

Experimental Evidence on Blended Training for Facilitating Deep Learning and Innovative Professional Development in Indonesia's Hinterland Education Context

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DOI: 10.23917/ijolae.v8i2.13375

Received: March 15th, 2026. Revised: May 9th, 2026. Accepted: May 14th, 2026

Available Online: May 25th, 2026. Published Regularly: May, 2026

Abstract

This study investigates the effectiveness of blended-based professional development in enhancing teachers' competencies for implementing Deep Learning pedagogies in Indonesia's hinterland educational contexts. The study addresses a critical gap in teacher professional development, particularly in geographically disadvantaged regions where access to sustainable and technology-supported training remains limited. Employing a mixed-methods approach with an exploratory sequential design, the research integrates qualitative exploration and quantitative validation to obtain comprehensive insights into the implementation of blended-based training. Preliminary data were collected from 3,520 teachers through surveys and interviews, followed by an experimental study involving 37 prospective teacher facilitators who participated in intensive blended training programs. The findings demonstrate that blended-based training significantly improves teachers' competencies in designing adaptive lesson plans, implementing student-centered instructional practices, integrating learning technology, and understanding Deep Learning principles. Statistical analysis using paired sample t-tests revealed significant improvements across all competency dimensions after the training intervention ($p < 0.05$). The study further reveals that blended-based training promotes innovative learning practices, strengthens teachers' digital pedagogical literacy, and supports progressive educational transformation in remote learning environments. This study contributes theoretically to the literature on technology-enhanced professional development and Deep Learning implementation in remote educational settings. Practically, the findings provide strategic implications for policymakers and educational institutions in designing adaptive, scalable, and context-sensitive teacher training models that support equitable and sustainable educational development in geographically diverse regions.

Keywords: blended training, deep learning, innovative learning, learning technology, progressive education, transformative learning, joyful learning, mindful learning, meaningful learning.

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1. Introduction

The Indonesian Ministry of Primary and Secondary Education has mandated the implementation of Deep Learning in the educational process for the 2025-2026

academic year. This policy represents a strategic initiative aimed at enhancing the quality of education across elementary, junior high, and senior high levels in Indonesia. The decision to adopt this approach stems from the

concerning results of the 2022 Programme for International Student Assessment (PISA) survey, which revealed that 99% of Indonesia's 53.14 million students scored below the lower thinking skills level.

The PISA results, published by the OECD (2022), assessed student competencies in three domains: reading (reasoning), mathematics, and science. In reading, 74.5% of students were classified at a very low level, 19.3% at a low level, 5.4% at a moderate level, and 0.8% at a high level. In mathematics, 81.7% were at a very low level, 14.1% at a low level, 3.8% at a medium level, and 0.4% at a high level. Similarly, in science, 65.8% were at a very low level, 26.3% at a low level, 7.0% at a medium level, and 0.9% at a high level. These findings underscore the ineffectiveness of the current classroom learning processes.

Previous research has indicated that the low PISA 2022 results stemmed from conventional learning practices that failed to promote higher-order thinking, educational literacy, critical problem solving, and innovative learning engagement among students (Baran & Kabael, 2023). Additionally, there were lacks of effective school readiness to implement the national curriculum, and student engagement in the learning process was ineffective, particularly in implementing joyful, mindful, and meaningful learning (Purnomo et al. 2023). Furthermore, teachers were not optimally prepared to implement the national curriculum (Suardana et al. 2022).

In light of these issues, the Indonesian Ministry of Education believes that implementing Deep Learning will enable students to participate more effectively in their learning process. Cai et al. (2025) found that Deep Learning creates an effective environment that enhances students' adaptability to the learning process, as well as their social and emotional skills, critical

thinking abilities, and understanding of the subject matter through various enjoyable activities. Deep Learning fosters transformative and progressive educational practices by encouraging reflective thinking, meaningful engagement, collaborative learning, and adaptive knowledge construction in modern classrooms (Huberman et al., 2014; Zhong, 2021; Kleinsasser, 2025).

To successfully implement Deep Learning in Indonesia, the Ministry must ensure that teachers are well-prepared and competent in this approach. Teachers are pivotal in achieving educational goals worldwide, as they are primarily responsible for transferring knowledge to students and ensuring that this knowledge aligns with established standards (Decker-Woodrow, 2018). They must also comprehend the academic development students undergo, understand the evolution of student character, and be attuned to students' readiness for learning, academic needs, and mental changes (Robert et al., 2014). Consequently, enhancing teacher competency is paramount for delivering quality education. To ensure teachers effectively contribute to improving learning quality, they must engage in ongoing competency development programs continuously through various training initiatives that leverage technology to meet training objectives efficiently and effectively based on the real situation where they teaching for, especially in hinterland area.

The Indonesian Ministry of Education has introduced a technology-enhanced professional development program for Deep Learning implementation through the In-On-In model supported by Learning Management Systems (LMS). This initiative aims to strengthen digital pedagogical literacy and prepare facilitators capable of implementing innovative and technology-integrated learning across diverse educational regions in

Indonesia. According to [Pratomo & Wahanisa \(2021\)](#), the implementation of Learning Management System enhances the efficiency and effectiveness of the teaching and learning process while simplifying the management of training materials ([Yenni et al., 2023](#)). Additionally, this system bolsters learning capabilities through various communication media and aids in presenting more concrete information ([Yildiz et al., 2015](#)). However, the effectiveness of the In-On-In training supported by Learning Management System is diminished in hinterland areas due to geographical disparities between cities and other provinces in Indonesia. [Yudhana & Kusuma \(2021\)](#) noted that the system fosters an uncommunicative training community, as it primarily provides training materials. This observation is consistent with the findings of [Fitriani \(2020\)](#), which highlight a neglect of academic and social aspects, with the learning process more towards training rather than education. Furthermore, this implementation is limited in functionality, focusing mainly on providing information resources and facilitating learning through the cloud ([Rizal & Walidain, 2019](#)).

Previous research indicated that in-person teacher competency improvement training, aimed at implementing the national curriculum in the hinterland area of Karimun Regency, Riau Islands Province, Indonesia, and supported by Learning Management System (LMS), proved ineffective ([Pohan et al., 2025](#)). This study found that 68.75% of the 150 elementary and junior high school teachers surveyed struggled to master the training materials presented in the LMS due to minimal communication between facilitators and teachers.

A study by [Pohan et al. \(2021\)](#) in Batam City highlighted that the ineffectiveness of LMS-based teacher training hindered teachers from effectively designing innovative

learning suitable for the hinterland context. This was because the models and materials provided in the training were not relevant to the hinterland context. The findings of this previous study are consistent with a preliminary study conducted by the research team with 3,140 elementary and junior high school teachers in the hinterland area of Riau Islands Province from May 21-25, 2025, using an online survey, which revealed that 42.6% of the teachers did not participate in competency improvement training.

Beyond these issues, interview results indicated that research implementation in the hinterland area was ineffective due to the challenging conditions on the islands, which made it difficult for facilitators to reach them. Moreover, teachers on the hinterland area are seldom involved in training activities conducted by the government, specifically the Department of Education. They also lack easy access to various training programs offered by learning communities, such as principal working groups, subject teacher meetings, and other professional communities ([Hartz et al., 2017](#), [Thambu et al., 2021](#)). This situation results in the majority of teachers working in hinterland areas being unable to properly master curriculum concepts, and consequently, they are unable to apply the curriculum to the learning process at school.

Moreover, teachers in hinterland areas lack the same opportunities for competency development as their counterparts in urban schools. They face difficulties in leaving their teaching locations due to challenging conditions, such as the costly and time-consuming task of crossing oceans from one island to another. This situation poses a significant challenge for teachers in accessing opportunities to enhance their skills in accordance with the demands of a frequently changing national curriculum in Indonesia ([Asrial et al., 2022](#)). Interviews with teachers

and school principal in hinterland are have revealed that the government has yet to implement solution for equitably distributing teacher training in hinterland areas to enhance their competency. The government's focus has been on improving the competency of

teachers in urban areas. This focus is evident in the 44% disparity in education quality between urban areas in Java and underdeveloped regions (Anwar, 2022). The results of the preliminary study are presented in the table below.

Table 1. Results of Preliminary Research Observations

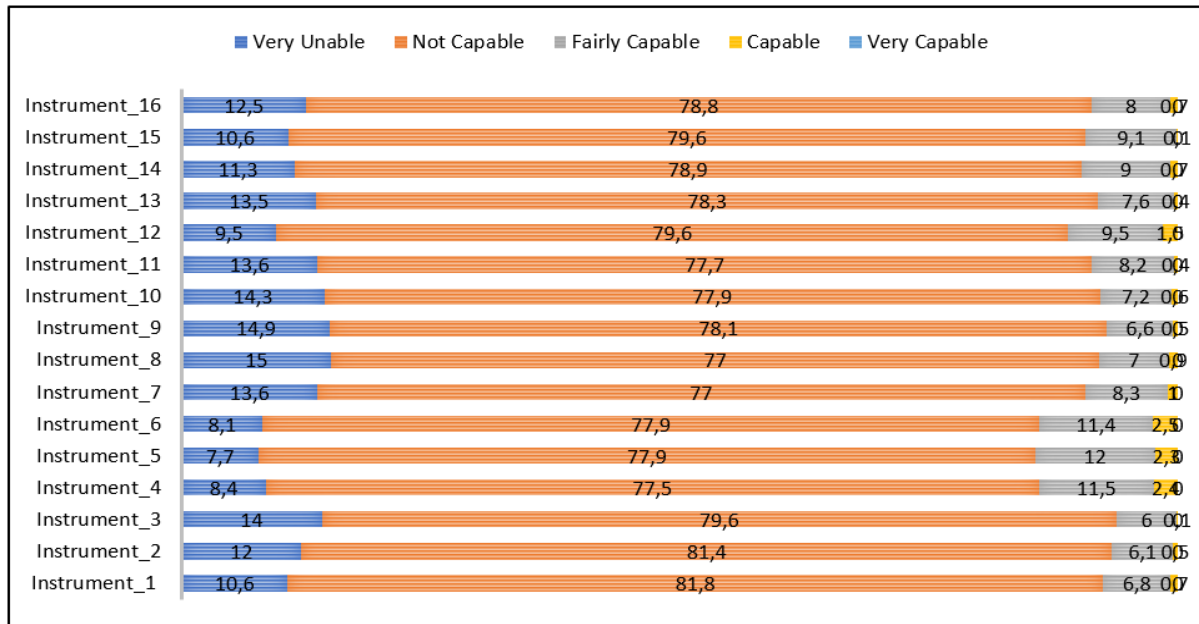


Table 1 indicates an average score of 11.85% in terms of the ability to implement the national curriculum. Yellow is the predominant color, representing an average of 78.68% of teachers who, despite participating in in-on-in training facilitated by government, still lack the capability to implement the national curriculum. Additionally, 8.39% reported being unable to engage in competency-enhancing training offered by their schools or government-sponsored programs. According to Zang et al. (2021), shortcomings of the in-on-in training model supported by the Learning Management System mentioned above, the proposed teacher training model for implementing Deep Learning in the context of hinterland areas is blended-based training. Blended training combines face-to-face meetings with online learning activities (Wu, 2016).

Moreover, blended learning can seamlessly integrate online and offline learning environments in real time, facilitating instruction in both physical and virtual classrooms (Xu et al., 2020).

Previous studies have demonstrated that the implementation of blended learning and training can enhance the effectiveness and efficiency of achieving goals. Pohan et al. (2021) applied blended-based training to boost teacher competency in North Sumatra Province, Indonesia. The findings indicated an improvement in teachers' ability to design learning and teaching skills in the classroom, aligning with the 2013 national curriculum. Additionally, a study by Pohan et al. (2025) employed a blended-based training model to enhance the competency of private school teachers in Batam City, revealing its high effectiveness and efficiency.

The research gap in this study refers to the results of previous research on blended-based training in underdeveloped areas entitled "Improving Teachers' Professionalism Through Blended-Based Training in Indonesia's Remote Areas". This study has not been able to provide accurate information regarding the effectiveness of blended-based teacher training. In addition, the previous research method was not effective in digging for broader and deeper information because it only used one type of research, namely quantitative research (Bosire, 2024). To achieve more accurate research results, this study used a mixed method research type. By applying this method, the information obtained through quantitative and qualitative studies obtained more optimal and accommodating results.

In addition, the research gap in this study is also from the author's research entitled "Virtualization of Teacher Training on Improving Online Teaching Competence for the Students of Riau Island University in Indonesia." The results of this study are also relatively narrow in describing appropriate training methods for the hinterland areas of the Riau Islands Province. Based on the weaknesses of previous research, including the contribution of research results, ineffective research methods, and a low number of research subjects, the researcher conducted this study as a follow-up to the weaknesses of previous research. This study used a much larger research subject group, mixed research methods, and various complex data collection and processing techniques.

Overall, blended learning and blended training models have demonstrated substantial effectiveness in promoting innovative learning environments, digital pedagogical literacy, adaptive instruction, and progressive professional development for teachers and students (Kintu et al. 2017; Owston & York, 2018; Huang, 2019). However, none of the

mentioned studies on blended-based training or learning have been conducted in hinterland contexts. Consequently, previous research differs from the study conducted in the Riau Islands Province, one of Indonesia's hinterland areas. This study was undertaken to scientifically and methodologically assess whether blended-based training can enhance teacher competency in implementing Deep Learning in hinterland area.

2. Method

To achieve the objectives of this study, the researchers adopted a mixed-methods approach utilizing a sequential exploratory design, as defined by Creswell (2018). This design involves the systematic integration of qualitative and quantitative methods in a phased sequence. The rationale for selecting this approach lies in its ability to generate a comprehensive and nuanced understanding of the phenomenon under investigation, while simultaneously reducing potential bias in the research data (Wolf et al., 2021; Asimov, 2025). By employing this model, the researchers were able to examine whether the qualitative and quantitative findings converged or diverged thereby strengthening the validity of the conclusions and aligning them with the study's overarching goals.

a. Qualitative Research Phase

According to Creswell (2018), qualitative research seeks to uncover the meanings individuals or groups assign to a social issue. This study began with a qualitative phase to gain deeper insight into the research questions, capture contextual realities, and portray actual conditions in the field (Bekker & Clark, 2018; Morse et al., 2021). The qualitative component aimed to explore the challenges faced in teacher training within Indonesia's hinterland regions, evaluate existing teacher competencies, and analyze training-related

documentation specific to these remote contexts. Data collection methods included (1) Closed interviews with key stakeholders, (2) Online surveys targeting educators in remote areas, (3) Document analysis of training programs conducted in the hinterland. The results of this qualitative research stage are presented in the background section, not in the results and discussion sections. This foundational phase provided rich, contextual data that informed the subsequent quantitative analysis and experimental validation.

b. Quantitative Research Phase

Following the qualitative exploration, the study progressed to a quantitative phase designed to validate and extend the initial findings. This phase employed structured data collection and statistical analysis to examine patterns, test hypotheses, and quantify relationships identified during the qualitative stage (Kachole & Upadhyay, 2025). The quantitative component served three primary purposes:

a. **Verification:** To confirm the themes and insights uncovered in the qualitative phase.

- b. **Generalization:** To assess the broader applicability of findings across a larger population.
- c. **Comparative Analysis:** To identify correlations or discrepancies between different variables, such as geographic location, training modality, and teacher competency levels.

Data Collection and Instruments consist of (1) Standardized online surveys distributed to educators across multiple hinterland regions. (2) Performance metrics extracted from training program records. (3) Statistical coding of qualitative themes for cross-tabulation and regression analysis. The survey instrument was designed to measure the teacher self-assessed competencies, perceived effectiveness of training programs, and accessibility and relevance of educational resources in hinterland areas.

The study's variables include Variable X and Variables Y1, Y2, and Y3. Variable X pertains to the implementation of blended-based training. Y1 measures the teacher's ability to design lesson plan, Y2 assesses the teacher's capability teaching practice, and Y3 evaluates the teacher's mastery of the training material. Below is the depiction of the research variables:

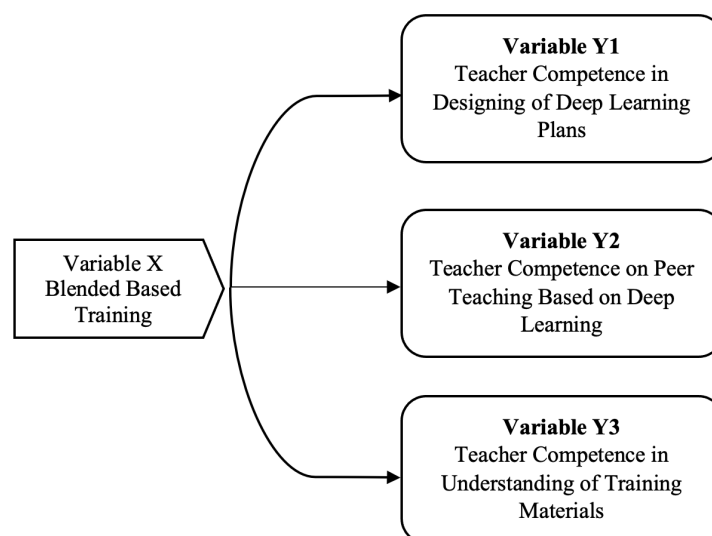


Figure 1. Research variabel

This research was carried out in the hinterland region of Riau Islands Province, Indonesia, from June to August 2025. The study involved 37 teachers, selected by the Education Office, as prospective facilitators for implementing Deep Learning in the Hinterland Area. These teachers underwent 7 days of online training followed by 7 days of offline training. Data collection was conducted through tests, including a pre-test before the training and a post-test afterward. The study assessed teacher competency in creating deep learning plans, peer teaching, and mastery of deep learning training materials (Ashraf et al. 2022).

The research instrument comprised a teacher competency measurement tool, which included a rubric for assessing competency in designing Deep Learning plans, peer teaching, and 30 questions by multiple-choice test. This instrument was sourced from the 2025 Implementation of Deep Learning Documents by the Ministry of Primary and Secondary Education. The research data were statistically analyzed using the Statistical Package for the Social Sciences, version 29. To evaluate the training outcomes, a paired simple t-test was employed to determine if there was a significant improvement before and after the blended learning implementation (Jerry & Yunus, 2021). Before these t-tests, a normality test using a one-sample Kolmogorov-Smirnov test was performed, as the t-test requires normally distributed data.

The normality test results for the research data indicated a normal distribution, as evidenced by a Sig. (2-tailed) value of 0.705, which is greater than 0.05, confirming the normal distribution of the residual values. However, the homogeneity of variance for this research data was not met, with a Sig. value of 0.000, which is less than 0.05,

indicating non-homogeneity. This result is not problematic because the sample group in this research comprises two research data samples from a single research group. The homogeneity test is not an absolute requirement in one-way ANOVA. Even if the homogeneity test assumptions are not satisfied, further testing can proceed as long as the data are normally distributed, as confirmed by the one-sample Kolmogorov-Smirnov test. The homogeneity test results highlight differences in the initial competencies of teachers in the hinterland area before they participated in blended-based training. Preliminary research revealed variations in the length of teaching experience among the 37 teachers and their certification status, which undoubtedly influenced their initial competency levels. Among the teachers selected as candidate facilitators, 56.5% were certified, while 43.5% were not yet certified.

3. Result and Discussion

The results of this study demonstrate that blended-based training substantially improved teachers' competence in designing Deep Learning lesson plans, conducting peer teaching, and understanding Deep Learning materials. However, the magnitude and pattern of improvement varied across the three competency dimensions. Rather than merely indicating statistical improvement, the findings suggest that blended-based training functions as a context-sensitive professional development model that combines flexible access to learning materials with direct practice, mentoring, and feedback. This is particularly important in hinterland areas, where geographical barriers often limit teachers' opportunities to participate in conventional face-to-face training (Moser & Wei, 2023).

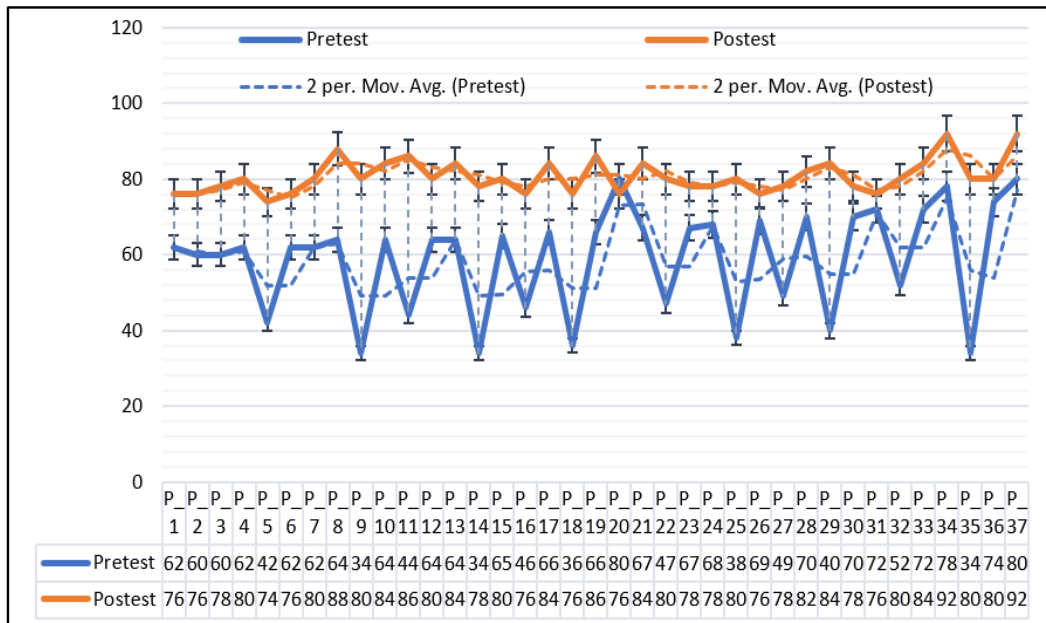


Figure 2. Pretest and Poster Scores for Learning Plan Design Skills

Figure 2 illustrates the changes in teachers' competencies in designing Deep Learning lesson plans before and after participating in blended-based training in the hinterland areas of Riau Islands Province. The figure demonstrates a substantial improvement in teachers' performance following the implementation of the training program.

Before the training intervention, the pretest scores were predominantly categorized as low to moderate. Most participants obtained scores below 60, and several teachers achieved scores ranging between 30 and 40. These findings indicate that teachers initially lacked adequate competency in designing instructional plans aligned with Deep Learning principles. The low performance reflects teachers' difficulties in developing learning designs that promote meaningful learning, critical thinking, student-centered instruction, and contextual problem-solving activities (Flores et al., 2015; Hanno, 2020). Furthermore, many teachers were not yet capable of integrating reflective, exploratory, and collaborative learning activities into their instructional planning.

This condition is consistent with the preliminary findings of the study, which revealed that teachers in hinterland regions experienced limited access to sustainable professional development programs. Geographical barriers, limited educational infrastructure, and insufficient academic mentoring contributed to the persistence of conventional teacher-centered instructional approaches (Hu et al., 2023). Consequently, many teachers were unable to develop innovative and progressive lesson plans that aligned with the current national educational transformation agenda.

Following participation in the blended-based training, the posttest results showed a significant and consistent increase across nearly all participants. Most teachers achieved scores above 80, while several participants reached scores close to 100. This improvement demonstrates that blended-based training effectively enhanced teachers' competencies in designing systematic, adaptive, and contextualized lesson plans. Teachers became more capable of integrating Deep Learning principles into instructional planning, including inquiry-based learning,

collaborative learning, reflective learning, and authentic assessment practices (Chang, 2025).

The improvement further indicates that blended-based training not only strengthened teachers' theoretical understanding but also improved their practical ability to design relevant instructional activities suited to the socio-cultural characteristics of students in hinterland regions. The integration of online and face-to-face learning environments provided flexibility for teachers to study learning materials independently while simultaneously receiving direct guidance from facilitators (Kamila & Agus, 2023). Compared with conventional LMS-based training models, this approach enabled teachers to gain deeper and more meaningful understanding of curriculum implementation.

From a pedagogical perspective, the improvement in lesson planning competency reflects a transformation from traditional instructional paradigms toward progressive and innovative educational practices. Teachers gradually shifted from focusing solely on knowledge transmission to facilitating active student engagement in knowledge construction processes (Sawyer et al., 2022). This transformation is essential within the implementation of Deep Learning because effective lesson planning serves as

the foundation for creating meaningful, mindful, and joyful learning experiences.

In addition, the findings in Figure 2 demonstrate that blended-based training contributed significantly to the enhancement of teachers' educational literacy and digital pedagogical literacy. Throughout the training process, teachers were not only trained to develop instructional plans but were also introduced to various learning technologies that support instructional innovation (Dewi, 2021). Therefore, blended training can be considered an effective professional development model for strengthening innovative learning practices in geographically disadvantaged educational contexts.

Overall, Figure 2 provides empirical evidence that blended-based training significantly improves teachers' competencies in designing Deep Learning-oriented instructional plans. These findings reinforce the argument that adaptive, flexible, and technology-supported training models have strong potential to support progressive educational transformation in remote areas of Indonesia.

Descriptively, teacher competency in the hinterland region improved following the blended training. Additionally, the results of measuring teacher competency in teaching are presented in the figure below.

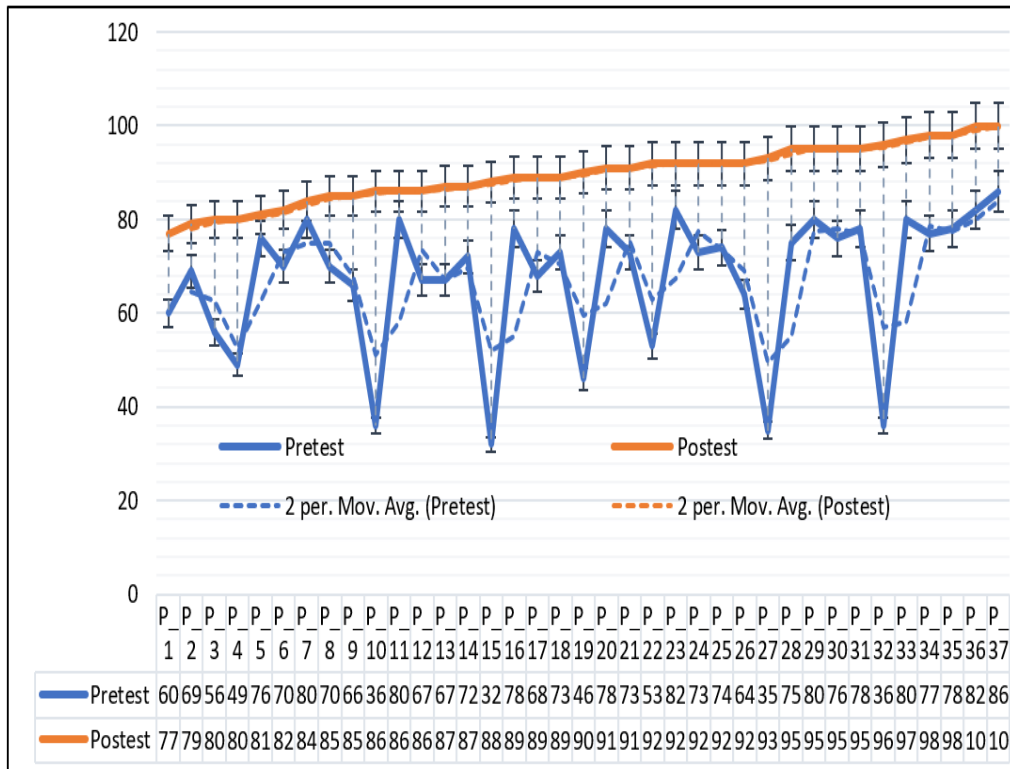


Figure 3. Teaching Skills Pretest and Poster Scores

Figure 3 presents the changes in teachers' teaching practice competencies before and after participating in blended-based training. The figure clearly demonstrates a substantial improvement in teachers' instructional performance following the implementation of the training program.

During the pretest stage, teachers' teaching competencies were generally categorized as low. Most participants obtained scores below 40, while several others achieved scores between 50 and 60. These findings indicate that teachers initially lacked the ability to effectively implement Deep Learning practices in classroom settings. According to [Sasmoko et al. \(2020\)](#), the low teaching practice scores suggest that teachers experienced difficulties in creating interactive learning environments, facilitating collaborative discussions, encouraging student engagement, and integrating reflective learning activities into classroom instruction.

Moreover, classroom instruction prior to the training remained largely dominated by teacher-centered approaches and one-way communication methods. Teachers primarily functioned as knowledge transmitters, while students had limited opportunities to actively explore concepts, think critically, or construct knowledge independently ([Hindaryatiningsih et al., 2025](#)). This condition indicates that the implementation of innovative learning practices in hinterland regions still faces substantial challenges, particularly concerning teachers' pedagogical readiness to implement twenty-first-century learning approaches.

After participating in blended-based training, the posttest results showed a highly significant improvement across nearly all participants. Most teachers achieved scores above 80, and several participants reached the maximum score. These findings confirm that blended-based training successfully enhanced teachers' competencies in implementing

Deep Learning practices in more effective and innovative ways. Teachers became more capable of applying student-centered, collaborative, and reflective instructional strategies in classroom settings (Salite et al., 2025).

The improvement in teaching skills demonstrates that blended-based training effectively bridged the gap between theoretical understanding and practical classroom implementation. Through the integration of online and offline learning sessions, teachers were provided with opportunities to study modern pedagogical concepts flexibly while simultaneously engaging in peer teaching simulations and direct instructional practice (Pohan et al., 2021). This approach enabled participants to receive continuous feedback from facilitators and peers, thereby optimizing the professional learning process.

From the perspective of advanced education and learning, the enhancement of teachers' instructional competencies reflects a pedagogical transformation toward more progressive and adaptive educational practices. Teachers no longer focused solely on content delivery but gradually adopted the role of learning facilitators who actively support meaningful and participatory learning environments (Jerry & Yunus, 2021). This transformation is highly important for fostering higher-order thinking skills, problem-solving abilities, communication skills, and collaborative learning competencies among students.

Furthermore, blended-based training contributed significantly to teachers' abilities to integrate learning technology into classroom instruction. Throughout the

training process, teachers became familiar with digital learning media, online learning platforms, and various electronic educational resources (Zheng et al., 2022). These experiences strengthened teachers' digital literacy and improved their readiness to implement technology-enhanced learning practices within their respective schools.

The findings presented in Figure 3 also indicate that blended-based training possesses strong potential as a professional development model for teachers in remote and geographically isolated regions. The flexibility of the training program enabled teachers to participate in competency development activities without leaving their teaching responsibilities for extended periods (Ramadhan et al., 2025). Therefore, blended-based training not only improves teachers' pedagogical quality but also supports equitable access to high-quality professional development opportunities in hinterland educational contexts.

Overall, Figure 3 demonstrates that blended-based training has a significant positive impact on teachers' teaching practice competencies. These findings strengthen the argument that the integration of innovative learning, learning technology, and progressive education through blended training represents an effective strategy for supporting educational transformation in remote areas of Indonesia.

Descriptively, teacher competency in the hinterland region improved following the blended-based training. Additionally, the results of the measurement of teachers' pedagogical competency are presented in the figure below.

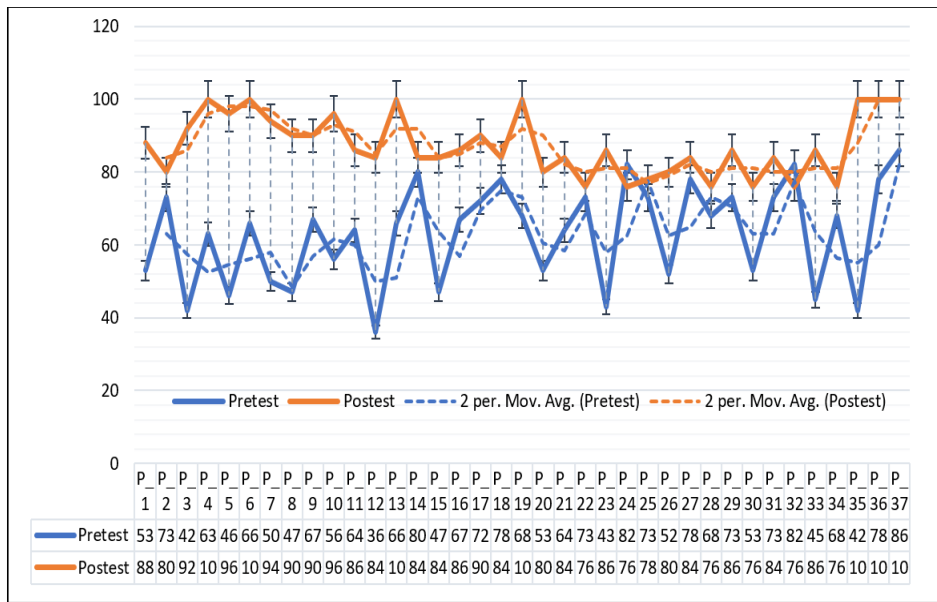


Figure 4. Pretest and Posttest Scores of Teachers' Pedagogical Skills

Figure 4 above shows the difference in pre- and post-test scores for measuring teachers' pedagogical skills in understanding the implementation of in-depth learning. The blue curve in the figure illustrates that pretest scores were predominantly below 40 and even below 30. The curve in this diagram illustrates that teachers' pedagogical skills in understanding the implementation of in-depth learning are still low. After teachers participated in blended training, the orange curve above experienced a significant increase compared to the blue curve. The orange curve shows that the scores of the training participants were above 80 and reached 100. Descriptively, teachers' pedagogical competence in the hinterland region increased after they participated in blended training (Huang et al., 2021).

The data for this paired sample t-test comprised the average pre-test and post-test scores for teacher competency in designing

Deep Learning plans, peer teaching, and understanding of training materials. This test aimed to determine whether there was a significant difference between the averages of the two paired samples (two groups), specifically the pre-test and post-test scores (Yu, 2017). Additionally, to assess whether blended-based teacher training in the hinterland area enhanced teacher competency, a paired sample test was conducted, which included paired sample statistics, paired sample correlation, and a paired sample t-test.

a. Paired Sample Statistics Test

The paired sample statistical test aims to compare two related samples, specifically the same sample measured at two different times or under varying conditions. This test was employed to assess whether a significant difference exists between the two measurements. The table below displays the results of the paired-sample statistical test.

Table 2. The Result of Paired Sample Statistics

Variables	Mean	N	Std. Deviation	Std. Error Mean
Variable Y1	Pre-Test	67.4054	37	5.15568
	Pos-Test	80.5405	37	4.41333
Variable Y2	Pre-Test	73.6486	37	6.18787
	Pos-Test	89.5676	37	6.08066

Variables		Mean	N	Std. Deviation	Std. Error Mean
Variable Y3	Pre-Test	72.5676	37	5.69376	.93605
	Pos-Test	86.3784	37	7.70047	1.26595

The table 2 presents the results of paired sample statistical tests involving three dependent variables (Y) measured from pre-test and post-test results. For variable Y1, there was an increase in teacher competency in designing Deep Learning plans after participating in blended-based training. The average competency value rose from 67.4054 before the training to 80.5405 afterward. Similarly, for variable Y2, teacher competency in peer teaching, aligned with the concept of implementing Deep Learning, also improved. The average competency value increased from 73.6486 before the training to 89.5676 after. The same output was observed for variable Y3, where teacher competency in understanding the Deep Learning training material increased from a pretest value of 72.5676 to 86.3784. The implementation of blended-based training has the potential to enhance teacher competency across all research variables, serving as a facilitator for implementing Deep Learning in hinterland areas (Barni et al., 2019).

A cross-dimensional comparison indicates that the improvement was not identical across the three competency dimensions. The largest increase occurred in peer teaching competence (Y2), with a mean gain of 15.92 points, followed by understanding of Deep Learning training materials (Y3), with a gain of 13.81 points, and lesson plan design competence (Y1), with a gain of 13.14 points. This pattern suggests that blended-based training was particularly effective in strengthening practice-based pedagogical competence. The stronger improvement in Y2 may be explained by the structure of the training,

which combined online preparation with offline teaching practice, peer interaction, and facilitator feedback. In contrast, the relatively smaller improvement in Y1 and the greater variation in Y3 indicate that designing Deep Learning lesson plans and mastering conceptual training materials may require more sustained guidance, structured scaffolding, and follow-up mentoring. The largest improvement occurred in peer teaching competence, suggesting that blended-based training was particularly effective in strengthening practice-based pedagogical competence (Xu et al., 2025).

b. Paired Sample Correlation

Paired-sample correlations aim to assess the connection between two related variables within the same group. This type of analysis is employed to ascertain if there is a meaningful correlation between two measurements taken from the same sample. Specifically, it examines the outcomes of pre-test and post-test evaluations of variable Y1, which is teacher competence in designing Deep Learning lesson plans; variable Y2, which is teacher competence in peer teaching; and variable Y3, which is teacher pedagogical competence in understanding the Deep Learning materials in the hinterland area (Shurygin et al., 2021). The findings from this paired-sample correlation analysis provide researchers with insights into the relationship between these variables, enabling them to make well-informed decisions. The table below displays the results of the paired-sample correlation tests.

Table 3. The Result of Paired Sample Correlations

	Variables	N	Correlation	Sig.
Variable Y1	Teacher Competence in Designing of Deep Learning Plans	37	.337	.042
Variable Y2	Teacher Competence on Peer Teaching Based on Deep Learning	37	.710	.000
Variable Y3	Teacher Competence in Understanding of Training Materials	37	.079	.644

The paired sample correlation results show different patterns across the three competency dimensions. For lesson plan design competence (Y1), the correlation between pretest and posttest scores was statistically significant but relatively low-to-moderate ($r=0.337$, $p=0.042$). This indicates that teachers' initial ability in designing deep learning plans was associated with their post-training performance, although the relationship was not strong. For peer teaching competence (Y2), the correlation was strong and significant ($r=0.710$, $p<0.001$), suggesting that teachers with higher initial teaching practice competence tended to maintain stronger performance after training. In contrast, understanding of training materials (Y3) showed a very weak and non-significant correlation ($r=0.079$, $p=0.644$), indicating that teachers' initial understanding did not strongly predict their post-training mastery.

The weak correlation in Y3 should not be interpreted as evidence that blended training was ineffective. Instead, it suggests that

teachers with different levels of initial understanding were able to improve after training. However, the higher posttest standard deviation in Y3 indicates that mastery of deep learning materials remained more varied among participants. This finding suggests that the online learning component may require stronger facilitator monitoring, clearer learning pathways, and more structured formative assessment to ensure more equal mastery across participants (Araka et al., 2021).

c. Paired Sample T-Test

The Paired Sample T-Test is designed to compare the averages of two related samples, such as the same sample measured at two different times or under varying conditions. This test was employed to assess whether there was a significant difference between two sets of measurements: the average teacher competency in the hinterland area before and after participating in blended-based training (pre-test and post-test, respectively).

Table 4. The Result of Paired Sample T-Test

Categories of Variables	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% CID				
				Lower	Upper			
Variable Y1 Designing of Lesson Plan	-13.13514	5.54358	.91136	-14.98346	-11.28681	-14.413	36	.000
Variable Y2 Peer Teaching	-15.91892	4.66892	.76757	-17.47561	-14.36222	-20.739	36	.000
Variable Y3 Understanding of Materials	-13.81081	9.21001	1.51412	-16.88158	-10.74004	-9.121	36	.000

Based on the results of the analysis, the observed p-value was 0.000, which is less than the conventional alpha level of 0.05. This indicates that the difference between the sample groups is statistically significant. Consequently, we reject the null hypothesis and conclude that the implementation of blended-based training has a measurable and positive effect on teachers' competence in designing lesson plans-specifically in their role as prospective facilitators of Deep Learning within hinterland areas.

Although all three competency dimensions showed statistically significant improvement, the magnitude of the t-values indicates different levels of training impact. Peer teaching competence (Y2) produced the strongest statistical evidence of improvement ($t = -20.739$), followed by lesson plan design (Y1; $t = -14.413$) and understanding of training materials (Y3; $t = -9.121$). This result reinforces the finding that blended-based training had the strongest effect on practical teaching competence (Philipsen et al., 2019). Therefore, the training model appears to be especially effective when teachers are given opportunities to translate Deep Learning concepts into actual teaching performance through peer teaching activities.

Blended training proves highly effective because it allows teachers to easily access training materials and efficiently engage in discussions with tutors and other participants to clarify any uncertainties. Teachers find the training material more comprehensible due to the significant flexibility blended training offers, enabling them to review content anytime and anywhere (Huang, 2019; Qothrunada & Satria, 2025). This approach also facilitates optimal results for teachers, as interaction among participants is more accessible. Previously, training using the In-On-In model based on the Learning Management System did not foster effective

communication for discussing all training materials between participants and the instructor, as communication was limited to written text within the available features.

The standard deviation values also provide important insight into the distribution of participants' competence. The posttest standard deviation for Y1 decreased from 5.16 to 4.41, indicating that teachers became more consistent in designing deep learning lesson plans after training. In Y2, the standard deviation remained relatively stable, suggesting that improvement in peer teaching occurred broadly across participants. However, Y3 showed an increase in standard deviation from 5.69 to 7.70, indicating greater variation in teachers' mastery of training materials. This suggests that while blended training improved overall understanding, some participants may still need additional scaffolding in the LMS-based learning component (Pianta et al., 2020).

This finding is important because Deep Learning facilitation does not only require teachers to understand concepts theoretically, but also to translate those concepts into classroom interaction, questioning strategies, student engagement, feedback, and reflective teaching practices. Therefore, the stronger improvement in peer teaching indicates that the blended training model successfully supported teachers in moving from conceptual understanding to pedagogical enactment (Ainun et al. 2025). In other words, the training did not merely increase teachers' knowledge about Deep Learning, but also strengthened their ability to perform Deep Learning-oriented teaching practices.

d. Effectiveness of Blended-Based Training in Teaching Practice

The effectiveness of blended-based training in enhancing teachers' teaching

practice competencies is supported by both inferential statistical analysis and descriptive visualization. The paired sample t-test results indicate a statistically significant improvement in teaching practice (Y2), with a t-value of -20.739 and a significance level of $p = 0.000 (< 0.05)$, confirming that the training intervention had a measurable and positive impact on teachers' instructional performance.

The effectiveness of blended-based training can be explained by its integration of flexibility, interaction, practice, and feedback (Müller & Mildenerger, 2021). The online component enabled teachers in hinterland areas to access learning materials without being constrained by distance, transportation, or time. However, access to materials alone is insufficient for developing deep learning facilitation competence. The offline component complemented online learning by providing opportunities for direct mentoring, peer teaching, collaborative reflection, and immediate feedback. This combination created a professional learning cycle in which teachers could prepare, practice, receive feedback, and revise their pedagogical strategies (Primus, 2024).

This mechanism is particularly relevant for hinterland contexts, where teachers often face limited access to continuous professional development. Blended-based training does not merely reduce geographical barriers, it also preserves the pedagogical value of direct interaction (Tricahyati & Zaim, 2023). Therefore, its effectiveness lies not simply in combining online and offline modes, but in aligning training delivery with the actual constraints and learning needs of teachers in remote areas.

This statistical evidence reflects not only a quantitative increase in performance scores but also signifies a meaningful transformation

in teachers' instructional behaviors and classroom practices. In particular, the blended-based training model appears to facilitate a more integrative learning experience, where teachers engage in both self-directed online learning and structured face-to-face interactions (Saputri et al., 2025). This dual modality enables participants to internalize pedagogical concepts more effectively while simultaneously applying them in practical teaching scenarios (Chunhui Li & Wen, 2023). Such an approach is consistent with contemporary educational theories that emphasize experiential and reflective learning as key drivers of professional competency development.

Moreover, the observed improvement suggests that blended training addresses several limitations commonly associated with traditional training models, particularly in remote and hinterland contexts. By providing flexible access to learning materials and opportunities for continuous interaction with facilitators and peers, the model enhances both cognitive understanding and practical skill acquisition (Elhanashi et al., 2023). This is especially important for teaching practice competencies, which require not only theoretical knowledge but also the ability to adapt instructional strategies to diverse classroom situations.

To further substantiate these findings, a graphical representation is provided to illustrate the magnitude of improvement across key instructional indicators. The visualization complements the statistical results by offering a clearer and more intuitive depiction of performance gains across different dimensions of teaching practice, thereby strengthening the overall validity and interpretability of the research findings.

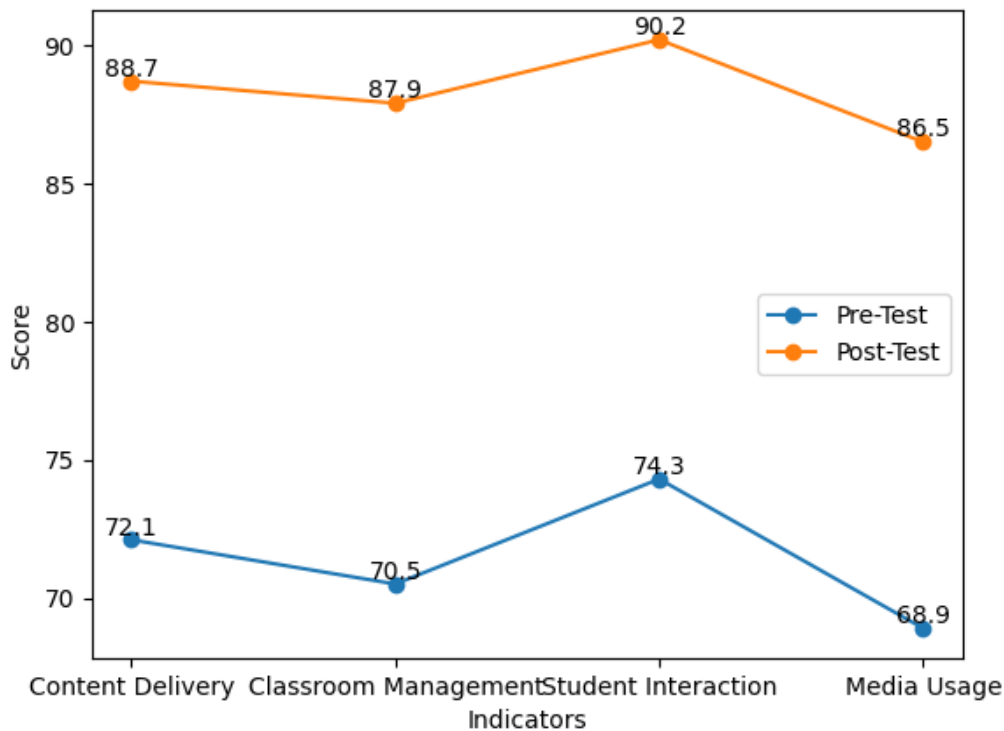


Figure 5. Improvement in Teaching Practice Competency (with Dat)

Figure 5 demonstrates a consistent and substantial improvement across all teaching competency indicators following the implementation of blended-based training. Each data point is labeled explicitly, allowing precise interpretation of performance gains.

The most prominent increase is observed in *media usage*, which rose from 68.9 to 86.5. This finding suggests that blended-based training effectively enhances teachers' digital pedagogical literacy, technology integration competencies, and innovative instructional practices within student-centered learning environments. This aligns with prior studies emphasizing that blended learning environments significantly contribute to the development of digital literacy and instructional innovation (Kintu et al., 2017; Smith & Hill, 2018).

Similarly, *classroom management* improved from 70.5 to 87.9, indicating that teachers developed more structured and adaptive strategies for facilitating student-centered learning. This is consistent with

findings from Borup et al. (2019) and Berga et al. (2021), which highlight that blended learning promotes more effective classroom interaction and instructional control.

The increase in *student interaction* (74.3 to 90.2) further confirms that teachers became more capable of fostering active engagement and collaborative learning environments. This reflects the principles of Deep Learning and progressive education, which emphasize meaningful interaction, reflective inquiry, collaborative knowledge construction, and critical thinking (Cai et al., 2025; Zhong, 2021).

Additionally, the relatively uniform improvement across all indicators indicates that blended-based training not only raises the average competency level but also contributes to reducing performance disparities among participants. This finding supports previous research demonstrating that blended learning provides equitable learning opportunities and improves overall instructional quality (Pohan et al., 2021).

Overall, the integration of statistical and visual evidence confirms that blended-based training is highly effective in improving practical teaching competencies, particularly in geographically disadvantaged areas.

e. Implications for Remote Education Delivery

The implementation of blended-based training presents significant implications for educational delivery in remote and hinterland regions. By integrating online and face-to-face learning modalities, this approach addresses structural barriers such as

geographical isolation, limited infrastructure, and restricted access to professional development programs.

One of the most critical implications is the enhancement of accessibility and inclusivity. Teachers in remote areas can participate in training without the need for extensive travel, thereby reducing logistical constraints and financial burdens. This finding aligns with previous research highlighting that blended learning improves access and flexibility in educational settings (Xu et al., 2020; Huang et al., 2021).

Table 5. Impact of Blended Training on Educational Access in Remote Areas

Aspect	Before Blended Training	After Blended Training	Strategic Impact
Training Access	Limited to specific locations	Flexible (online + offline)	Equitable access to professional development
Participation Cost	High (transportation & accommodation)	Lower	Cost efficiency in training programs
Training Frequency	Occasional	Continuous and scalable	Sustainable professional development
Professional Interaction	Limited (face-to-face only)	Hybrid (synchronous & asynchronous)	Cross-regional collaboration

Table 5 illustrates a substantial transformation in training accessibility following the adoption of blended-based training. The shift from geographically constrained access to flexible participation represents a critical advancement in addressing educational disparities in remote regions.

The reduction in participation costs is particularly important, as it enables broader teacher involvement in professional development programs. This supports scalability and aligns with findings from Ashraf et al. (2022) and Kachole & Upadhyay (2025), which emphasize the cost-effectiveness of blended learning models.

Furthermore, the transition from occasional to continuous training reflects a paradigm shift toward sustainable professional development. Teachers are no longer limited to one-time training sessions but can engage in ongoing learning cycles, which are essential for adapting to evolving curriculum demands (Hindaryatiningsih et al., 2025).

The enhancement of professional interaction through hybrid communication channels also fosters collaborative learning ecosystems. Teachers can exchange knowledge, share best practices, and receive feedback across geographical boundaries, thereby improving instructional quality and innovation.

Table 6. Pedagogical Implications of Blended Training in Remote Education

Dimension	Before Implementation	After Implementation	Educational Implication
Pedagogical Skills	Teacher-centered approach	Student-centered & reflective	Improved instructional quality
Lesson Planning	Less structured	Systematic & contextual	More relevant learning design
Digital Literacy	Low	Significantly improved	Technology integration in teaching
Student Engagement	Passive learning	Interactive & participatory	Enhanced learning outcomes

Table 6 highlights that the implications of blended-based training extend beyond accessibility and operational efficiency, influencing the core pedagogical dimensions of teaching practices. The transition from teacher-centered to student-centered approaches indicates the adoption of constructivist learning principles, where students actively engage in knowledge construction (Zhong, 2021; Huberman et al., 2014).

The improvement in lesson planning demonstrates that teachers are better equipped to design structured and contextually relevant learning experiences. This aligns with Cahyana et al. (2023), who emphasize that effective lesson planning is a key indicator of pedagogical competence.

Additionally, the significant increase in digital literacy underscores the role of blended training in preparing teachers for technology-enhanced education. This is consistent with findings from Kintu et al. (2017) and Smith & Hill (2018), which highlight the importance of digital competencies in modern educational practices.

Finally, the increase in student engagement reflects the downstream impact of improved teacher competency. As teachers adopt more interactive and participatory approaches, students become more actively involved in the learning process, leading to improved learning outcomes and deeper understanding.

In summary, blended-based training serves as a transformative mechanism that enhances not only teacher competency but also the overall educational ecosystem in remote areas, making it a strategic solution for achieving equitable and sustainable education development.

4. Conclusion

This study provides compelling empirical evidence that blended-based training is a highly effective model for advancing teacher competency, promoting innovative and technology-enhanced learning practices, and supporting progressive educational transformation in Indonesia's hinterland regions. It strengthens teachers' capacity to design comprehensive lesson plans, refine pedagogical skills, and implement Deep Learning strategies in challenging contexts. This study also makes a significant contribution to the literature on teacher professional development in Indonesia by demonstrating the effectiveness of blended-based training in enhancing teacher competency in hinterland regions. The study's findings provide empirical evidence that context-sensitive training models can improve teacher capacity to design comprehensive lesson plans, refine pedagogical skills, and implement Deep Learning strategies in challenging contexts. The study's unique contribution lies in its focus on the Indonesian context, where geographical and socio-economic disparities often hinder access to quality education. The study's results have practical

implications for national and local education authorities, highlighting the need for adaptive, region-specific solutions to address the unique challenges faced by teachers in hinterland regions.

While the research was limited by time and resource constraints, it opens a clear path forward for future studies should focus on developing localized learning instruments and culturally responsive teaching materials tailored to the unique needs of hinterland students. With continued innovation and strategic investment, blended-based training can become a strategic foundation for equitable, technology-supported, and sustainable advanced education across Indonesia's diverse educational landscapes.

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