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Empowering Teacher Pedagogical Competencies through the Implementation of Deep Learning Approach Training

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ABSTRACT

A training program on implementing the Deep Learning approach was conducted at Muhammadiyah Mlati High School in January 2025, involving 18 teachers. The program consisted of three phases: counselling, training, and mentoring. The counselling phase aimed to enhance teachers' understanding of Deep Learning concepts and benefits through lectures and discussions. The training phase focused on developing innovative and interactive instructional strategies, while the mentoring phase provided consultation and guidance to support classroom implementation. Program effectiveness was evaluated through pretest and posttest assessments with 30 multiple-choice questions on a five-point Likert scale. The pretest average score of 62,11 increased to 93,33 in the posttest, with an n-Gain score of 0,82, categorized as high. Observations and open-ended questionnaires confirmed improvements in teachers' ability to design and implement engaging learning strategies. This training effectively enhanced pedagogical competence and contributed to improving instructional quality through Deep Learning integration.

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1. Introduction

The advancement of science and technology requires educators to continuously adapt to various innovative learning approaches to enhance the quality of the teaching and learning process (Suryani et al., 2024). The rapidly evolving digital era presents both challenges and opportunities for educators in creating more effective and engaging learning experiences for students (Alghiffari et al., 2024; Setiawan et al., 2024). One approach that has gained increasing attention in the field of education is the Deep Learning approach. This approach not only focuses on memorization

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but also emphasizes problem-solving, creative thinking, and collaboration skills, which are highly relevant to the challenges of the 21st century (Azis et al., 2025). Therefore, the implementation of the Deep Learning approach in education is crucial to fostering an adaptive and competitive generation.

The application of the Deep Learning approach in senior high schools serves as an effective strategy for enhancing teachers' pedagogical competence. Pedagogical competence encompasses the ability to design, manage, and evaluate learning in accordance with students' needs and characteristics (Kadwa & Alshenqeeti, 2024). Teachers who possess this competence can create a conducive, interactive, and problem-solving-based learning environment (Caesaria et al., 2024; Pulungan et al., 2024). Consequently, training programs are necessary to equip teachers with the knowledge and skills required to implement Deep Learning in classroom practices. Through such training, teachers are expected to improve the quality of their teaching and provide more meaningful learning experiences for students.

Muhammadiyah Mlati Senior High School, as an educational institution committed to improving the quality of learning, needs to adopt the Deep Learning approach in its teaching processes. However, in reality, many teachers still rely on conventional teaching methods that are teacher-centered and do not fully accommodate exploratory and in-depth learning. This one-way teaching pattern limits students' opportunities to explore their own ideas and develop a broader understanding of concepts (Siswanto & Susetyawati, 2024). The lack of understanding of Deep Learning concepts and the insufficient skills to integrate this approach into teaching remain major obstacles that need to be addressed through systematic and continuous training. Therefore, a more structured effort is required to provide teachers with the necessary understanding and skills to effectively implement Deep Learning in their classrooms.

Training on Deep Learning implementation is expected to provide teachers with new insights into designing more innovative teaching strategies. This training will help teachers understand the fundamental principles of Deep Learning, problem-solving-based teaching techniques, and how to create learning environments that encourage students to think critically and analytically. By grasping the core concepts of Deep Learning, teachers can design instructional strategies that focus on developing students' higher-order thinking skills (Azis et al., 2025). Moreover, this training can enhance teachers' abilities to utilize digital technology as a learning tool that effectively supports the implementation of Deep Learning in the classroom. The integration of technology in learning can help students comprehend complex concepts more easily and provide them with opportunities for more independent and flexible learning based on their individual needs.

According to a study by Herliani (2025), the implementation of Deep Learning in education has been proven to improve students' comprehension and learning outcomes. This approach enables students to explore concepts more deeply, connect learning materials to real-life situations, and develop higher-order thinking skills. Through Deep Learning-based instruction, students are not merely passive recipients of information from teachers but are actively encouraged to explore, discuss, and seek solutions to various problems they encounter (Arif et al., 2025).. Therefore, by enhancing teachers' pedagogical competence through this training, it

is expected that student learning outcomes at Muhammadiyah Mlati Senior High School will also experience significant improvement. With a better understanding of the subject matter, students will be better prepared to face both academic challenges and the increasingly complex real-world demands (Putri et al., 2024).

Furthermore, this training aims to increase teachers' awareness of their crucial role in guiding students to become independent learners with strong analytical skills. By adopting Deep Learning, teachers are not merely information providers but also facilitators who assist students in exploring various perspectives and constructing their own knowledge in a more meaningful way (Bintang & Imaduddin, 2024). This shift in teaching roles will positively impact the academic atmosphere in schools and encourage a more dynamic and engaging learning process. In the long term, the implementation of Deep Learning will help foster a more progressive learning culture in schools, where students are encouraged to be more active, creative, and critical thinkers in every learning process they undertake (Jauhari et al., 2025).

The implementation of this training will also incorporate various methods, such as group discussions, teaching simulations, and mentoring in Deep Learning classroom applications. Through a holistic and practice-based approach, it is expected that teachers will internalize the concepts they learn and apply them consistently in their teaching practices (Widyastuti et al., 2024). Additionally, this program will provide teachers with opportunities to share experiences and discuss challenges and solutions in implementing Deep Learning. Through interaction and collaboration, a learning community among teachers can be established, enabling them to support one another and exchange insights to improve their teaching quality (Siswanto, 2025).

Thus, training on the implementation of the Deep Learning approach in education represents a strategic step in enhancing teachers' pedagogical competence at SMA Muhammadiyah Mlati. Through this training, teachers are expected to be better prepared to address contemporary educational challenges and to create inspiring and transformative learning experiences for students (Zein et al., 2025). The enhancement of teachers' competencies through the Deep Learning approach will positively impact the overall quality of education in schools and contribute to the broader improvement of the education system. By continuously innovating and developing their skills, teachers will be able to guide the younger generation toward a brighter future filled with opportunities (Hatmoko et al., 2024; Mariam & Regina, 2024).

2. Method

This activity was conducted at Muhammadiyah Mlati Senior High School in January 2025, involving 18 teachers as participants. The methodology consisted of three main stages counseling, training, and mentoring which were interrelated to enhance teachers' understanding and skills in implementing Deep Learning in teaching. The first stage, counseling, aimed to provide in-depth comprehension through lectures, discussions, and Q&A sessions on the concept and benefits of Deep Learning in education. The training stage then allowed participants to develop and implement Deep Learning-based instructional strategies creatively and engagingly, supported by hands-on tutorials. The mentoring phase involved consultations and guidance to help teachers overcome challenges in classroom

implementation.

The activity began with a pre-test consisting of 30 multiple-choice questions on a 5-point Likert scale to assess teachers' initial understanding. This was followed by material presentations delivered by supervisors from Sleman Regency in the form of interactive lectures and discussions. The training and mentoring sessions took place over three face-to-face meetings, focusing on conceptual understanding, lesson plan development, and classroom implementation simulations. Evaluation was conducted through open-ended questionnaires and a post-test with 30 multiple-choice questions on a 5-point Likert scale to measure improvements in teachers' ability to apply Deep Learning. Data analysis employed both quantitative and qualitative approaches. The pre-test and post-test results were compared using descriptive statistics and the n-Gain method to assess teachers' competency improvement, following Hake (1999) n-Gain criteria.

3. Results and Discussion

Results

In the initial stage, a pretest is carried out to measure participants' initial understanding of the material to be presented. This pretest consists of 30 multiple choice questions which are arranged based on pedagogical competency indicators with the application of Deep Learning. The results of the pretest carried out on January 3 2025 can be seen in the following table.

Table 1. Pretest Results

Information	N	Minimum	Maximum	Sum	Mean	Std. Deviation	Variance
Value	18	51.00	79.00	1118.00	62.1111	7.40	54.81

Based on the table above, among the 18 participants who took the pretest, the minimum score obtained was 51, while the maximum score reached 79. The total cumulative score of all participants was 1,118, with an average score of 62.11. The standard deviation of the data was 7.40, reflecting the distribution of participants' scores from the mean, while the variance was recorded at 54.81. These data provide an overview of the participants' performance in the evaluation. This indicates that most participants already have a sufficient understanding of the material; however, further reinforcement in training methods is necessary to increase the number of participants achieving higher scores.

During the counselling stage, participants were introduced to the concept of Deep Learning in education, emphasizing the importance of critical thinking, creativity, and deep comprehension of the subject matter. The material was delivered through lectures, discussions, and question-and-answer sessions aimed at enhancing teachers' understanding of the application of Deep Learning in teaching. Below is an image of the counselling session. This activity highlighted the importance of creating an engaging learning environment to increase student participation in the learning process. Several participants actively shared their previous experiences in implementing enjoyable learning models in their classrooms.

Following the counselling stage, participants took part in a training session focused on applying Deep Learning in lesson planning and classroom instruction. Teachers were trained to develop teaching modules that integrate the Deep

Learning approach with problem-solving strategies, interactive discussions, and collaborative learning. They were also encouraged to incorporate elements of joyful learning through educational games, creative activities, and the use of visual aids and technology.

The mentoring stage was conducted in the form of individual consultations to assist teachers in overcoming challenges in implementing Deep Learning in the classroom. Teachers were given the opportunity to discuss the difficulties they encountered, such as adapting teaching strategies to students' characteristics and refining the instructional designs they had developed. This mentoring process also emphasized the significance of joyful learning as an integral part of an effective Deep Learning approach. After the training and mentoring sessions, a posttest was conducted to evaluate the participants' improvement in understanding. The results of the posttest can be seen in the following table.

Table 2. Posttest Results

Information	N	Minimum	Maximum	Sum	Mean	Std. Deviation	Variance
Value	18	82.00	97.00	1680.00	93.3333	3.64611	13.294

Based on the table above, of the 18 participants who took the posttest, the lowest score obtained was 82, while the highest score was 97. The total number of participant scores was 1,680, with an average score of 93.33. The standard deviation of this data was recorded at 3.65, which shows the level of spread of values from the mean, while the variance was 13.29. This data provides an overview of the distribution of participants' posttest scores. The overall increase in both data can be seen in this figure.

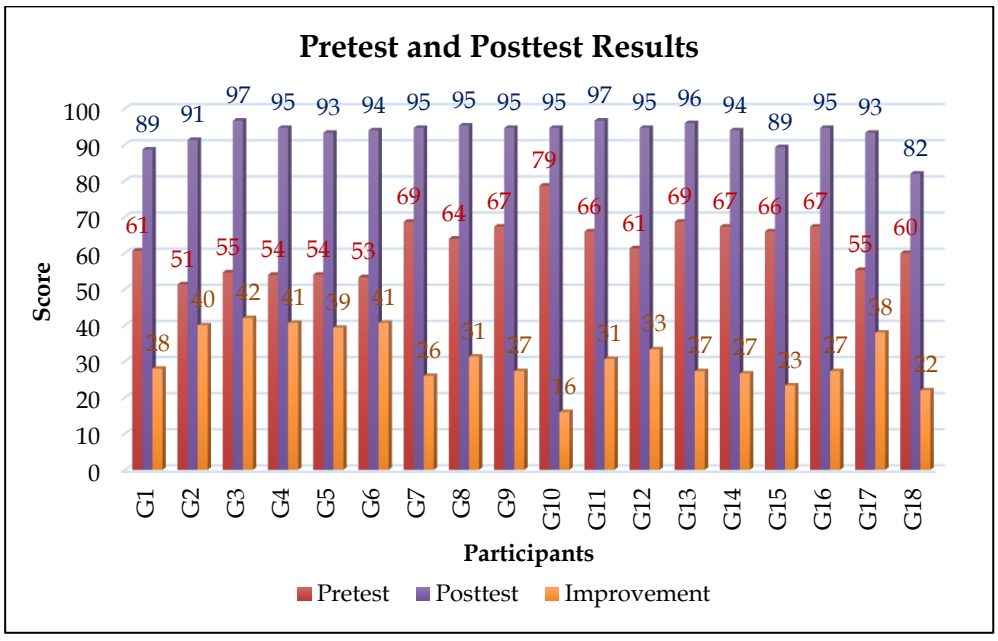

Figure 1. Pretest dan Posttest Results

Based on the picture above, the highest improvement score was 42 and the lowest was 16. Next, n-Gain was tested to determine the overall increase in pretest and posttest results, with the following calculations.

$$\langle g \rangle = \frac{S_{post} - S_{pre}}{SMI - S_{pre}} = \frac{93{,}33 - 62{,}11}{100 - 62{,}11} = \frac{31{,}22}{37{,}89} = 0{,}82$$

Based on the results of the calculations above, the n-Gain value is 0.82 which shows that the pretest and posttest increase in training on implementing the Deep Learning approach to improve the pedagogical competence of teachers is in the high category.

Discussion

The teacher competency enhancement training through the implementation of the Deep Learning approach has had a significant impact on participants. A total of 18 teachers took part in this program, which was designed to strengthen their understanding and skills in applying a learning approach that emphasizes deep comprehension, critical thinking, and meaningful learning. The training included counselling sessions, hands-on practice, and mentoring in the form of consultations, all focused on implementing Deep Learning principles, with a particular emphasis on joyful learning. Through this approach, teachers are expected to create a more interactive and engaging learning environment for students.

According to Zhang & Cao (2021), implementing the Deep Learning approach in teacher training has proven effective in enhancing pedagogical competence by encouraging active student participation and personalized learning. Similarly, Mou et al. (2022) stated that training programs integrating Deep Learning can help teachers develop strategies to actively engage students, thereby improving their pedagogical skills. Furthermore, group-based Deep Learning instructional strategies can enhance experiential training by assessing students' abilities before class and grouping them accordingly (Uwurukundo et al., 2020). Consequently, this approach not only strengthens teachers' instructional skills but also helps them gain a deeper understanding of students' learning needs.

Although this training has shown positive results, the implementation of Deep Learning in the classroom still faces various challenges that need to be addressed, particularly in terms of curriculum adaptation and student potential development. One of the main obstacles is teachers' readiness to adapt this method to diverse teaching environments with students of varying characteristics (Aprilia et al., 2025; Wahyuni et al., 2024). Not all teachers have equal access to supporting resources, such as technology or relevant teaching materials, which can hinder the effectiveness of Deep Learning implementation. Moreover, differences in students' levels of understanding also pose a challenge, as this approach requires more flexible strategies and differentiated instruction. As highlighted by Astiwi & Siswanto (2024) and O'leary et al. (2021), balancing in-depth exploration with achieving curriculum targets is a crucial aspect that often emerges in traditional training programs. Teachers need to possess a high level of adaptability to implement this approach without compromising the expected quality of learning (Siswanto, 2025; Wantoro et al., 2025).

As stated by Mou et al. (2022), teachers often struggle to integrate the principles of Deep Learning into the existing curriculum without sacrificing the essential content of the subject matter. This challenge is further compounded by the pressure to meet stringent academic standards, making it difficult for teachers to apply more exploratory and in-depth learning strategies (Rezaee et al., 2021; Tarso et al., 2025).

Additionally, support from stakeholders, such as school principals and the government, is crucial to ensuring the successful implementation of Deep Learning. Aligning training programs with the actual needs and challenges faced by teachers in practice will help refine these training methods, making them more applicable and relevant to real-world classroom conditions. Consequently, the Deep Learning approach can be applied more effectively in various learning environments while simultaneously enhancing teachers' competence in managing dynamic classrooms.

The results of the n-Gain score from this training showed a high category score of 0.82, reflecting its success in helping teachers understand and apply the Deep Learning approach. Overall, this training positively impacted the development of teachers' pedagogical competencies. With a deeper understanding of Deep Learning, teachers can design more meaningful and relevant learning experiences that align with students' needs. They can implement more exploratory teaching methods, enabling students to actively seek information and construct their own knowledge.

The emphasis on joyful learning during the training proved effective in creating a more dynamic learning atmosphere, increasing student motivation, and encouraging their active engagement in the learning process (Affandi et al., 2024; Mahmudi & Arief, 2025). Joyful learning within the Deep Learning framework helps reduce academic pressure while enhancing students' comprehension of the subject matter (Purwandari et al., 2022). Through this approach, teachers are expected to create a more enjoyable and engaging learning experience, ensuring students are more interested and actively involved in the learning process.

These findings suggest that combining Deep Learning with joyful learning can be a highly effective strategy for creating meaningful and enjoyable learning experiences. This training is expected to inspire similar initiatives in other schools to support educational advancement. This aligns with the findings of Suryani et al. (2024), Tarso et al. (2024) and Yogyanto et al. (2024), who identified several key factors influencing training effectiveness, including motivation, attitude, emotional intelligence, support from management and colleagues, training styles, training environment, trainers' openness, job-related factors, self-efficacy, and basic abilities. Therefore, for the optimal implementation of the Deep Learning approach, support from various stakeholders, including education policies that promote innovation in teaching, is essential.

4. Conclusions

Based on the research findings, the training on implementing the Deep Learning approach has proven effective in enhancing teachers' pedagogical competencies. The pretest results indicated varying initial levels of understanding among participants, with an average score of 62.11. After undergoing counselling, training, and mentoring, the posttest results showed a significant improvement, with an average score of 93.33 and an n-Gain score of 0.82, categorized as high. This improvement demonstrates that the Deep Learning approach, particularly joyful learning, helps teachers create more interactive and meaningful learning experiences. Consequently, this program contributes to enhancing teachers' skills in designing and implementing more effective and engaging teaching strategies for students.

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