

Implementation of Deep Learning in the Digital Age through Training and Mentoring Programs in Cluster IV Minomartani

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Abstrak

Pendidikan dasar di Indonesia masih menghadapi tantangan, khususnya dalam literasi, numerasi, dan berpikir tingkat tinggi siswa. Pembelajaran yang bersifat satu arah dengan dominasi guru sebagai sumber informasi menjadi salah satu penyebab rendahnya pemahaman siswa. Pengabdian kepada masyarakat ini bertujuan untuk meningkatkan kualitas pembelajaran melalui implementasi pendekatan pembelajaran mendalam (*deep learning*) yang berlandaskan prinsip *mindful*, *meaningful*, dan *joyful learning*. Sasaran kegiatan adalah guru-guru Sekolah Dasar di Gugus IV Minomartani, Sleman. Metode yang digunakan meliputi pelatihan, pendampingan penyusunan perangkat ajar berbasis teknologi, serta refleksi terhadap implementasi pembelajaran. Kegiatan pelatihan dan pendampingan implementasi pembelajaran mendalam di era digital yang dilaksanakan di Gugus IV Minomartani, Sleman, menunjukkan peningkatan pemahaman dan keterampilan guru dalam merancang dan melaksanakan pembelajaran berbasis pemikiran kritis, kolaboratif, kreatif, dan komunikasi efektif. Berdasarkan evaluasi awal dan akhir, terjadi peningkatan rata-rata sebesar 35% dalam pemahaman konsep pembelajaran mendalam. Selain itu, 90% peserta mampu mengintegrasikan teknologi digital dalam proses pembelajaran dengan lebih inovatif, seperti penggunaan platform interaktif, media digital, serta strategi pembelajaran berbasis proyek.

Kata Kunci: *Pendidikan Dasar, Pembelajaran Mendalam, Teknologi Digital, Gugus IV Minomartani.*

Abstract

Basic education in Indonesia still faces challenges, particularly in literacy, numeracy, and higher-order thinking skills. One-way learning, dominated by teachers as sources of information, is one of the causes of low student understanding. This community service program aims to improve the quality of learning through the implementation of a deep learning approach based on the principles of *mindful*, *meaningful*, and *joyful learning*. The target group is elementary school teachers in Cluster IV Minomartani, Sleman. The methods used include training, mentoring in the development of technology-based teaching materials, and reflection on learning implementation. The training and mentoring activities for the implementation of deep learning in the digital era carried out in Cluster IV Minomartani, Sleman, demonstrated an increase in teachers' understanding and skills in designing and implementing learning based on critical, collaborative, creative thinking, and effective communication. Based

on initial and final evaluations, there was an average increase of 35% in understanding of deep learning concepts. In addition, 90% of participants were able to integrate digital technology into the learning process more innovatively, such as using interactive platforms, digital media, and project-based learning strategies.

Kata Kunci: *Basic Education, Deep Learning, Digital Technology, Cluster IV Minomartani.*

INTRODUCTION

Teachers in Indonesia need to transform themselves to be more adaptive to the changing times. Teachers and students are facing an era where changes occur very quickly and unpredictably (Aspandi & Muttaqin, 2025). Critical thinking, creativity, and flexibility in facing challenges are skills that must be possessed by the next generation. Deep learning is the right approach to prepare students for an increasingly complex world by mastering literacy, numeracy, and higher order thinking skills (HOTS) (Hamzah et al., 2022). Deep learning is also a paradigm that must be adopted in the national education system because it emphasizes deep understanding, not just memorization. Students are not only equipped with the ability to read, but also to understand. Students are not only able to calculate, but also to analyze. Students do not only memorize, but are also able to apply and innovate (Metha & Fine, 2014).

Teachers in Indonesia still face many challenges, especially in terms of reading comprehension and the application of mathematical concepts in everyday life. One of the main weaknesses of teachers in Indonesia is that many students are only able to read without understanding the meaning (Puspitaningrum et al., 2025). The Deep Learning approach will bring about changes in the relationship between teachers and students. Until now, learning in elementary schools has tended to be one-way, with teachers as the center of information and students as mere recipients (Fitrah et al., 2025; Xu et al., 2025). The application of Deep Learning can create an environment in which students are more active in building their own understanding, while teachers act as facilitators who guide them in finding answers (Waluyo et al., 2025; Nafi'ah & Faruq, 2025; Pangabea et al., 2024).

Higher education institutions play an important role in developing and applying the concept of Deep Learning in Indonesia (Lu et al., 2023). Teachers must be able to respond to the needs of the times, and Deep Learning is the key to ensuring that students and teachers have the relevant skills in this digital age (Weng, Chen, & Ai, 2023). The success of teachers is not only determined by a good curriculum, but also by how learning is delivered (Kamaruddin et al., 2025). A good teacher not only delivers material, but also builds deep understanding among students. In this way, the knowledge gained is not only remembered for exams, but can be applied in real life. The lessons that leave the deepest impression are those taught with meaning and emotional involvement. An elementary school teacher who teaches a song in such a profound way, not

only teaching the lyrics but also the meaning behind them, will form the concept of deep learning, which is not just memorization, but also truly understanding and internalizing knowledge (Lu et al., 2023; Sari et al., 2025).

METHOD

This community service activity uses a training and mentoring approach that is systematically designed to improve teachers' competence in implementing deep learning in the digital age. The form of activity was chosen by considering the needs of teachers in the field who are currently required to be able to adapt to technological developments while integrating them into meaningful learning. The main target of this activity is elementary school teachers who are members of Cluster IV Minomartani, Sleman, because they are at the forefront of developing the quality of basic education.

The activity was carried out in several interrelated stages. The first stage was a needs assessment. At this stage, the community service team conducted preliminary observations and interviews with school principals and teachers to identify the real needs related to the implementation of deep learning in schools. The instruments used were questionnaires and observation sheets that were specifically designed to obtain preliminary data on teachers' understanding and learning practices in the classroom. The results of this needs analysis became the basis for developing a training and mentoring program design.

The second stage is program planning. At this stage, the team develops training materials that focus on the concept of deep learning, which includes the principles of mindful learning, meaningful learning, and joyful learning that are relevant to the digital era. In addition, training modules, mentoring guidelines, and evaluation tools are also developed to measure the effectiveness of the activities. The team also determined the activity schedule, technical implementation, and division of tasks among members so that activities could run smoothly and in a focused manner.

The next stage was the implementation of training. This activity was carried out through a combination of face-to-face meetings and the use of digital media so that teachers not only gained theoretical understanding but also practical skills in using educational technology. The material was delivered through interactive lectures, group discussions, case studies, and hands-on practice. In the practice sessions, teachers were trained to develop deep learning-based learning tools and try to integrate digital technology, for example, through the use of interactive learning applications or digital platforms that support teaching and learning activities.

After the training, the activity continued to the coaching and mentoring stage. At this stage, the community service team visited schools to assist teachers in implementing the learning designs that had been created. Coaching and mentoring are carried out directly in the classroom through learning observation, followed by reflection sessions and follow-up discussions with teachers. Thus,

teachers not only gain knowledge from the training but also receive guidance when applying deep learning strategies in the real context of their respective classrooms.

The final stage is monitoring and evaluation. Formative evaluation is carried out during the training process using pre-tests and post-tests to measure the improvement in teachers' understanding. Summative evaluation is conducted after mentoring through the distribution of satisfaction questionnaires, teacher reflections, and observation of learning implementation in the classroom. The indicators of success for this activity include an increase in teachers' understanding of deep learning, teachers' skills in utilizing digital technology, and their ability to integrate deep learning principles into their daily teaching and learning activities.

Data collection techniques in this activity used several methods, namely observation, questionnaires, interviews, and documentation. Observation was used to observe the implementation of training and mentoring, questionnaires were used to measure teachers' understanding and perceptions before and after the activity, interviews were conducted with teachers and principals to obtain more in-depth information, while documentation in the form of photos, videos, and teaching materials created by teachers served as supporting evidence (Chotijah & Hasanah, 2020).

The collected data were analyzed descriptively by combining simple qualitative and quantitative approaches. Quantitative data from pre-tests and post-tests were analyzed using the percentage of increase in teachers' understanding, while qualitative data from observations, interviews, and documentation were analyzed through data reduction, data presentation, and conclusion drawing. The results of this analysis were used to assess the effectiveness of the program and provide input for the sustainability of similar activities in the future.

The entire series of activities is summarized in Table 1, which describes the stages of community service, starting from socialization and mapping to training. Each stage is accompanied by a description of the activities, the parties involved, and the outputs produced, in order to ensure the achievement of program objectives and the sustainability of interventions in the future.

Table 1. Stages of Community Service Activities

Activity Stage	Activity Description	Output/Indicators
Needs Analysis	Development of training materials (mindful, meaningful, joyful learning).	Data on teacher requirements related to the implementation of deep learning.
	Creation of modules and guidelines.	
Program Planning	Determination of schedule and technical implementation.	Modules, guidelines, activity schedules, and evaluation tools.
	Face-to-face and digital-	

	based training.	
	Methods: interactive lectures, discussions, case studies, practice.	
Training Implementation	Teachers develop deep learning-based learning tools.	Teachers acquire knowledge and skills to integrate deep learning with technology.
	School visits.	
	Class observation, reflection, and follow-up discussions.	
Mentoring	Direct coaching and mentoring.	Teachers receive guidance when implementing learning designs in the classroom.
	Pre-tests and post-tests.	
	Teacher satisfaction surveys.	
Monitoring & Evaluation	Reflection and observation of learning implementation.	Data on improved understanding, teacher satisfaction, and evidence of learning implementation.
	Development of training materials (mindful, meaningful, joyful learning).	
	Creation of modules and guidelines.	
Data Collection Techniques	Observation, questionnaires, interviews, documentation.	Primary and secondary data related to the process and results of activities.
Data Analysis	Simple quantitative (pre-test & post-test percentages).	Descriptive information regarding the effectiveness of activities and recommendations for follow-up.
	Qualitative (reduction, presentation, conclusions).	

RESULTS AND DISCUSSION

Deep Learning Socialization of Learning Paradigm Change with the Deep Learning Approach

The research team provided information to elementary school teachers in Cluster IV Minomartani, Sleman, regarding the DL-based learning paradigm. This information focused on the understanding that current learning needs to be transformed to make optimal use of technology, so that learning is not just about memorizing information, but involves critical thinking, problem solving, and the development of 21st century skills. Through this socialization, teachers were introduced to the concept of deep learning, which emphasizes the process of creating mindful, meaningful, and joyful learning.

1) Mindful Learning

This aspect focuses on developing awareness and concentration during the learning process. The goal is for students to be more present, pay attention to every detail, and be more connected to the material being taught.

Practices such as meditation or reflective journaling can be used to support increased focus in learning.

2) Meaningful Learning

Meaningful learning connects new knowledge with what students already know, making learning more relevant and applicable. This can be achieved through context-based learning, real-world application of material, and project-based activities.

3) Joyful Learning

Joyful learning creates a positive and engaging atmosphere that motivates students to actively participate and overcome challenges. This can be achieved through gamification, collaborative activities, and providing space for creative expression, making the learning experience more enjoyable and exciting.

The training participants were also given an understanding of the importance of a more personal and contextual approach to teaching, utilizing digital technology that supports a more holistic learning process. This socialization is expected to increase teachers' awareness of the importance of technology in creating a more meaningful and effective learning experience for students in this digital age.

Several key aspects of DL-based learning were presented to teachers during this socialization activity, including::

- a. Deep Conceptual Understanding. Essentially, deep learning aims to ensure that students not only understand information superficially, but can also explain, connect, and apply these concepts in various contexts. Learning encourages students to think critically and analyze the relationships between the concepts they learn, rather than simply memorizing them.
- b. Application of Knowledge in Real-World Contexts. Deep learning encourages students to apply the knowledge they have learned in real-world situations. This means that the material studied is not only relevant in an academic context but can also be applied in everyday life. This approach emphasizes problem solving and innovation, and encourages students to adapt to various situations and challenges.
- c. Development of 21st Century Skills. Deep learning-based learning aims to develop the skills needed to compete in an increasingly complex and connected world. Skills such as critical thinking, collaboration, communication, creativity, and problem solving are central to this approach. Therefore, students not only learn content, but also learn how to learn (metacognition), adapt to technology, and work together in teams (teamwork).
- d. Empowering Technology in Learning. Deep learning is closely related to the use of digital technology. In this digital age,

technology plays an important role in supporting deep learning. By utilizing various online learning platforms, interactive applications, and digital tools that support practical exploration and application of concepts, such as YouTube, Learning Management System (LMS) websites, Google Classroom, Wayground, Kahoot, Google Earth, etc.

- e. Student-Centered Learning. Giving students the freedom to explore material, work independently, and develop solutions to problems they encounter. In this case, teachers serve as facilitators or mentors who provide guidance and direction, rather than just being the main source of information.
- f. Collaboration and Discussion. Deep learning-based learning can be used to encourage students to work together in groups, discuss, and share their views. This collaboration helps students understand the material more broadly and thoroughly, as they can see various perspectives and ideas from their friends. In DL-based learning, teachers must also apply a two-way communication model in classroom discussions, so that the learning discussions will feel more lively and provide a deeper understanding of the material being taught.
- g. Holistic Evaluation. Evaluation in deep learning does not only measure students' ability to memorize facts, but more on their ability to apply knowledge, think critically, and solve more complex problems. Assessment also covers various dimensions, including higher-order thinking skills, collaboration, and creativity, which reflect how well students internalize and apply their learning.
- h. Student Reflection and Feedback. Students are given the opportunity to reflect on their learning process, identify areas for improvement, and receive constructive feedback from teachers or classmates. This allows them to continuously improve and deepen their understanding of the material being studied.

The socialization program successfully reached all teachers in Cluster IV Minomartani with the main material being the transformation of the traditional learning paradigm towards digital-based deep learning. This socialization program had several targets, including:

- 1) Teachers were able to understand the concept of deep learning, which emphasizes deep understanding, critical analysis, and the application of knowledge in real contexts.
- 2) Interactive discussions and case studies provided a real picture of the implementation of DL in the classroom.
- 3) Teachers began to adopt a more student-centered, two-way communication learning mindset and effectively integrate digital technology.

Development of Quality Learning Resources, Especially Learning Tools Appropriate for the Grade Level Taught by Service Participants.

In the concept of deep learning, elementary school teachers in Cluster IV Minomartani are required to develop DL learning tools that are appropriate for the grade levels they teach at school. Therefore, at this stage, teachers are trained to design and modify learning tools that are appropriate for the characteristics of students at each grade level, from elementary to middle school. The learning tools developed include interactive modules, instructional videos, and digital-based evaluation tools, which enable students to learn independently and in greater depth.

In addition, these tools are also designed to be easily accessible to students, both inside and outside the classroom, using various digital platforms in line with current technological developments, such as YouTube, the Learning Management System (LMS) website, Google Classroom, Wayground, Kahoot, etc. With the availability of quality learning resources that are appropriate for each grade level, it is hoped that teachers can create a more interesting, relevant, and effective learning experience that not only improves students' understanding but also encourages them to be more active in the learning process.

The implementation of IPTEKS in this program focuses on the use of easily accessible digital learning media, meaningful and joyful training models, as well as documentation and evaluation that are easy to apply by teachers and students. This training will provide examples of digital teaching modules that will guide teachers to develop them in different contexts and materials according to grade levels and subjects. In addition, the volunteers also provide sample videos of joyful learning, with the hope that the learning activities shown in the videos will inspire teachers to modify them according to the topics being taught. All digital devices are designed to be easily accessible by teachers and students using the facilities available in their respective schools.

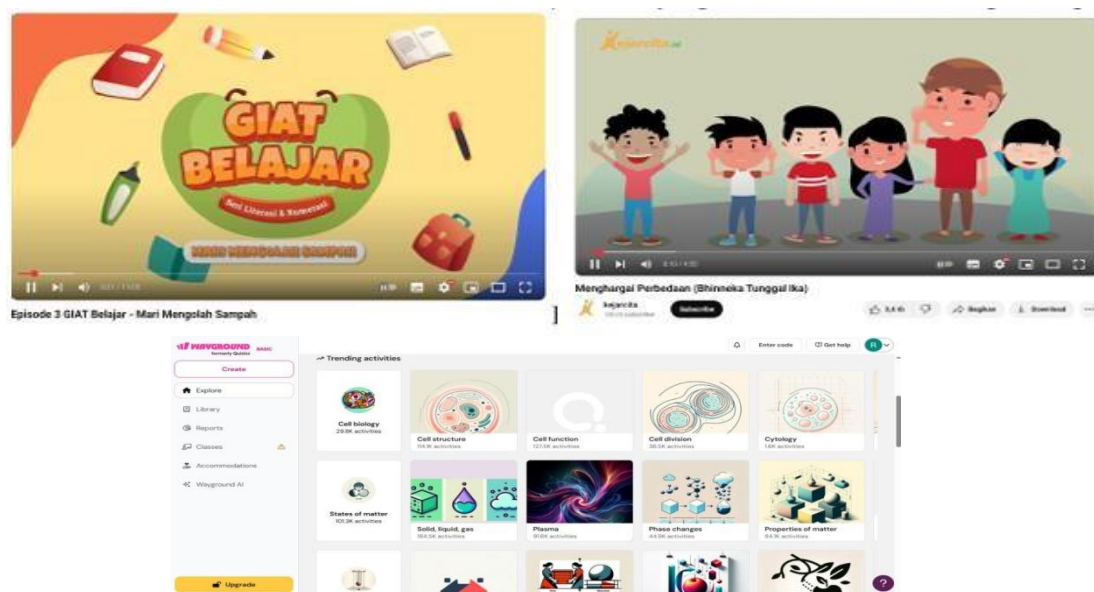


Figure 1. Examples of Platforms that Can Be Used in Deep Learning-Based Learning

The implementation of the PKM DLK program entitled Training and Assistance for the Implementation of Deep Learning in the Digital Age in Cluster IV Minomartani, Sleman, has succeeded in making a significant contribution to changing the learning paradigm among local teachers. One of the main results of this activity was the dissemination of information about the change in the learning paradigm using the deep learning (DL) approach, which emphasizes the importance of deeper, more critical, and technology-based learning. Teachers were invited to understand how the DL approach could change the way they delivered material, focusing not only on knowledge transfer but also on the development of critical thinking and problem-solving skills. With this new understanding, teachers began to realize the importance of student active engagement in the learning process, as well as how technology could be an effective tool to deepen their understanding of the material being taught.

In addition, this program has also been successful in developing quality learning resources, particularly in the form of learning tools that are appropriate for the grade levels taught by the participants. In this training, teachers were equipped with the skills to design interactive, technology-based learning tools that are appropriate for the characteristics and needs of students at various grade levels. The learning resources developed include learning modules that are easily accessible and can be adapted to students' learning styles, as well as the use of digital media that supports more flexible and engaging learning. These learning tools are expected to not only improve the quality of learning in the classroom but also support independent learning outside of school hours.

The improvement of teacher competence is one of the significant outcomes of this program. Through a series of intensive training and mentoring sessions, teachers in Cluster IV Minomartani gained practical understanding and skills regarding the implementation of deep learning-based learning in the context of digital learning. They were taught to design learning strategies that are more adaptive and responsive to technological developments, as well as how to utilize various digital tools to improve teaching effectiveness. With this increased competency, it is hoped that teachers will be better prepared to face the challenges of the digital age and provide a more meaningful learning experience for their students. This increase in competency is also expected to improve the overall quality of teaching in the region, in line with a more modern learning paradigm that is integrated with technology.



Figure 2. Community Service Activity Process

This figure shows the stages of implementing community service activities, which include training sessions, mentoring, and teacher reflection on implementing deep learning based on digital technology in Cluster IV Minomartani, Sleman. This activity was conducted interactively, involving discussions, practice in developing teaching tools, and direct application in the classroom.



Figure 3. Community Service Team and Teacher Participants

This picture shows the community service team from the Faculty of Education, Yogyakarta State University, together with the participating teachers at Cluster IV Minomartani, Sleman. This photo was taken at the end of the activity as documentation of the collaboration and enthusiasm of the participants in attending the training program and in-depth learning assistance in the digital era.

CONCLUSION

This Community Service program has conducted ongoing training in an effort to improve the knowledge, skills, and competencies of elementary school teachers in Cluster IV Minomartani, Sleman. The training activities for elementary school teachers in Cluster IV Minomartani included: (1) Socialization of changes in the learning paradigm with a deep learning (DL) approach; (2) Development of Quality Learning Resources, specifically learning tools appropriate for the grade levels taught by the participants; and (3) Improvement of Educator Competence. This strategy is an effort to optimize results, with a focus on selected areas based on assessment, social analysis, time availability, and optimization of research resources. This Community Service proposal was designed under the Campus-Outside Activities (DLK) scheme.

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