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Optimization of Clinical Learning Supervision Models through the Merdeka Curriculum Program to Improve Teachers' Pedagogical Content Knowledge

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ABSTRACT

Effective supervision aligned with the Merdeka Curriculum is needed to strengthen teachers' Pedagogical Content Knowledge (PCK), particularly in integrating subject-matter understanding with appropriate pedagogical strategies. This study examined the effectiveness of an optimized clinical instructional supervision model in improving Islamic Religious Education teachers' PCK. The study employed a quantitative one-group pre-test–post-test design supported by interview data. Participants were selected through purposive sampling and included teachers, school principals, and supervisors. Data were collected using a PCK mastery test and semi-structured interviews. Instrument validity was assessed using Aiken's V, while reliability was measured using Cronbach's alpha. Quantitative data were analyzed using descriptive statistics, N-gain, and a paired-sample t-test, while interview data were analyzed through reduction, display, and conclusion drawing. The findings showed an increase in teachers' mean PCK score from 61.85 in the pre-test to 79.40 in the post-test. The N-gain score was 0.46, indicating a moderate improvement. The paired-sample t-test showed a significant difference after the intervention, suggesting that the optimized clinical supervision model contributed to improved PCK. Interview findings further indicated that supervision supported teacher reflection, feedback, and the integration of content knowledge with student-centered pedagogy. The optimized clinical instructional supervision model can support teacher professional development under the Merdeka Curriculum. However, effective implementation requires stronger supervisor competence and deeper understanding of curriculum principles. Future studies should use comparison groups, larger samples, and longitudinal designs.

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1. INTRODUCTION

The implementation of the Merdeka Curriculum in Indonesia emphasizes differentiated instruction, learner autonomy, and contextual learning, which require teachers to possess strong Pedagogical Content Knowledge (PCK). However, many teachers still experience difficulties in integrating content mastery with appropriate pedagogical strategies aligned with the curriculum's principles. Instructional supervision, which should function as a professional support system, has often been limited to administrative compliance rather than pedagogical improvement. Consequently, optimizing instructional supervision models becomes urgent to ensure that teachers are adequately supported in developing PCK that aligns with the Merdeka Curriculum framework (Darling-Hammond et al., 2020; Kemendikbudristek, 2022).

Despite continuous curriculum reforms, empirical evidence shows that teachers' instructional practices frequently remain teacher-centered and content-oriented, with limited attention to students' conceptual understanding. This condition indicates a persistent weakness in teachers' PCK, particularly in selecting teaching strategies, representations, and assessments that suit students' learning needs. Without systematic supervision focused on instructional quality, teachers may struggle to translate curriculum ideals into classroom practice. Therefore, instructional supervision must evolve from evaluative inspection to developmental guidance that directly targets teachers' pedagogical competencies (Shulman, 1987; Glickman et al., 2018).

Previous studies on instructional supervision have largely examined its impact on teacher performance or instructional effectiveness in general terms, without explicitly linking supervision practices to the development of PCK. Moreover, research on the Merdeka Curriculum has predominantly focused on implementation readiness, policy analysis, or teachers' perceptions, rather than examining how supervision models can optimize teachers' pedagogical and content integration. This indicates a significant research gap in exploring instructional supervision models that are systematically aligned with the Merdeka Curriculum to enhance teachers' PCK (Sergiovanni, 2019; Suyanto & Jihad, 2021).

Instructional supervision in this study is conceptually defined as a structured, collaborative, and continuous professional assistance process aimed at improving teachers' instructional practices through observation, feedback, reflection, and coaching. Pedagogical Content Knowledge (PCK) refers to teachers' integrated understanding of subject matter, pedagogy, students' misconceptions, and instructional strategies that enable effective teaching of specific content (Shulman, 1987; Magnusson et al., 1999). Conceptually, the Clinical Learning Supervision Model is an interactive and systematic process in which an experienced clinician provides support, guidance, and evaluation to students in the context of clinical supervision practice. This model aims to bridge the gap between the theory learned in class and real practice in the field (theory-practice gap). Milne (2009) defines clinical supervision as Formal support and instruction provided by supervisors to practitioners, which aims to help them develop clinical skills and professionalism. McSherry (2005) emphasizes that clinical supervision is a process of exchange between professional practitioners to enhance self-development, maintain standards, and improve services.

The Merdeka Curriculum serves as a contextual framework that emphasizes flexibility, project-based learning, and student-centered instruction, requiring supervision models that are adaptive and reflective.International research has demonstrated that effective instructional supervision positively influences teachers' instructional competence and professional growth when it is formative and dialogical in nature. Studies by Darling-Hammond et al. (2020) and Hattie (2023) highlight that feedback-oriented supervision significantly enhances instructional quality. Meanwhile, Indonesian studies indicate that supervision practices often lack pedagogical depth and focus mainly on documentation and compliance, limiting their impact on teachers' instructional competence (Mulyasa, 2021; Arifin et al., 2022). However, limited studies explicitly examine supervision as a mechanism for strengthening PCK within a new curriculum framework.

Optimizing instructional supervision models within the Merdeka Curriculum is highly relevant to Indonesia's ongoing educational transformation. As teachers are positioned as facilitators of learning, supervision must function as a professional learning system that supports instructional innovation and reflective practice. A supervision model that explicitly targets PCK development can bridge the gap between curriculum policy and classroom practice, ensuring that learning objectives are achieved meaningfully. This relevance aligns with global trends emphasizing instructional leadership and teacher professional learning communities (Hallinger, 2020).

This study is expected to contribute theoretically and practically by proposing an optimized instructional supervision model that integrates Merdeka Curriculum principles with PCK development. The findings may provide empirical evidence for policymakers, school leaders, and supervisors on how supervision can be redesigned to support instructional improvement rather than administrative control. Practically, the study offers a framework for sustainable professional development that enhances teachers' pedagogical competence and ultimately improves student learning outcomes.

This research focuses on a clinical learning supervision model implemented to encourage deep learning for teachers and students, emphasizing improvements in thinking processes, learning strategies, and in-depth conceptual understanding. It also strengthens the learning community in schools. Furthermore, it aligns with the love curriculum approach. The supervision process is conducted with empathy, compassion, and mutual respect. Based on the background and issues outlined above, this research aimed to analyze the effectiveness of optimizing clinical model learning supervision through the Independent Curriculum program in improving teachers' Pedagogical Content Knowledge (PCK). Therefore, the research question is: How does the effectiveness of optimizing instructional supervision models through the Merdeka Curriculum program improve teachers' Pedagogical Content Knowledge (PCK), and hypothesis H1: Teachers' PCK scores increase after the clinical supervision intervention.

2. METHOD

2.1 Research design

This research aimed to analyze the effectiveness of optimizing clinical model learning supervision through the Independent Curriculum program in improving teachers' Pedagogical Content Knowledge (PCK). The research employed a quantitative approach. The quantitative design used in this study is a Pre-test - Post-test One Group Design, where one group of subjects is given a specific treatment (experiment). The study involved 60 respondents consisting of school principals, supervisors, and teachers, who were selected through purposive sampling. The research design can be seen in Table 1 below.

Table 1. Research Design

Group	Pre test	Treatment	Post test
Class	O_1	Xa	O_2

Class = The experimental class is a class that is given treatment using the clinical learning supervision model.
O1 = (*Pre test*)
O2 = (*Post test*)
Xa = clinical learning supervision model

2.2 Instruments and Data Collection

Data were collected using test instruments and interviews. The test instrument, in the form of descriptive test questions (pre-test and post-test), was used to determine teachers' mastery of Pedagogical Content Knowledge (PCK) competencies before and after the model was implemented. Interview guide instruments were used to obtain data and support the answers on the test instrument.

The test used in this study was a descriptive test. It was used to determine mastery of Pedagogical Content Knowledge (PCK) competency. The test instrument outline is presented in Table 2 below.

Table 2. PCK mastery test grid

Aspect	Indicator	Item	Score
PK (*Pedagogical Knowledge*)	-Determine appropriate learning strategies for Islamic Religious Education (PAI) material.	1	Score 1-3
	-Explain the use of active learning methods.	2	Score (3) if the answer is correct, complete and according to the concept, score (2) The answer is less precise and only part of the concept is correct, score (1) The answer is less precise
	-Design learning evaluations.	3	
CK (*Content Knowledge*)	- Understand the basic concepts of Islamic Religious Education (PAI) material according to the curriculum.	4	Score 1-3
	- Explain the rational and rational arguments in Islamic Religious Education (PAI) material.	5	Score (3) if the answer is correct, complete and according to the concept, score (2) The answer is less precise and only part of the concept is correct, score (1) The answer is less precise
	- Relate the material to everyday life contexts.	6	
PCK (*Pedagogical Content Knowledge*)	represent content knowledge and adopt pedagogical strategies	7	Score 1-3 Score (3) if the answer is correct, complete and according to the concept, score (2) The answer is less precise and only part of the concept is correct, score (1) The answer is less precise

These research instruments have been validated by two educational experts, confirming their validity. Validity analysis is conducted to determine whether the instrument's items are valid. To assess the instrument's validity, the researchers evaluate the expert agreement index using the Aiken index (V). The reliability of the instrument is determined using Cronbach's alpha coefficient. The reliability of the PCK mastery test instrument was 0.87, placing it in the high-reliability category (Taber, 2018). The results of this evaluation are shown in Table 3 below:

Table 3. The results of the Aiken Index Coefficient of Instrument Validity

Instruments	V	Validity
PCK mastery test	0.84	Valid

2.3 Data Analysis

The paired-samples t-test was employed at the 0.05 significance level. If the probability is less than the specified significance level, it indicates that the clinical learning supervision model improves teachers' PCK mastery. Data normality was assessed using the One-Sample Kolmogorov-Smirnov Test, while homogeneity was examined through the Levene test. Furthermore, a paired-samples t-test was conducted to determine whether there were significant differences in the average scores of the experimental class.

3. FINDINGS AND DISCUSSION

3.1 Findings

The pre-test and post-test results for the implementation of the optimized learning supervision model are presented in Table 4.

Table 4. Pre-test and post-test results for the optimized learning supervision model.

Data	N	Maximum Value	Minimum Value	Mean
Pre test	30	65.3	58.4	61.85
Post test	30	82.3	76.5	79.40

In the table above, the results of the descriptive statistical analysis of the learning supervision model optimization data show that the average pretest value is 61.85. While the average posttest value is 79.40. This indicates that there is an increase in the Pedagogical Content Knowledge of PAI group teachers before and after treatment. Furthermore, to determine whether there is an increase in the mastery of Pedagogical Content Knowledge of PAI group teachers can be seen from the N-Gain value in Table 5. The N-Gain value of the experimental class has a Criterion for increasing Pedagogical Content Knowledge of PAI group teachers before and after being given treatment in the moderate criteria.

Table 5. The N-Gain test results

Class	Mean		Gain value	Category
	Pre test	Post test		
Experiment	61.85	79.40	0.46	medium

The N-Gain test results indicate that the N-Gain value for the improvement of Pedagogical Content Knowledge (PCK) among Islamic Education (PAI) teachers in the experimental class is 0.46, falling into the "Medium" category. There is an improvement in the teachers' Pedagogical Content Knowledge due to the role of supervisors/principals who are capable of effectively organizing instructional supervision.

The results of the normality test were carried out using the Kolmogorov-Smirnov method. The significance value of the pre-test and post-test results in the class was more than .05. This indicates that H0 is accepted, meaning the data is normally distributed. The homogeneity test for pre-test and post-test data was carried out using the Levene test. The results of the pre-test data homogeneity test obtained a significance value of 0.57 with F = .074, while the post-test data obtained a significance value of 0.35 with F = 1.044. This means that the pre-test and post-test data all have the same variance (homogeneous). All data are normally distributed and homogeneous, so the hypothesis testing uses parametric statistics, namely the paired sample t-test using the SPSS program. The results of the paired sample t-test analysis are presented in the table below.

Table 6. The results of the paired sample t-test

Dependent Variable	t-test for Equality of Means			information
	t	Df	Sig.	
Pedagogik Content Knowledge (Pre test)	.75	25	.210	There is no difference in the average PCK of teachers
Pedagogik Content Knowledge (Post test)	11.061	25	.000	There is a difference in the average PCK of teachers

The results of the paired sample t-test on the pre-test data obtained a significance value of .210. The significance value is above .05 (sig. > .05), so that H0 is accepted and H1 is rejected, which means

that there is no difference in the average before being given the supervision model treatment. While in the post-test data, a significance value of .000 was obtained. The significance value is below .05 (sig. < .05), so that H0 is rejected and H1 is accepted, which means that there is a difference in the average PCK of teachers after being given the supervision model treatment. This shows that the implementation of an effective supervision model can improve the PCK competency of Islamic Education teachers.

Based on interviews regarding the urgency of supervision in improving teachers' Pedagogical Content Knowledge (PCK) competencies, it was found that supervision conducted by the principal not only encourages Islamic Religious Education teachers to teach and deliver material, but also fosters awareness of the importance of improving the administration and learning tools used. From interviews with Islamic Religious Education teachers at madrasahs, researchers found:

> *"I think supervision is very important because teachers are often unaware of their weaknesses in delivering material according to student characteristics. With supervision, we can get constructive feedback, especially on how to effectively integrate material and pedagogical knowledge. That is the essence of PCK, and without supervision, improvement in this area will be slow."*

This statement indicates that supervision plays a crucial role as a tool for professional reflection for teachers. Teachers often get caught up in teaching routines without realizing shortcomings in the way they present material or the pedagogical strategies they use. Supervision serves as a coaching tool that helps teachers recognize, understand, and address the gap between their understanding of the material and the methods they deliver it to students, which is the essence of PCK. The teacher also emphasized the importance of feedback, which serves as a basis for continuous improvement and enhancement. Meanwhile, the principal stated:

> *"Academic supervision gives us the opportunity to reflect on our learning practices. Supervisor guidance helps guide us so that teaching strategies are not only appropriate in terms of material, but also aligned with students' learning needs. So, supervision is crucial for improving teachers' PCK."*

The principal views supervision as a reflective and collaborative process aimed at guiding teachers to be more adaptive in designing and implementing learning. He emphasized that appropriate teaching strategies are not only based on understanding the material (content knowledge), but must also consider the context and needs of students (pedagogical knowledge). Supervision, in this case, is positioned as a bridge between learning theory and practice, as well as a dialogue space that fosters teachers to develop PCK competencies more deeply and contextually.

Based on the opinions of both informants, both teachers and principals, there is a shared view that supervision is highly urgent in supporting teacher professional development, particularly in the PCK aspect. Supervision is not only an assessment tool, but also a coaching tool that strengthens the integration between learning content and delivery strategies. This finding supports Shulman's theory that PCK is a combination of content knowledge and pedagogy that needs to be continuously developed through training, coaching, and collaborative reflection.

Interviews conducted by researchers with Madrasah Supervisors revealed:

> *"Academic supervision is an integral part of efforts to improve the quality of learning. Through supervision, teachers can be guided to understand and develop their skills in integrating teaching materials with appropriate pedagogical approaches. In the context of PCK, supervision is a strategic tool to help teachers reflect on their teaching practices, so they can be tailored to the characteristics and needs of students."*

Meanwhile, another Madrasah Islamic Education (PAI) teacher stated:

"As an Islamic Religious Education (IS) teacher, I feel that supervision serves not only as an evaluation tool but also as a professional development process. Through supervision, I receive very helpful feedback on linking religious material with contextual and relevant learning approaches to students' lives. Thus, supervision is very supportive in strengthening my PCK competency as an educator."

These two statements emphasize that supervisors view supervision not merely as a formality, but as a development tool aimed at improving the integration of content and pedagogical knowledge (PCK). Supervision helps teachers reflect on the learning process and adapt it to student characteristics, thereby increasing learning effectiveness. Meanwhile, Islamic Religious Education teachers (PAI) argue that supervision benefits from strengthening professionalism. Specifically, they emphasize the importance of supervision in helping them connect religious material to students' real lives, a concrete form of developing contextual and relevant PCK.

3.2 Discussion

The findings indicate that the optimized clinical instructional supervision model contributed to improving teachers' Pedagogical Content Knowledge (PCK) in Islamic Religious Education learning. The increase in mean scores from pre-test to post-test suggests that structured supervision can support teachers in integrating subject-matter knowledge with appropriate pedagogical strategies. This finding is consistent with Shulman's (1987) concept of PCK, which emphasizes that effective teaching requires more than content mastery; teachers must also be able to transform content into forms that are pedagogically meaningful and accessible to students.

Clinical supervision appears to support PCK development because it involves systematic stages of pre-observation, classroom observation, feedback, and reflection. Through these stages, teachers are guided to identify instructional weaknesses, evaluate learning strategies, and improve the connection between content, pedagogy, and student characteristics. Glickman et al. (2014, 2018) argue that instructional supervision is most effective when it functions as developmental assistance rather than administrative inspection. In this study, supervision helped teachers reflect on how Islamic Religious Education materials could be delivered through more contextual, student-centered, and meaningful learning activities.

The interview findings strengthen the quantitative results by showing that teachers perceived supervision as a professional learning process. Teachers reported that supervision helped them recognize weaknesses in explaining concepts, selecting methods, and linking religious content with students' daily experiences. This supports the view that feedback-oriented professional development can improve instructional quality when it is specific, reflective, and connected to classroom practice (Darling-Hammond et al., 2020; Hattie, 2023). In the context of the Merdeka Curriculum, such support is particularly important because teachers are expected to implement differentiated, flexible, and learner-centered instruction (Kemendikbudristek, 2022).

The role of principals and supervisors is central to the success of clinical supervision. Effective supervision requires supervisors who understand not only classroom management and pedagogy but also the subject-specific challenges faced by teachers. Magnusson et al. (1999) emphasize that PCK includes knowledge of learners' misconceptions, instructional representations, curriculum orientation, and assessment strategies. Therefore, supervisors need adequate PCK-related competence to provide meaningful guidance. Without this competence, supervision may remain procedural and fail to address the deeper integration of content and pedagogy.

These findings are also aligned with previous studies showing that clinical supervision can improve teachers' pedagogical competence and instructional performance. Makawimbang (2011) describes clinical supervision as systematic professional assistance designed to develop teaching skills, while Maulidiyah (2022) highlights its role in improving pedagogical competence through reflective instructional support. Similarly, Nasution et al. (2022) found that school supervision contributes to

improving teaching preparation and classroom implementation. This study extends those findings by positioning clinical supervision specifically as a strategy for strengthening teachers' PCK within the Merdeka Curriculum framework.

Nevertheless, the findings should be interpreted cautiously. Since the study used a one-group pre-test–post-test design, the increase in PCK scores cannot be attributed exclusively to the intervention without considering other possible influences. The absence of a comparison group limits causal claims. Therefore, the results are better interpreted as evidence of improvement after the implementation of the optimized clinical supervision model, rather than definitive proof of effectiveness. Future studies should involve control groups, larger samples, multiple school contexts, and longitudinal designs to provide stronger evidence.

Overall, the study suggests that optimized clinical instructional supervision can serve as a strategic model for teacher professional development. When implemented collaboratively and reflectively, it helps teachers integrate pedagogical strategies with subject content in ways that are responsive to students' needs. However, successful implementation requires stronger supervisor training, clearer supervision guidelines, and a deeper understanding of the Merdeka Curriculum. Schools and education authorities should therefore position supervision not as an administrative routine, but as a continuous professional learning process aimed at improving instructional quality and teachers' PCK.

4. CONCLUSION

The findings of this study indicate that the optimization of the clinical instructional supervision model through the Merdeka Curriculum program contributed to improving teachers' Pedagogical Content Knowledge (PCK), particularly in helping Islamic Religious Education teachers integrate subject-matter knowledge with appropriate pedagogical strategies, reflective teaching practices, and student-centered learning approaches. The increase in teachers' PCK scores after the intervention suggests that clinical supervision can serve as a meaningful professional development strategy when implemented collaboratively, systematically, and in alignment with curriculum principles. However, this study has several limitations, including the use of a one-group pre-test–post-test design without a control group, which limits the strength of causal claims, as well as the relatively limited sample scope and focus on Islamic Religious Education teachers in a specific context. In addition, the implementation of supervision was influenced by supervisors' and principals' varying levels of understanding of the Merdeka Curriculum and PCK. Therefore, future research should involve control or comparison groups, larger and more diverse samples, multi-site settings, and longitudinal designs to examine the sustained impact of clinical instructional supervision on teachers' PCK across different subjects, educational levels, and regional contexts.

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