

Deep Learning in Vocational Education: A Quantitative Study of Teachers' Readiness and Implementation Challenges in Lampung, Indonesia

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ABSTRACT

This study aims to examine the readiness of vocational school teachers in Lampung to implement deep learning pedagogy and to identify the challenges they face in the process. A quantitative descriptive survey design was employed, with data collected from 1,000 public vocational school teachers using a structured questionnaire distributed via Google Forms, and analyzed through descriptive statistics in Microsoft Excel. The findings indicate that teachers demonstrated medium-to-high readiness, with strong results in access to technology (79%), digital competence (75%), integration and implementation (78%), and innovation and evaluation (77%), while collaboration and professional development were relatively weaker (71%), signaling the need for enhanced peer learning and sustained training. The novelty of this study lies in being among the first to map teacher readiness for deep learning pedagogy in vocational education, offering empirical evidence from a large-scale sample. The results have practical implications for policymakers and school leaders to strengthen digital infrastructure, expand professional development programs, and foster collaborative practices that support sustainable adoption of deep learning. Overall, this study contributes to the global literature by confirming teacher readiness as a decisive factor for the successful implementation of deep learning pedagogy and provides context-specific insights to inform future policy and practice in vocational education.

Keywords

Deep Learning Pedagogy
Digital Competence
Educational Innovation
Teacher Readiness
Vocational Education

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Introduction

Deep learning pedagogy has gained significant attention in recent years as a transformative approach to foster students' critical thinking, creativity, collaboration, and problem-solving skills, competencies that are indispensable in the 21st century and in the era of Society 5.0 [1]–[3]. In vocational education, where the primary mandate is to equip learners with practical skills and adaptive capacities for the labor market, the adoption of deep learning is particularly crucial [4]. A growing body of international literature has documented the potential of deep learning-oriented instruction to enhance not only academic achievement but also the employability and entrepreneurial mindset of vocational school graduates [5]–[7]. These insights highlight the importance of teachers' readiness to implement this pedagogical shift in classroom practice.

Despite its acknowledged importance, the extent to which teachers, particularly in vocational schools, are prepared to adopt and implement deep learning pedagogy remains underexplored. Most existing studies tend to focus on general teacher readiness for digital or technology-enhanced learning, leaving a knowledge gap in understanding the specific preparedness for deep learning pedagogy. Moreover, empirical evidence regarding the contextual challenges teachers face, ranging from limited infrastructure and professional development to cultural resistance toward student-centered learning, has not been sufficiently examined, especially in emerging economies such as Indonesia. This lack of comprehensive mapping of readiness and implementation barriers creates uncertainty about the actual feasibility of embedding deep learning pedagogy in vocational classrooms [8].

In Indonesia, vocational education has been positioned as a strategic sector to accelerate human capital development and economic competitiveness [9]–[11]. Policies encourage the integration of student-centered, deep learning approaches supported by digital innovation [12]–[14]. However, the reality on the ground often reveals a misalignment between policy aspirations and classroom practices, particularly in regions outside major urban centers [15],[16]. Lampung Province, with its diverse vocational schools and significant contribution to the local workforce, provides a critical case for examining this issue. Understanding teachers' readiness and the challenges they encounter in implementing deep learning pedagogy is therefore essential to bridge the gap between national policy and school-

level practice, as well as to provide evidence-based recommendations for strengthening vocational education.

The successful implementation of deep learning pedagogy in vocational education is highly dependent on teachers' readiness to adopt new instructional paradigms [17]. Teachers serve as the primary agents of change in integrating critical thinking, collaboration, and problem-solving skills into classroom practice [18]–[20]. However, many vocational school teachers still encounter difficulties in aligning their teaching strategies with the principles of deep learning [21]. Limitations in technological integration, inadequate exposure to student-centered approaches, and challenges in designing authentic assessments often hinder the optimal adoption of deep learning pedagogy [22]–[24]. These conditions suggest that the level of teachers' readiness is uneven and requires systematic investigation.

In the context of vocational schools in Lampung, Indonesia, this issue becomes particularly significant. Lampung is one of the provinces with a relatively large number of vocational schools, yet empirical evidence on how well teachers are prepared to implement deep learning pedagogy remains scarce. Moreover, the specific challenges faced by teachers in applying this approach, ranging from infrastructure limitations to pedagogical competence, have not been sufficiently documented [25]. Without a clear understanding of both readiness levels and implementation challenges, efforts to strengthen vocational education through deep learning remain fragmented [26]. Therefore, mapping teachers' readiness while identifying barriers to implementation is crucial for informing policy directions, professional development programs, and future curriculum reforms.

Teachers' readiness has been widely recognized as a decisive factor in the successful implementation of innovative pedagogical approaches, including deep learning pedagogy. In the context of vocational education, where the primary goal is to equip students with competencies relevant to the demands of the twenty-first century workforce, teachers' ability to adopt and integrate deep learning strategies becomes crucial [27]. However, despite the global emphasis on student-centered learning and the increasing call for critical thinking, problem-solving, and collaborative skills, empirical evidence on how ready teachers are to implement such approaches remains limited in developing countries, particularly within the vocational education sector.

This study aims to examine the readiness of vocational school teachers in Lampung, Indonesia, to implement deep learning pedagogy and to identify the challenges they encounter in practice. By employing a quantitative survey distributed to a wide range of teachers, the research provides a comprehensive mapping of their preparedness levels as well as the barriers hindering effective adoption. The findings are expected to generate insights that not only enrich the literature on deep learning in vocational contexts but also inform policymakers

and stakeholders in designing targeted professional development programs that bridge the gap between policy aspirations and classroom realities.

Although international research has increasingly explored teachers' readiness for 21st-century learning, limited attention has been given to deep learning pedagogy within vocational education contexts. Most existing studies emphasize digital readiness or blended learning adoption, overlooking the more complex pedagogical shift required in deep learning approaches. In Indonesia, research has primarily focused on general secondary education, leaving vocational schools underexplored despite their strategic role in workforce preparation. Furthermore, studies rarely integrate both readiness assessment and the identification of implementation challenges, resulting in fragmented insights. In particular, there is a lack of quantitative evidence mapping vocational teachers' preparedness to adopt deep learning pedagogy in specific regional contexts. Lampung Province, with its large and diverse network of vocational schools, provides a critical case to address this gap. Therefore, a systematic investigation of teachers' readiness and the challenges they face in implementing deep learning pedagogy is essential to enrich the literature and inform practical policy directions.

This study provides a novel contribution by simultaneously examining teachers' readiness and the challenges they encounter in implementing deep learning pedagogy within vocational education. While previous research has predominantly explored digital readiness or general pedagogical competencies, few have specifically addressed the multidimensional aspects of deep learning in the context of vocational schools in developing countries. The investigation of vocational teachers in Lampung, Indonesia, adds contextual depth to the global discourse on deep learning implementation in secondary-level vocational education. By adopting a quantitative survey, this research generates empirical evidence that captures both the preparedness of teachers and the structural barriers that impede effective adoption. Such insights not only enrich the theoretical understanding of deep learning pedagogy but also offer practical directions for policy design and teacher training programs. The study's findings are expected to inform stakeholders about the alignment between educational policies and classroom realities in vocational settings. Ultimately, this research justifies its significance by bridging a critical gap in the literature while providing actionable implications for strengthening vocational education in Indonesia and beyond.

Understanding the readiness of teachers to implement deep learning pedagogy is crucial in ensuring the success of educational transformation in vocational schools. Despite increasing attention to 21st-century learning, limited empirical evidence exists regarding teachers' preparedness and the challenges they encounter, particularly in the context of Indonesian vocational education. This study focuses on mapping the readiness of vocational school teachers in Lampung, Indonesia, to adopt deep learning approaches in their classrooms.

In addition, it explores the key challenges teachers face in translating deep learning pedagogy into practical teaching strategies. Accordingly, this research seeks to answer two central questions: (1) What is the descriptive level of vocational school teachers' readiness in Lampung Province to implement deep learning pedagogy, and (2) What are the dominant challenges faced by vocational school teachers in Lampung Province in implementing deep learning pedagogy?

Material and Methods

This study adopted a quantitative descriptive survey design to investigate teachers' readiness and the challenges they encountered in implementing deep learning pedagogy in vocational education. This design was considered appropriate because it allowed the researchers to collect numerical data that could be systematically analyzed. By employing a survey approach, the study was able to capture a broad range of teachers' perceptions and experiences across different contexts. The descriptive nature of the design further enabled the identification of patterns and trends related to teachers' preparedness and the obstacles they face. In addition, the use of statistical descriptions helped provide an objective picture of the current state of readiness among vocational school teachers. Such an approach has been widely recognized in educational research as effective for examining numerical data and providing statistical descriptions of teachers' perceptions [28]–[30].

The research was conducted in Lampung Province, Indonesia, which is known for having a wide distribution of vocational high schools (SMK) across urban and rural areas. The educational landscape in this province reflects diverse socio-economic backgrounds, making it a relevant context for investigating vocational education. The study population comprised all teachers working in public and private vocational schools throughout the region. From this broad population, the research specifically selected teachers from public vocational schools (SMK Negeri) as the main sample. The choice was based on their accessibility, availability of structured data, and the relatively larger number of teachers compared to private schools. In addition, SMK Negeri was considered more representative in reflecting the implementation and challenges of vocational education practices at the provincial level.

The study was carried out in several steps. First, a structured questionnaire was developed and formatted into an online survey using Google Forms. Second, the survey link was distributed to vocational school teachers through teacher forums, professional groups, and institutional networks across Lampung Province. Third, responses were collected within a specified timeframe, after which the data were downloaded and prepared for analysis.

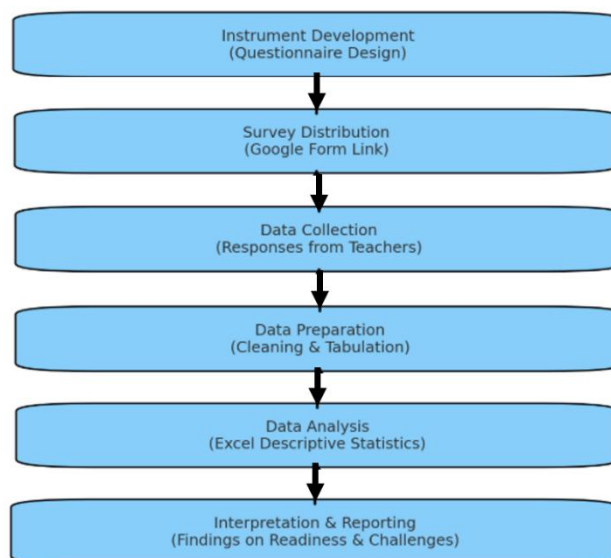


Fig. 1. Research Procedure Flowchart

Data were collected using a questionnaire consisting of closed-ended items measured on a five-point Likert scale ranging from “strongly disagree” to “strongly agree” [31],[32]. The questionnaire was designed to capture two main aspects: (1) teachers’ readiness for deep learning pedagogy, including access to technology, pedagogical knowledge, and classroom application, and (2) the challenges encountered in its implementation.

Table 1 shows that the instrument met acceptable standards of validity and reliability. Content validity was confirmed through expert judgment, empirical validity through item-total correlation, and reliability through Cronbach’s alpha above 0.70, indicating consistent and appropriate measurement of the intended constructs.

Table 1. Instrument Validity and Reliability Summary

Aspect	Method Used	Result Summary	Interpretation
Content Validity	Expert judgment	Specialists in vocational education and educational technology reviewed items	Questionnaire items were aligned with the constructs of teacher readiness and implementation challenges.
Empirical Validity	Item-total correlation	All items exceeded the minimum acceptable correlation threshold	All questionnaire items were valid indicators of the intended constructs.
Reliability	Cronbach’s alpha	The alpha coefficient exceeded 0.70	The instrument demonstrated satisfactory internal consistency and reliable measurement.

The collected responses were tabulated and analyzed using Microsoft Excel [33]. The analysis involved descriptive statistics, including frequency distributions, percentages, means, standard deviations, categorization/level, indicator analysis, and instrument validity & reliability testing, to describe the level of readiness and identify dominant challenges [34]. The

results were then interpreted to highlight patterns of teachers' readiness and the barriers to implementing deep learning pedagogy in vocational education (Table 2).

Table 2. Readiness Level Classification Framework

Category	Criterion	Description
Low Readiness	Scores below the normative threshold based on mean and standard deviation	Teachers show insufficient preparedness to implement deep learning pedagogy.
Moderate Readiness	Scores within the normative middle range	Teachers demonstrate adequate but uneven preparedness across indicators.
High Readiness	Scores above the normative threshold based on mean and standard deviation	Teachers demonstrate strong preparedness to implement deep learning pedagogy effectively.

Results

The descriptive analysis revealed that the majority of respondents were female teachers (59%), predominantly aged between 30 and 40 years (46%), and most held a bachelor's degree (90%) with substantial teaching experience, where more than one-third had over 14 years of service. Table 3 presents the demographic profile of respondents. Most participants were female teachers, aged 30–40 years, and held a bachelor's degree. In addition, more than one-third had over 14 years of teaching experience, indicating a sample dominated by academically qualified and experienced teachers.

Table 3. Demographic Characteristics of Respondents

Variable	Category	Percentage (%)	Interpretation
Gender	Female	59	The majority of respondents were female teachers.
Age	30–40 years	46	Most respondents were in the productive mid-career age group.
Educational Qualification	Bachelor's Degree	90	Nearly all respondents held an undergraduate degree.
Teaching Experience	More than 14 years	More than one-third	A substantial proportion of teachers had long teaching experience.

Regarding readiness indicators (Table 4), teachers reported strong access to technology and institutional support, with an average score of 79%, indicating that most had adequate access to digital devices and reliable internet connections. Teachers' digital competence was also categorized as strong, with a mean score of 75%, reflecting their ability to utilize software and applications that support deep learning pedagogy. In terms of integration and implementation, the results showed a readiness level of 78%, suggesting that teachers were confident in embedding deep learning strategies into classroom practices. However, the dimension of collaboration and professional development was relatively lower, at 71%, highlighting the need for stronger peer collaboration and sustained professional training. Innovation and evaluation of learning processes scored 77%, confirming that

teachers demonstrated creativity and reflective practices in designing and assessing deep learning activities.

Table 4. Ranking of Readiness Indicators

Rank	Indicator	Score (%)	Main Finding	Interpretation
1	Access to Technology	79	Highest scoring indicator, reflecting strong technological support.	Teachers generally have sufficient access to digital devices and internet connectivity.
2	Integration and Implementation	78	Teachers show strong ability to apply deep learning pedagogy in practice.	Teachers are confident in integrating deep learning strategies into classroom instruction.
3	Innovation and Evaluation	77	Teachers demonstrate capacity for creativity and reflective assessment.	Teachers are able to design innovative learning activities and apply reflective assessment practices.
4	Digital Competence	75	Teachers possess relatively strong digital literacy skills.	Teachers are able to use digital tools and applications effectively.
5	Collaboration and Professional Development	71	Lowest scoring indicator, indicating the main area requiring improvement.	Opportunities for peer collaboration, professional learning communities, and continuous training remain limited.

The overall descriptive statistics ($M = 56.78$; $SD = 9.55$) indicated that the readiness of vocational school teachers in Lampung to adopt deep learning pedagogy fell within the medium-to-high category, suggesting a generally positive outlook for its broader implementation. See Table 5.

Table 5. Overall Readiness Level of Vocational School Teachers in Lampung

Variable	Mean (M)	Standard Deviation (SD)	Readiness Category	Interpretation
Overall Teacher Readiness for Deep Learning Pedagogy	56.78	9.55	Moderate-to-High	Most teachers demonstrate adequate preparedness to implement deep learning pedagogy, although score dispersion indicates variability across respondents.

Discussions

The findings of this study indicate that vocational school teachers in Lampung demonstrate a medium-to-high level of readiness to implement deep learning pedagogy, with particularly strong outcomes in access to technology, digital competence, and the ability to integrate deep learning into classroom practices. These results are consistent with theoretical perspectives on deep learning pedagogy, which emphasize the critical role of teacher readiness in ensuring the success of student-centered and technology-driven learning approaches [35],[36]. Similar studies in emerging contexts have also highlighted that adequate infrastructure and digital literacy are fundamental enablers for the adoption of deep learning

strategies [37],[38]. The relatively high readiness observed among Lampung teachers reflects broader regional trends where teachers are increasingly adapting to the demands of 21st-century competencies, particularly in vocational education settings that require close alignment with workplace skills [39],[40]. However, the comparatively lower score on collaboration and professional development suggests that structural and cultural factors still constrain collective practices among teachers, echoing findings from other studies in Southeast Asia that emphasize the need for ongoing peer support and professional learning communities [41],[42].

To provide a clearer interpretation of the descriptive statistics, teachers' readiness scores were further categorized into readiness levels. The categorization was based on the distribution of total scores obtained from the Likert-scale questionnaire, using a normative approach derived from the mean and standard deviation. Readiness levels were classified into three categories: low, moderate, and high readiness.

The results indicate that the overall readiness of vocational school teachers in Lampung Province falls within the moderate-to-high category ($M = 56.78$; $SD = 9.55$). This suggests that most teachers possess adequate preparedness to implement deep learning pedagogy, particularly in terms of technological access, digital competence, and instructional integration. However, the dispersion of scores also reveals variability among respondents, indicating that not all teachers experience the same level of readiness. This categorization provides a more nuanced understanding of teachers' preparedness and supports the descriptive findings by highlighting the distribution of readiness levels across the sample.

Beyond the overall readiness score, an indicator-level analysis was conducted to examine variations across specific dimensions of deep learning pedagogy implementation. The analysis focused on five key indicators: access to technology, digital competence, integration and implementation, collaboration and professional development, and innovation and evaluation.

The findings reveal that access to technology obtained the highest average score (79%), indicating that most teachers have sufficient access to digital devices and internet connectivity to support deep learning practices. Similarly, digital competence showed a strong mean score (75%), reflecting teachers' ability to utilize digital tools and applications effectively. The integration and implementation indicator also demonstrated a high level of readiness (78%), suggesting that teachers are confident in embedding deep learning strategies into classroom instruction.

In contrast, the indicator of collaboration and professional development recorded the lowest score (71%), identifying it as the most prominent challenge. This result indicates limited opportunities for peer collaboration, professional learning communities, and

continuous training related to deep learning pedagogy. Meanwhile, innovation and evaluation scored relatively high (77%), suggesting that teachers are able to design creative learning activities and apply reflective assessment practices. Overall, this indicator-level analysis highlights specific strengths and areas requiring improvement, thereby enriching the descriptive findings of the study.

To ensure the quality of the data, additional analysis was conducted to examine the validity and reliability of the questionnaire used in this study. Content validity was established through expert judgment, where the questionnaire items were reviewed by specialists in vocational education and educational technology to ensure alignment with the constructs of teacher readiness and implementation challenges in deep learning pedagogy.

For empirical validation, item validity was assessed using item-total correlation analysis. The results showed that all items had correlation coefficients exceeding the minimum acceptable threshold, indicating that each item contributed meaningfully to the measurement of the intended constructs. This confirms that the questionnaire items were valid indicators of teachers' readiness and challenges.

Instrument reliability was examined using Cronbach's alpha coefficient. The analysis demonstrated that the overall reliability coefficient exceeded the commonly accepted criterion of 0.70, indicating satisfactory internal consistency. This suggests that the instrument reliably measured teachers' perceptions across different indicators and that the responses were stable and consistent. Therefore, the questionnaire can be considered both valid and reliable for assessing teachers' readiness and challenges in implementing deep learning pedagogy in vocational education.

The findings of this study contribute significantly to both theoretical perspectives and practical applications in vocational education. From a theoretical standpoint, the evidence that teachers in Lampung demonstrate strong readiness across dimensions such as access to technology, digital competence, and pedagogical integration reinforces the framework of deep learning pedagogy, which emphasizes the centrality of teacher preparedness as a critical determinant of successful classroom transformation. These results align with constructivist and student-centered learning theories that argue teachers must not only have technical access but also the pedagogical skills to design authentic, inquiry-based, and collaborative learning experiences [13], [43]–[45]. Practically, the results highlight the importance of continuous professional development and institutional support to sustain implementation. For policymakers and practitioners in vocational education, this underscores the need for structured training programs, digital infrastructure investment, and collaborative communities of practice to ensure that teachers can translate deep learning approaches into meaningful and sustainable classroom practices.

The results are broadly consistent with prior international research reporting that teacher readiness for technology-enhanced and deep learning pedagogies is generally high in contexts where digital infrastructure is sufficiently available (See Table 6). Studies have emphasized that access to technology, combined with pedagogical knowledge, significantly enhances teachers' adoption of innovative teaching practices [36], [46]–[49]. Similarly, empirical evidence from Southeast Asia [50]–[52] also revealed comparable readiness among vocational and secondary teachers when digital competence is prioritized. Other studies [53–58] confirm the role of collaboration and reflective practices as enablers of deep learning pedagogy. Additionally, research in Indonesia [59]–[63] demonstrates that vocational school teachers show strong motivation to adopt digital pedagogies, supporting the present findings. However, not all studies are in agreement. Evidence from studies [64]–[67] revealed that inadequate infrastructure, lack of training, and teacher resistance can hinder effective adoption of deep learning, which partially contrasts with the readiness observed in Lampung. These divergences suggest that while readiness is context-dependent, the strong results in Lampung may reflect both supportive policies and relatively advanced digital adaptation among teachers in this province.

Table 6. Comparison of Present Findings with Previous Studies

Aspect	Present Study Finding	Previous Research Trend	Alignment
Access to Technology	High readiness	Prior studies highlight infrastructure as a key enabler of deep learning adoption	Consistent
Digital Competence	High readiness	Previous studies report that digital literacy supports innovative pedagogy	Consistent
Pedagogical Integration	High readiness	International and regional studies emphasize teacher preparedness for technology-enhanced learning	Consistent
Collaboration and Professional Development	Lower readiness	Southeast Asian studies identify peer support and professional learning communities as ongoing needs	Consistent
Contextual Differences	Lampung teachers show relatively strong readiness	Some studies report barriers such as inadequate infrastructure, lack of training, and resistance	Partially contrasting

Despite its valuable contributions, this study has several limitations that must be acknowledged. First, the sample was restricted to public vocational school teachers in Lampung, which may not fully capture the perspectives of private school teachers or those in other provinces of Indonesia. This limits the generalizability of the findings to broader contexts. Second, the reliance on self-reported survey data collected through Google Forms may introduce response bias, as teachers with limited internet access or lower digital literacy might have been underrepresented. Third, the analysis was limited to descriptive statistics using Microsoft Excel, which, while effective in presenting readiness levels, does not allow for

examination of causal relationships or predictive factors influencing readiness. These limitations highlight the need for more comprehensive approaches to strengthen the robustness and external validity of the findings. See Table 7 for the details.

Table 7. Limitations of the Study and Recommendations for Future Research

Limitation	Description	Implication	Recommendation
Sample Scope	Participants were limited to public vocational school teachers in Lampung	Findings may not be generalizable to private schools or other provinces	Include private schools and multiple provinces in future studies
Data Collection Method	Self-reported survey through Google Forms	Possible response bias and underrepresentation of teachers with low digital access	Combine surveys with interviews or offline data collection
Analytical Technique	Analysis relied on descriptive statistics in Microsoft Excel	Unable to examine causal or predictive relationships	Apply advanced statistical methods such as SEM or regression analysis
Temporal Scope	Cross-sectional design	Readiness changes over time could not be observed	Conduct longitudinal studies

The findings of this study carry important social and ethical implications (Table 8). From a social perspective, the evidence of strong teacher readiness suggests significant potential for improving the quality of vocational education in preparing students for the demands of Industry 4.0 and Society 5.0.

Table 8. Social, Ethical, and Practical Implications

Dimension	Key Implication
Social	Strong teacher readiness indicates potential to improve vocational education quality in response to Industry 4.0 and Society 5.0 demands.
Ethical	Unequal access to digital infrastructure may widen educational inequality if inclusivity is not ensured.
Practical	Policymakers should strengthen professional development, digital infrastructure, and collaborative communities of practice.
Research	Future studies should broaden context, use mixed methods, and apply more advanced statistical approaches.

However, ethical concerns remain regarding equitable access to resources, as disparities in digital infrastructure across regions may exacerbate educational inequalities if not properly addressed. Ensuring inclusivity in teacher training and digital support is critical to prevent widening of the digital divide among schools and communities. For future research, expanding the scope to include private schools and multiple provinces, employing advanced statistical techniques such as structural equation modeling, and integrating qualitative insights would provide a more nuanced understanding of teachers' readiness and the contextual challenges they face. Longitudinal studies are also recommended to track changes in readiness over time, especially as policies and professional development initiatives evolve. By addressing these aspects, subsequent research can deepen theoretical contributions and guide practical interventions to foster equitable and sustainable integration of deep learning pedagogy in vocational education.

Conclusion

The results of this study demonstrate that vocational school teachers in Lampung, Indonesia, possess a medium-to-high level of readiness for implementing deep learning pedagogy, with strong scores in access to technology (79%), digital competence (75%), integration and implementation (78%), and innovation and evaluation (77%), while collaboration and professional development scored relatively lower (71%). These findings suggest that most teachers have the technical resources and pedagogical knowledge to adopt deep learning approaches, though sustained institutional support and peer collaboration remain critical challenges. In practical terms, the results indicate that policymakers and school leaders should prioritize strengthening digital infrastructure, expanding professional development programs, and fostering communities of practice to ensure teachers can effectively translate deep learning pedagogy into classroom settings. Equitable strategies are particularly important to prevent digital disparities between urban and rural schools and to ensure inclusive participation in vocational education reforms. For practitioners, the evidence emphasizes the importance of moving beyond technical training toward comprehensive programs that integrate digital skills with innovative, student-centered learning design. Despite these promising findings, the study acknowledges limitations, including its focus on public schools in Lampung and reliance on descriptive statistics, which constrain the generalizability and depth of analysis. Therefore, future research should broaden the scope by including private vocational schools and other provinces, employ more advanced statistical techniques such as structural equation modeling, and adopt mixed-methods or longitudinal designs to capture both causal relationships and evolving trends in teacher readiness. Collectively, the findings provide theoretical reinforcement for the centrality of teacher readiness in deep learning pedagogy and offer practical guidance for policymakers, institutions, and educators seeking to enhance vocational education in the era of Industry 4.0 and Society 5.0, while also pointing to clear pathways for future scholarly inquiry.

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Conflict of Interest

There is no conflict of interest.

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