

Pedagogical Content Knowledge (PCK): Conceptualizations and Characteristics

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Publication Date: 2026/10/07

Abstract: This research paper traces the place of PCK in teachers knowledge base of teaching and also its development from Shulman's two key components to various models of PCK. The paper reviews different conceptualizations of PCK leading to expansion of components of PCK. The analysis reveals different characteristics of PCK along with the taxonomy of PCK. The paper concludes that teacher education programs should develop PCK through development of knowledge across all components of PCK. Workshops, seminars can be conducted for the same purpose.

Keywords: Pedagogical Content Knowledge; Teacher Knowledge; PCK; Teacher Education; Components of PCK, Characteristics of PCK.

How to Cite: Dr. Mamta Rajput (2026) Pedagogical Content Knowledge (PCK): Conceptualizations and Characteristics. *International Journal of Innovative Science and Research Technology*, 11(9), 3072-3075. <https://doi.org/10.38124/ijisrt/26sep1303>

I. INTRODUCTION

Effective teaching requires more than knowing the subject and general pedagogical skills. A teacher must anticipate how learners will interpret a particular idea, represent it meaningfully, which examples and analogies will make it understandable, what can be the probable learning difficulties and misconceptions and whether learning has taken place, how to assess it. This specialised knowledge has been named Pedagogical content knowledge. It occupies the productive intersection between content and pedagogy while remaining sensitive to learners, curriculum, assessment, and context.

Shulman (1986, 1987) introduced PCK as the “missing paradigm” in research on teaching. He redirected attention from generic teaching behaviour of teachers to transformation of subject matter knowledge into students understanding through examples, analogies and illustrations. Shulman's conceptualization of PCK subsequently expanded, contested, reviewed and researched by various educationist especially in science and mathematics education. PCK has consequently become an accepted academic construct.

This research paper attempts to discuss, How PCK has developed as a concept? Different models of PCK, implications for teacher education and research. Its purpose is not to declare a single model definitive, but to produce a coherent account of the construct and identify principles that remain useful.

II. METHODOLOGY

The paper uses a narrative conceptual-review approach. It synthesizes foundational and model-building works beginning with Shulman's original idea and examining major expansions by Tamir, Grossman, Marks, Cochran, Fernandez-Balboa and Stiehl, Veal and MaKinster, Magnusson, Loughran and Park and Oliver.

The analysis includes: (a) the place of PCK in the teacher-knowledge base; (b) the components of PCK; (c) integrative vs transformative model of PCK; (d) characteristics of PCK and (e) implications for teacher education and further research. This is a theoretical synthesis rather than a systematic review; it does not claim exhaustive database coverage or meta-analytic inference.

III. PCK WITHIN THE KNOWLEDGE BASE FOR TEACHING

According to Lee S. Shulman(1986) “teaching necessarily begins with a teachers' understanding of what is to be learned and how it is to be taught. It proceeds with a series of activities during which the students are provided specific instruction and opportunities for learning, though the learning itself ultimately remains the responsibility of the students.”(Shulman, 1987, p.7). He described seven categories of knowledge that teachers need to facilitate comprehension among students. “The seven categories of knowledge identified by Shulman were:

- Content knowledge;
- General pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend subject matter;
- Curriculum knowledge, with particular grasp of the materials and programs that serve as “tools of the trade” for teachers;
- Pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding;
- Knowledge of learners and their characteristics;
- Knowledge of educational contexts, ranging from the workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures; and
- Knowledge of educational ends, purposes, and values, and their philosophical and historical grounds.

Among those categories, pedagogical content knowledge is of special interest because it identifies the distinctive bodies of knowledge for teaching” (Shulman, 1987, p. 8).

Building upon Shulman’s (1987) work, Tamir (1988) reorganized and extended the categories suggested by Shulman into six categories as:

- “General liberal education,
- Personal performance,
- Subject matter,
- General pedagogical,
- Subject matter specific pedagogical; (equivalent to PCK) and
- Foundations of the teaching profession.”

Grossman’s (1990) model of teacher knowledge gave four general areas of teacher knowledge:

- “Knowledge of subject matter,
- General pedagogical knowledge,
- Knowledge of context, and
- Pedagogical content knowledge (PCK)”.

Magnusson, Krajcik, and Borko (1999) expanded models of teacher knowledge given by Shulman (1987) and Grossman (1990) and included the same knowledge domains as present in Grossman’s model.

Carlsen (1999) categorised teachers’ knowledge into five general categories:

- “Knowledge about the general educational context;
- Knowledge about the specific educational context, including the classroom and students to be taught;
- General pedagogical knowledge;
- Subject matter knowledge, and
- Pedagogical content knowledge.”

Barnett and Hudson (2001) suggested “pedagogical context knowledge”, including four categories of knowledge:

- “Academic and research knowledge,
- Pedagogical content knowledge,
- Professional knowledge, and
- Classroom knowledge.”

Thus it could be seen that in defining teachers’ knowledge base for teaching, the common components which occurred amongst the researchers’ conceptualization of knowledge base for teaching are: “subject matter knowledge, pedagogical knowledge, Pedagogical Content Knowledge (PCK) and knowledge of context.”

Of these, pedagogical content knowledge has prompted considerable interest among the educational researchers.

➤ *Shulman’s Pedagogical Content Knowledge*

Shulman (1986) emphasized two core elements: representations of subject matter and understanding of learners’ conceptions. Representations include analogies, examples, explanations, demonstrations, illustrations, and other ways of formulating a topic so that it becomes comprehensible. Knowledge of learners includes awareness of students previous knowledge, their cognitive level, the prior conceptions students bring, and strategies for reorganizing inadequate understandings. PCK is therefore relational: the suitability of an explanation cannot be judged apart from the idea being taught and the learners for whom it is intended.

The model of pedagogical reasoning and action (Shulman, 1987) placed this knowledge in a cycle of “comprehension, transformation, instruction, evaluation, reflection, and new comprehension.”

“Comprehension includes understanding purposes, subject matter structures, what to teach and why to teach. Transformation includes teacher’s capacity to transform content knowledge into forms that are pedagogically powerful and yet adaptive to the variety of student abilities and backgrounds. Instruction includes organizing and managing the classrooms; presenting clear explanations and vivid descriptions; interacting effectively with the students through questions and probes, answers and reactions, and praise and criticism.

Evaluation includes formal testing and evaluation that teachers do to provide feedback and grades. Teachers need to think about testing and evaluation as an extension of instruction, not as separate from the instructional process. Reflection includes reviewing, reconstructing, reenacting, and critically analyzing one’s own teaching abilities and then grouping these reflected explanations into evidence of changes that need to be made to become a better teacher. Through reflection the teacher achieves new comprehension of the educational purposes, the subjects taught, the students, and the processes of pedagogy themselves.” (Shulman, 1987).

IV. DIFFERENT CONCEPTUALIZATIONS OF PCK

➤ *Expansion of Components of PCK*

Following Shulman's idea, Tamir (1988) added “knowledge of curriculum” and “knowledge of assessment” alongside “knowledge of student understanding and instructional strategies”. Introduction of “knowledge of assessment” was Tamir's contribution to the PCK components. Grossman (1990) added “teachers' conceptions of purposes for teaching subject matter”. Marks (1990) conceptualization was different from other scholars as he included knowledge of media as a PCK component and stressed on the integration of components in a teachers' PCK.

Cochran, DeRuiter, and King (1993) preferred to use “Pedagogical Content Knowing (PCKg)” to denote constructivist view because knowledge reflected a static nature, which contradicted to PCK's ever developing structure. Fernandez-Balboa and Stiehl (1995) similarly emphasized the integration of subject matter, students, strategies, context, and teaching purposes.

Veal and MaKinster (1999) proposed “taxonomy of PCK”.

- “Discipline-specific PCK (e.g., English, math, history, or science),
- Domain-specific PCK (e.g., physics, chemistry, geology, or biology), and
- Topic-specific PCK (e.g., genetics or evolution).”

For science teaching, Magnusson, Krajcik, and Borko (1999) proposed a PCK model, in which PCK was considered to be a distinct knowledge base for teaching which is a result of the transformation of “Subject Matter Knowledge (SMK)”, “Pedagogical Knowledge (PK)” and “knowledge of context”. They included five components of PCK among which important one is “orientations toward science teaching” They acknowledged that teaching orientations shape the use of other components.

➤ *Integrative vs Transformative Model of PCK*

On one extreme PCK is considered as integration of “subject matter knowledge”, “pedagogical knowledge” and “contextual knowledge” thus generating integrative model of PCK where the three components integrate together and makes teacher knowledge during classroom teaching. the identity of each component can be seen despite integration whereas in transformative model the three components transform to give birth to a new knowledge which is called PCK, where the identity of each component is submerged in PCK. Jess- Newsome & G.Ledeman (1999) present a continuum of these models as the two models are not incompatible: teachers may integrate multiple knowledge bases, yet resulting instructional understanding can have properties that are not reducible to any single source.

➤ *Characteristics of PCK*

The analysis of different conceptualizations led to the conclusion that:

- PCK is dynamic in nature. It keeps on evolving and is unique to every teacher. Cochran, DeRuiter, and King (1993)
- PCK includes affective components also like “beliefs” (Grossman (1990), Magnusson et al., 1999) and “self-efficacy” (Park & Oliver, 2008).
- For PCK to develop, knowledge in all the components must interact and integrate with each other. (Fernandez-Balboa & Stiehl, 1995; Magnusson et al., 1999; Marks, 1990; Veal & MaKinster, 1999).
- PCK has a taxonomy; “general PCK”, “discipline specific PCK” and “topic specific PCK”. Veal and MaKinster (1999)

Thus it can be concluded that PCK is not only the knowledge possessed by teachers, but their beliefs and values associated with teaching which they develop over a period of time. (Fernandez-balboa & Stiehl, 1995; Gess-Newsome, 1999; Loughran et al; 2001; Loughran, Mulhall, & Berry, 2004; Marks, 1990; Van Driel, Verloop, & De Vos, 1998).

➤ *Implications for Teacher Education and Professional Learning*

- Apart from “general PCK”, the pre - service teachers should be trained in “topic specific PCK” as examples, misconceptions, resources, teaching strategy, assessment of each topic is different and teachers must acquire knowledge in each component for each topic and must integrate that knowledge to transform it into PCK.
- Model of “pedagogical reasoning” as suggested by Shulman should be taken into consideration for teacher preparation.
- For the development of PCK, different workshops, seminars, field visits etc. can be conducted for the in-service secondary science teachers to help them gain knowledge w.r.t curriculum, different learner centered strategies for teaching, students' learning requirements (their difficulties, misconceptions, knowledge and skills appropriate to their cognitive level) related to different topics.
- The practice of planning and reflection should be emphasized so that the knowledge doesn't become static.

➤ *Directions for Research*

- Research can be taken up to explore topic specific PCK of the teachers to know what examples, analogies, instructional strategies, assessment procedures do the teachers use to teach some specific topics. How do these teachers deal with students' misconceptions and difficulties in making the students understand those topics? How do they organize the subject matter knowledge for teaching?

- Research can be conducted to study the interaction of the different components of the PCK and in depth analysis of different interaction patterns of different components can be studied, which components interact frequently and which components show the least interaction and how does the interaction pattern differ with individual teachers and with different topics.
- Research can be conducted to study the development of PCK of science in longitudinal studies to gather empirical evidence.
- Research can be conducted in which empirical evidence of students' learning outcomes can be related to teachers' PCK.

V. CONCLUSION

PCK has a value as an academic construct as it represents the knowledge needed by teachers to teach effectively. It is not static, teachers can develop it by updating their knowledge of instructional strategies, students understanding, curriculum, assessment, resources and orientations towards teaching. It is not merely knowledge contained in some components but those components must interact reversibly with each other for robust PCK. It grows when teachers plan deliberately, enact responsively, examine evidence, and reflect. Teacher education should therefore treat PCK not as an abstract list of components, but as disciplined professional reasoning that can be articulated, rehearsed, studied, and improved.

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