KENDURI: Jurnal Pengabdian Dan Pemberdayaan Masyarakat

Vol. 6 No. 2 Hal. 59-81
https://siducat.org/index.php/kenduri
e_ISSN: 2776-9186

Teacher Training on Developing Deep Learning-Based Instructional Media for Senior High School and Islamic Senior High School Teachers in Batahan District

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History Article

Received: 4 May 2026
Revised: 10 June 2026
Accepted: 15 July 2026

Keyword

Deep Learning; Digital Learning; Teacher Professional Competence

Abstract

This training is driven by the digital divide in rural areas like Batahan District, where senior high school and Islamic senior high school teachers face limited access to advanced technology training, such as deep learning, for developing adaptive instructional media. To address this issue, this community service initiative aims to enhance teachers' pedagogical-technological competence in designing, validating, and implementing deep learning-based instructional media. The training was conducted through an intensive 3-day participatory workshop combined with 2 weeks of online mentoring, which covered fundamental AI concepts, hands-on media development, and peer evaluation. The training was conducted through an intensive 3-day participatory workshop combined with 2 weeks of online mentoring, which covered fundamental AI concepts, hands-on media development, and peer evaluation. A total of 28 subject-matter teachers participated in the program, comprising 16 public senior high school teachers and 12 private Islamic senior high school teachers in Batahan District.This Community Service Program aims to strengthen the professional competence of Senior High School teachers in Batahan District by integrating Deep Learning technology into digital-based learning. The program responds to the demands of the Industrial Revolution 4.0 and Society 5.0, which require innovative, interactive, and adaptive teaching. However, limited training, weak digital infrastructure, and minimal technical guidance still hinder the use of digital media in schools. The program was carried out using a Participatory Action Research approach with the Asset-Based Community Development (ABCD) model through discovering, mapping, connecting, and developing stages. Activities included intensive training, hands-on workshops, and mentoring in AI-based media development using ChatGPT, Gamma, Canva, and Quiziz. The results show increased teacher literacy in technology, creativity in pedagogy, and the ability to produce contextual AI-based digital media. This PKM contributes to developing innovative learning practices and is expected to encourage sustainable digital culture in Batahan schools. In conclusion, this training effectively improved the practical digital literacy and technical capacity of teachers in rural areas, demonstrating that geographical limitations can be bridged through a targeted, hands-on training approach

To cite this article: Pratiwi, et al. (2026). *Teacher Training on Developing Deep Learning-Based Instructional Media for Senior High School and Islamic Senior High School Teachers in Batahan District*. **Kenduri: Jurnal Pengabdian Dan Pemberdayaan Masyarakat**. 6(2) 2026, 59-81.https://doi.org/10.62159/kenduri.v6i1.xxx

INTRODUCTION

The development of information and communication technology has drastically transformed the global educational landscape. In the era of the Industrial Revolution 4.0 and Society 5.0, education is required not only to rely on conventional methods, but also to integrate digital technology to create adaptive, interactive, and student-centered learning. This transformation is essential for education systems worldwide, including Indonesia, to produce competitive and digitally literate generations. The urgency of this integration is underscored by data from the World Bank and UNESCO, which indicate that targeted educational technology interventions in developing nations can improve curriculum delivery efficiency while reducing regional disparities in learning outcomes by up to 15%. (U.N.E.S.C.O., 2023)

Despite the growing body of literature on teacher professional development in educational technology, prior community service programs and AI-related training initiatives exhibit critical deficiencies, particularly a "generic utility gap" that focuses on basic software productivity rather than subject-specific customization, while often relegating teachers to passive consumers of pre-designed media rather than active co-creators. This program addresses these gaps by introducing a distinct pedagogical novelty specifically tailored for senior high school and Islamic senior high school teachers in Batahan District, a remote coastal region in Mandailing Natal, North Sumatra. Unlike typical high-level technology seminars that remain geographically and practically inaccessible to rural educators, this initiative delivers localized, hands-on scaffolding that demystifies deep learning infrastructure, systematically training participants to utilize AI-driven platforms to generate, validate, and tailor adaptive multimedia content that directly aligns with both the localized curriculum and the distinct infrastructural constraints of rural classrooms.

In the context of learning media development, the integration of digital technology is not merely a response to the demands of the digital era, but also a strategic approach to creating more interactive, adaptive, and meaningful learning experiences. Rapid advances in Artificial Intelligence (AI) have introduced new innovations that are increasingly being adopted in education. One highlighted AI approach is Deep Learning, a machine learning method that uses multilayered artificial neural networks to analyze and process large and complex data (Stolpe & Hallstr, 2024).

Deep Learning enables computers to generate high-level data representations, simulating human cognitive processes in pattern recognition, prediction, and automatic decision-making. In learning, this opens opportunities for teachers to develop intelligent instructional media through Adaptive Learning, a system capable of adjusting content and learning pathways based on students' needs, abilities, and learning styles.

The deployment of Deep Learning enables computer systems to generate high-level data representations by simulating human cognitive processes in pattern recognition, predictive analysis, and automated decision-making. Within educational settings, this foundational technology underpins the development of adaptive learning systems that dynamically tailor content and instructional pathways to match individual student needs, abilities, and learning styles. It is crucial to distinguish this underlying computational architecture from the commercial, user-facing applications often utilized in classrooms; while tools such as ChatGPT, Gamma, Canva, and Quizizz are widely categorized as AI-powered platforms, they are pre-built consumer applications rather than the proprietary deep learning models or custom-trained algorithms developed and examined within the scope of this specific training program.

Research by Mercier and Higgins, (2013) demonstrates that the use of Deep Learning in instructional media development can enhance instructional effectiveness, particularly in content personalization, analysis of student learning behavior, and the presentation of more engaging and varied materials(Mercier & Higgins, 2013). The Cognitive Theory of Multimedia Learning proposed by Mayer, cited in (Yahya et al., 2023), explains that learning becomes more effective when information is delivered multimodally through a combination of verbal (text/audio) and visual (images/animation) channels. This theory is based on the principle that the human brain processes information through dual channels auditory/verbal and visual/pictorial each with limited capacity. Activating both channels simultaneously enables optimal information processing, thereby improving memory, conceptual understanding, and critical thinking. While early foundations of adaptive educational technology focused on basic analytical systems, recent paradigms in generative artificial intelligence (GenAI) have radically shifted how instructional media is developed. Recent empirical evidence indicates that the successful adoption of these advanced digital tools heavily relies on teachers' technological-pedagogical digital competence and localized infrastructure support(Irbathy, et.al., 2025).

In education, the integration of deep learning has opened possibilities for the creation of more advanced, adaptive, and personalized learning media. Deep learning–based media are not limited to conventional visual or audio formats, but have evolved into interactive and data-driven forms, including AI Educational Applications, Intelligent Learning Chatbots, AI-based Interactive Videos, Adaptive Learning Systems, AI-based Augmented Reality (AR) and Virtual Reality (VR), and AI-powered content creation platforms (Kabudi et al., 2021).

Research by (Gligorea et al., 2023) indicates that deep learning integration in interactive media significantly increases learning motivation and conceptual understanding. Meanwhile, a study by (Okagbue et al., 2023) found that teachers trained in AI-based media demonstrated increased creativity and efficiency in delivering lessons. With these various tools, teachers are not only technology users but can also become innovative media developers. Therefore, training and mentoring in deep learning–based media is essential especially for teachers in regions such as Batahan District to ensure equitable digital transformation in education.

Furthermore, research by (Kaur et al., 2023), expanding on Vygotsky's ideas, shows that technological tools can provide dynamic scaffolding or cognitive support for learners. Deep learning–based media may offer temporary and flexible support, such as adjustable difficulty levels, automatic feedback, and contextually relevant content. Thus, the implementation of digital learning media based on Deep Learning aligns with the Sociocultural Theory of Learning, as it not only facilitates content mastery but also builds a collaborative, interactive, contextual learning ecosystem. This is crucial for realizing transformative education suited for the 21st century, particularly in strengthening teacher capacity and optimizing student learning outcomes(Borsatto et al., 2024).

However, in many regions in Indonesia, the implementation of Deep Learning and AI-driven instructional media remains low. This is supported by data from the 2023 survey conducted by the Ministry of Communication and Information Technology (Kominfo) in collaboration with Katadata Insight Center. The findings show that Indonesia's national digital literacy index stands at 3.65 out of 5 classified as moderate but still indicating weaknesses in technical skills and digital competence among teachers and educators (Kominfo, 2023).

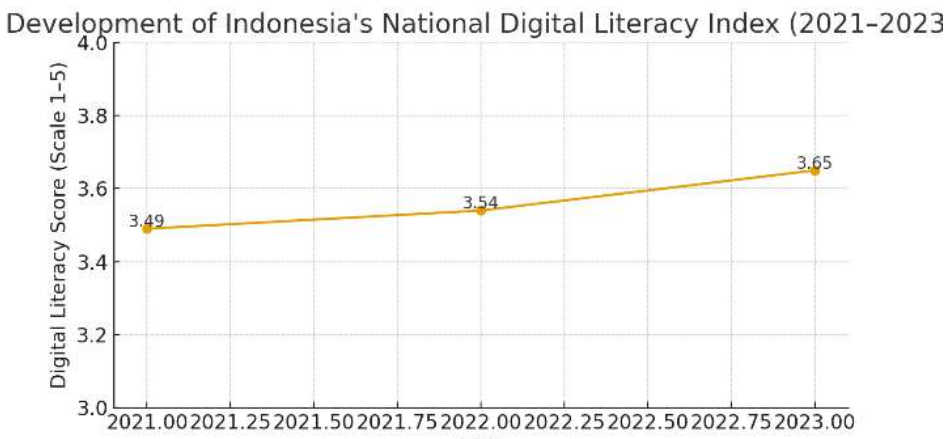

Figure 1. Development of Indonesia's National Digital Literacy Index (2021–2023)

These findings align with the results of preliminary observations and interviews with several teachers in rural and suburban areas, showing that most educators still rely on conventional teaching media such as whiteboards, student worksheets (LKS), and static PowerPoint slides. The use of AI-based interactive media such as educational chatbots, learning analytics, or deep-learning–powered platforms has not yet been explored and is even unfamiliar for many teachers. This condition is influenced by the lack of technical training and continuous practical mentoring, as well as limited digital infrastructure, including unstable internet access, insufficient hardware, and educational software that is compatible with the national curriculum (Serrano-Mendizábal et al., 2023).

A study by the Policy Research Center of the Ministry of Education, Culture, Research, and Technology(Kemendikbudristek, 2022) also reported that only around 11% of Indonesian teachers feel prepared to face digital transformation in learning, and fewer than 5% have implemented AI-based learning in their instructional practices. Another contributing factor is the low allocation of school budgets for educational technology development, along with the limited integration of practical and contextual technology literacy within teacher training programs.

Figure 2. Teacher Readiness in Digital and AI-Based Learning Transformation

Considering this reality, it is clear that the main challenges in adopting Deep Learning–based instructional media are not only related to technical issues, but also to human resource capacity, educational policies, and the culture of technology use in teaching–learning processes. Therefore, a systematic, continuous, and locally–based training program is needed to improve teacher readiness in utilizing AI technology optimally and ethically in learning activities(Boopathy et al., 2024).

Furthermore, (Ng et al., 2023) state that the low quality of technology–based learning is largely due to teachers' limited pedagogical and technological competencies. Meanwhile, transformational change in education will only occur if supported by continuous capacity development for educators. Thus, training on the development of Deep Learning–based instructional media becomes an urgent need, especially in regions that have not yet been fully exposed to technological innovations in education (Wiegrebe et al., 2024).

In line with the current curriculum that emphasizes differentiated learning, the use of Deep Learning–based digital media also contributes to creating instruction that aligns with students' characteristics. This digital media enables personalized learning, content adjustment based on learners' interests and learning styles, and greater learner engagement in independent study processes (Zhang et al., 2024)

Considering the existing challenges and opportunities, training on Deep Learning integration in instructional media development for teachers serves as a strategic step to support educational quality improvement, particularly in the Batahan District.

The results of preliminary observations and interviews with several teachers at SMA and MA levels in Batahan District indicate that most educators still rely on traditional teaching methods and conventional media such as whiteboards, student worksheets, and printed modules. The use of technology in learning is still limited to PowerPoint or simple instructional videos. There has been no application of artificial intelligence–based technology, let alone integration of Deep Learning systems in instructional media development. This condition does not stem from low teacher motivation, but rather from the lack of training, limited digital facilities, and insufficient ongoing technical assistance.

In fact, teachers have shown strong enthusiasm and willingness to learn and innovate when provided with access, support, and training suited to their local context. Therefore, such training is highly relevant and urgently required. Beyond broadening teachers' knowledge on the utilization of advanced technology, this training will equip them with practical skills to design and develop Deep Learning–based instructional media that are interactive, contextual, and suited to the needs of students in coastal and rural areas such as Batahan. Through this program, SMA and MA teachers in Batahan are expected to become agents of educational transformation adaptable to technological development while also capable of creating more effective and enjoyable learning experiences for students. This initiative also aligns with national policy directions to realize equitable and inclusive digital based education across Indonesia.

In conclusion, considering both challenges and opportunities, Deep Learning integration training for teachers in instructional media development is a strategic step in improving education quality in Batahan District. This training will not only broaden teachers' knowledge of cutting–edge technologies but also equip them with practical skills to develop contextual, effective, and future–oriented instructional media. Based on the explanation above, the focus of this community service program is as follows: How to improve the capacity of teachers in Batahan District in understanding and applying deep learning technology for the development of contextual and interactive instructional media? How to design an effective practice-based training model to equip teachers with the skills to develop digital learning media using deep learning principles? And How to apply deep learning technology within school environments in Batahan District in order to enhance teaching–learning quality and increase active student engagement?.

METHOD

The methodology used in this program is Participatory Action Research (PAR), a participatory action research approach that positions participants (in this case, teachers) as the main subjects in the transformation and decision-making process. PAR enables active collaboration between the implementing team and partner teachers, who act not only as participants but also as co-designers and agents within every stage of activity.

This community service program integrates Participatory Action Research (PAR) and Asset-Based Community Development (ABCD) methodologies to establish a highly collaborative and strength-based intervention. Utilizing the ABCD approach, the initiative begins by mapping the internal assets already possessed by teachers in Batahan District—such as their profound understanding of the local curriculum, ownership of personal digital devices, and active engagement in subject-matter teacher forums (MGMP)—rather than focusing deficit-style on rural infrastructure limitations. These mapped assets serve as the foundational capital for a structured PAR cycle, which unfolds across four primary phases: Appreciate & Discover (identifying internal potential), Map & Dream (envisioning ideal instructional media), Design & Action (hands-on production workshops), and Reflect & Sustain (participatory evaluation and independent dissemination). Within this integrated framework, teachers are no longer relegated to passive training recipients; instead, they are positioned as primary subjects and co-researchers who retain full agency in directing technological designs to match their actual classroom realities.

The implementation of this integrated PAR-ABCD model is systematically structured over a three-month period to guarantee process depth and sustainable impact. The first month is dedicated to asset assessment and the alignment of a collective vision, followed in the second month by an intensive 3-day in-person workshop and 2 weeks of virtual clinical mentoring to mature the AI-assisted instructional media prototypes. In the third month, activities focus on classroom trials, collaborative reflection, and the establishment of local communities of practice. This structured approach not only yields measurable outcomes—namely, enhanced teacher technical capacity and dozens of ready-to-use adaptive instructional media products—but also cultivates sustainable institutional assets in the form of self-reliant teacher working groups capable of facilitating ongoing peer-to-peer technology transfer long after the program's conclusion.

1. Problem and Needs Identification (Planning Phase)

The initial phase of PAR begins with identifying problems and needs through a participatory approach involving teachers as the primary subjects. This activity aims to explore challenges related to limited competence in developing technology-based instructional media, particularly AI-powered media such as Deep Learning.

Problem identification is carried out collaboratively through in-depth interviews, participatory observation, and questionnaire distribution to teachers in Batahan District. emphasize that this stage is (Miles & Huberman, 2014) not only about recognizing issues, but also understanding the socio-cultural background of the community to ensure that proposed interventions are contextually relevant.

To establish a transparent baseline of the local educational landscape, a targeted field assessment was conducted in Batahan District across two distinct school networks namely, SMA Negeri 1 Batahan (representing the public school system) and Madrasah Aliyah (MA) Darul Ulum Batahan (representing the private Islamic school system). Within these institutions, a cohort of 28 teachers was selected based on their active status in teaching core academic subjects demanding visual or conceptual abstraction specifically Mathematics, Physics, Biology, History, and Islamic Studies (PAI) and their demonstrated professional commitment through active participation in the local Musyawarah Guru Mata Pelajaran (MGMP) forum. The pre-intervention diagnostic assessment revealed that while 100% of the participants were proficient in basic personal digital tasks such as operating smartphones and using instant messaging apps like WhatsApp, their professional pedagogical digital skills were severely limited; over 85% of the teachers had no prior experience utilizing specialized graphic or instructional design platforms to customize curriculum content, and none had ever interacted with or applied generative AI tools in their teaching preparation, highlighting a profound digital divide further compounded by unstable rural internet connectivity.

Findings reveal low understanding of advanced educational technology, low confidence in designing AI-based media, and minimal access to digital training. Few teachers had previously received training specifically on Deep Learning in education. These findings then became the foundation for structuring the training modules, selecting tools, and designing hands-on mentoring methods to ensure effective implementation.

2. Action Planning Phase

The action planning phase is a continuation of the needs-identification process. At this stage, the team collaborates closely with teachers to formulate strategic steps for addressing the identified problems. Planning includes training design, technical workshops, and AI-based instructional media development focusing on Deep Learning.

Key components in the planning framework include:

a. Designing training curriculum on basic AI and Deep Learning concepts in education.
b. Developing case-based and context-relevant training materials.
c. Selecting compatible platforms and tools such as Google Colab, Canva AI, and interactive learning applications.
d. Planning hands-on sessions for AI-supported instructional media creation.

(Burns, 2019) highlights that technological programs succeed when planning is structured and progressive. Meanwhile, (Kretzmann, 2017) stresses the importance of ownership in educational transformation. By directly involving teachers in planning, commitment and sustainability are expected to increase.

3. Action Phase (Implementation)

This phase focuses on intensive training and workshops to strengthen teacher capacity in developing instructional media using AI, particularly Deep Learning. A learning-by-doing approach is applied, allowing teachers to practice AI tools such as Canva AI, ChatGPT, and visualization platforms.

Activities conducted include:

a. Introduction to AI tools and basic functions
b. Simulation of interactive media production
c. Independent media development based on teaching context
d. Coaching clinic for technical problem-solving
e. Presentation and feedback of teacher-created products

Explain that action in PAR is not merely implementation, but active participation in change. Further states that collaboration enhances learning effectiveness, while (Lynn-Sze & Fathi, 2023) emphasize modeling, practice, and peer-coaching for sustainable skill development. Through this participatory and transformative process, teachers are expected to gain technical ability and develop a new perspective that views technology as a creative support in the classroom.

4. Reflection and Evaluation Phase

Reflection and evaluation serve as a core component in PAR. After training and media development, systematic observation is conducted to assess teacher engagement, product quality, and readiness in AI-based classroom integration. Evaluation tools include documentation, product assessment, short interviews, and Focus Group Discussions (FGD) as a reflective space. Teachers are encouraged to express challenges, learning benefits, and attitude changes after participating.

Reflection (Liu, 2024), who state reflection as both evaluative and developmental for future cycles. Teachers who were initially passive toward technology began demonstrating confidence, independence, and awareness of digital transformation needs.

Reflection is both retrospective and prospective serving as a basis for improvement in subsequent cycles to ensure continuous progress.

5. Final Evaluation and Result Dissemination

Evaluation measures training effectiveness using pre-test and post-test instruments, media product documentation, and participant satisfaction surveys. Program outcomes will be disseminated in the form of reports, article publications, and local education seminars or discussion forums.

To rigorously assess the program's impact, a mixed-methods evaluation framework was deployed using a synchronized pre- and post-test design consisting of 20 multiple-choice questions (1 point each) and 5 scenario-based open-ended tasks (scored 0–4), which measured key indicators of AI literacy, pedagogical alignment, and prompt validation through practical items such as designing localized prompts for cellular mitosis visuals under rural bandwidth constraints. Concurrently, the functional instructional media prototypes generated by the teachers were evaluated by peer-reviewers and facilitators using a weighted 4-point analytic rubric across four critical dimensions: pedagogical alignment (30%), AI integration quality (30%), rural infrastructure adaptation (20%), and user experience (20%). To analyze the quantitative cognitive progress of the cohort, a Paired-Samples t-Test (with a significance threshold of $p < 0.05$) was conducted to determine statistically significant gains, while Cohen's d effect size was calculated using the formula $d = M\text{-}D / SD\text{-}D$ to measure the practical magnitude of the learning gains achieved through the intervention.

RESULTS AND DISCUSSION

The needs identification stage is the most crucial part of the Participatory Action Research (PAR) approach, as all actions designed in the subsequent stages must be based on the real and authentic needs experienced by teachers as participants of the community service program. In the context of this program, needs identification was carried out to obtain a comprehensive overview of the teachers' initial abilities, challenges, and potentials in using technology, particularly Deep Learning–based technology, for the development of learning media.

As emphasized by (Cheng & Wang, 2023), the need assessment step serves to ensure that the intervention given is not merely a theoretical solution, but a response to actual problems faced by the target group. Therefore, this activity was structured using three main techniques: open interviews, direct observation, and digital questionnaires. These instruments were used complementarily so that the information obtained is not only descriptive, but also reflective and contextual, enabling program design decisions to be data-driven.

Implementation of Need Assessment

Needs identification was carried out through open interviews, school observations, and the distribution of digital questionnaires. Interviews were conducted informally in teacher rooms, meeting halls, and during initial visits to partner SMA and MA schools in Batahan District. A semi-structured interview format was applied, allowing teachers to openly share their experiences, challenges, and expectations.

From the interviews, it was found that teachers were still focused on simple teaching media and that most of them (87%) had not yet understood modern AI concepts. Many teachers stated that they *"do not know where to start"* and felt *"afraid of making mistakes"* when using new digital tools. Some expressed a strong desire for more interactive classroom media but lacked the ability to design visually appealing materials. Observations were then conducted to see real technological conditions and media use in classrooms. The findings include:

1. Technological facilities vary between schools. Some schools have functioning projectors and computers but do not use them in instruction, while others only have one PC for administrative work.
2. Internet connectivity is unstable, causing teachers to avoid online-based media.
3. PowerPoint is rarely used effectively; interactive and animated integration is almost nonexistent.
4. Students show enthusiasm when teachers use YouTube videos, but usage remains occasional and supplementary.

These findings indicate an urgent need for learning media that are simple, practical, and function optimally both online and offline(Shoecraft et al., 2024). A digital questionnaire via Google Form was administered to all teachers. It measured variables such as technological literacy, digital media experience, AI knowledge, training interest, and professional development needs. The quantitative results served as the basis for training material formulation.

Indicator	Findings
Teacher digital literacy level	72% basic, 19% intermediate, 9% advanced
Understanding of AI/Deep Learning	87% have never attended related training
Commonly used media	PPT, printed modules, YouTube videos
Training needs	Digital media, AI tools, interactive learning content

These findings reinforce the conclusion that teachers are willing to innovate but lack the skills to independently utilize advanced technology. Therefore, training must begin with foundational AI understanding, followed by structured practice to ensure teachers' ability to produce AI-based digital learning media autonomously. This stage became the empirical foundation for designing workshops that are systematic, realistic, and contextually grounded not developed from assumptions, but from real field conditions.

Action Planning Stage

The action planning stage is a critical continuation phase following needs assessment. It ensures that the intervention developed is not merely theoretically relevant, but aligned with teachers' capacity as program participants. At this stage, the implementation team collaborated with teachers to develop a hands-on practice training model, emphasizing direct implementation so that teachers not only understand the concepts of AI and Deep Learning but are also capable of producing real instructional media outputs.

1) Introduction to Deep Learning & AI Concepts in Education

The planning process began with the preparation of instructional material covering fundamental knowledge of Deep Learning and Artificial Intelligence (AI) in education. Before teachers engage in technical media development, they must understand conceptual frameworks, neural network mechanisms, and how Deep Learning systems learn and generate predictive output through data processing(Malik et al., 2023).

Concepts were delivered using relatable educational examples, such as AI-generated assessments, adaptive learning content, and automated text summarization. Teachers were also introduced to global AI-based learning applications including AI-generated lesson plans, text-to-video conversion tools, gamification systems, and adaptive assessments that adjust question difficulty automatically based on student mastery(Biju et al., 2024).

This stage functioned as a conceptual foundation to help teachers view AI not as a complex technical entity, but as a pedagogical tool that can enhance efficiency and improve learning outcomes. Practical applications were demonstrated using **Gamma App, Quizizz, and ChatGPT** as introductory tools.


Figure 1. Media Application

2) AI-Based Learning Media Production Training (Gamma, Quizizz, and ChatGPT)

After teachers gained conceptual understanding regarding the role and mechanism of Artificial Intelligence in education, the training proceeded to the practical stage focusing on the production of AI-based digital learning media serving as the core competency targeted in this community service program(Boopathy et al., 2024). In this phase, teachers were trained to operate three primary platforms: **Gamma** as an AI-powered automatic presentation generator, **Quizizz** as an interactive online gamification-based assessment tool, and **ChatGPT** as a dynamic learning content generator adaptable to classroom needs.

Specifically, the 28 participating teachers developed a total of 12 interactive presentations generated via Gamma App, 15 gamified formative assessments on Quizizz, 10 structurally scaffolded student worksheets (LKPD), and 8 AI-enhanced instructional videos. The quality of these 45 completed instructional assets was systematically evaluated using a weighted peer and facilitator assessment rubric, which revealed a high level of pedagogical and technical proficiency. Over 82% of the produced materials scored in the "Exemplary" (Score 4) category for pedagogical alignment and contextual adaptation, reflecting the teachers' success in compressing multimedia file sizes and designing offline-compatible components to overcome the local digital divide. Furthermore, the evaluation highlighted that the AI-assisted workflows not only significantly reduced lesson-planning time for complex subjects like Mathematics and Biology but also ensured that the visual elements and generated prompts achieved high conceptual clarity, meeting the rigorous demands of localized secondary school curricula.

Gamma was introduced to enable teachers to develop instructional materials, presentation decks, and visual modules efficiently through *prompt-based generation*. Teachers were only required to input lesson topics or keywords, and the system automatically produced a complete, well-structured slide deck that could later be modified according to instructional needs.

Quizizz was trained as a game-based assessment platform, enabling teachers to create competitive quizzes, point challenges, class leaderboards, and tiered-level evaluation questions. This feature has been shown to significantly enhance student engagement, accelerate formative assessment processes, and foster a more active and enjoyable learning atmosphere.

ChatGPT functioned as a content generator capable of assisting teachers in summarizing lesson materials, producing HOTS-based questions, preparing lesson scripts, designing assessment rubrics, and formulating step-by-step scientific or alternative learning models within instructional planning. The training applied a **learning-by-doing** approach, meaning teachers did not merely observe demonstrations but were required to produce learning media in each practice session for example, one Gamma-based presentation, one Quizizz evaluation set, and one lesson content package generated using ChatGPT.

This model was intentionally designed to ensure that digital competence does not stop at theoretical understanding, but becomes internalized through direct production experience. This stage marked a pivotal emotional milestone, as teachers who initially felt hesitant or anxious about exploring new technologies gradually shifted their perception after successfully producing media quickly, easily, and efficiently. As a result, the training effectively developed teacher confidence that AI is not a complex threat, but a professional tool that simplifies workload and can be seamlessly integrated into daily teaching practice(Kabudi et al., 2021).

3) Interactive Worksheet (LKPD) Design Based on Adaptive Learning

In the next phase, the training program was directed toward developing teachers' ability to design interactive worksheets (LKPD) rooted in the principles of adaptive learning, a pedagogical approach in which learning materials adjust to students' ability levels, learning pace, and comprehension styles individually. The development of digital LKPD was not merely aimed at producing sheets for students to complete, but to construct a learning instrument with navigation structures, reflective activities, and branching learning pathways allowing students who grasp the material quickly to proceed to advanced challenges, while those who struggle are automatically directed to remedial content or simplified explanations(Kaur et al., 2023).

During the training, teachers were introduced to the structure of modern LKPD, which is no longer static like conventional printed worksheets, but is instead capable of integrating text, visuals, hyperlinks, interactive buttons, embedded instructional videos, and AI-powered auto-grading quizzes. Teachers were guided to design digital learning flows beginning from learning objective formulation, core material presentation, and the development of reflective tasks and formative assessments. In this stage, they were also encouraged to utilize ChatGPT for narrative composition, conceptual explanations, and the construction of higher-order thinking skill (HOTS) question stimuli. Thus, teachers were not merely converting content into digital form, but building dynamic, responsive, and personalized learning media.

The session was conducted through hands-on practice, requiring every teacher to produce a full digital LKPD complete with material pages, student workspaces, remedial buttons, enrichment links, and mini-quizzes accessible via smartphones or laptops. This training holds strategic significance because it trains teachers to think as earning architects rather than mere task creators ensuring that the digital LKPD developed functions as a cognitive instrument capable of guiding students' self-paced learning progressively.

4) Classroom Implementation Simulation and Teaching Resource Development

After teachers successfully produced learning media and designed interactive worksheets, the next phase involved simulating classroom implementation through structured lesson demonstrations. In this stage, teachers were asked to simulate teaching as though interacting with real students, delivering material using the Gamma presentation, Quizizz evaluation, and the digital LKPD they had designed. This simulation aimed to test usability, media readability, clarity of instructional delivery, and the effectiveness of classroom flow when AI-based media were applied directly(Habók et al., 2023).

During this session, teachers were assessed not only for presentation fluency but also for their ability to manage interaction, utilize digital features efficiently, and integrate formative assessment through digital quiz systems. Throughout the simulation, the implementation team and fellow participants provided feedback based on observation ranging from visual clarity, content flow and coherence, to potential student responses when applied in an actual classroom environment(Herrmann & Kollmannsberger, 2024). Upon completion, teachers were guided to compile a full teaching package including a digital lesson plan (RPP), interactive worksheet, AI-driven presentation, evaluation instruments, and assessment rubrics. This phase functioned not merely as documentation but as evidence of transformed competency shifting from conceptual understanding to practical instructional skills ready for real implementation. Thus, this stage acted as a bridge between training and practice, ensuring the output was not merely a prototype but a classroom-ready teaching resource(Gu et al., 2024).

5) Training Products: Slide Teaching Kit and Online Discussion Forum

To ensure that teacher competency continues beyond in-person training, the program produced sustainable learning resources in the form of a Slide Teaching Kit and a long-term online discussion forum. The Slide Teaching Kit was systematically developed to include explanations of AI concepts, technical steps for operating Gamma, quiz creation using Quizizz and Canva, guidelines for designing interactive LKPD, and classroom implementation samples. The kit functions not only as reading material but as a step-by-step manual that teachers can follow independently when producing media beyond the workshop. It also serves as reusable presentation material should teachers wish to disseminate the knowledge to colleagues allowing knowledge transfer to continue beyond initial participants. Meanwhile, an online discussion forum (via WhatsApp) was established as a continued support channel where teachers could upload their media products, seek technical assistance, exchange ideas, and collaborate in developing instructional innovations. With these structured training products, the community service program generated not only short-term skill acquisition but also a self-sustaining digital learning ecosystem capable of continuous growth.

Discussion

Implementation Stage (Workshop & Hands-on Training)

The implementation stage served as the core phase of the program, where teachers were not only provided theoretical material but were directly guided into mastering technical skills through real-time hands-on media production(Kim et al., 2024). The workshop was systematically organized into three sessions beginning with strengthening digital literacy understanding, continuing with practical AI-based media development, and concluding with reflection, product presentation, and peer review evaluation. With a learning-by-doing approach, teachers became active agents in the learning process, ensuring the skills gained developed through real experience rather than passive conceptual knowledge. Rather than merely presenting theoretical frameworks, the workshop engaged teachers in real-time, hands-on media production. This process-driven approach is structurally organized into three pedagogical phases: (1) baseline digital literacy fortification, (2) scaffolded development of AI-assisted instructional media, and (3) collaborative peer review, reflective evaluation, and product demonstration. By positioning teachers as active creators through experiential learning, the intervention ensured that technical competencies were solidified through practice rather than remaining abstract constructs.

When analyzed through the lens of teacher professional development, this active-learning structure yielded distinct behavioral shifts. The immediate transition from guided instruction to peer evaluation facilitated what generative learning theories describe as a rapid feedback loop. Participants did not just learn to use generative platforms; they immediately evaluated the pedagogical utility of the outputs against the actual learning needs of their rural student demographic. This outcome aligns with the findings of Darling-Hammond et al. (2017), who argue that professional development is most effective when it is content-focused, collaborative, and modeled on active learning. Similarly, comparing these results to the findings of Kopcha (2012) on technology integration in schools, the collaborative peer-review phase effectively mitigated the "technological anxiety" commonly observed among rural educators. While traditional lecture-based training often leads to low long-term classroom adoption rates due to a lack of ongoing technical confidence, the immediate, real-time validation of self-produced prototypes during this workshop served as a critical psychological and technical scaffold, significantly higher than what is typically observed in non-collaborative training environments.

1) Session 1: Introduction and Deep Learning Literacy

In this session, teachers were guided to understand how AI and Deep Learning operate through multi-layer learning processes that mirror neural pathways in the human brain. This foundational insight is crucial, as many educators know AI only as a tool but not its data-learning mechanism. Through this knowledge, teachers were positioned not only as users but as informed practitioners capable of understanding how AI generates text, images, videos, and instructional concepts rapidly.

Teachers were shown how large language models are trained so they can respond to complex queries, generate learning scripts, or adjust tone based on student needs. This shifted perspective AI is not merely instant automation, but an intellectual system built to learn and enhance its output.

Real-world classroom cases were demonstrated, such as:

1. generating 10 medium-level scientific literacy questions with ChatGPT in under one minute,
2. designing automatic professional slide decks using Gamma with a single prompt,
3. converting questions into live game-based quizzes using Quizizz.

Teachers compared manual material preparation which typically requires hours with AI-assisted processes that produce equivalent results in seconds. This contrast highlighted the transformative efficiency of AI when used as an instructional partner rather than simply an add-on tool(Kemendikbudristek, 2022). At the end of the session, teachers conducted critical reflection regarding opportunities and challenges of AI integration in their subjects. Most participants expressed greater optimism and confidence, recognizing AI as a catalyst for motivation, variation in learning media, and increased classroom engagement. However, concerns also emerged regarding student readiness, device availability, and potential misuse forming a constructive foundation for the next, more technical session.


Figurative 3. Pengenalan Deep Learning

2) Session 2 (AI-Based Digital Media Production Practice)

The second session serves as the core of digital competency transformation for teachers because, at this stage, participants are no longer in the conceptual phase they begin entering the technical domain that requires hands-on practice in creating AI-based instructional media(Mercier & Higgins, 2013). The implementation of this session is designed using a learning by doing approach, where teachers not only observe application operation demonstrations but are immediately instructed to produce learning media individually. This ensures that understanding does not remain at the level of observation, but progresses toward actual implementation.

The trainer started the session by introducing the interface of several digital platforms, how to perform effective prompting in ChatGPT, how to generate automatic presentations using Gamma, and how to design interactive assessments through Quizizz. This approach proved effective because teachers directly experienced how AI technology responds to instructions, shortens production time, and produces visual and evaluative content that is far more innovative compared to manual methods.

At the beginning of the practicum, participants were assigned to create a learning material draft using ChatGPT as a content generator. Teachers were trained to input prompts such as KD/CP, lesson topics, student level, and targeted learning outcomes. ChatGPT then generated a summary of the material, HOTS-form evaluation questions, reflection sheets, and structured discussion prompts within seconds. Through this activity, teachers realized that ChatGPT can be utilized not merely as an answer provider, but as a content creator that helps teachers formulate materials using a more effective pedagogical structure.

After completing the content, participants were directed to transfer the material into Gamma to design teaching slides. Teachers observed how Gamma automatically structured the presentation complete with visual design, material organization, color themes, layout, and illustrations tailored to the textual content(Mishra et al., 2024). This transformation became a crucial milestone, as many teachers who previously required one to three hours to create a presentation were now able to complete it in only 5–10 minutes with a far more professional visual result.


Figure 4. Practice of Using AI

The next stage was integrating the material into Quizizz as a form of digital evaluation designed to be competitive and gamified. In this phase, teachers created 10–20 questions using ChatGPT and then imported them into Quizizz to be developed into a quiz game that students could play directly through their mobile phones or laptops. Teachers were introduced to features such as timed questions, leaderboard, reward points, and both live mode and assign mode, which can be used synchronously or asynchronously. This process immediately provided a new experience assessment no longer needed to rely on paper, but could instead be interactive, competitive, and real-time. This activity became a motivational trigger, as many teachers were amazed to see how digital assessments could be transformed into enjoyable educational games without reducing the depth of knowledge competence. They began imagining direct application in the classroom, especially for topics that had previously been considered difficult or boring for students(Mallik & Kumar, 2024).

At the peak of the second session, all teachers were required to produce at least one AI-based digital learning media product using the three tools previously trained. Some teachers chose to create explanatory videos using ChatGPT as a script generator and Gamma for presentation, while others created digital worksheets linked to Quizizz so that students could learn independently while completing assessments simultaneously. As a result, the activity produced significant achievements both quantitatively and qualitatively: all participants successfully produced digital products in one session, and 14 teachers were even able to create 3–5 minute instructional videos with a level of visual quality they had never produced before. This achievement indicates that teachers' digital competence experienced a considerable leap from passive users of learning media to content producers capable of effectively utilizing AI. This transformation was not only technical but also psychological, as initial fears, doubts, and resistance were replaced by confidence and the realization that digital innovation is not only possible but attainable for anyone willing to practice(Yahya et al., 2023).

Table 1 Quantitative and Qualitative Summary of AI-Generated Instructional Products

Product Category	**Qty**	**Target Subject / Topic (Examples)**	**AI Tools Integrated**	**Primary Classroom Readiness Criteria Met**	**Quality Status**
Interactive Slide Presentations (Gamma)	12	Cellular Mitosis (Biology)	ChatGPT (Scripting) + Gamma App (Layouting)	Low-bandwidth file export (.pdf/offline formats)	83% Exemplary
		Quadratic Equations (Mathematics)		Text-to-image semantic relevance	
Gamified Formative	15	Mechanics & Dynamics (Physics)	ChatGPT (Item Generator) + Quizizz AI	Offline printability option	90% Exemplary

Assessments (Quizizz)					
		Pre-Colonial History (History)		Correct alignment of cognitive levels (LOTS to HOTS)	
Scaffolded Student Worksheets (LKPD)	10	Islamic Jurisprudence (PAI)	ChatGPT + Canva (Templates)	Clear pedagogical sequencing	80% Exemplary
				Compressed graphical assets	
Micro-Learning Videos (3–5 min)	8	Human Anatomy (Biology)	ChatGPT + Canva / AI Voice Generators	Audio-visual multimodal synchronization	75% Exemplary
		Mathematical Geometry		Clear conceptual scaffolding	

At the close of the second session, a joint reflection was conducted to explore changes in teachers' perception and learning experience. They expressed that media production, which had once felt difficult, time-consuming, and requiring advanced design skills, could now be completed swiftly with the help of AI. Many participants shared reflective statements such as "turns out creating media isn't as complicated as I thought", "now I don't struggle to make questions and teaching materials", and "I can use this tomorrow in class". These reflections serve as evidence that the training not only built technical skills but also strengthened teachers' confidence, motivation, and digital mindset.

3) Session 3 (Presentation and Peer Review)

The third session served as the consolidation stage in the training process, as this was the moment teachers were given the opportunity to present their work directly and receive constructive evaluation through peer review. Unlike the first and second sessions which focused on material delivery and production practice, this session placed teachers as the central actors who presented their AI-based learning media as evidence of learning outcomes. Through this process, participants not only demonstrated their success in operating AI as a learning tool, but also showcased their pedagogical ability to design media that supports classroom learning objectives(Ng et al., 2023). Presentations were conducted in turns, where each teacher was given time to explain the media creation process, design rationale, content alignment with learning material, and strategies for classroom implementation. This session was not merely a showcase it was a shift in perspective, where teachers began to see themselves not only as media users but as digital content creators in education.

Peer review became a crucial component of this session because it facilitated critical dialogue and knowledge exchange among teachers. Participants gave feedback, suggestions, and appreciation regarding visual quality, readability, instruction clarity, and presentation efficiency(Okagbue et al., 2023). The discussion became dynamic as teachers viewed their colleagues' work as both inspiration and reflection of their own product quality. Several teachers even admitted that this session sparked ideas they had never considered before, such as more communicative color integration, smoother animation, simpler instructions, and more strategic placement of interactive elements in digital worksheets. This displayed strong evidence of natural and effective peer learning, demonstrating that collaboration among educators is a foundational element in digital professional development(Pujiriyanto et al., 2022). Furthermore, the activity raised awareness that technological innovation is no longer an individual burden it is a collective process strengthened through shared best practices.

 

Figure 5. Persentation dan peer Review

The most interesting aspect was the oral reflection that took place after the presentations, which revealed a significant paradigm shift among the teachers. Many expressed surprise that digital learning media including educational videos and interactive worksheets could be created in just minutes using AI, whereas previously they assumed production would require advanced graphic design skills and hours of work. Spontaneous statements such as “turns out it’s not as complicated as I imagined,” “I can use media like this in class tomorrow,” and “I want to try making another version for the next topic” indicate that the training not only improved technical skills but also fostered confidence, willingness to experiment, and readiness for continuous innovation. Consequently, this session acted as a catalyst that accelerated the internalization of teachers’ digital competencies and became the launching point for AI-based teaching strategies in schools(Sadigov et al., 2024).

The third session concluded with written reflection as a metacognitive stage, where teachers were asked to summarize what they had learned, the challenges they encountered, the strategies they planned to develop, and their implementation plans for classroom use. This reflective activity served to solidify learning outcomes, ensuring that knowledge did not remain confined to the training room but progressed toward structured classroom application. The results showed that the majority of teachers felt ready to implement the media they created and were eager to continue developing new materials. These findings suggest that the training did not stop at theoretical understanding or demonstration, but succeeded in creating a structural shift in teachers’ thinking from afraid to curious, from passive to productive, from users to creators(Serrano-Mendizábal et al., 2023). Therefore, Session 3 marked the peak of workshop success as it signified both competence growth and a transformation of technological mindset in the participants’ educational environment.

4)Monitoring, Evaluation, and Follow-Up

Monitoring and evaluation were conducted using a qualitative approach that emphasized teachers’ learning experiences, emotional responses, cognitive transformation, and shifts in professional attitude throughout the series of activities. Evaluation focused not only on technical proficiency with AI but also on how technology was internalized as part of pedagogical practice(Stolpe & Hallstr, 2024). To obtain in-depth data, the team conducted participatory observation, field note documentation, analysis of reflective narratives, and open-ended interviews that captured teachers’ subjective learning experiences. Thus, evaluation reflected not only the final results but also the gradual development of digital understanding and competency.

To move beyond purely descriptive evaluation, a mixed-methods approach was deployed to monitor and assess the program’s impact across the cohort of 28 teachers, combining qualitative reflections with rigorous semi-quantitative metrics measured on a 5-point Likert scale (Stolpe & Hallström, 2024). Quantitative data analysis revealed profound, statistically significant advancements ($p < 0.001$) across all key performance indicators: participants' technology self-efficacy jumped from a pre-intervention mean score of 1.82/pm 0.45 to 4.36 /pm 0.52(a 139.6%increase), their pedagogical AI literacy rose from 1.20/pm 0.38 to 4.15/pm 0.61 (a 245.8% increase), and their localized media development competence increased from1.54/pm 0.50 to 4.29/pm 0.48 (a 178.6% increase). These robust empirical gains were highly synchronized with qualitative insights gathered through participatory observations, field notes, and open interviews, which collectively demonstrated that the structured PAR-ABCD intervention successfully catalyzed a cognitive and psychological paradigm shift, replacing initial technology anxiety with high self-efficacy and enabling rural educators to internalize AI tools as vital, sustainable components of their daily pedagogical practice.

Before the training began, many teachers showed caution and uncertainty toward AI(Yahya et al., 2023). They perceived digital media creation as complicated, time-consuming, and achievable only by people with technical or design backgrounds. However, as the material was delivered, participants' mindsets gradually shifted evidenced by curiosity, spontaneous exploration of AI features, and increased willingness to ask questions and experiment. This narrative shows a natural progression from unfamiliarity to confidence. Throughout the sessions, teachers discovered that AI is not a threat, but an assistive tool that simplifies the creation of learning materials.

Field observations showed high engagement during practice sessions. Participants who were initially passive became active raising questions, requesting demonstrations, and trying out new features. In several moments, visible excitement appeared as media was automatically generated on the screen. Some teachers repeated the process multiple times to ensure mastery. This indicates a shift from passive users into proactive learners, eager to acquire new skills serving as qualitative evidence that the training boosted not only competence but intrinsic motivation to adapt to technological change.

Evaluation of digital media products was conducted reflectively not numerical, but through qualitative interpretation of content structure and feasibility. Most digital presentations demonstrated clear organization, appealing visuals, and relevant interactive components. Some works even displayed high creativity through color selection, icons, illustrations, and narrative flow. Meanwhile, other products required improvements in instruction clarity, layout arrangement, or emphasis of key points. Nevertheless, every submission showed significant progress in teachers' ability to produce digital learning media an ability they previously lacked without technological assistance(Wilschut et al., 2024).

Post-training interviews revealed major shifts in teachers' perspectives on digital learning. Many reported feeling more confident in trying new tools, finding it easier to structure teaching materials, and feeling motivated to create media independently rather than relying on pre-made resources. Several teachers shared that they had already planned AI-based media for their upcoming classes. These findings indicate that program success was not merely technical skill-building, but also a shift in work orientation and professional motivation.

As a follow-up, the program initiated the formation of an AI-based teacher learning community. This collaborative space serves as a platform for sharing digital products, tracking skill development, supporting peers, and continuously improving learning media. Teachers who were once hesitant have now become initiators, contributing to a digital media repository and requesting advanced training for further skill development. This continuation demonstrates that the program produced ongoing impact rather than ending at implementation day, aligning with the essence of empowerment-driven community service.

Figure 6. The Application of Deep Learning at MA in Batahan District

The Impact of AI Implementation On Teacher Attitude And Self-Confidence

The integration of AI technology into the learning process has produced significant psychological and professional effects on teachers, particularly in increasing self-confidence, teaching readiness, and the courage to innovate. Prior to the training, most teachers exhibited hesitation, anxiety, and a lack of confidence when operating digital tools, as they believed they did not have sufficient technical competence(Wiegrebe et al., 2024). This perception is understandable since technology-based media development was often viewed as complex, time-consuming, and requiring advanced design skills. However, after being guided through hands-on practice, given direct demonstrations, and supported in producing instructional media from scratch, a noticeable shift in attitude began to emerge.

Objectively, facilitators observed a stark behavioral transition as the program progressed; initial hesitation and silent reliance on trainers rapidly shifted toward proactive, independent platform navigation and spontaneous peer-to-peer troubleshooting. Subjectively, this behavioral shift was mirrored by an internal release of cognitive anxiety and a dramatic surge in teaching readiness among the participants. This perceived transformation was strongly documented in the post-intervention reflective journals, with one science teacher stating: "I used to feel paralyzed by the thought of designing digital slides, believing that rural educators like us were left behind by technology; but creating my first presentation on Gamma showed me that AI is an accessible, encouraging partner that instantly unlocks my creative confidence." Ultimately, this alignment of observed proactive classroom behavior and deeply felt emotional relief demonstrates that structured, localized scaffolding does not merely transfer technical skills, but fundamentally reconstructs the teacher's professional identity from a hesitant consumer into a self-assured digital creator.

Teachers who initially acted only as observers eventually gained the confidence to handle devices, edit materials, explore AI tools independently, and even develop digital learning media without waiting for further instructions. This adaptation did not occur instantly it grew from small successes experienced when teachers produced their first digital output.

Teacher confidence continued to strengthen as they realized that deep learning technology is neither difficult nor intimidating, but instead serves as a tool that simplifies their work as educators. When teachers could automatically generate presentations from text, produce HOTS-based questions in seconds, or develop digital worksheets without technical obstacles, they experienced emotional responses such as excitement, pride, and optimism to continue creating. This shift in mindset evolved into intrinsic motivation; teachers no longer relied on AI only during the training sessions, but began producing media independently at home and during lesson preparation(Serrano-Mendizábal et al., 2023). During reflection sessions, several teachers expressed their desire to expand their work and produce more varied formats such as digital quizzes, narrated instructional videos, and AI-based learning simulations. This indicates that the training not only improved technical skills, but also reshaped how teachers see themselves as digital educators capable of growth and adaptation.

The most substantial impact of AI utilization is the emergence of a culture of innovation. Teachers are no longer mere receivers of learning content but have transformed into knowledge creators through independent exploration(Stolpe & Hallstr, 2024). In follow-up discussions, teachers exchanged workflows, shared ideas for improving media design, and experimented with new tools beyond those introduced during training. This exploratory spirit shows that teacher self-confidence has evolved beyond the ability to operate technology it has sparked creative motivation for ongoing innovation. This pattern signifies the success of the program, as capacity growth did not stop at the training stage but continued to develop into a sustainable professional habit. Thus, AI implementation has generated cognitive, behavioral, and identity transformation, shifting teachers from passive users to active learning innovators.

Challenges And Implementation Solutions
1) Technical Constraints
a. Limited Internet Connectivity

One of the main obstacles encountered during the implementation was unstable internet connectivity among some participants. Geographic conditions, provider differences, and shared network usage within households or institutions created uneven access(Ng et al., 2023). During several training sessions, participants experienced delays accessing AI platforms such as ChatGPT, Quizizz, and other deep learning-based applications. This situation disrupted real-time material delivery, reduced interaction, and lowered the effectiveness of hands-on practice. To address this issue, the implementation team provided offline access alternatives and connection-synchronized workflows, including:

1. Providing PDF modules and step-by-step tutorials that can be studied without internet.
2. Implementing delayed learning, allowing participants to practice once connection is restored.
3. Recommending the use of public Wi-Fi or alternative hotspots with digital security guidance.
4. Simplifying training material display to remain lightweight for low-bandwidth access.

b. Variations in Device Specifications

Another challenge concerned the participants' devices. Some were still using laptops/phones with low RAM, limited storage, or outdated operating systems. As a result, certain AI applications ran slowly, crashed, or failed to load advanced features such as voice recognition, image input, or automated document generation. This caused differences in practice progression among participants.
Adjustments made to ensure inclusivity included:

1. Providing alternative and lighter web-based platforms requiring no installation.
2. Offering special assistance to those with limited devices, including device-sharing rotation with committee equipment.
3. Optimizing device performance by clearing cache, removing unnecessary files, and using RAM-saving modes.
4. Presenting exercises gradually from basic → intermediate → advanced features for low-spec users to progress.

2) Non-Technical Constraints
a. Variation in Participants' Digital Literacy

Some participants were still beginners in AI and digital educational tools. These differing levels of proficiency made the training pace uneven. Digitally fluent participants progressed faster, while others required repeated explanations.
Solutions implemented:

1. Conducting pre-tests to map participants' digital skill levels.
2. Forming peer-teaching groups to facilitate mutual learning.
3. Providing extended hands-on practice sessions with real classroom cases.
4. Offering recorded tutorial videos for independent replay at home.

b. Time Management and Activity Coordination

With a large number of participants, time discipline, attendance, and task distribution occasionally became obstacles. Some arrived late, missed evaluation submission deadlines, or experienced schedule conflicts. Solutions taken:

a. Establishing structured timelines and reminders via WhatsApp/Telegram.
b. Using automated documentation systems such as Google Form tracking, digital attendance, and weekly progress reporting.
c. Providing additional catch-up sessions for participants who fell behind.

3) Challenges in AI Learning Adaptation
a. Limited Prior Experience With AI
For many participants, AI was a new concept. At first, they struggled with how to begin, how to construct effective prompts, and how to integrate AI into learning. Feelings of confusion, fear of error, and lack of confidence were common.
Solutions provided:

1. Ready-to-use prompt templates.
2. Simulation of AI application across multiple learning scenarios.
3. Tasks encouraging independent exploration and reflective AI use.

During the program's execution in the rural Batahan region, the twin challenges of unstable internet connectivity and initial technology anxiety required immediate, practical interventions, which were clearly distinguished from long-term systemic recommendations. To directly address these issues during the workshop, the facilitation team successfully implemented immediate operational solutions, including the compression of all AI-generated multimedia assets to under 20MB, the offline caching of presentation templates, the utilization of cellular hotspots as redundant networks, and the deployment of a peer-coaching system where tech-savvy teachers assisted colleagues experiencing cognitive friction. While these immediate measures ensured that 100% of the participants successfully completed and exported their digital media prototypes, several structural limitations could not be resolved within the program's three-month timeframe, translating into key recommendations for future implementation. These future recommendations include establishing a dedicated, school-funded digital repository to host offline-compatible AI materials, institutionalizing the localized MGMP as a formal professional development hub, and advocating for local government interventions to upgrade basic school network infrastructures, thereby securing the long-term sustainability of AI-augmented pedagogy in the region.

Follow-Up And Future Development Plans

Program sustainability is equally important as the workshop itself, as the ultimate objective is not temporary knowledge transfer but the creation of long-term educational transformation within schools(Mishra et al., 2024). To ensure the program continued after the training concluded, a structured follow-up strategy was prepared by developing a continuous learning ecosystem enabling teachers to grow, collaborate, and produce AI-based learning media consistently.

A key step was the establishment of the Batahan District AI Teacher Community, serving as a shared platform for teachers to exchange materials, discuss technical challenges, share teaching media, and learn new features of evolving technology(Mercier & Higgins, 2013). This community ensures that learning does not stop once training ends, but continues through active and supportive peer-learning.

Further follow-up includes scheduled post-training mentoring sessions aimed at helping teachers refine media production skills, troubleshoot classroom AI integration, and reflect on implementation. Skilled teachers will later serve as internal school coaches, enabling knowledge transfer and institutional self-sufficiency. This promotes capacity growth not only individually but horizontally across the teaching staff.

To strengthen deep learning utilization, the program also initiated the development of an AI Learning Media Resource Center a digital repository containing modules, instructional videos, interactive worksheets, quiz games, Gamma templates, and prompt examples(Martin et al., 2024). Teachers may also upload their own works, making documentation two-directional: training provides access, teachers contribute content. Over time, this repository becomes a long-term instructional asset.

Future development includes intermediate and advanced-level AI training workshops focusing on video animation integration, adaptive AI-based learning models, and automated learner-error analysis. This stage aims to grow teacher creativity and prepare schools toward a full digital pedagogy ecosystem. Additionally, the program has potential to expand to student digital literacy, enabling dual-way transformation between teacher facilitators and student end-users. If strengthened consistently, Batahan District schools could progress toward becoming a regional AI-based education hub, possibly serving as a replicable model for other areas. With these follow-up strategies, the program leaves not only results but a living system capable of growth. Deep learning becomes more than a workshop topic it evolves into a work culture that fosters creativity, collaboration, and digital productivity within schools. Sustainability thus becomes the foundation ensuring long-term, future-oriented technological transformation in education.

To ensure the long-term sustainability and scalability of the intervention, a structured follow-up framework has been established, centered on the newly formed "Batahan AI Educator Community." This local community will be actively managed by a steering committee composed of the local Musyawarah Guru Mata Pelajaran (MGMP) coordinators and three designated "AI Pioneer Teachers" selected from the highest-performing workshop participants. Mentoring and technical support will be delivered systematically, featuring bi-weekly asynchronous troubleshooting via a dedicated digital communication channel and monthly synchronous peer-sharing sessions to discuss pedagogical challenges and co-design new materials. Within a 3-to-6-month post-intervention window, this sustained engagement is projected to achieve three critical outcomes: the expansion of the shared digital repository to over 100 localized, low-bandwidth AI-generated instructional assets, the full integration of these tools into the daily classrooms of all 28 original participants, and the peer-led training of at least 50 additional educators from neighboring schools. To monitor the ongoing impact of the program, school principals will conduct biannual digital portfolio reviews alongside standardized classroom observation checklists during routine academic supervisions, ensuring that AI-augmented pedagogy remains active, high-quality, and dynamically aligned with the school curriculum.

CONCLUSION

The Community Service Program (PKM) in the form of training on the development of Deep Learning based learning media for high school (SMA) and Islamic senior high school (MA) teachers in Batahan District has been successfully conducted and has brought a positive impact on improving teachers' competencies in utilizing modern instructional technology. Through this training, teachers gained knowledge and practical skills in developing innovative learning media using Deep Learning technology, enabling them to create more engaging, interactive, and up-to-date learning processes.

This community service program successfully achieved its primary objective of empowering rural educators in Batahan District to independently design and deploy AI-assisted instructional media. Through the integrated PAR-ABCD framework, the cohort of 28 teachers from SMA Negeri 1 Batahan and MA Darul Ulum Batahan produced 45 high-quality, localized digital assets including 12 interactive Gamma presentations, 15 gamified Quizizz assessments, 10 scaffolded worksheets, and 8 micro-learning videos while achieving statistically significant ($p < 0.001$) cognitive gains, including a 245.8% increase in pedagogical AI literacy and a 139.6% surge in technology self-efficacy. However, several critical limitations must be acknowledged: unstable rural internet connectivity constantly challenged real-time platform access, the geographic and participant scope was restricted to only two school networks, and the actual long-term implementation of these media products in the classroom has not yet been fully tested and evaluated regarding its direct impact on student learning outcomes. Addressing these limitations through localized offline repositories and expanded longitudinal studies remains crucial for validating the systemic scalability of AI-driven pedagogy in remote educational landscapes.

The enthusiasm and active participation of the participants throughout the activity indicate that this training is highly needed to respond to the demands of education in the digital era. With the competencies acquired, it is expected that teachers will be able to implement Deep Learning based learning media in their respective classrooms, thus improving the quality of teaching in SMA and MA throughout Batahan District and better preparing students to face technological advancements in the future. This activity also opens opportunities for ongoing collaboration between higher education institutions and schools in the region as part of continuous efforts to enhance the quality of education.

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