

5. DOMAINS OF TEACHER KNOWLEDGE

Overview

My goal in this chapter is to examine pedagogical content knowledge (PCK) using structural and poststructural tools. From a structural perspective, PCK can be considered in relation to other types of teacher knowledge, without consideration of historical or political contexts, educational ideologies, or the idiosyncrasies of individual teachers. Such a general approach has many advantages -- it makes sensible the title, "Domains of Teacher Knowledge," for example! -- but it has disadvantages as well. These prompt the second, poststructural perspective -- one that returns the teacher to the center of meaning, that foregrounds historical and political context, and that questions the promise of ideological neutrality.

This chapter provides an overview of pedagogical content knowledge and the more general (for the most part, structural) model of teacher knowledge within which it was created. It also briefly describes the theoretical, political, and historical background of Lee Shulman's original formulation of teacher knowledge, a poststructural move. Finally, I offer some recommendations concerning the use of teacher knowledge domains in contemporary science education. "Pedagogical content knowledge" was invented for two different but related sets of reasons, one set theoretical/empirical in nature, the other political. Some familiarity with these reasons is important for understanding PCK and for using it within the changing landscape of American science education.

A Brief History of Pedagogical Content Knowledge

In the early 1980's, dissatisfaction was growing with the state of American educational research and was already widespread with the status of teaching and school reform in the U.S. (see, e.g., Carnegie Forum on Education and the Economy, 1986; Holmes Group, 1986). In a series of widely read articles, Lee Shulman at Stanford University promoted a paradigm shift in educational research (in part, by "chronicling" it, Shulman, 1986a) and, simultaneously, proposed an approach to educational reform that labeled teaching a profession (Shulman, 1987; Shulman & Sykes, 1986; Shulman, Sykes, & Phillips, 1983). These two goals were complementary in many ways, one being that the view of profession that Shulman proposed was contingent on the existence of a specialized knowledge base of teaching.¹ A paradigm shift in educational research -- or perhaps, more accurately, a shift from overreliance on one predominately psychological paradigm to a multi-

plicity of paradigms -- would help produce the knowledge base of teaching. By addressing the goal of better research, the political goal of professionalizing teaching could also be addressed. And the cycle would continue: for example, the professionalization of teaching would breathe new life into research, in part by stimulating new perspectives on educational practice via a growing corps of Board-certified teachers and affiliated academic projects.

Most traces of the political dimension of Shulman's work have disappeared from published scholarship on teacher knowledge, leaving pedagogical content knowledge and its conceptual companions dangling in rhetorical space. Some authors have questioned the need for the pedagogical content knowledge construct at all (Carlsen, 1991, April; McEwan & Bull, 1991), generally on epistemological grounds. McEwan and Bull, for example, argued that "all content knowledge, whether held by scholars or teachers, has a pedagogical dimension" (p. 318). Others questioned the "general practice of viewing knowledge as a 'substance'... located in the minds of individuals," and argued for seeing knowledge "as a situated construction of social networks, a textually produced phenomenon rather than an entity with an existence independent of our practices of representation" (Nespor & Barylske, 1991, p. 806).

These objections had little apparent impact on the use of pedagogical content knowledge as a tool in research and teacher education. There is now an interesting literature on science teachers' knowledge, much of it utilizing PCK. There is also evidence, some of it in this book, that, once identified, what we call PCK can be taught to prospective teachers; it might even productively serve as a major organizer for some teacher education curricula. Although PCK may have an epistemologically ambiguous identity, it has certainly proven to be useful.

Nevertheless, both of PCK's motivators -- the empirical and the political-- should be understood, in part because the terrain of American science education is changing significantly and our conceptions of teacher knowledge should change with it. The view of science teaching that has emerged in recent national science curriculum projects is interdisciplinary, socioculturally and technologically informed, and emphasizes the student's role in sense-making and knowledge construction (American Association for the Advancement of Science, 1993; National Research Council, 1996; National Science Teachers Association, 1993). From such a curricular vantage point, Shulman's descriptions of teacher knowledge and its application already seem dated, in part because they draw very heavily on Schwab's structures of the (traditional) disciplines (Schwab, 1964). For example, in describing content knowledge in his 1986 *Educational Researcher* article, Shulman wrote:

Teachers must not only be capable of defining for students the accepted truths in a domain. They must also be able to explain why a particular proposition is deemed warranted, why it is worth knowing, and how it relates to other propositions, both within the discipline and without, both in theory and in practice. (Shulman, 1986b, p. 9)

Part of Shulman's motivation in making claims like this was political; by defining content knowledge in disciplinary terms, teachers shown to possess it might

strengthen their claim to the rights, privileges, and responsibilities enjoyed by other disciplinary specialists. This was a strategically bold move. The status of teaching clearly needed to be enhanced if the movement to professionalize teaching were to succeed. By adopting disciplinary specialization (in, for example, biology) as the content standard for teachers, two problems could be addressed simultaneously: "How can we define subject matter knowledge in ways that are useful in research?" and "How can we make teaching a more prestigious and rewarding career choice?"

These two questions are still important, but the conceptions of knowledge that inform them need to be updated. This can be done without a major overhaul of Shulman's original formulation of the domains of teacher knowledge. Nevertheless, we should not be surprised to see that the structural weaknesses of a structural perspective remain. The "domains of teacher knowledge" are best viewed as a heuristic, not an immutable roadmap of any real individual's cognitive structure.

Pedagogical Content Knowledge: A Structural View

Structurally, pedagogical content knowledge is a form of teacher knowledge, distinct from other forms and defined by its relationship to those forms. Figure 1 is one view of the domains of teacher knowledge. The five general domains are (a) Knowledge about the general educational context, (b) Knowledge about the specific educational context, (c) General pedagogical knowledge, (d) Subject matter knowledge, and (e) Pedagogical content knowledge.

Note the following structural features² of such a view: (1) There is assumed a correspondence between word-labels, concepts, and (in most flavors of structuralism) real-world referents, a correspondence bound into units called *signs*. "Subject matter knowledge" is simultaneously a term, a concept, and something more or less identifiable in the world, for example through teacher testing. (2) Signs do not exist outside a *system*. "Pedagogical content knowledge" is a sign that exists within a system of other signs, one that here includes other forms of teacher knowledge. (3) The meaning of a sign like "pedagogical content knowledge" is established through its *relationship to and difference from* other signs. Here, PCK is defined as different from, but related to, "general pedagogical knowledge" and "subject matter knowledge."³ (4) This view of teacher knowledge is static, focusing on a moment in time (what Saussure calls the *synchronic*) and eschewing historical analysis, either of an individual teacher's knowledge or of the general knowledge domains. (5) The structure of teacher knowledge might be described using binary distinctions or *oppositions*, as in knowing/not knowing, cognitive/affective, and subject-centered/learner centered.⁴ Finally, (6) with its emphasis on describing and ordering teacher knowledge, the view obtains some *ideological neutrality*. No sides are taken concerning what is worth knowing. For example, a component of pedagogical content knowledge is (Knowledge of) "Students' Common Misconceptions," which implies, but does not articulate, that effective science teaching is a process of inducing conceptual change: certainly a prevalent view in science education, but by no means the only view.

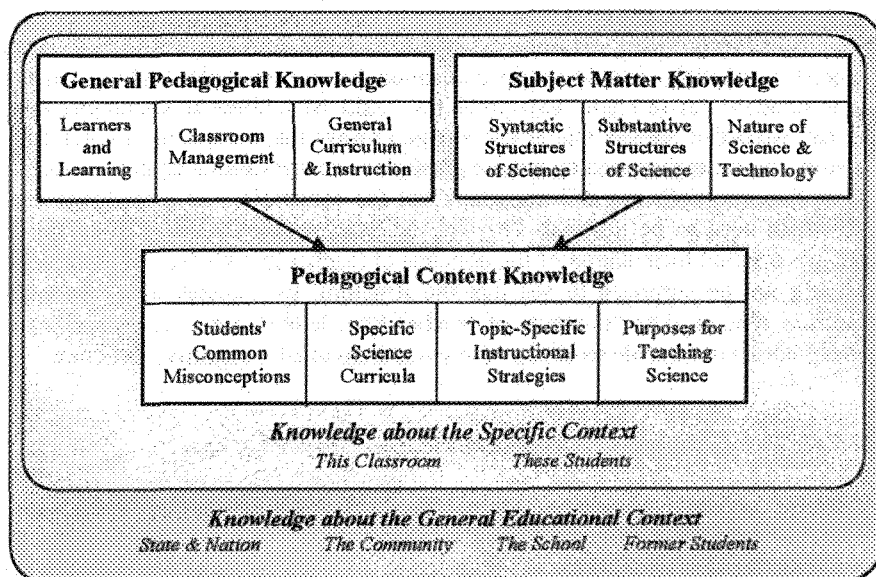


Figure 1. Domains of teacher knowledge

A structuralist approach foregrounds the relationship between forms of teacher knowledge. It supports the consideration of questions like, "How is Biology different from History?" (a structures of the disciplines question), "What substantive structures does a Biology teacher need to understand?" (a teacher education question), and "How might a Biology teacher's knowledge differ from a biologist's?" (a question central to the establishment of teaching as a profession). Much of the appeal of this perspective is that it is reassuring: systematic knowledge is possible; furthermore, that knowledge can be discovered without political disputation. If we assume that pedagogical content knowledge is real, then we can finesse the problem of establishing what veteran teachers *should* know, and instead concentrate on teaching novice teachers what veterans *do* know.

Although Shulman's view of teacher knowledge has structural features, there is little reason to believe that he viewed his model as an immutable template of what teachers should know or do know. In fact, the domains of teacher knowledge differ among the papers he wrote or co-authored. Figure 2 contrasts three that might be considered seminal; some comments on these papers follow.

"Those Who Understand: Knowledge Growth in Teaching" (Shulman, 1986b) was Shulman's 1985 Presidential Address to the American Educational Research Association. The paper's emphasis was on a "missing paradigm" in educational research: subject matter content and teachers' knowledge about that content. Other aspects of teacher knowledge were left to a footnote and another project.⁵ Curriculum knowledge, pedagogical content knowledge, and subject matter knowledge

were described as *categories* of the *domain* of "content knowledge." Pedagogical content knowledge was described for the first time in this paper as "the particular form of content knowledge that embodies the aspects of content most germane to its teachability" (Shulman, 1986b, p. 9). It includes "the most regularly taught topics in one's subject area, the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations -- in a word, the ways of representing and formulating the subject that make it comprehensible to others" (p. 9).

Knowledge Category or Domain	Shulman, 1986b	Shulman & Sykes, 1986	Shulman, 1987	Grossman, 1990
Curriculum				
Learners and learning				
Liberal knowledge & skills (general)				
Pedagogy (general)				
Pedagogical content knowledge				
Performance skills				
Philosophy, goals, and objectives				
School contexts				
Subject matter (content)				
Substantive structures of the discipline				
Syntactic structures of the discipline				

Key	
Major category in the model	
Subsidiary category in the model	
Not explicitly referenced in the model	

Figure 2. Domains of Teacher Knowledge: Four Alternatives

"A National Board for Teaching? In Search of a Bold Standard" (Shulman & Sykes, 1986) was a paper commissioned by the Carnegie Forum on Education and the Economy Task Force on Teaching as a Profession. The paper, coauthored with Gary Sykes, analyzed two possible mechanisms for effecting national standards for teachers: a political strategy (which "relies on the constitutionally-based authority of the states to regulate the professions," p. 31) and a market strategy (which "seeks to create demand for teachers at a recognized level of quality," p. 32). Although the authors advocated the latter, they anticipated that a mature standard might well be adopted eventually by states for licensure. Much of the manuscript was an analysis of the political dynamics of standard setting and testing within the teaching

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