

Strengthening elementary school teachers' competence in the development and implementation of Deep Learning-based instructional materials

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ABSTRACT

This community service program aimed to strengthen elementary school teachers' competence in developing and implementing Deep Learning-based instructional materials within the Kurikulum Merdeka framework. The program was conducted at SD Negeri Sidorejo 03, Sukoharjo, involving 35 teachers through workshops, guided practice, mentoring, and evaluation activities. The training focused on helping teachers design contextual and reflective teaching modules that support meaningful learning processes. The results showed improvements in teachers' understanding and practical skills in preparing deep learning-based instructional materials, reflected in the increase of average scores from 74.13 in the pretest to 91.73 in the posttest. In addition, teachers demonstrated better readiness to apply deep learning principles in classroom instruction and successfully developed teaching modules relevant to students' learning contexts. Participants also responded positively to the program and considered the training useful in supporting instructional innovation. This program contributed to strengthening teachers' pedagogical competence and provided a foundation for the sustainable implementation of deep learning practices in elementary schools.

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1. INTRODUCTION

Primary education plays an important role in shaping the quality of human resources from an early age. However, reality in the field shows that the learning process in elementary schools still faces various serious challenges. Many national and international reports show the existence of a learning crisis phenomenon, which is marked by low student achievement in reading literacy and numeracy (Newaz, 2023; Pek et al., 2024; Pek et al., 2025). This condition not only shows that learning outcomes are not yet optimal, but also reflects that classroom learning has not fully been able to encourage higher-order thinking skills and complete student character building (Bulkani et al., 2025; Dona et al., 2026; Kim, 2025). In this situation, the role of teachers becomes highly crucial, as transformations in educational quality fundamentally stem from the instructional practices that take place within the classroom (Paniagua & Istance, 2018).

Along with efforts to overcome this condition, the Indonesian government introduced the Merdeka Curriculum (*Kurikulum Merdeka*) as part of a learning recovery strategy. This curriculum gives flexibility for teachers to design learning that is more contextual, adaptive, and oriented toward developing student competencies. However, in practice, curriculum shifts are not always followed by teachers' readiness to implement them within actual classroom instruction. Many teachers still encounter difficulties in designing appropriate teaching modules, developing active learning strategies, and integrating key components such as differentiated learning, formative assessment, and the Pancasila Student Profile Strengthening Project (*Projek Penguatan Profil Pelajar Pancasila/P5*) (Kemendikbudristek, 2022).

On the other hand, the demands of Merdeka Curriculum lean toward the application of a Deep Learning approach, which emphasizes the importance of learning that is not merely oriented on memorization, but rather on strong and meaningful conceptual understanding. This learning approach is expected to encourage students to think critically, solve problems, and connect knowledge with daily life experiences. Within this framework, learning is designed to be mindful, meaningful, and joyful, so that students do not just study, but truly understand and actively engage in the learning process (Kemendikdasmen, 2025).

However, the implementation of this approach faces tangible obstacles. Many teachers still lack a clear understanding of how to shift from traditional teacher-centered instruction to more active and reflective learning. A report by the Center for the Development and Empowerment of Educators and Education Personnel (*Pusat Pengembangan dan Pemberdayaan Pendidik dan Tenaga Kependidikan/P4TK*), over 70 percent of elementary school teachers do not fully comprehend the concepts and practices of Deep Learning. Consequently, classroom instruction remains dominated by lecturing, one-way textbook use, and exercises that focus on final outcomes rather than students' thinking processes (P4TK, 2023).

This condition is clearly visible within the partner community, SD Negeri Sidorejo 03 in Bendosari District, Sukoharjo Regency. Based on initial observations and interviews with teachers, classroom learning still tends to take place conventionally. Teachers generally rely on direct explanations, followed by assignments from textbooks, without activities that encourage student exploration, discussion, or reflection. Additionally, some teachers admitted they still face difficulties in designing teaching modules that integrate the Deep Learning approach, particularly in connecting the material with students' real-life contexts.

Furthermore, teachers encounter confusion when connecting Deep Learning with other Merdeka Curriculum components, such as P5, differentiated learning, and formative assessment. In practice, these components are often understood as separate parts, making the learning process fragmented. This condition shows that the challenges experienced by teachers are not just a lack of conceptual understanding, but also limited experience in applying learning in an integrative and practical manner.

Various previous studies demonstrate that strengthening teacher competence through practice-based training, workshops, and continuous mentorship can help teachers overcome these difficulties (Chatrath et al., 2026; Rhew et al., 2025). Various previous studies demonstrate that strengthening teacher competence through practice-based training, workshops, and continuous mentorship can help teachers overcome these difficulties (Atmojo et al., 2025; Suwandi et al., 2024). Therefore, teacher professional development needs to be designed contextually and practically to truly address real needs in the field.

Based on these conditions, this Community Service activity is designed to address the real needs of teachers in developing learning modules and implementing the Deep Learning approach aligned with the Merdeka Curriculum. Similar programs have been conducted previously and proven capable of resolving the problems experienced by teachers (Dewi et al., 2024; Widiastuti et al., 2026). This program is implemented through stages of initial survey, motivational sessions, workshops, hands-on practice,

mentorship, and evaluation via pretest and posttest. Through this activity, it is expected that teacher competence in designing and implementing learning can increase tangibly, thereby impacting the quality of students' learning experiences in the classroom.

2. METHODS

This community service activity is designed as workshop-based training using a participatory and dialogic approach. This approach was chosen so that teachers do not merely receive material in a one-way manner, but are actively involved in discussion, practice, and reflection on their current teaching practices. The main focus of the activity is to help teachers develop learning modules while applying Deep Learning principles within the context of the Merdeka Curriculum.

The activity was conducted at SD Negeri Sidorejo 03, Bendosari District, Sukoharjo Regency, involving 35 teachers as the primary participants. The entire series of activities is designed in stages to allow teachers to understand the concepts, try them out firsthand, and receive mentorship during the implementation process. The execution of the project is divided into three main phases: preparation, implementation, and evaluation.

Preparation Stage

This phase was conducted to ensure the designed program truly aligns with the needs of the partner school. The activity began with an initial survey and brief interviews with teachers to identify current classroom practices, particularly regarding their understanding of Deep Learning and their ability to develop learning modules. These findings were then used as a baseline to develop training materials, design workshop activities, and prepare teaching aids as well as simple evaluation instruments for the program. Additionally, coordination with the school administration was established to determine the timing, venue, and technical logistics to ensure the activity runs effectively.

Implementation Stage

The implementation phase is the core of the community service activity, conducted through interactive workshops and hands-on practice. The activity began by providing motivation and strengthening initial understanding regarding the importance of Deep Learning in improving the quality of elementary school instruction. During this stage, teachers were invited to reflect on their current teaching practices, creating an awareness of the need for change.

Next, the service team delivered a brief presentation (mini-lecture) on the concept of Deep Learning and its connection to the Merdeka Curriculum, especially in developing teaching modules that are mindful, meaningful, and joyful. The material was not delivered in a dominant manner but was integrated with guided discussions, enabling teachers to connect the concepts with their daily teaching experiences.

Following this, the activity continued with discussion and problem-solving. Teachers were encouraged to identify classroom difficulties, such as limited variation in methods, trouble connecting material to real life, and suboptimal student engagement. These problems then served as the foundation for designing learning modules based on Deep Learning.

In the next stage, teachers engaged in hands-on practice to draft their teaching modules. During this activity, teachers were guided to integrate Deep Learning principles into lesson steps, including designing activities to encourage critical thinking, reflection, and connections to students' real-world contexts. This process was not only individual but also collaborative through group discussions.

Each group then presented their designed learning modules. This activity was followed by feedback from the service team and fellow participants (peer review), allowing for a gradual improvement process. Through these steps, teachers did not merely produce an output, but also gained a deeper learning experience.

Evaluation Stage

A simple evaluation was conducted to assess changes in teachers' understanding and their response to the completed activities. Before the program began, teachers took a pre-test to determine their initial understanding of Deep Learning and module design. After completing the entire series of activities, teachers took a post-test to measure any increase in knowledge.

Additionally, throughout the program, the service team observed participant engagement, involvement in discussions, and the ability to design learning modules. Teacher feedback was also collected through discussion and reflection sessions at the end of the activity, capturing their impressions, perceived benefits, and commitment to implementing the training results in their classrooms. These evaluation results were used to describe the overall effectiveness of the activity, both in terms of improving teacher understanding and their engagement throughout the training and mentorship process.

3. RESULTS AND DISCUSSION

Results

Overview of implementation and partner participation

This community service activity was conducted at SD Negeri Sidorejo 03, Bendosari District, Sukoharjo Regency, involving 35 teachers as the primary participants. The high rate of teacher participation indicates a real, felt need among the partners to strengthen their competence in developing learning modules and understanding the Deep Learning approach.

The program was executed through several systematically designed stages, ensuring teachers gained not only conceptual reinforcement but also practical experience and instructional reflection. Each phase focused on interconnected achievements to support the strengthening of teacher competence in implementing Deep Learning within the Merdeka Curriculum. The complete sequence of activities and their achieved results can be seen in Table 1.

Table 1. Program implementation stages and results achieved

Activity Stages	Form of Activity	Results Achieved
Initial survey and needs identification	Observation and interviews with teachers	Identified teacher constraints in developing Deep Learning-based modules
Delivery of material	Workshop and presentation on Deep Learning concepts	Teachers comprehended the concepts of mindful, meaningful, and joyful learning
Discussion and reflection	Q&A and sharing teaching experiences	Teachers linked concepts with real classroom problems
Practice in drafting modules	Individual and group lesson design	Produced 25 Deep Learning-based teaching modules
Peer review and feedback	Presentation of results and shared reflection	Teachers obtained feedback to refine their teaching modules
Project evaluation	Pre-test, post-test, and final reflection	Increased understanding and shifted teacher instructional practices

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Based on Table 1, the activities did not focus solely on delivering material, but also emphasized practical experience, reflection, and collaboration among teachers. This execution pattern allowed teachers to understand the concepts more deeply while gaining hands-on experience applying them to the development of learning modules.

Throughout the program, teachers demonstrated active engagement, particularly during the discussion and practice sessions. In the initial stage of the training, the service team provided conceptual reinforcement regarding the development of Deep Learning-based teaching modules within the framework of the Merdeka Curriculum. The material focused on how teachers can design learning experiences not just oriented toward content delivery, but also capable of providing mindful, meaningful, and joyful learning experiences for students. The delivery of the material was highly interactive, directly linking these concepts to real-world problems teachers face in their day-to-day classroom instruction.



Figure 1. Presentation of teaching module development materials aligned with the Deep Learning approach by speakers 1 and 2

Through this session, teachers began to understand that learning modules function not merely as administrative documents, but as guides to creating more active, reflective, and contextual learning. Additionally, they gained a clear picture of how to integrate observation, discussion, reflection, and environmental exploration into lesson designs tailored to the characteristics of elementary school students.

Real product: Deep Learning-based PPM development

After attending the material presentation session on developing learning modules aligned with the deep learning approach, teachers proceeded to the module drafting session. One of the main achievements of this activity was the production of 25 draft teaching modules by the participating teachers who completed the entire practical session. All these teaching modules were developed based on the subjects and grade levels each teacher instructs, making them contextual and ready for classroom implementation. The resulting modules no longer merely contain sequences of material and questions, but incorporate more structured components, such as competency-based learning objectives, learning activities that actively engage students, and assessments measuring students' thinking processes. Furthermore, these modules have begun to demonstrate a more holistic integration of Deep Learning principles, specifically the aspects of mindful, meaningful, and joyful learning.

Regarding the mindful learning aspect, teachers began designing activities to encourage students to think consciously and reflectively, such as observing phenomena, asking questions, and discussing the reasoning behind an answer. These activities provide space for students to become aware of their own thinking processes, rather than focusing solely on the final answer. In terms of meaningful learning, the

lesson content is linked to real-world situations close to students' lives, enabling them to understand concepts more contextually instead of merely memorizing them. Meanwhile, in the joyful learning aspect, instruction is packaged into more engaging and involving activities, such as group discussions, exploring the surroundings, and problem-solving relevant to students' experiences. This creates a more lively learning atmosphere, ensuring students are engaged not only cognitively but also emotionally.

Thus, the resulting teaching modules serve not only as guides for content delivery but also as tools to create a more holistic learning experience, combining conceptual understanding, thinking awareness, and students' emotional engagement in the learning process.

The subsequent session focused on implementation practice. In this session, teachers were directly involved in simulating learning activities based on the Deep Learning approach. During this stage, participants attempted to apply learning activities reflecting the principles of mindful, meaningful, and joyful learning based on the lesson plans they had drafted. The activity was conducted collaboratively to provide teachers with hands-on experience in creating more active, student-centered instruction.



Figure 2. Implementation practice of Deep Learning principles through collaborative and participatory learning activities

Through this practice, teachers began to understand that deep learning can be applied through simple activities involving observation, discussion, exploration, and reflection. The learning atmosphere appeared more lively as participants were actively engaged both cognitively and emotionally. This activity also demonstrated a shift in the teachers' instructional approach, moving from a previously one-way method to a more interactive and dialogic one.

Implementation of learning in class

One example of implementation arising from the training results was observed in fourth-grade Science and Social Studies (IPAS) instruction. Before the training, lessons about the environment tended to rely on lectures and textbook reading, limiting student engagement to merely receiving information. Following the training, the teacher began designing more active and contextual lessons. Students were invited to directly observe environmental conditions around the school, such as classroom cleanliness, waste management, and water usage. This activity not only encouraged students to witness phenomena firsthand, but also fostered an awareness of their immediate environment as an integral part of their lives.

In the next stage, students were asked to identify the problems they discovered, subsequently discussing the causes and potential solutions in groups. Throughout this process, students learned to think more consciously and reflectively about their observations (mindful learning), while understanding

the connection between the concepts studied and real-world situations in their environment (meaningful learning). Additionally, the lesson was packaged in a more interactive and collaborative atmosphere, where students actively discussed, exchanged viewpoints, and openly presented solution ideas. This activity created a more lively and enjoyable learning environment, engaging students both cognitively and emotionally (joyful learning). Thus, instruction no longer centered on content delivery, but evolved into a holistic learning experience where students actively observed, thought, discussed, and reflected on their learning.

Changes in teacher teaching practices (before-after)

The observed changes appeared not only in the resulting products, but also in how teachers perceive and practice instruction. Before the activity, teachers tended to focus on content delivery, using lectures and practice questions while rarely engaging students in active thinking processes. These changes can be observed by comparing conditions before and after the training, as presented in Table 2.

Table 2. Changes in teacher competence before and after training

Aspects	Before Training	After Training
Learning approach	Teacher-centered	More student-centered
Teaching strategy	Lectures and practice questions	Discussion, exploration, and reflection
Student engagement	Students tend to be passive	Students are more active and participatory
Learning context	Focused on textbooks	Linked to students' real lives
Module development	Administrative-oriented	Learning experience-oriented
Deep learning integration	Not yet visible	Began integrating deep learning principles

Table 2 shows a clear shift in how teachers perceive and practice instruction. Teachers have begun moving away from conventional teaching patterns toward more active, contextual, and reflective learning. This change demonstrates that the training and mentoring program not only enhanced knowledge but also began to influence the teachers' pedagogical practices in the classroom.

Strengthening teacher understanding as an impact of training

Teacher capacity building was also evident in their increased understanding of the Deep Learning concept. This is supported by the results of a simple evaluation using a pre-test and post-test, which showed an increase in the average score from 74.13 to 91.73. However, this improvement should not be understood merely as a change in numbers; it reflects that teachers have begun to grasp how the concepts of mindful, meaningful, and joyful learning can be applied in real-world instruction. This understanding serves as the foundation for shifting classroom teaching practices.

Teacher response to activities (evidence-based)

Changes were also evident in the teachers' responses to the program's execution. Based on the reflection results, teachers not only stated the activity was beneficial, but were also able to explain the changes they experienced in concrete terms. The training activity was conducted not only through material presentation, but also through discussions and Q&A sessions, providing space for teachers to share their experiences, difficulties, and needs in implementing the Merdeka Curriculum. During this session, teachers appeared more active in discussing various obstacles faced, such as difficulties

developing contextual learning activities, linking material to students' real lives, and building active student engagement in learning.



Figure 3. Participating teachers sharing questions and learning experiences during the discussion and Q&A session

The open discussion made the training atmosphere more participatory and reflective. Teachers did not merely receive solutions from the speakers, but also exchanged experiences and current teaching practices. This condition demonstrates that a dialogic approach in training can enhance participant engagement while strengthening teachers' understanding of Deep Learning implementation in elementary schools. One teacher stated:

"Selama ini saya mengajar itu langsung ke materi. Setelah pelatihan ini, saya jadi berpikir bagaimana membuat siswa mengalami dulu, baru memahami. Ternyata hasilnya lebih hidup."

"All this time, I usually jumped straight into the material when teaching. After this training, I started thinking about how to let students experience it first before understanding. It turns out the results are much more alive."

Another teacher also expressed:

"Saya baru sadar kalau pembelajaran itu bisa dikaitkan dengan kehidupan sehari-hari siswa. Setelah mencoba membuat modul, ternyata lebih mudah membuat siswa aktif."

"I just realized that learning can be linked to students' daily lives. After trying to develop a module, it turns out to be much easier to keep students active."

Additionally, several teachers revealed that the practical and peer-review sessions were the most helpful experiences, as they could directly improve their lesson designs based on the feedback received.

Initial impact on strengthening teacher competency

Viewed holistically, this activity provides a clear initial impact on strengthening teacher competence. Before the training program, teachers did not fully understand the concept of Deep Learning, struggled to link material to real-world contexts, and tended to use conventional learning approaches. Following the training, teachers began to demonstrate the ability to develop teaching modules based on Deep Learning, implement more contextual learning activities, and shift classroom interaction patterns to become more active and dialogic.

This change demonstrates that the intervention not only enhanced understanding but also began to shape more meaningful learning practices. This initial impact serves as an essential foundation for sustainable classroom implementation and the development of similar training models in other schools.

Discussion

Effectiveness and success of program implementation

The results of the program execution indicate that the training and mentoring program, designed as a participatory workshop, operated effectively in meeting the partner's needs. This effectiveness is evident not only in high teacher participation but also in their active involvement throughout the training process, particularly during the discussion, practice, and peer-review stages. This condition demonstrates that a training approach prioritizing hands-on experience over mere knowledge transfer can significantly enhance the quality of participant engagement.

The success of the program is also reflected in the achievement of tangible outputs: 25 teaching modules based on Deep Learning ready for classroom use. This achievement shows the activity did not stop at conceptual understanding but successfully encouraged teachers to produce applicable materials. Consequently, the program can be considered successful because it integrates three critical aspects of teacher professional development: conceptual reinforcement, hands-on practice, and reflection.

Furthermore, the increase in teachers' understanding scores from the pre-test and post-test reinforces the finding that the program effectively enhanced teachers' cognitive capacity. More importantly, however, this improvement was accompanied by a shift in how teachers design instruction, ensuring the program's effectiveness is not merely short-term but holds the potential to persist in actual classroom practices.

Changes in teacher competence: From Teacher-Centered to Student-Centered Learning

One of the primary findings from this activity is a significant shift in teacher competence, regarding both understanding and teaching practices. Prior to the training, instruction was dominated by conventional, teacher-centered learning approaches, where students primarily functioned as passive recipients of information.

Following the program, a shift occurred toward more student-centered learning. Teachers began demonstrating the ability to design learning activities actively engaging students through observation, discussion, and reflection. This change indicates teachers do not merely understand the concept of Deep Learning theoretically, but have also begun implementing it in practice.

This competence shift is also evident in the teachers' ability to integrate the three primary dimensions of Deep Learning, they are mindful, meaningful, and joyful learning. Teachers have begun providing space for students to think reflectively (mindful), link material to real life (meaningful), and create a more interactive, enjoyable learning atmosphere (joyful). Consequently, teacher competence has developed not only in planning aspects but also in the ability to create a more holistic learning experience for students.

The relationship of findings with learning theory

The findings in this activity align with various learning theories emphasizing the importance of active, reflective, and meaningful learning experiences. From the perspective of meaningful learning

theory, the program results indicate teachers have begun linking instructional material with students' existing knowledge structures, as proposed by David Ausubel. In this context, instruction is no longer merely a transfer of information, but a process of connecting new knowledge with students' real-world experiences (Agra et al., 2019; Bryce & Blown, 2024).

Regarding the mindful learning aspect, the shift in teaching practices also comports with Ellen Langer's view, which emphasizes the importance of mindfulness in the learning process (Davenport & Pagnini, 2016; Fox Lee, 2019). Activities such as observing, questioning, and reflecting on experiences demonstrate students do not learn passively, but are consciously engaged in the thinking process. Meanwhile, concerning the joyful learning aspect, the more interactive and collaborative learning environment demonstrates students' emotional engagement in learning. This aligns with Barbara Fredrickson's broaden-and-build theory, which explains positive emotions can broaden mindsets and enhance learning engagement (Kushkiev, 2019; Low et al., 2016). Consequently, the results of this activity are not only practically relevant, but also possess a solid theoretical foundation in explaining how deep learning can be implemented in elementary schools.

Program implications and sustainability

The results of this activity hold important implications for professional teacher development, particularly within the context of the Merdeka Curriculum implementation. First, a training program based on practice and mentoring proves more effective than training focusing solely on content delivery. This indicates teacher development designs need to be directed toward active and contextual learning experiences.

Second, the resulting teaching module outputs can serve as a starting point for broader instructional development in schools. These modules can be used not only by participating teachers, but can also be shared and co-developed with other teachers through learning community activities, such as the Teacher Working Group (*Kelompok Kerja Guru/KKG*).

Third, the emerging shifts in teaching practices demonstrate the program has potential for sustainability. However, for these changes to endure and expand, continued mentoring and school support are required, both through policies and by facilitating collaborative spaces among teachers.

Consequently, this activity not only provides a short-term impact in the form of enhanced teacher competence, but also opens opportunities to develop more systematic and sustainable training models to support learning transformation in elementary schools.

4. CONCLUSION AND RECOMMENDATIONS

The community service activity, implemented through training and workshop-based mentoring, proved effective in enhancing elementary school teachers' competence in developing instructional tools (teaching modules) and applying the Deep Learning approach within the context of the Merdeka Curriculum. The success of the program is demonstrated not only by increased teacher understanding, but also by the production of 25 teaching modules integrating the principles of mindful, meaningful, and joyful learning, all ready for classroom implementation. Additionally, this activity encouraged a shift in teaching practices from a previously teacher-centered approach toward more student-centered learning. Teachers began designing more contextual lessons, actively engaging students, and providing space for reflective thinking processes. This change indicates the intervention impacted not only cognitive aspects, but also how teachers perceive and practice instruction. Consequently, this program yields more than short-term competence enhancement; it provides an initial foundation for a more meaningful, reflective, and enjoyable learning transformation in line with the policy direction of the Merdeka Curriculum.

Based on the results of the program execution, several recommendations can be considered for future program development. First, similar training activities should be continued through ongoing mentoring to ensure the newly formed teaching practices develop more consistently in the classroom. This mentoring can focus on module implementation and periodic reflection on teaching practices. Second, schools need to facilitate the establishment of teacher learning communities, such as the Teacher Working Group (KKG), to serve as spaces for sharing best practices and collaboratively developing instructional tools. Through this forum, the developed modules can be refined and replicated. Third, future program development can be directed toward the classroom implementation and evaluation stage, ensuring the impact of Deep Learning is visible not only in teachers but also in the improved quality of student learning experiences and outcomes. Fourth, for future researchers or community service organizers, it is recommended to develop a more structured training model integrated with school needs, while examining the long-term impact of Deep Learning implementation in the context of elementary education.

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