

2. THE COMPLEX NATURE AND SOURCES OF TEACHERS' PEDAGOGICAL KNOWLEDGE¹

SETTING THE STAGE

The concept of pedagogical knowledge has been given short shrift in most discussions of Shulman's (1987) model of teacher knowledge. Shulman himself seems to limit the parameters of pedagogical knowledge in presenting his initial set of categories of teacher knowledge, describing the category only as:

general pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend subject matter (p. 8).

This limited view of pedagogical knowledge may have been a side effect of Shulman's concern for reinstating content as a critical facet of teacher knowledge, and a contextual feature too much ignored in classroom research at the time. One of the important effects of Shulman's introduction of the concept of pedagogical content knowledge was to restore some balance in the attention given to content vs. pedagogy in research on teaching.² Now that that goal has been accomplished, it is time to acknowledge the true complexity of pedagogical knowledge, and to identify the varieties of sources that contribute to that knowledge. A carefully detailed reading of Shulman's full essay (1987) reveals his acknowledgement of several aspects of pedagogical knowledge in addition to the initially identified principles of classroom management and organization. More recent research and scholarship provides further material to flesh out this important category of teacher knowledge.

The conception of pedagogical knowledge to be explicated in this chapter can be summarized briefly in two graphic displays. Figure 1 shows our interpretation of the place of pedagogical knowledge in relation to the full set of categories of teacher knowledge identified by Shulman (1987). Three points are important to note here. First, we contend that knowledge of educational ends and purposes is inseparable from knowledge about evaluation and assessment procedures. Second, we hold that curriculum knowledge is fed by both content knowledge and knowledge of goals/assessment procedures, while pedagogical knowledge is fed by both knowledge of learners/learning and knowledge of goals/assessment procedures. Third, in our display only the category of knowledge of general educational contexts is further delineated to the sub-category of knowledge of specific contexts, but each of the other categories contributing to pedagogical content knowledge can be so delineated, i.e., knowledge of specific content, specific curriculum, specific goals/assessment procedures, specific pedagogy, and specific learners.

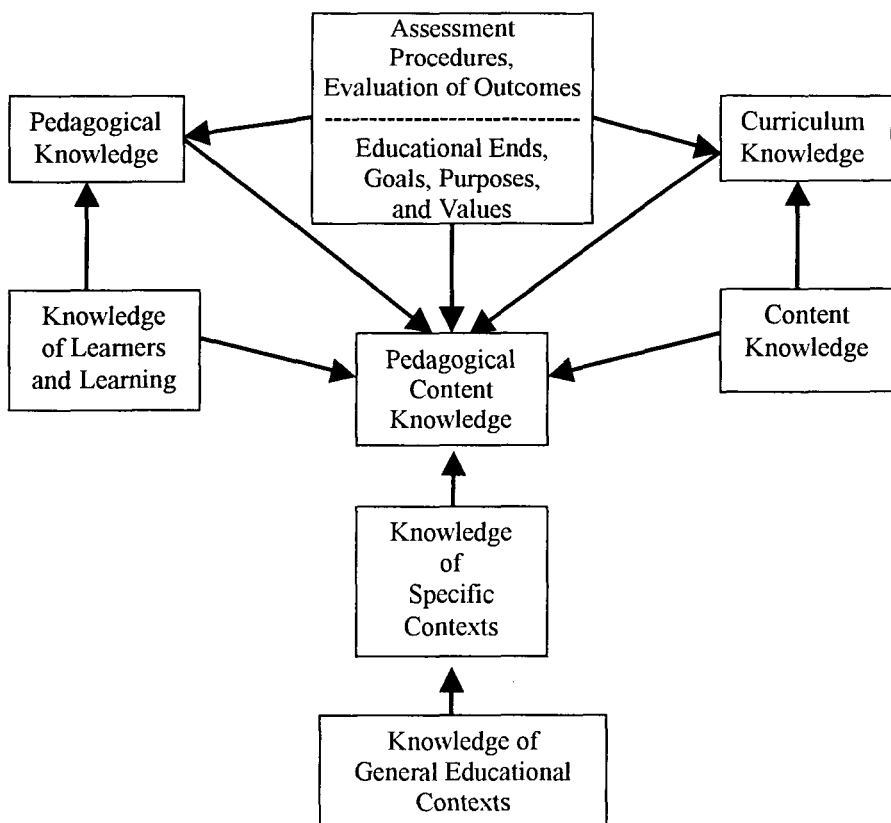


Figure 1. Categories Contributing to Pedagogical Content Knowledge

Figure 2 shows our conception of the various facets of pedagogical knowledge that have been informed by recent research on teaching. Studies in the three major areas contributing to general pedagogical knowledge (classroom organization and management, instructional models and strategies, and classroom communication and discourse) have been attentive to educational goals/evaluation and learners as critical contextual features of pedagogical practice, confirming the relationship depicted in Figure 1. Of particular importance here is the interplay between general pedagogical knowledge, which is derived from the research and scholarly literature, and personal pedagogical knowledge, which is fueled by personal beliefs and personal practical experience. The process of reflection promotes the interplay between general and personal pedagogical knowledge such that perceptions formed

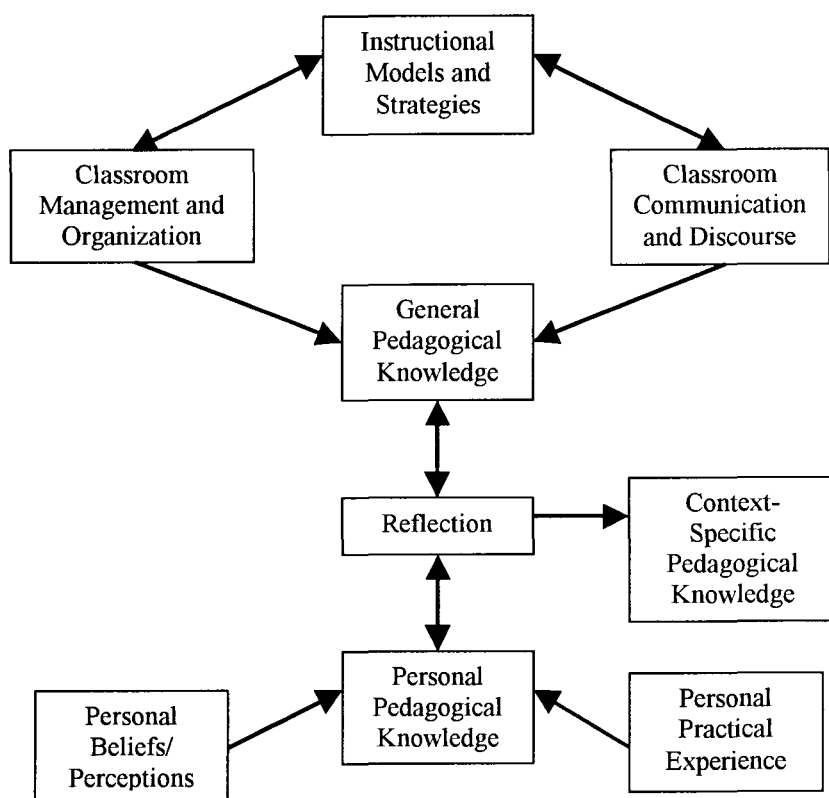


Figure 2. Facets of Pedagogical Knowledge

by personal beliefs and experiences are broadened and made more objective, while conceptions and principles of pedagogy explicated by research are exemplified and contextualized. What results from this process is the context-specific pedagogical knowledge that helps to guide teachers' decisions and actions.

This conceptualization of pedagogical knowledge will serve to organize the content of this chapter. We first discuss the research bases for general pedagogical knowledge in relation to classroom organization and management, instructional models and strategies, and classroom communication and discourse. Next, we consider research on the sources of personal pedagogical knowledge. Finally, we suggest possible implications of this research for science teaching, science teacher education, and future research related to science teaching and teacher education.

RESEARCH CONTRIBUTIONS TO GENERAL PEDAGOGICAL
KNOWLEDGE*Classroom Organization and Management*

Knowledge about classroom organization and management is well grounded in research on teaching. Process-product studies have repeatedly established consistent relationships between certain teacher behaviors and measurements of student achievement. Many of these relationships contribute to a type of general pedagogical knowledge that can transfer across grade levels and content areas. This knowledge forms a basis for the professional knowledge that beginning teachers acquire through teacher education programs. However, any application of this knowledge must take into account the different contextual factors that might affect the meanings of teacher behavior. In addition, the relationships linking teacher behavior, student achievement, and contextual factors are complex and may be non-linear or may interact with individual student differences (Rosenshine, 1971). Teacher educators promoting acquisition of such knowledge must guard against simplification and insulation from context in order to preserve the integrity and meaning of the observed relationships (Brophy, 1997).

The available knowledge base. Brophy and Good (1986; see also Brophy, 1997) have clearly demonstrated the link between student achievement and teacher behavior through a thorough review and synthesis of process-product research. Their findings have helped form a foundation for continued research that has expanded the understanding of the complexities of behavior-outcome relationships. Their review identifies a number of important relationships between teacher behavior and student achievement. Students learn best from teachers who spend most of their available time focusing on content, who provide learning activities for their students that are appropriate in their level of difficulty, and who also maintain momentum in the pacing of instruction. Students respond well to active teaching which structures the presented material. Clear presentations, a degree of redundancy, and adequate wait-time for student responses are all factors that promote positive student outcomes.

Brophy and Good acknowledge a tension between teaching behaviors that maximize content coverage and the need to move through instruction in small steps that allow student practice, mastery, and integration of subject matter. Such tensions create the arenas where teachers' pedagogical decisions become most critical.

Brophy and Good summarize their synthesis of research with two generalizations: 1) academic learning is influenced by the amount of time students spend on appropriate academic tasks, and 2) students learn more efficiently when their teachers structure new information, relate it to prior knowledge, monitor performance, and provide adequate feedback. They caution however, that research findings must be qualified by grade level, type of objective, type of student, and other contextual factors. In addition, they advise that different teacher behavior patterns may be functionally equivalent in their impact. Their review ends with an acknowledgment of the complexity of pedagogical knowledge related to classroom organi-

zation and management. Better understanding, they argue, can be achieved through attention to variation in factors like the sequencing of content and activities, and teachers' goals and intentions.

Student achievement is also influenced by teachers' processes of classroom management. Teachers manage classrooms effectively through the ability to address more than one classroom event at a time or by demonstrating "withitness" in identifying and resolving problems in a timely and accurate manner. The influence of effective classroom management has been confirmed in research by Emmer and Evertson (1981). Systems of consequences were shown to be effective in promoting desirable student performance, and the way teachers structured the first part of the school year was revealed as having management consequences throughout the school year (Emmer & Evertson, 1981; Evertson, Emmer, Sanford, & Clements, 1983). Teachers who set clear expectations for behavior, academic work standards, and classroom procedures were better classroom managers. The researchers note, however, that these characteristics are subject to contextual influences including the level of student ability, the degree of student homogeneity, and school level management procedures.

Evertson and Harris (1992), in a more recent review of research on classroom management, have concluded that management practice must move beyond a model of behavior modification to create an environment that supports all aspects of learning (see also Evertson, 1997). The use of extrinsic rewards as a management tool has been shown to have the potential for detrimental effects (Brewer, Dunn, & Olszewski, 1988). Research suggests that the effectiveness of reward systems depends on student characteristics such as the locus of motivational control. Externally motivated students work measurably better with externally motivating teachers, whereas students with a developed internal locus of control perform better with a non-directive teacher.

To summarize, the research on classroom organization and management is consistent in noting general principles of teacher behavior that promote student achievement. Students learn more when new information is structured and related to their prior knowledge and experience, when they are assigned academic tasks at appropriate levels of difficulty, and when they are provided with adequate feedback on their task performance. Students learn more when teachers use time efficiently, implement group and instructional strategies with high levels of involvement, communicate rules and expectations clearly, and prevent problems by introducing a management system at the beginning of the school year and implementing it consistently throughout the year. This research demonstrates that teachers' classroom organization and management procedures have a critical impact on student learning. An understanding of this aspect of classroom life is therefore an essential element of pedagogical knowledge. These general principles, however, should not be adopted by teachers in a simplistic fashion. They must be adapted to fit the particular contexts in which teachers work. For example, the degree of structure, the complexity of the academic task, and the type of feedback provided would all appropriately vary depending on contextual factors such as the age, ability, gender, or cultural background of the students being taught. Thus teachers need to become

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