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Pedagogical Content Knowledge (PCK)

In a recent meeting in Colorado Springs, USA (The PCK Summit), in October 2012, a set of experts on PCK were discussing about definitions, applications and interpretations of this construct, and the following description was proposed by one the groups of discussion and adopted by consensus (Gess-Newsome & Carlson, 2013): PCK is "defined as a personal attribute of a teacher and is considered both a knowledge base and an action". It is the "knowledge of, reasoning behind, planning for, and enactment of teaching a particular topic in a particular way for a particular reason to particular students for enhanced student outcomes".

The four times that the word "particular" appears in this definition is a double-edged sword. On one hand, it means that PCK must be reconstructed specifically almost each time a given teacher within some objectives has to proceed lecturing a precise topic to certain set of students with a definite background and learning characteristics. But on the other, it represents a superb challenge, being PCK an academic construct that represents an intriguing idea, rooted in the belief that teaching requires much more than delivering content knowledge to students, involving the designed purposes and the best ways to represent and evaluate that knowledge.

PCK has been a topic in which much research has been conducted and reviewed, since Gess-Newsome and Lederman (1999) book, that joined the description of several visions of PCK, the ways of assessing, measuring the construct and the impact on science teacher education programs, to the Kind (2009) extended paper where an analysis of PCK models as proposed by various researchers is presented, together with methods of elucidating PCK in experienced and novice teachers.

The idea of PCK was enticing because it seemed to be such a clever way of imagining what the specialist knowledge of teaching might involve. PCK is complex and usually so deeply a part of a teacher's intrinsic practice that it is tacit and, more often than not, largely inaccessible. The difficulties allied to making more use of PCK lies in its elusive nature. PCK conjured up an image of cutting-edge knowledge of practice, something special and important, something that could define expertise, something that could illustrate in a meaningful way why teaching needed to be better understood and more highly valued. PCK is the knowledge and beliefs that teachers develop over time, and through experience, about how to teach particular content in particular ways in order to enhance student understanding (Loughran et al 2012, Preface).

Lee Shulman, who coined the term, developed a couple of famous papers after the conference he lectured in Summer 1983 at the University of Texas at Austin entitled “The missing paradigm in research on teaching”, where he comments that inside the public “most were shocked when I declared that the missing paradigm was the study of subject-matter content and its interaction with pedagogy”. In his second paper, Shulman constructs seven categories of the teachers’ knowledge base, as they are included in table 1, with descriptions further developed by some other authors. Teacher Professional Knowledge Bases are the backbone of the profession.

Table 1. Seven categories of Teacher Knowledge base.

Knowledge Category	Description
Orientations	Educational ends, purposes, and values, and their philosophical and historical grounds
General Pedagogical	Encompasses the general knowledge, beliefs, and skills about methods for teaching
Content	The facts, concepts, principles, and procedures taught about the respective subject
Curricular	Understanding how particular concepts fit into the grade level at which it is taught
Learners	The prior knowledge of students and how students will most likely enhance or change that knowledge
Contextual	Specific knowledge that is unique to the learning setting
Pedagogical Content	An amalgam of content and pedagogy unique to a subject matter teacher. The blending of content and pedagogy into an understanding that allows the teacher to more thoroughly understand how to present a topic

We can see that the last row of this table includes PCK as part of the knowledge base that a teacher should possess and enact while teaching. In the last part of his second paper, Shulman develops a “model for pedagogical reasoning and action”, a diagram of which is presented in figure 1. This diagram shows how teachers proceed each time they have to give lecture(s) on a specific topic, starting from comprehending the content, transforming it in intelligent representations, selecting

them from their repertoire, and adapting them to the actual student characteristics. The second stage is a cycle in which the instruction is followed by its evaluation, the revision of the class's performance and a new set of comprehensions in a spiral trajectory, now over the first one that started this figure.

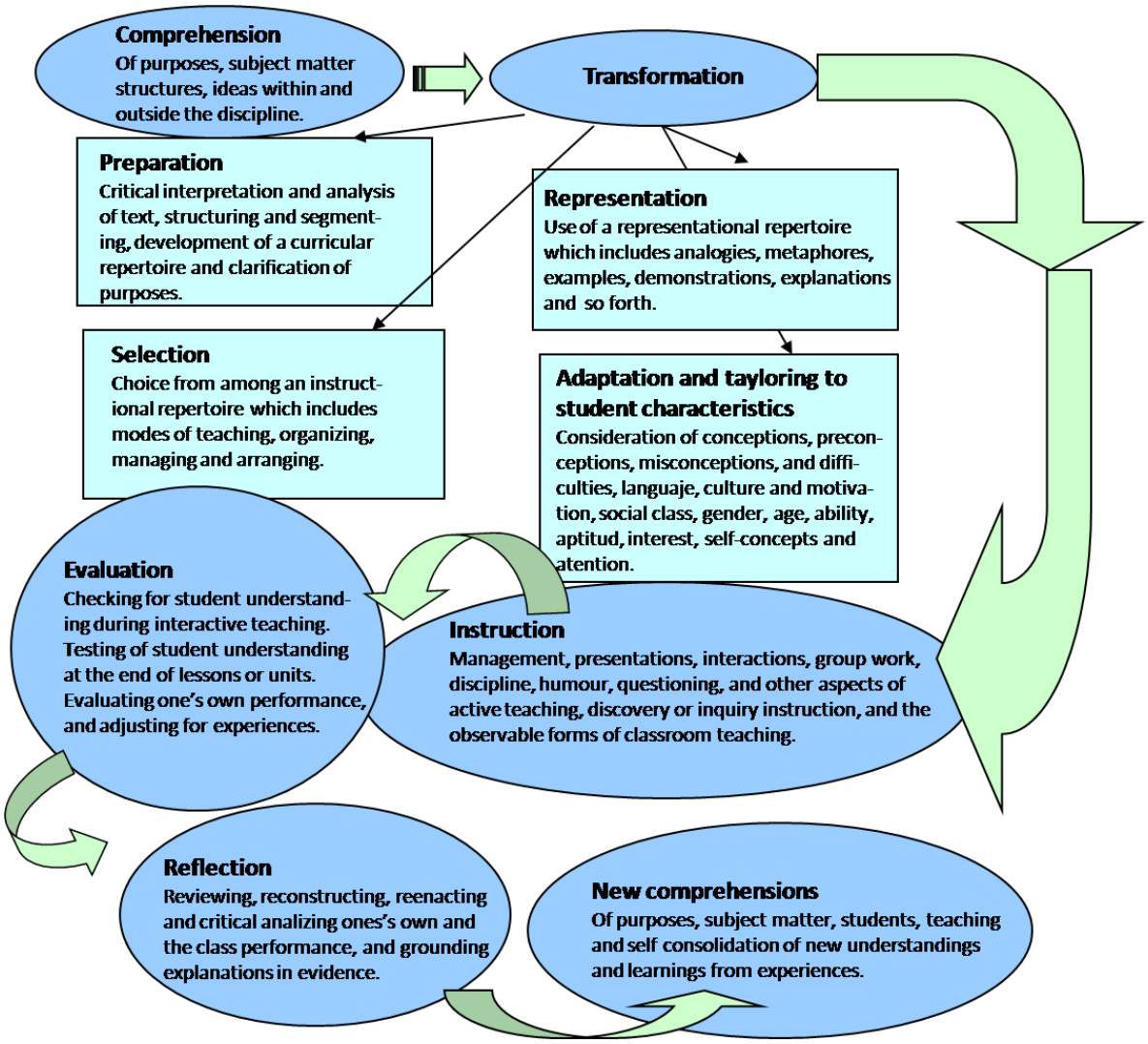

Figure 1. This information was proposed by Shulman (1987) in "Table 1. A model of pedagogical reasoning and action". It was adapted to a diagram by Salazar (2005), who has given permission to reproduce it here.

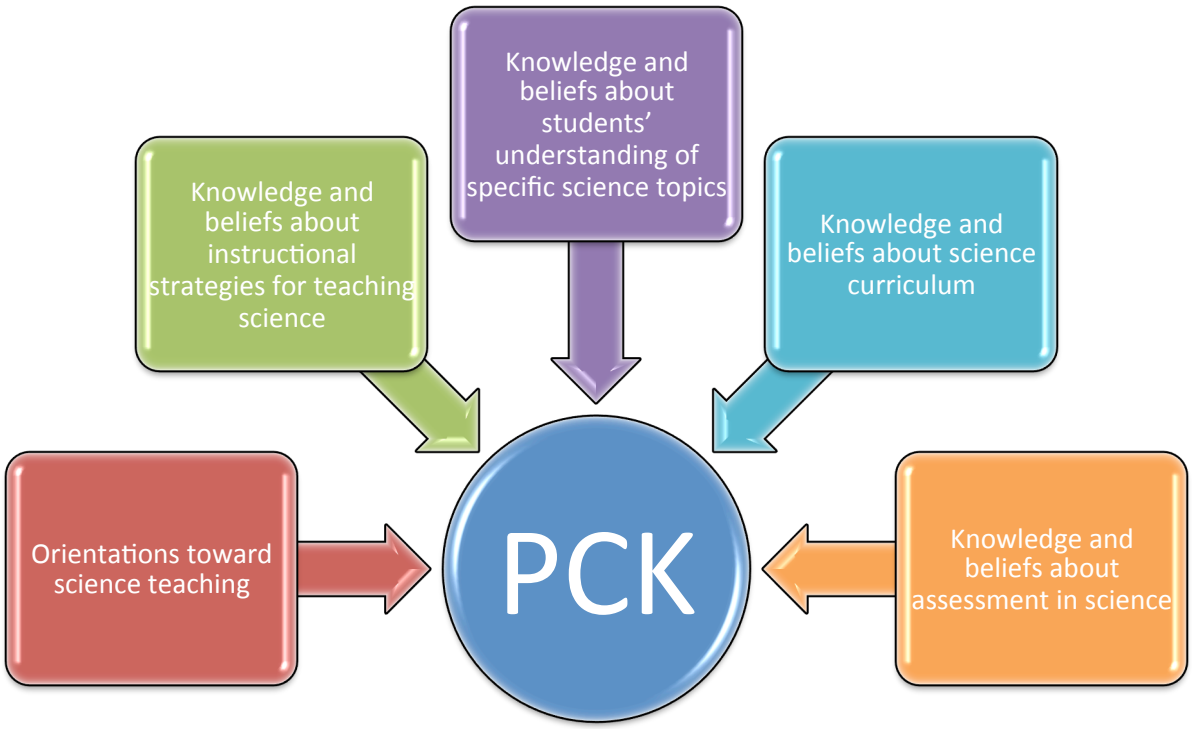

Figure 2. In the Gess-Newsome and Lederman (1999) book, Magnusson, Krajcik & Borko chose a set of five components of PCK. It has to be mentioned that these authors made a diagram in which the "Orientations" box was connected with the other four components, because it refers to "purposes and goals for teaching science at a particular grade level". In this figure it has been presented as one of the five components without making any emphasis on it, as it is also shown by Morine-Dershimer & Kent (also in Gess-Newsome and Lederman 1999).

It has to be overemphasized that *beliefs* are mentioned in almost all of the components, except in the "Orientations" one, but recently this component has been defined as "a set of beliefs with the following dimensions: goals and purposes of science teaching, views of science, and beliefs about science teaching and learning". So that *beliefs* and *knowledge* permeate all of the components of PCK.

In the PCK Summit, Marissa Rollnick mentioned that she conceives that beliefs act as a filter the teacher unwittingly places between its knowledge base and his/her action in the classroom or laboratory.

Gess-Newsome & Carlson (2013) included all those ideas in the diagram of figure 3. Assessment, Content, Pedagogical, Student and Context knowledge compose the knowledge base of the teacher, but all that is filtered by teacher's beliefs, orientation and context to the practice of teaching, where classroom context also acts. The final purpose of teaching is to increase student-learning outcome, but that is mediated (or filtered) by a set of factors that enact in each one of the

students in different ways, because of their individual motivation, behavior, alternative conceptions, learning styles and knowledge construction.

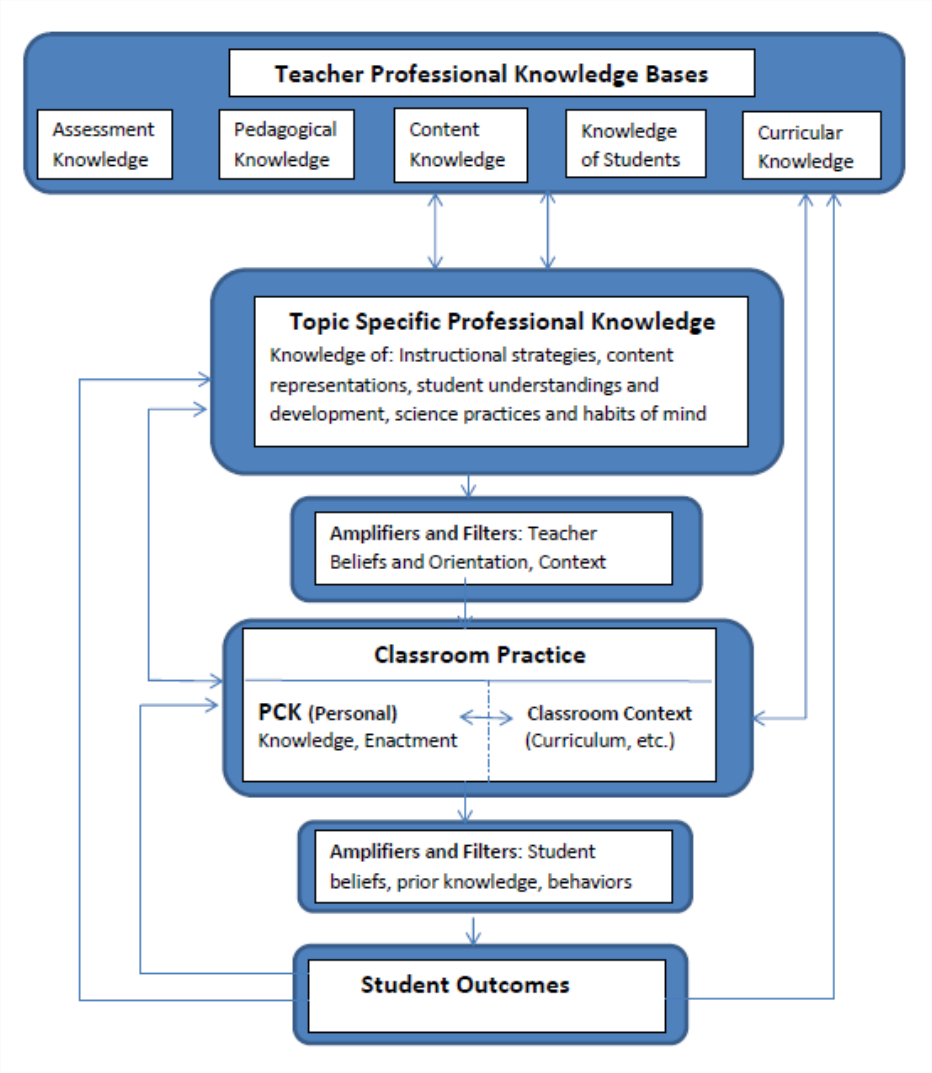

Figure 3. Situating PCK on Teacher Professional Knowledge and Influences on Classroom Practice and Student Outcomes. Julie Gess-Newsome has given permission to reproduce this diagram here.

Ensuring teachers have good content (subject matter) knowledge (SMK) is only part of the story: possession of effective teaching skills is also needed. Pedagogical Content Knowledge (PCK) is a concept that represents the knowledge a teacher uses in the process of teaching. If we can identify this, our understanding of what 'good science teaching' looks like and how to develop this more consistently may be enhanced (Kind 2009, p 170).

As an closing remark we are copying two questions that Sandra Abell (2008, p. 1412) posed to PCK researchers as future challenges: *The first question is: 'What is the relation of PCK (in terms of quality and quantity) to teacher practice?'* The corollary question is: *'What is the relation of PCK to student learning?'*

In the PCK Summit there was present in the discussion what should be included in

the following ten years research. The answers given by the participants were Abell's repetitive and directed towards:

1. Clarifying the features or aspects of PCK that most influence practice
2. Evidencing that PCK influences students' outcomes
3. Gathering Meta-analysis of PCK effects on achievement
4. All of the above used to influence policy surrounding the impact of our work

As, Kind (2009, p 198) emphasizes, "There is strong evidence that PCK is a useful concept and tool for describing and contributing to our understanding of teachers' professional practices".

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