

Collegiality-Based Professional Development for Mathematics Teachers: Contextualizing Tulungagung's Local Wisdom through the KPRB Framework

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Abstract. Mathematics teacher professional development is often separated from teachers' daily instructional practice, limiting opportunities for collaborative learning, reflection, and use of evidence from classroom experiences. This article formulates a conceptual framework for mathematics teacher professional development based on collegiality, practice, reflection, and sharing, incorporating the local cultural context of Tulungagung. A narrative literature review and thematic synthesis were conducted on literature concerning teacher professional development, mathematics teacher professional development, Lesson Study, professional learning communities, digital technology, and the *manjing* practice of Tulungagung marble artisans. The synthesis resulted in the Collegiality–Practice–Reflection–Sharing (KPRB) framework, which conceptualizes professional development as a continuous learning cycle embedded in instructional practice. The *manjing* practice provides a cultural context for learning through observation, imitation, and hands-on practice with more experienced artisans. The framework offers a relatively low-resource, context-responsive approach but remains conceptual and requires empirical testing.

Keywords: teacher professional development; mathematics teacher; collegiality; Lesson Study; local wisdom; Tulungagung; KPRB

1 Introduction

Teacher professional development is a crucial component of improving the quality of instruction. However, professional development should not be understood merely as a series of short-term training activities. To influence instructional practice, professional development needs to provide teachers with opportunities to explore new ideas, connect those ideas with actual classroom practice, receive feedback, and reflect on their experiences continuously [1]; [2]. Professional learning therefore needs to be situated as close as possible to the instructional realities that teachers encounter in their daily work.

This need is particularly important in mathematics teacher professional development. Mathematics instruction presents challenges that cannot always be addressed through subject-matter knowledge or pedagogical techniques alone. Teachers need to understand students' mathematical thinking, respond to diverse solution strategies, use productive questioning, and adjust instruction based on evidence emerging during the learning process. Systematic reviews indicate that mathematics teacher professional development commonly emphasizes reflection on practice, the development of learning environments, content-focused learning, Lesson Study, and inquiry-based approaches [3]. Other studies emphasize the importance of developing teachers' abilities to address tasks specific to mathematics instruction, including noticing and interpreting students' mathematical thinking [4].

A major challenge in professional development is integrating teacher learning into everyday work routines. Lesson Study and professional learning communities (PLCs) provide structures through which teachers can learn through collaborative planning, lesson observation,

discussion, and reflection. Research on Lesson Study indicates promising potential for teacher professional learning, although the empirical evidence remains limited and the quality of research designs varies across studies [5]; [6]. In mathematics education, research on PLCs likewise highlights the role of professional interaction and collaboration in creating spaces for teacher learning [7].

These issues are particularly relevant in resource-constrained schools. Professional development models that depend heavily on external training, specialized facilitators, or particular technologies may be difficult to sustain once external support ends. Digital tools can broaden opportunities for teacher collaboration, but technology is more appropriately viewed as a means of supporting professional learning rather than as the primary goal of professional development [8]. In this context, the social and cultural environment in which teachers work can provide an immediate and accessible source of learning. Tulungagung, for example, has a longstanding tradition of marble craftsmanship that includes the *manjing* practice, through which skills are acquired through observation, imitation, and hands-on practice alongside more experienced artisans [9]. This practice should not be equated directly with teacher professional development. Rather, *manjing* offers a cultural perspective on how knowledge and skills can develop through sustained engagement in practice and interaction with more experienced individuals.

This context leads to the central conceptual question of this article: how can the principles of practice-based professional development and collegiality be integrated into a simple and sustainable cycle suited to resource-constrained school environments while remaining relevant to the local cultural context of Tulungagung? In response, this article proposes the Collegiality–Practice–Reflection–Sharing (KPRB) framework. The contribution of this article does not lie in presenting a pre-validated professional development model. Instead, it lies in constructing a conceptual framework that connects principles identified in the professional development literature with a local cultural context. In this capacity, the KPRB framework provides a basis for further development, contextual adaptation, and empirical testing in mathematics teacher professional development.

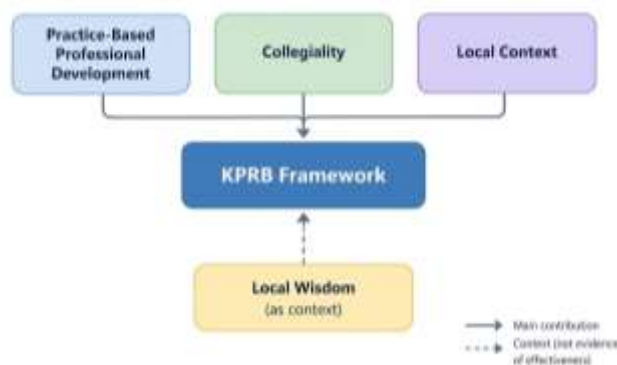


Fig. 1. Conceptual positioning of the KPRB framework within mathematics teacher professional development based on practice, collegiality, and local context.

2 Methods

This article employs a narrative literature review with thematic synthesis. The literature was purposively selected based on its relevance to teacher professional development, particularly mathematics teacher professional development, as well as professional collaboration, Lesson Study, professional learning communities (PLCs), digital technology as professional learning support, and local culture-based informal learning practices. This approach was used to connect relevant concepts and organize them into a conceptual framework rather than to estimate effect sizes, as in a meta-analysis.

The analysis was conducted in four stages. First, relevant literature was identified based on key concepts related to teacher professional learning. Second, the characteristics and

mechanisms of professional learning were compared to identify recurring elements, particularly practice, collaboration, reflection, and sharing. Third, these elements were synthesized into the principles of the KPRB framework. Fourth, the framework was contextualized through the manjing practice found within the Tulungagung marble artisan community.

3 Result and Discussion

3.1 Teacher Professional Development as Practice-Based Learning

The literature indicates a shift in the understanding of teacher professional development from training activities toward learning processes that are more closely connected to instructional practice. Several key characteristics of effective professional development have been identified, including a focus on content, active learning, coherence, sufficient duration, and collective participation [1]. Other studies similarly emphasize active learning, collaboration, the use of practice models, feedback, reflection, and sustainability [2].

More recent findings further highlight the importance of connecting professional development with instructional practice. A meta-analysis shows that teacher professional development interventions are, on average, associated with improved student learning outcomes, although the magnitude of the effects varies across interventions [10]. Another review likewise reports positive relationships among professional development, instructional practices, and student achievement, while noting that causal evidence in professional development research remains limited [11].

These findings suggest that the central issue is not simply whether teachers participate in training, but how professional learning experiences are translated into classroom practice. In mathematics teacher professional development, this can involve activities that enable teachers to observe lessons, examine student responses, discuss instructional strategies, and make adjustments based on evidence. Professional learning therefore does not exist separately from teachers' work but develops through their engagement with that work.

Lesson Study and Professional Learning Communities (PLCs) provide organizational structures that support such processes. Teachers can begin with authentic instructional challenges, develop or refine an instructional plan, observe its implementation, and discuss the evidence that emerges. However, formal and intensive structures may not be feasible in every school. The underlying principles therefore need to be translated into simpler cycles that can make use of resources already available within the school.

3.2 The KPRB Framework: Collegiality, Practice, Reflection, and Sharing

Based on the synthesis of the literature, this article proposes the KPRB framework, consisting of four stages: Collegiality, Practice, Reflection, and Sharing. These stages form a cycle rather than a linear sequence that ends after a single round.

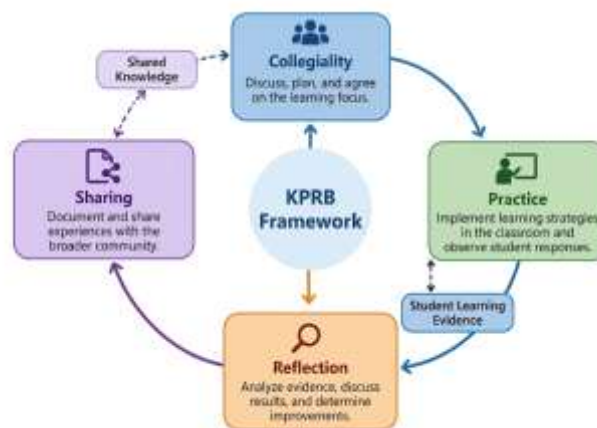


Fig. 2. The KPRB cyclical framework.

The first stage is Collegiality. Teachers collaborate with colleagues to identify meaningful instructional issues and determine a specific focus for professional learning. These issues may include students' difficulties in understanding mathematical concepts, the quality of mathematical reasoning, the use of representations, or problem-solving strategies. Establishing a shared focus helps ensure that professional development responds to authentic instructional needs rather than being driven solely by externally mandated training topics.

The second stage is Practice. Teachers implement the instructional strategies or lesson designs developed during the preceding stage. Other teachers may participate as observers when conditions permit, but their involvement does not need to take the form of formal observation. Teacher notes, student work, student responses, or simple documentation can provide sufficient evidence for discussion during the next stage. The third stage is Reflection. Teachers and their colleagues examine the evidence of learning and discuss what occurred during instruction. Reflection focuses not on evaluating the teacher as an individual but on understanding the relationship among the instructional design, the teacher's actions, and students' responses. In this way, classroom experience becomes a source of professional knowledge.

The fourth stage is Sharing. The outcomes of reflection need not remain within the individual teacher or small group involved in the activity. Teaching strategies, instructional materials, reflection notes, or brief findings can be shared with other teachers through school-based forums, Subject Teacher Working Groups (MGMP), or available digital communication channels. Sharing allows individual experiences to contribute to collective professional knowledge and provides a starting point for the next cycle. KPRB therefore integrates several principles identified in the professional development literature without claiming to constitute an entirely new professional development model. Its conceptual value lies in connecting and simplifying these elements so that professional development can be understood as a small-scale learning cycle embedded in everyday instructional practice.

Table 1. Operationalization of the KPRB Framework

Stage	Guiding Question	Main Activities	Evidence or Artifacts	Minimum Resources
Collegiality	What instructional issue needs to be understood and improved together?	Identify an instructional issue; establish a shared focus; develop possible instructional actions	Problem focus; lesson design; notes of agreements	Meeting time; colleagues; available instructional materials
Practice	How can the agreed ideas be implemented in instruction?	Implement the lesson design; observe student responses; collect evidence of learning	Student work; observation notes; student responses; learning documentation when available	Regular classroom; instructional materials; simple documentation tools
Reflection	What happened during the lesson, and what can be learned from the evidence?	Examine evidence of learning; discuss student responses; identify strengths and aspects requiring improvement	Reflection notes; analysis of student work; recommendations for improvement	Learning evidence; discussion time; colleagues
Sharing	What knowledge or experience can be used collectively?	Share reflection outcomes; document practice; discuss possible application in other contexts	Instructional materials; examples of practice; reflection notes; sharing materials	School or MGMP forums; communication or digital storage tools when available
	What instructional issue needs to be understood and improved together?	Identify an instructional issue; establish a shared focus; develop possible instructional actions	Problem focus; lesson design; notes of agreements	Meeting time; colleagues; available instructional materials

improved
together?

possible instructional
actions

Note: KPRB is understood as a cycle. Therefore, Sharing is not the final stage but provides input for the Collegiality stage of the next cycle.

A basic implementation of KPRB can be carried out without specialized equipment. Collegial interaction can take place during existing teacher meetings, while Practice occurs within regular classrooms. Reflection can draw on student work or student responses as evidence, and knowledge sharing can make use of existing teacher forums such as MGMP or digital communication channels already in use. Within this framework, technology is optional. It can expand opportunities for collaboration and documentation but is not a prerequisite for professional learning.

3.3 Contextualizing KPRB through the *Manjing* Practice in Tulungagung

Local contexts can provide opportunities to connect professional development more closely with the social environment in which teachers work. One relevant example is the manjing practice found within Tulungagung's marble artisan community. Manjing is described as a process of skill transmission in which less experienced artisans learn by observing, imitating, and practicing skills demonstrated by more experienced artisans [9].

This practice is not intended to be a direct equivalent of teacher professional development. Teachers are not artisans, and mathematics teaching has its own characteristics and demands. The value of manjing in this article lies in the learning principles that can be interpreted conceptually, including learning through engagement in practice, observing the practices of more experienced individuals, having opportunities to experiment, and participating in knowledge-sharing processes.

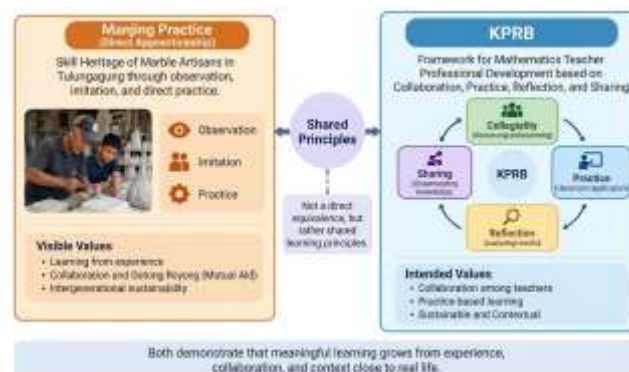


Fig. 4. Conceptual illustration comparing the manjing practice and the KPRB framework.

The relationship can be understood at a conceptual level. Observation within manjing resembles teachers' engagement in observing instruction. Opportunities to experiment correspond to the Practice stage. Evaluation and refinement of skills provide a conceptual parallel to Reflection. Meanwhile, the transmission of knowledge among artisans can inform professional knowledge-sharing practices among teachers.

Local wisdom is therefore not positioned as evidence that KPRB will be effective. Instead, it serves as a contextual lens for illustrating how learning can develop through participation in practice and interaction with people who possess different levels of experience. This approach prevents local wisdom from being reduced to cultural ornamentation while also avoiding unsupported empirical claims.

For schools with limited resources, this approach offers possibilities for professional development that do not depend entirely on external programs. Schools can begin with existing instructional issues, engage available colleagues, use simple evidence of student learning, and gradually build shared professional knowledge. Inter-school forums such as MGMP can subsequently broaden the exchange of experiences. Where available, digital tools can be used to archive materials, share reflections, and maintain communication among teachers.

However, the sustainability of KPRB cannot be assumed solely because its resource requirements are relatively low. Its implementation will still depend on factors such as teachers' available time, school leadership support, collaborative culture, workload, and opportunities for continued professional interaction. Thus, the term *sustainable* in this article refers to the potential sustainability of the design rather than an empirically established outcome.

4 Conclusion

Mathematics teacher professional development needs to move beyond training activities that are detached from classroom practice toward professional learning grounded in practice, collaboration, reflection, and knowledge sharing. Literature on teacher professional development, Lesson Study, Professional Learning Communities, and mathematics teacher professional development provides a basis for positioning these elements as important components of ongoing professional learning.

Based on this synthesis, this article proposes the KPRB framework, consisting of Collegiality, Practice, Reflection, and Sharing. The framework is designed as a simple cycle that makes use of resources already available within schools. The *manjing* practice found in the Tulungagung marble artisan community serves as a cultural context for reinforcing the idea that professional learning can develop through engagement in practice, observation, hands-on experience, and knowledge sharing.

The KPRB framework should not yet be regarded as a validated or proven effective professional development model. It remains conceptual and requires empirical validation across diverse school contexts. Future research may examine its feasibility, implementation processes, continuity across cycles, changes in teachers' professional practices, and potential relationships with students' learning experiences and outcomes.

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