

A Review of Pedagogical Knowledge and its Impact on Student-Teacher Interaction

Vasudev Narayan¹ and Dr. Jagdish Babu Lal Rathore²

¹Research Scholar, ² Research Guide

Department of Education

Sunrise University Alwar (Raj.) India

Abstract: *Pedagogical knowledge is a fundamental component of effective teaching because it determines how teachers organize learning experiences, communicate subject matter, respond to students' needs, manage classrooms, and facilitate meaningful interaction. In contemporary teacher education, pedagogical knowledge is increasingly understood not merely as knowledge of teaching methods but as an integrated professional capacity involving instructional strategies, classroom management, assessment, learner understanding, communication, reflection, and adaptation to contextual needs. This review examines literature published between 2010 and 2025 concerning pedagogical knowledge and its influence on student-teacher interaction. The review indicates that teachers possessing stronger pedagogical knowledge are better positioned to select appropriate instructional strategies, formulate meaningful questions, provide constructive feedback, recognize student misconceptions, encourage participation, and create supportive classroom environments. Research on pedagogical content knowledge further suggests that the effective transformation of subject knowledge into teachable forms is closely connected with the quality of classroom interactions.*

Keywords: Pedagogical Knowledge, Pedagogical Content Knowledge, Teacher Knowledge, Student-Teacher Interaction.

I. INTRODUCTION

The quality of education depends substantially on the knowledge, skills, attitudes, and professional practices of teachers. Among these dimensions, pedagogical knowledge occupies a central position because it concerns teachers' understanding of how students learn and how instruction can be designed to support learning. Pedagogical knowledge includes knowledge of instructional methods, classroom organization, assessment, learner characteristics, questioning techniques, feedback, motivation, and strategies for adapting teaching to different learners. It therefore influences not only what teachers teach but also how they interact with students during the teaching-learning process.

Student-teacher interaction is one of the most visible manifestations of teachers' pedagogical knowledge. Classroom interaction includes questioning, explanation, discussion, feedback, encouragement, classroom management, collaborative activities, and responses to students' ideas. Effective interaction is not simply a matter of maintaining communication; it involves teachers interpreting students' responses and adjusting instruction accordingly. Research has increasingly emphasized that teacher-student interactions constitute an important mechanism through which teaching affects students' academic and developmental experiences. The Teaching Through Interactions framework, for example, identifies emotional support, classroom organization, and instructional support as major dimensions of classroom interaction.

The concept of pedagogical content knowledge is particularly important in understanding this relationship. PCK refers to teachers' capacity to transform subject-matter knowledge into forms that are understandable and useful for particular learners. Alonzo et al. (2012) demonstrated how PCK can be examined through actual teacher-student interactions and identified flexibility, richness, and learner-centeredness as important characteristics of teachers' use of content knowledge.

Between 2010 and 2025, research has increasingly moved from viewing teacher knowledge as a collection of separate competencies toward understanding it as an integrated and context-sensitive professional resource. Recent systematic research indicates that PCK is strongly connected with teachers' content knowledge and teaching practices, while evidence concerning direct relationships with student achievement remains more complex. This review therefore focuses on the relationship between pedagogical knowledge and student-teacher interaction and identifies major themes emerging from the literature published during 2010–2025.

II. CONCEPTUALIZING PEDAGOGICAL KNOWLEDGE

Pedagogical knowledge can be understood as the knowledge teachers require to facilitate effective learning irrespective of a particular subject. It encompasses knowledge about teaching strategies, classroom management, assessment, student motivation, learning processes, instructional planning, and classroom communication. It allows teachers to make informed decisions about what to teach, how to teach it, when to introduce particular strategies, and how to respond to differences among learners.

Pedagogical knowledge differs from content knowledge because it emphasizes the processes through which knowledge is taught. However, effective teaching generally requires integration between content and pedagogy. PCK represents one important form of this integration. It allows teachers to identify difficult concepts, anticipate misconceptions, choose appropriate representations, and modify explanations according to learners' needs.

Research with pre-service teachers has also demonstrated the multidimensional character of teacher knowledge. Koh (2010), in a large-scale study of Singaporean pre-service teachers, identified distinct dimensions involving technological knowledge, content knowledge, pedagogical knowledge, technology-supported teaching knowledge, and critical reflection. This development contributed to a broader understanding of teacher knowledge in which pedagogical competence is increasingly connected with technological and reflective competencies.

III. DEVELOPMENT OF PEDAGOGICAL KNOWLEDGE IN TEACHER EDUCATION

Teacher education is a major context for developing pedagogical knowledge. Initial teacher education provides prospective teachers with theoretical knowledge about learning, instructional methods, assessment, classroom management, and student development. Nevertheless, theoretical knowledge alone does not guarantee effective classroom interaction. Student teachers need opportunities to apply pedagogical principles in authentic classrooms.

A study of mathematics student teachers found that participants considered courses designed to develop mathematical PCK necessary, while also identifying limitations in how such knowledge was developed through undergraduate education. This finding highlights the importance of connecting university-based learning with practical teaching experiences.

Mentoring and reflective dialogue are particularly valuable. Zimmerman Nilsson and Nilsson (2019) found that mentor-student-teacher conversations could support the development of PCK by helping student teachers connect pedagogical knowledge, subject matter knowledge, and contextual knowledge. Such findings suggest that pedagogical knowledge develops through an interaction between theory, classroom experience, reflection, and professional dialogue.

IV. PEDAGOGICAL KNOWLEDGE AND CLASSROOM COMMUNICATION

Communication represents a fundamental dimension of student-teacher interaction. Teachers with strong pedagogical knowledge are more likely to recognize that communication is a two-way process rather than simply the transmission of information. Effective teachers listen to students, interpret their responses, use appropriate explanations, and encourage students to express ideas and questions.

Pedagogical knowledge enables teachers to select communication strategies according to learners' developmental levels and prior knowledge. For example, a teacher may use concrete examples with beginners, conceptual questioning with advanced learners, or visual representations when students experience difficulty with abstract concepts.

The nature of pedagogical interaction also varies according to teachers' conceptions of their roles. Beutel (2010) identified qualitatively different forms of pedagogic teacher-student engagement, ranging from information provision to mentoring. This suggests that pedagogical knowledge can influence whether teachers perceive interaction primarily as knowledge transmission or as a broader process of guidance, dialogue, and learner development.

V. PEDAGOGICAL KNOWLEDGE AND QUESTIONING STRATEGIES

Questioning is one of the most important mechanisms through which teachers stimulate student participation. Pedagogically knowledgeable teachers can distinguish between questions that merely require factual recall and questions that encourage explanation, reasoning, evaluation, and reflection.

Effective questioning can create opportunities for students to articulate their understanding and reveal misconceptions. Teachers can then use students' responses as formative information for modifying instruction. Thus, questioning becomes an interactive diagnostic process rather than merely an assessment technique.

PCK is especially relevant because good subject-specific questions require teachers to understand both the structure of the content and the ways students typically understand or misunderstand that content. Consequently, pedagogical knowledge and PCK can contribute to more meaningful classroom dialogue.

VI. PEDAGOGICAL KNOWLEDGE AND FEEDBACK

Feedback is another important component of student-teacher interaction. Effective feedback provides students with information about their current performance, identifies areas requiring improvement, and guides subsequent learning. Pedagogical knowledge enables teachers to provide feedback that is specific, understandable, timely, and connected with learning objectives.

Teacher feedback can also influence classroom relationships. Supportive feedback communicates that mistakes are opportunities for learning rather than evidence of failure. This can encourage students to participate more actively and ask questions without excessive fear of negative evaluation.

The relationship between teachers' instructional expertise and interpersonal relationships has been empirically investigated. Research involving in-service teachers found systematic associations between levels of instructional expertise and patterns of interpersonal relationships with students. This supports the view that instructional expertise and interpersonal interaction should not be treated as completely separate dimensions of teaching.

VII. PEDAGOGICAL KNOWLEDGE AND LEARNER-CENTERED TEACHING

Learner-centered teaching requires teachers to understand learners' prior knowledge, interests, learning difficulties, cultural backgrounds, abilities, and motivational needs. Pedagogical knowledge provides the basis for adapting instruction to these differences.

Alonzo et al. (2012) showed that learner-centeredness was one of the characteristics through which PCK was reflected in classroom interactions. This is important because a teacher may possess extensive subject knowledge but still struggle to communicate it effectively if instruction is not adapted to students.

Recent research on teachers' knowledge and perceptions of individual students also indicates that teachers' knowledge of students is closely connected with teacher-student relationships. Therefore, pedagogical knowledge should include not only knowledge of general learning principles but also knowledge of particular learners.

VIII. PEDAGOGICAL KNOWLEDGE AND CLASSROOM MANAGEMENT

Classroom management is another major component of pedagogical knowledge. Effective classroom management establishes conditions in which meaningful interaction can occur. Teachers need to organize classroom activities, establish expectations, manage transitions, maintain student attention, and respond appropriately to disruptive behavior.

Poor classroom management can reduce opportunities for productive interaction because excessive time is spent addressing behavioral problems. In contrast, effective organization creates more instructional time and allows teachers to devote attention to students' learning needs.

The Teaching Through Interactions framework conceptualizes classroom interaction through emotional support, classroom organization, and instructional support. Evidence from thousands of classrooms indicates that these dimensions represent distinguishable components of classroom interaction. This framework reinforces the idea that effective interaction involves both instructional and relational processes.

IX. PEDAGOGICAL CONTENT KNOWLEDGE AND STUDENT-TEACHER INTERACTION

PCK provides perhaps the strongest conceptual bridge between teacher knowledge and classroom interaction. Teachers need to transform disciplinary knowledge into explanations, examples, representations, analogies, questions, demonstrations, and learning activities that students can understand.

Alonzo et al. (2012) examined PCK through video analysis of physics teachers' classroom instruction and demonstrated how teachers' use of content knowledge could be studied through their interactions with students. Their findings emphasized flexibility, richness, and learner-centeredness as important characteristics.

The implication is that PCK is not merely something teachers possess internally; it becomes visible through teaching actions and interactions. When teachers respond to unexpected student ideas, modify explanations, connect concepts to prior knowledge, and choose representations according to students' needs, their PCK is manifested through interaction.

X. TECHNOLOGICAL PEDAGOGICAL KNOWLEDGE AND CONTEMPORARY INTERACTION

The development of digital education has expanded the meaning of pedagogical knowledge. Teachers increasingly need knowledge about how digital tools can support explanation, collaboration, assessment, feedback, and individualized learning.

The TPACK framework extends traditional conceptions of teacher knowledge by considering the relationships among technology, pedagogy, and content. Koh et al. (2010) found multiple dimensions within pre-service teachers' perceptions of technology-related teacher knowledge, highlighting the complexity of integrating technology into teaching.

Digital tools can potentially increase interaction through online discussion, collaborative documents, simulations, adaptive learning systems, and immediate feedback. However, technology itself does not guarantee effective interaction. Teachers require pedagogical knowledge to select appropriate technologies and integrate them with instructional objectives.

XI. RECENT EVIDENCE

Recent literature has provided increasingly systematic evidence concerning the relationship between PCK, teaching quality, and student outcomes. A 2025 systematic review and meta-analysis examined 298 effect sizes from 56 studies of mathematics and science teachers. The findings indicated positive relationships between PCK and content knowledge and teacher efficacy, while multilevel analyses indicated positive relationships involving teaching quality and student achievement.

Another major 2025 systematic synthesis examined 217 empirical studies of science teachers' PCK. The review reported strong connections between PCK, teaching practices, and teacher competence, but relationships with student outcomes were less consistent. It also emphasized differences in how PCK is conceptualized, measured, and operationalized across studies.

Research on EFL student teachers published in 2025 similarly found that PCK components can initially be fragmented but may become increasingly integrated during mentoring-enriched practicum experiences. Instructional strategies emerged as an especially prominent component in this development.

These findings indicate that pedagogical knowledge should not be treated as a static qualification. Rather, it develops through experience, reflection, mentoring, subject-specific practice, and interaction with learners.

XII. CRITICAL ANALYSIS

The literature reviewed demonstrates a generally positive relationship between pedagogical knowledge and the quality of student-teacher interaction, but the relationship is neither simple nor entirely linear. Possessing pedagogical knowledge does not automatically produce effective interaction. Teachers must be able to activate and adapt their knowledge in particular classroom situations.

One important issue is the difference between declarative and practical knowledge. A teacher may know theoretically that open-ended questioning promotes higher-order thinking but may still rely primarily on closed questions during actual classroom instruction. Similarly, teachers may understand the importance of formative assessment but fail to use student responses effectively to modify instruction.

A second issue concerns the contextual nature of teaching. Pedagogical strategies that work effectively in one classroom may not produce the same results in another. Class size, student characteristics, curriculum requirements, cultural context, available resources, and institutional expectations can influence the application of pedagogical knowledge.

A third issue concerns measurement. Recent reviews have noted considerable variation in the conceptualization and measurement of PCK, making comparisons across studies difficult. This methodological issue should be addressed through more consistent and multidimensional approaches involving classroom observation, interviews, teacher artifacts, student perceptions, and measures of student learning.

XIII. IMPLICATIONS FOR TEACHER EDUCATION

The literature suggests several implications for teacher education.

First, teacher education programs should integrate pedagogical theory with authentic classroom practice. Student teachers should have repeated opportunities to observe, teach, receive feedback, and reflect.

Second, mentoring should be strengthened. Mentor teachers can help student teachers interpret classroom events, identify student thinking, and connect theoretical knowledge with practical decision-making.

Third, teacher education should emphasize PCK rather than treating content and pedagogy as completely independent areas. Student teachers should learn how specific concepts, misconceptions, examples, representations, and learning difficulties influence instructional decisions.

Fourth, communication and interaction skills should receive greater attention. Student teachers should be trained in questioning, active listening, feedback, discussion facilitation, and dialogic teaching.

Finally, technology should be integrated into pedagogical preparation. Teachers need to understand not simply how digital tools operate but when and why particular technologies can improve learning and interaction.

XIV. RESEARCH GAPS

Although substantial research has examined pedagogical knowledge, several gaps remain. First, more longitudinal studies are needed to determine how pedagogical knowledge develops from teacher preparation through early career teaching.

Second, research should examine the interaction between pedagogical knowledge and specific student characteristics. More attention is required to understand how teachers adapt pedagogical knowledge for students with different abilities, languages, cultural backgrounds, and learning needs.

Third, many studies rely on teacher self-report measures. Future research should combine self-reports with classroom observations, student evaluations, video analysis, interviews, and learning outcomes.

Fourth, research should investigate how artificial intelligence, adaptive learning systems, virtual classrooms, and other emerging technologies influence the relationship between pedagogical knowledge and student-teacher interaction.

Finally, greater methodological consistency is needed. Recent systematic reviews have highlighted differences in PCK conceptualization and measurement, indicating the need for stronger common frameworks.

XV. CONCLUSION

Pedagogical knowledge is a central foundation of effective student-teacher interaction. The literature from 2010 to 2025 indicates that teachers' knowledge of instructional strategies, learners, assessment, classroom management, communication, and subject-specific pedagogy contributes to their capacity to create meaningful and responsive learning environments. PCK is especially important because it connects what teachers know about a subject with how that knowledge can be represented and communicated to particular learners.

Evidence suggests that pedagogically knowledgeable teachers are better positioned to ask productive questions, recognize misconceptions, provide meaningful feedback, adapt instruction, manage classroom activities, and support learner participation. Research also demonstrates that pedagogical knowledge is dynamic and develops through classroom experience, reflection, mentoring, and professional learning. Recent systematic reviews reinforce the strong relationship between PCK and teaching practices, although the direct relationship with student achievement is more variable.

Student-teacher interaction should be understood as a practical expression of teachers' professional knowledge. Strengthening pedagogical knowledge within teacher education and continuing professional development can therefore contribute to more dialogic, inclusive, adaptive, and learner-centered teaching. Future research should move toward integrated models that examine pedagogical knowledge, classroom interaction, teacher development, technology, and student outcomes together.

REFERENCES

1. Alonzo, A. C., Kobarg, M., & Seidel, T. (2012). Pedagogical content knowledge as reflected in teacher-student interactions: Analysis of two video cases. *Journal of Research in Science Teaching*, 49(10), 1211–1239.
2. Beutel, D. A. (2010). The nature of pedagogic teacher-student interactions: A phenomenographic study. *The Australian Educational Researcher*, 37(2), 77–91.
3. Fukaya, T., Nakamura, D., Kitayama, Y., & Nakagoshi, T. (2025). A systematic review and meta-analysis of research on mathematics and science pedagogical content knowledge: Exploring its associations with teacher and student variables. *Teaching and Teacher Education*, 155, 104881.
4. Koh, J. H. L., Chai, C. S., & Tsai, C. C. (2010). Examining the technological pedagogical content knowledge of Singapore pre-service teachers with a large-scale survey. *Journal of Computer Assisted Learning*, 26(6), 563–573.
5. Li, S., Liu, L., & Jiang, A. L. (2025). Profiling the development of integration among Chinese EFL student-teachers' pedagogical content knowledge. *SAGE Open*.
6. Park, S., & Chan, K. K. H. (2025). Unpacking PCK relationships and development in science teachers: A systematic synthesis of empirical research. *Review of Educational Research*.