitative responses demonstrate that training content has been processed into actionable professional knowledge, creating a window of opportunity that post-training activities should act on before motivational momentum is lost. Taken together, the findings converge on a single overarching conclusion: structured, framework-aligned, two-session online training delivered to a geographically diverse national cohort can initiate high self-efficacy, accurate metacognitive self-diagnosis, and an AI literacy orientation among Indonesian teachers. The distinction between breadth and depth of impact is not a failure but a design parameter defining the agenda for continued community service investment in practice-intensive, community-sustained professional development.

Several limitations must be acknowledged. First, the post-only design without pre-training baseline measurement precludes causal claims about competency change. Second, self-report instruments are susceptible to social desirability bias, and Cronbach's alpha values reflect internal consistency rather than objective performance. Third, purposive sampling may introduce pre-selection bias, as participants selected on motivation may not represent the broader Indonesian teacher population. Fourth, a two-session, five-hour intervention inherently limits the development of applied competency in higher-order skills such as critical information evaluation and technical troubleshooting. Fifth, the absence of inferential testing means descriptive cross-level differences cannot be confirmed as statistically non-significant; future iterations should employ one-way ANOVA or the Kruskal-Wallis H test.

CONCLUSION

This community service activity successfully addressed all four objectives. Participants reported high to very high post-training digital literacy self-efficacy across all seven UNESCO DLGF dimensions, confirming that framework-aligned online delivery is associated with strong competency development at the national scale. AI-CFT integration generated concrete applied intentions, and the 29-item instrument identified Data Literacy as the most persistent development priority. The results of this community service program demonstrate that structured, framework-aligned online training can effectively reach teachers across Indonesia's geographic and institutional diversity. Participants across all school levels and provinces achieved consistently high post-training digital literacy self-efficacy across all seven UNESCO DLGF dimensions. The convergence of quantitative outcomes with qualitative evidence indicates that the training produced not only self-perceived competency gains but also a meaningful shift in participants' professional orientation toward digital and AI literacy. These outcomes confirm that community service-based professional development, when aligned with internationally validated frameworks, can serve as an equity-oriented mechanism for building teacher capacity at a national scale. As supplementary guidance for future program iterations, three evidence-based recommendations are noted. First, a follow-on module on Data Literacy should employ scenario-based exercises drawn from Indonesian misinformation cases to bridge the awareness-to-practice gap. Second, the AI literacy component should be expanded around the complete UNESCO AI-CFT Acquire-Deepen-Create progression, incorporating subject-specific application examples. Third, structured peer mentoring circles organized by island groups should be established to sustain post-training collaborative professional learning, consistent with the Communities of Practice framework.

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