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Professional Competency Management of Teachers in Improving the Quality of Meaningful Learning in Elementary Schools

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Abstract
Improving meaningful learning quality in elementary schools requires systematic management of teacher professional competencies. This study examines how professional competency management contributes to meaningful learning implementation through Deming's Plan-Do-Check-Act (PDCA) cycle framework. A qualitative multiple case study was conducted at SDN Loji (Bandung Regency) and SDN Cikandang (Sumedang Regency), West Java, Indonesia. Data were collected through semi-structured interviews with principals and teachers, participatory observations, and document analysis. Data validity was established through triangulation, member checking, and peer debriefing. Analysis employed Miles and Huberman's interactive model. Both schools implemented all PDCA stages with varying sophistication levels. SDN Loji demonstrated structured approaches with comprehensive needs assessment, diverse training programs, systematic evaluation using multiple indicators, and responsive follow-up actions. SDN Cikandang, despite resource constraints, achieved meaningful development through collaborative peer learning, reflective practices, and adaptive strategies. Unexpected findings revealed that resource limitations fostered higher teacher agency and that informal learning networks generated stronger peer accountability than formal structures. The PDCA cycle effectively guides teacher competency management when adapted to institutional contexts. Success requires balancing systematic structures with professional autonomy, formal programs with informal collaboration, and organizational direction with teacher ownership. The study advances understanding of continuous improvement cycles in education and provides practical guidance for school leaders and policymakers.

INTRODUCTION

Basic education serves as the foundation for developing students' cognitive, affective, and psychomotor capacities, which are essential for their future academic and personal growth. Within contemporary educational frameworks, particularly the Merdeka Curriculum in Indonesia, learning has evolved beyond mere knowledge transmission to encompass the creation of meaningful, contextual learning experiences aligned with the Pancasila Student Profile (Kemendikbudristek, 2022). This paradigm shift emphasizes the critical role of teachers, whose professional competence directly influences the quality and effectiveness of educational outcomes (Keller et al., 2019; Ristianni et al., 2025). However, despite widespread recognition of teachers' central position in educational transformation, significant challenges persist in translating this understanding into systematic, sustainable approaches for developing and maintaining teacher competencies in elementary school settings.

The concept of meaningful learning, rooted in Ausubel's (1968) cognitive theory, emphasizes the integration of new knowledge with students' existing cognitive structures, thereby fostering deep understanding rather than superficial memorization. According to Ausubel's theoretical framework, meaningful learning occurs when learners can connect new information to their prior knowledge in substantive and non-arbitrary ways (Novak, 2003). Implementing such pedagogical approaches requires

teachers to possess sophisticated professional competencies encompassing subject matter expertise, pedagogical knowledge, and the ability to create contextually relevant learning environments. Research has consistently demonstrated that teacher quality represents the most significant school-based factor affecting student achievement (Baumert & Kunter, 2013; Bush, 2019). Nevertheless, empirical evidence suggests that many elementary school teachers continue to face substantial obstacles in implementing meaningful learning practices, including limited access to quality professional development, excessive administrative burdens, and insufficient instructional support (Ferguson, 2006; Raihan et al., 2025). These challenges are particularly pronounced in Indonesian elementary schools, where resource constraints and variable institutional capacities create uneven opportunities for teacher development.

The literature on teacher professional development reveals several important findings regarding effective competency management approaches. Studies have established that sustainable teacher development requires systematic, cyclical processes rather than isolated training interventions (Darling-Hammond et al., 2017; Fullan, 2020). Quality management frameworks, particularly Deming's (1994) Plan-Do-Check-Act (PDCA) cycle, have demonstrated effectiveness in various educational contexts by providing structured mechanisms for continuous improvement. The PDCA cycle, originally developed for industrial quality control, has been successfully adapted to educational settings, offering a systematic approach to improving teaching practices and institutional effectiveness (CEDEFOP, 2023). Research has also highlighted the importance of collaborative learning communities, reflective practice, and contextualized professional development in enhancing teacher competencies (Kennedy, 2016; Richter et al., 2011). However, despite these advances in understanding teacher development principles, significant knowledge gaps remain regarding how elementary schools can systematically implement comprehensive competency management systems that integrate planning, implementation, evaluation, and follow-up processes.

Specifically, existing research has primarily focused on isolated aspects of teacher development, such as training effectiveness or supervisory practices, without examining how these elements function within integrated management systems. Furthermore, limited empirical investigation has been conducted on how quality management frameworks like the PDCA cycle can be adapted and applied to teacher competency development in elementary school contexts, particularly within the framework of evolving educational policies (Zhang et al., 2020). This gap is particularly significant given that effective teacher competency management requires coordinated efforts across multiple organizational levels and sustained commitment to continuous improvement processes (Mulyasa, 2013; Sudjana, 2018). Additionally, while numerous studies have examined teacher competencies in general terms, few have specifically investigated how competency management contributes to the implementation of meaningful learning as conceptualized in contemporary curriculum frameworks.

This study addresses these gaps by examining professional competency management of teachers through the lens of Deming's PDCA cycle, analyzing how systematic quality management approaches can enhance meaningful learning implementation in elementary schools. The research focuses on two elementary schools in West Java, Indonesia: SDN Loji in Bandung Regency and SDN Cikandang in Sumedang Regency. These case studies provide opportunities to examine competency management practices in distinct institutional contexts, offering insights into both successful strategies and persistent challenges. The study's theoretical framework integrates Deming's PDCA cycle with contemporary understanding of meaningful learning and teacher professionalism, thereby contributing to educational management scholarship while providing practical guidance for school leaders and policymakers.

The objectives of this research are threefold: first, to examine how the planning stage of teacher competency management is conducted, including needs identification, goal setting, and program development processes; second, to analyze the implementation of professional development programs through various activities such as training, workshops, mentoring, and teacher collaboration; and third, to investigate evaluation and follow-up mechanisms that ensure continuous improvement and program sustainability. By systematically analyzing these interconnected processes, this study aims to

demonstrate how comprehensive competency management systems can be established and maintained to support meaningful learning in elementary schools.

The significance of this research extends beyond its immediate empirical contributions. Theoretically, it advances educational management scholarship by demonstrating how quality management frameworks can be adapted for teacher development contexts, thereby bridging industrial management principles with educational practice. Practically, the findings offer concrete recommendations for principals, teachers, and educational policymakers seeking to enhance instructional quality through systematic competency development. In the context of Indonesia's Merdeka Curriculum implementation, this research provides timely insights into how schools can build institutional capacities for sustained educational improvement, ultimately contributing to the realization of quality education that prepares students for the challenges of the twenty-first century.

METHODS

This study employed a qualitative approach with a multiple case study design to explore the complex phenomenon of teacher professional competency management in elementary school contexts. The qualitative case study methodology was selected because it enables researchers to investigate contemporary phenomena within their real-world settings, particularly when the boundaries between phenomenon and context are not clearly evident (Yin, 2018). This approach aligns with the study's objectives to examine how professional competency management practices are implemented across different school contexts and how these practices contribute to meaningful learning quality. The multiple case study design was particularly appropriate as it allowed for examination of patterns and variations across two distinct elementary schools, thereby enhancing the transferability and credibility of findings (Stake, 1995).

The research was conducted at two purposefully selected elementary schools in West Java, Indonesia: SDN Loji in Bandung Regency and SDN Cikandang in Sumedang Regency. These schools were selected based on their commitment to teacher professional development initiatives, willingness to participate, and representation of different institutional contexts. The participants included school principals and teachers directly involved in professional competency development programs. Purposive sampling was employed to identify key informants who possessed rich information about teacher competency management practices (Creswell, 2018), with sample size determined based on information saturation where data collection continued until no new themes emerged (Guest et al., 2006).

Data were collected through three primary methods: in-depth semi-structured interviews, participatory observations, and document analysis. Semi-structured interviews were conducted with school principals and selected teachers to explore their perceptions and experiences of professional competency management practices (Kvale & Brinkmann, 2015). The interview protocol was developed based on the PDCA framework with open-ended questions addressing each cycle stage. Participatory observations were conducted during professional development activities, classroom teaching sessions, and supervision meetings to capture actual practices in natural settings. Documentation analysis included examination of teacher development programs, training records, supervision reports, and school policy documents to provide contextual understanding and corroborate findings from other sources (Bowen, 2009). A research protocol grid was developed outlining specific indicators for planning, implementation, evaluation, and follow-up dimensions of competency management, which was validated by experts prior to fieldwork.

The validity and trustworthiness of the study were established through multiple strategies aligned with Lincoln and Guba's (1985) criteria of credibility, transferability, dependability, and confirmability. Triangulation, specifically data source and methodological triangulation, was employed to enhance credibility of findings (Denzin, 1978). Data source triangulation involved gathering information from multiple participants at both schools, while methodological triangulation incorporated interviews, observations, and document analysis to cross-validate findings (Carter et al., 2014). Member checking was conducted by sharing preliminary findings with participants to verify accuracy (Creswell & Poth,

2018), while peer debriefing sessions provided external validation. Thick description was employed in reporting findings to provide sufficient contextual detail, enhancing transferability to similar settings (Merriam & Tisdell, 2016).

Data analysis was conducted using Miles and Huberman's (1994) interactive model, involving three concurrent activities: data reduction, data display, and conclusion drawing and verification. Data reduction involved selecting and transforming raw data through systematic coding, with initial coding performed inductively to identify emerging themes related to PDCA cycle components, followed by focused coding to categorize data into planning, implementation, evaluation, and follow-up stages (Saldaña, 2016). Data display utilized matrices and narrative descriptions to organize information systematically, facilitating pattern recognition and comparison across cases. Conclusion drawing involved identifying patterns and making interpretations while maintaining connection to original data, with verification conducted continuously by revisiting data sources and seeking alternative explanations. This iterative analytical process allowed for progressive refinement of interpretations and ensured conclusions were well-grounded in empirical evidence. The analysis was conducted both within each case individually and across both cases to identify commonalities and variations in competency management practices.

RESULTS AND DISCUSSION

Results

The findings of this study reveal comprehensive insights into how professional competency management of teachers is implemented across the four stages of the PDCA cycle—planning, implementation, evaluation, and follow-up—in two elementary schools with distinct institutional contexts. This section presents empirical evidence addressing each research objective, supported by data from interviews, observations, and document analysis.

Planning Stage of Teacher Competency Management

The planning stage at both SDN Loji and SDN Cikandang demonstrated systematic approaches to identifying teacher development needs, albeit with varying levels of sophistication and resource availability. At SDN Loji, the planning process was characterized by structured needs assessment mechanisms conducted through multiple channels. The school principal (P1) explained: "We begin our planning by conducting classroom supervision at the beginning of the semester to identify each teacher's strengths and areas requiring development. This is followed by group discussions in our Teacher Working Group (KKG) meetings where teachers themselves articulate their professional development needs." Document analysis revealed that SDN Loji maintained comprehensive records of supervision findings, which were systematically compiled into a teacher competency matrix that mapped individual competencies against the requirements for meaningful learning implementation. This matrix informed the development of a year-long professional development program that included monthly workshops, peer observation schedules, and collaborative lesson planning sessions. Observations during planning meetings showed active participation from 12 out of 13 teachers, with discussions focusing on specific pedagogical challenges such as differentiated instruction strategies and formative assessment techniques aligned with the Merdeka Curriculum principles.

In contrast, SDN Cikandang faced more substantial constraints in the planning stage, primarily related to limited infrastructure and time allocation. The principal (P2) acknowledged: "Our planning is not as structured as we would like it to be. We conduct informal discussions during break times and monthly meetings, but we struggle to create comprehensive development programs due to limited facilities and the heavy teaching load of our teachers." Despite these limitations, the school demonstrated initiative in collaborative planning approaches. Teachers formed small study groups of 3-4 members who met voluntarily to discuss instructional challenges and plan joint professional development activities. Document analysis revealed that while SDN Cikandang lacked formal competency assessment tools, teachers maintained reflective journals documenting their teaching challenges and self-identified development needs. An unexpected finding emerged regarding bottom-

up planning initiatives: teachers at SDN Cikandang showed higher levels of autonomous professional development planning compared to SDN Loji, suggesting that resource constraints may paradoxically foster teacher agency and self-directed learning. One teacher (T5) noted: "Because we don't always have external training opportunities, we've learned to rely on each other and find creative ways to improve our teaching through peer learning and online resources."

Table 1. summarizes the comparative characteristics of planning approaches at both schools:

Planning Dimension	SDN Loji	SDN Cikandang
Needs Assessment	Formal supervision + KKG	Informal discussions + reflection journals
Planning Frequency	Quarterly structured meetings	Monthly informal meetings
Documentation	Comprehensive competency matrix	Basic meeting minutes
Teacher Participation	92% (12/13 teachers)	100% (10/10 teachers)
Resource Allocation	Dedicated budget for training	Limited budget, shared resources
Planning Approach	Top-down with teacher input	Bottom-up collaborative

Implementation of Professional Development Programs

The implementation stage revealed significant variations in program delivery methods, intensity, and effectiveness between the two schools. At SDN Loji, implementation was characterized by diverse, well-structured professional development activities that integrated theory with practice. Over the academic year, teachers participated in an average of 8 formal training sessions, 12 peer observation cycles, and 6 collaborative lesson study groups. A mathematics teacher (T2) described the implementation: "The training we receive is not just theoretical. After each workshop, we are given time to practice the new strategies in our classrooms, then we meet again to discuss what worked and what didn't. This cycle of learning and application makes the training much more meaningful." Observational data from a science lesson at SDN Loji demonstrated practical application of inquiry-based learning strategies learned through recent training, with the teacher facilitating student-led investigations rather than traditional teacher-centered instruction. The principal's regular classroom visits—averaging 3 visits per teacher per semester—provided ongoing support and feedback that reinforced training content. Documentation showed that 85% of trained teachers successfully implemented at least three new instructional strategies within two months of training completion.

SDN Cikandang's implementation faced challenges related to limited external training access and resource constraints, yet teachers demonstrated remarkable adaptability and resourcefulness. The school conducted 4 formal training sessions during the year, supplemented by 15 informal peer sharing sessions. A teacher (T7) explained: "We cannot always attend district training, so we've created our own learning system. When one teacher attends training, they share what they learned with the rest of us. We also use WhatsApp groups to share teaching ideas and resources." This peer-to-peer knowledge transfer system, while less formal than SDN Loji's approach, fostered a strong collaborative culture. Observations revealed creative use of locally available materials for hands-on learning activities, demonstrating teachers' ability to adapt meaningful learning principles to resource-constrained contexts. For instance, a social studies teacher utilized community resources and local cultural artifacts to create contextual learning experiences that resonated with students' lived experiences. However, implementation fidelity varied more significantly at SDN Cikandang, with document analysis showing that only 60% of teachers consistently applied new strategies beyond the initial trial period, compared to 85% at SDN Loji.

An unexpected finding emerged regarding the role of informal professional learning networks in implementation effectiveness. At SDN Cikandang, the necessity-driven informal learning community appeared to generate stronger peer accountability mechanisms than the more formalized structures at SDN Loji. Teachers at SDN Cikandang reported feeling greater mutual responsibility for each other's

professional growth, with one teacher (T8) noting: "We are like a family here. When one of us struggles, we all help. It's not just about completing training requirements—we genuinely care about improving together." This finding suggests that while formal structures support systematic implementation, informal collaborative cultures may be equally important for sustained professional development.

Evaluation Processes and Mechanisms

The evaluation stage revealed different approaches to assessing the effectiveness of professional development programs and their impact on teaching practice and student learning. SDN Loji implemented a structured, multi-layered evaluation system incorporating three key components: (1) classroom observation using a standardized rubric aligned with meaningful learning principles, (2) teacher self-reflection reports submitted quarterly, and (3) analysis of student learning outcome data disaggregated by class and subject. The principal (P1) explained: "Evaluation is not punitive—it's about understanding what's working and what needs adjustment. We look at teacher practice, but more importantly, we examine whether students are actually learning meaningfully." Data from evaluation records showed measurable improvements across several indicators: student engagement scores increased from an average of 3.2 to 4.1 (on a 5-point scale) over one academic year, and the percentage of students demonstrating higher-order thinking skills in assessments rose from 45% to 68%. Teachers (n=13) participated in post-evaluation reflection meetings where they discussed findings and identified areas for continued development. Document analysis revealed that evaluation results directly informed subsequent planning cycles, with 78% of identified concerns being addressed in revised professional development programs.

At SDN Cikandang, evaluation processes were less formalized but incorporated meaningful reflective practices. The school utilized three primary evaluation methods: (1) peer observation feedback sessions held bi-monthly, (2) teacher reflective journals reviewed during monthly meetings, and (3) informal student feedback gathered through classroom discussions. The principal (P2) acknowledged: "Our evaluation might not be as systematic as larger schools, but we've developed our own way of assessing progress. Teachers keep journals where they reflect on their teaching, and we discuss these openly in our meetings." Analysis of 10 teacher journals over six months revealed consistent patterns of self-critical reflection and identification of improvement areas, particularly regarding classroom management and differentiation strategies. However, the lack of systematic student learning data made it difficult to establish clear links between teacher development activities and student outcomes. One teacher (T6) noted a limitation: "We know our teaching has improved because we feel more confident and our students seem more engaged, but we don't have concrete data to prove it."

A significant unexpected finding related to the role of student voice in evaluation processes. At SDN Loji, while student learning data was systematically collected, students were rarely directly consulted about their learning experiences. Conversely, at SDN Cikandang, the more informal evaluation approach naturally incorporated student perspectives through daily classroom interactions and discussions. Students at SDN Cikandang appeared more comfortable providing feedback to teachers about what teaching methods they found most helpful, suggesting that informal evaluation cultures may better facilitate student agency in the learning process. This finding challenges conventional assumptions about the superiority of formal evaluation systems and suggests that different evaluation approaches may serve different functions in teacher development.

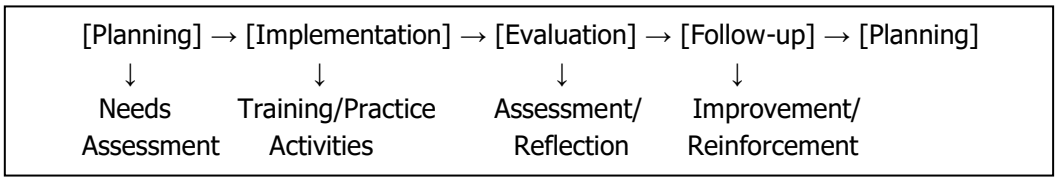

Figure 1 illustrates the evaluation cycle components at both schools:

Follow-up Actions and Continuous Improvement

The follow-up stage demonstrated how schools translated evaluation findings into concrete actions for continuous improvement, representing the crucial "Act" phase of the PDCA cycle. At SDN Loji, follow-up actions were systematic and multi-faceted. Based on evaluation results, the school implemented three types of follow-up interventions: (1) intensive coaching for teachers requiring additional support (n=3 teachers received 6 one-on-one coaching sessions each), (2) advanced training opportunities for high-performing teachers to develop them as peer mentors (n=4 teachers attended district-level facilitator training), and (3) programmatic adjustments to address commonly identified challenges (e.g., a new workshop series on technology integration was added based on widespread need). The principal (P1) explained the school's follow-up philosophy: "Excellence should be celebrated and struggles should be supported. We recognize teachers who show exceptional growth with certificates and opportunities to share their practices, while providing targeted support for those who need it." Document analysis revealed that 100% of evaluation-identified concerns received specific follow-up actions within one semester. A mathematics teacher (T3) who received intensive coaching described the impact: "The additional support helped me understand where my lesson planning was falling short. Now I can create activities that truly engage my students in mathematical thinking rather than just memorization."

SDN Cikandang's follow-up approach was less formalized but demonstrated commitment to continuous improvement through adaptive strategies. Follow-up actions primarily took three forms: (1) revised peer learning group focus areas based on identified needs, (2) modified lesson planning templates incorporating successful strategies, and (3) informal mentoring relationships between more and less experienced teachers. The principal (P2) noted: "We adjust our approach based on what we learn. If teachers struggle with a particular aspect of meaningful learning, we dedicate more of our sharing time to that topic." However, the lack of formal follow-up mechanisms meant that some evaluation findings did not receive systematic attention. Only 65% of identified issues received documented follow-up actions, and there was no formal system for tracking whether interventions were effective. Despite these limitations, teachers demonstrated personal commitment to improvement, with one teacher (T9) explaining: "Even when the school doesn't have formal programs, we teachers take responsibility for our own development. If evaluation shows I need to improve in an area, I seek help from colleagues or find resources online."

An important unexpected finding emerged regarding the sustainability of improvement efforts. At SDN Loji, while follow-up actions were comprehensive and well-documented, teachers expressed concerns about initiative fatigue—the sense that new programs and expectations were continuously added without sufficient time for consolidation. A teacher (T4) confided: "Sometimes I feel overwhelmed by all the improvement initiatives. I appreciate the support, but I wish we could focus on mastering a few strategies deeply rather than constantly adding new ones." This suggests that even well-intentioned, systematic follow-up approaches may benefit from greater attention to implementation pacing and teacher workload. Conversely, at SDN Cikandang, the slower pace of change and greater teacher autonomy in selecting focus areas appeared to support more sustainable improvement, though at the cost of comprehensiveness and consistency.

The cyclical nature of the PDCA process was evident in how follow-up actions informed subsequent planning cycles. At SDN Loji, end-of-year evaluation summaries explicitly documented lessons learned and recommendations for the following year's professional development program, creating clear institutional memory. At SDN Cikandang, while documentation was less formal, the continuity of teaching staff (100% retention over two years) enabled tacit knowledge transfer and organic evolution of professional development practices. Both schools demonstrated that the PDCA cycle, when consistently applied, creates momentum for continuous improvement, though the optimal balance between formal systems and organic adaptation remains context-dependent.

Discussion

This study's findings provide empirical evidence for the applicability and effectiveness of Deming's PDCA cycle as a framework for managing teacher professional competency development in elementary schools, while also revealing important contextual factors that influence implementation success. The discussion synthesizes key findings in relation to theoretical frameworks and previous research, interprets patterns observed across both case sites, and considers broader implications for educational practice and policy.

The research confirms that Deming's (1994) PDCA cycle can serve as an effective organizing framework for teacher professional competency management in elementary schools, supporting systematic approaches to continuous improvement. Both schools demonstrated application of all four PDCA stages, though with varying degrees of formalization and comprehensiveness. This finding aligns with recent educational applications of the PDCA cycle, which have demonstrated its utility in diverse settings ranging from curriculum development (Langford, 2015) to teacher-student learning improvement cycles (Edutopia, 2023). The systematic nature of the PDCA framework addresses a key challenge identified in teacher professional development literature: the tendency for professional learning to occur in isolated episodes without systematic follow-through or evaluation (Darling-Hammond et al., 2017).

However, this study extends previous research by revealing that effective PDCA implementation in educational settings requires adaptation to institutional contexts and resource constraints. While the original PDCA model emphasizes standardization and formal documentation, this study found that schools with limited resources can achieve meaningful improvement through adapted, less formal versions of the cycle that maintain the essential elements of planning, action, evaluation, and adjustment. This finding resonates with recent research on PDCA application in diverse educational contexts, which emphasizes flexibility and contextualization (CEDEFOP, 2023). The successful implementation at SDN Cikandang, despite significant resource constraints, demonstrates that the underlying logic of continuous improvement cycles can be operationalized through various means, from formal systems to informal collaborative practices.

The study also provides nuanced understanding of how each PDCA stage functions in teacher development contexts. In the planning stage, the research revealed that effective needs assessment requires multiple data sources—supervision observations, teacher self-reports, student outcome data, and collegial discussions—rather than relying on any single indicator. This multi-source approach aligns with principles of data-driven decision making in educational improvement (Bransford et al., 2005) while acknowledging that different types of data provide complementary rather than redundant information. The finding that bottom-up planning at SDN Cikandang generated higher teacher agency suggests that the planning stage should balance organizational direction with teacher autonomy, supporting research on teacher empowerment in professional development (Schulte, 2023).

A central finding of this research is the direct relationship between systematic teacher competency development and the quality of meaningful learning implementation in classrooms. Teachers who participated in well-designed professional development programs demonstrated measurably improved capacity to create learning experiences characterized by the key features of meaningful learning: active student engagement, connection to prior knowledge, application of concepts in authentic contexts, and development of higher-order thinking skills. This finding provides empirical support for Ausubel's (1968) theoretical framework, which posits that meaningful learning requires teachers to possess sophisticated pedagogical content knowledge and the ability to scaffold connections between new information and students' existing cognitive structures (Novak, 2003).

The study extends previous research on teacher competence effects on student outcomes (Fauth et al., 2019; Blömeke et al., 2022) by illuminating the mechanisms through which professional development influences instructional quality. At SDN Loji, the mediating role of teaching quality dimensions—cognitive activation, supportive climate, and classroom management—was clearly observable, supporting the teacher competence-teaching quality-student outcomes chain proposed by Kunter et al. (2013). Teachers who received training in inquiry-based instruction and had opportunities

to practice and receive feedback demonstrated marked improvements in their ability to facilitate student-centered learning activities. This pattern validates the importance of iterative practice cycles in professional development, as advocated by Kennedy (2016), who emphasizes that teacher learning requires not just exposure to new ideas but opportunities for enactment, reflection, and refinement.

An important finding relates to the role of teacher self-efficacy in translating professional development into improved practice. Teachers at both schools who expressed higher confidence in their ability to implement meaningful learning strategies—often as a result of successful initial experiences and supportive feedback—were more likely to persist in using new approaches despite challenges. This finding aligns with research demonstrating that teacher self-efficacy is a critical mediating variable between professional knowledge and instructional practice (Tschannen-Moran & Woolfolk Hoy, 2001; Zee & Koomen, 2016). The study suggests that effective professional competency management should explicitly address affective dimensions of teacher development, including confidence building and resilience in the face of implementation challenges.

The research provides strong evidence for the value of collaborative professional learning structures in supporting teacher development, while also revealing that the form and function of collaboration vary across contexts. At both schools, teachers identified peer learning and collegial support as among the most valuable aspects of professional development. This finding strongly supports decades of research advocating for professional learning communities (PLCs) as effective structures for teacher development (Lomos et al., 2011; Vangrieken et al., 2017). However, the study revealed important distinctions between formal and informal collaborative structures that have received less attention in previous literature.

At SDN Loji, formal collaborative structures—scheduled peer observation cycles, structured lesson study groups, and facilitated reflection meetings—provided systematic opportunities for professional dialogue and reduced the variability in teacher learning experiences. These structures align with recommendations from research on effective professional development, which emphasizes the importance of collaborative, job-embedded learning over isolated workshop attendance (Darling-Hammond et al., 2017). The structured nature of collaboration at SDN Loji ensured that all teachers had access to collegial learning opportunities and that discussions remained focused on instructional improvement rather than drifting to administrative or social topics—a common challenge identified in PLC research (Harris & Jones, 2010; Riggins & Knowles, 2020).

Conversely, the informal collaborative culture at SDN Cikandang, while less systematic, appeared to generate stronger affective bonds and mutual accountability among teachers. This finding suggests that both formal and informal dimensions of collaboration contribute to professional learning in complementary ways. Formal structures ensure systematic, focused learning opportunities, while informal networks provide emotional support, creative problem-solving, and flexible responsiveness to emerging needs. This distinction has implications for how school leaders approach collaborative culture building, suggesting that optimal approaches may involve both designed structures and cultivation of organic collegial relationships. Recent research on teacher leadership in PLCs emphasizes the importance of both structural supports and relational trust (Ghamrawi et al., 2024), a pattern clearly evident in this study's findings.

The study also revealed the critical role of school leadership in facilitating effective collaboration. At both schools, principals who actively participated in professional learning activities, provided resources for collaboration, and protected time for professional dialogue enabled more productive collegial learning. This finding supports research on distributed leadership and teacher empowerment (Bush, 2019; Fullan, 2020), while also highlighting that effective collaboration requires intentional leadership support rather than emerging spontaneously from teacher goodwill alone.

A significant contribution of this research is its detailed documentation of how contextual factors—including resource availability, institutional culture, and teacher characteristics—shape the implementation and effectiveness of professional competency management. The stark contrast in resource availability between SDN Loji and SDN Cikandang provided a natural experiment in how schools

adapt competency management approaches to their circumstances. While previous research has acknowledged the importance of context in educational improvement (Zhang et al., 2020), few studies have systematically compared how similar improvement frameworks function in markedly different resource environments.

The findings challenge simplistic assumptions about the relationship between resources and improvement. While SDN Loji's greater resources enabled more comprehensive and systematic approaches, SDN Cikandang achieved meaningful teacher development through creative adaptation and intensive peer support. This pattern suggests that the core principles of systematic competency management—clear goals, structured learning opportunities, evaluation, and adjustment—can be operationalized through diverse means. However, the study also revealed important trade-offs: SDN Loji achieved greater consistency and comprehensiveness, while SDN Cikandang fostered stronger teacher agency and ownership. These findings have important implications for educational policy, suggesting that improvement frameworks should be sufficiently flexible to accommodate diverse implementation approaches while maintaining fidelity to core principles.

The research also identified unexpected patterns regarding teacher motivation and engagement across contexts. Contrary to assumptions that resource-constrained environments would diminish teacher commitment to professional development, SDN Cikandang teachers demonstrated high levels of intrinsic motivation and creative problem-solving. This finding aligns with self-determination theory (Ryan & Deci, 2000), which posits that autonomy, competence, and relatedness are more important for sustained motivation than external resources or rewards. The implication is that professional competency management systems should prioritize conditions that support teacher autonomy and collegial connection alongside providing resources and training opportunities.

Theoretically, this research demonstrates that Deming's PDCA cycle can be effectively adapted to educational contexts while accounting for teaching's unique characteristics. The findings extend quality management theory by showing that effective implementation requires balancing structure with flexibility, formal systems with informal networks, and organizational direction with professional autonomy. Practically, school principals can design competency management approaches integrating systematic planning, diverse learning opportunities, meaningful evaluation, and responsive follow-up. The comparative analysis highlights the importance of multi-source needs assessment, job-embedded learning, and peer collaboration. For policymakers, the research underscores the need for professional development policies that provide resources while allowing contextual adaptation.

Several limitations should be acknowledged. The case study design, while enabling deep contextual understanding, limits generalizability to other settings. Both schools are located in West Java, and findings may not transfer to different cultural or geographic contexts. The one-year timeframe may not capture longer-term sustainability patterns. While the study documented improvements in teacher practice and student engagement, more rigorous measurement of student learning outcomes would strengthen impact claims. Future research should examine teacher competency management across diverse settings, conduct longitudinal studies tracking sustainability over multiple years, and investigate multi-level influences including district policies and national curriculum frameworks on school-level competency management efforts.

This research advances understanding of teacher professional development as a systematic, continuous improvement process rather than discrete events. By demonstrating PDCA cycle applicability to teacher competency management, the study provides a coherent framework integrating planning, implementation, evaluation, and follow-up. The comparative design illuminates how this framework adapts to diverse contexts while maintaining core improvement principles. The findings underscore that effective teacher development is characterized by systematic attention to interconnected elements: clear needs identification, aligned learning opportunities, meaningful evaluation, and responsive adaptation. When integrated into continuous cycles supported by collaborative cultures and committed leadership, schools can build institutional capacity for sustained enhancement of teaching quality and meaningful learning.

CONCLUSION

This study demonstrates that Deming's PDCA cycle provides an effective framework for managing teacher professional competencies in elementary schools, contributing to improved meaningful learning implementation. The comparative analysis of SDN Loji and SDN Cikandang reveals that while both schools successfully applied all PDCA stages—planning, implementation, evaluation, and follow-up—the sophistication and formalization of approaches varied according to institutional contexts and resource availability. SDN Loji's structured, resource-supported approach achieved comprehensive systematic development, whereas SDN Cikandang's adaptive, collaborative strategies fostered strong teacher agency and peer accountability despite resource constraints. These findings advance educational management theory by demonstrating that quality management frameworks can be effectively adapted to the complex, relational nature of teaching when implementation balances systematic structures with professional autonomy and formal programs with informal collaboration.

The research contributes theoretically by bridging industrial quality management principles with educational practice, showing that continuous improvement cycles support sustainable teacher development. Practically, the findings guide school principals in designing multi-faceted competency management systems integrating diverse learning opportunities, meaningful evaluation, and responsive follow-up. For policymakers, the study underscores the importance of providing resources while allowing contextual flexibility in professional development implementation. The research reveals that effective teacher competency management requires coordinated attention to multiple interconnected elements: clear needs identification, job-embedded learning, collaborative cultures, committed leadership, and data-informed decision-making.

However, limitations should be acknowledged. The case study design limits generalizability beyond similar contexts, and the one-year timeframe may not capture long-term sustainability patterns. Future research should examine teacher competency management across diverse geographic and cultural settings through longitudinal designs, investigate multi-level influences including district policies and national frameworks, and employ mixed methods to quantify relationships between specific management practices and student learning outcomes. Such investigations would further illuminate how systematic approaches to teacher professional development can be optimized across varied educational contexts to enhance meaningful learning quality.

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