PEDAGOGICAL CONTENT KNOWLEDGE IN SIGHT? A COMMENT ON KANSANEN

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Abstract: *In the debate on the nature of pedagogical content knowledge (PCK) two different perspectives on PCK need to be distinguished: PCK as a general body of knowledge and PCK as an element of teacher knowledge. It is foremost the discussion of the second perspective on PCK that contributes to our understanding of PCK. PCK is understood as topic-specific teacher knowledge that involves the transformation of content and pedagogical knowledge into instruction. Within the debate on the conceptualization of PCK there is agreement on two essential elements of PCK: knowledge of students' conceptions and of ways to react adequately to these conceptions. The definition of a 'special content knowledge' domain outside the PCK realm by Bass and colleagues provides a new impulse for the debate on the nature of PCK.*

Key words: *content knowledge, knowledge of students' conceptions, nature of pedagogical content knowledge, pedagogical content knowledge, pedagogical knowledge*

Shulman's PCK

In 1983, Lee Shulman stated at a national conference at the University of Texas that an element was missing in research on teaching, namely the study of subject-matter content and its interaction with pedagogy (Shulman, 1999). Shulman elaborated this idea – that became pedagogical content knowledge (PCK) – in two papers: 'Those who understand: Knowledge growth in teaching', published in 1986, and 'Knowledge and teaching: foundations of the new reform', published in 1987. In the first paper, Shulman (1986, p. 6) described the missing element in the study of teaching in terms of the interaction between content, teacher and student: "no one focused on the subject matter content itself. No one asked how subject matter was transformed from the knowledge of the teacher into the content of instruction. Nor did they ask how particular formulations of that content related to what students come to know or misconstrue."

In this paper Shulman not only presented a research program – 'Knowledge Growth in Teaching' – addressing questions concerning what a teacher knows,

the sources of teacher knowledge, how a new knowledge base is formed and the consequences of varying degrees of subject matter competence and incompetence; he also suggested a theoretical framework for inquiry into teacher knowledge. Within this theoretical framework Shulman distinguished three categories in the domain of 'content knowledge in teaching': curriculum knowledge, content knowledge and a new category named PCK. Shulman (1986, p. 9) described PCK as a special kind of content knowledge "which goes beyond knowledge of subject matter per se to the dimension of subject matter knowledge *for teaching*." He writes further: "I still speak of content knowledge here, but of the particular form of content knowledge that embodies the aspects of content most germane to teachability." In this category of PCK Shulman includes:

> "For the most regularly taught topics in one's subject area, 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. Since there are no single most powerful forms of representation, the teacher must have at hand a veritable armamentarium of alternative forms of representation some of which derive from research whereas others originate in the wisdom of practice.
> Pedagogical content knowledge also includes an understanding of what makes the learning of specific topics easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons. If those preconceptions are misconceptions, which they so often are, teachers need knowledge of the strategies most likely to be fruitful in reorganizing the understanding of learners, because those learners are unlikely to appear before them as blank slates." (Shulman, 1986, p. 9-10)[1]

In the second aforementioned paper, Shulman (1987) described PCK as one of seven categories of a knowledge base for teaching instead of a subcategory in the content knowledge domain: (1) content knowledge, (2) general pedagogical knowledge, (3) curriculum knowledge, (4) PCK, (5) knowledge of learners and their characteristics, (6) knowledge of educational contexts, (7) knowledge of educational ends, purposes and values, and their philosophical and historical grounds. With respect to this knowledge base for teaching Shulman (1987, p. 8; emphasis added) stated that: "Among those categories, pedagogical content knowledge is of special

1 Examples of science teachers' PCK can be found in studies of Mastrilli (1997), Van Driel, Verloop, & De Vos (1998) and myself (Van Dijk, 2009). Mastrilli (1997) focused on the use of analogies in the science classroom. The biology teachers in his study used analogies like, "nucleosomes in prokaryotic cells are like beads on a string." Van Driel et al. (1998) studied and discussed teachers' PCK about the dynamic nature of chemical equilibrium. For example, one chemistry teacher tried to clarify the dynamic nature of chemical equilibrium by comparing the equilibrium system with a classroom with two doors, through which students continuously move in and out. Van Dijk (2009) focused on the PCK of biology teachers concerning evolutionary theory. The interviewees in her study discussed a number of problems and possible solutions – for example, that the students often have a mono-causal conception of selection. In reaction to this problem skin colour was suggested as an example, because more than one selection factor plays a role here.

interest because it identifies the distinctive bodies of knowledge for teaching. It represents the *blending of content and pedagogy* into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction."

After Shulman introduced PCK in the research literature the concept was developed further, resulting in a plethora of conceptualizations of this category of teacher knowledge. Differences occur with respect to the elements that scholars include or integrate in PCK and with respect to the descriptions of these elements. In this process of further development, the concept of PCK lost its most important characteristic, namely its topic specificity (see also Hashweh, 2005). For example, Magnusson et al. (1999) suggested a broader view of PCK than the original conceptualization (Abell, 2007; Ball, Thames, & Philips, 2008). They distinguished five components within PCK namely (1) orientation to teaching science, (2) knowledge of assessment of science literacy, (3) knowledge of science curricula, (4) knowledge of instructional strategies and (5) knowledge of students' understanding of science. But including orientations as a component of PCK is problematic, as orientations are *general* views on science teaching and not *topic-specific* knowledge (Abell, 2007). Another example is McCaughtry (2005), who argued that teachers' understanding of students' emotional and social lives is an overlooked form of PCK. As more and more is included in PCK, we appear to be losing sight of PCK as a specific domain of teacher knowledge.

Kansanen's Point of View

The paper titled 'The curious affair of pedagogical content knowledge' by Pertti Kansanen (in this issue) represents an attempt to find the core of PCK. Considering the brief description of the development of the PCK concept above, this is an extremely relevant topic. Kansanen aims to find the core of the PCK concept by analysing its relation to three important elements of the teaching-studying-learning process: the student, the teacher, the subject matter, as well as the interrelationships between these. In Germany and the Nordic countries these elements of the teaching-learning process are often presented in the form of a didactic triangle, a tool to structure the field of educational research. Within this triangle Kansanen characterizes the relationship between the student and the content as studying. The relation that the teacher has to this relationship between the student and the content is the so-called didactical relation: "Thus, helping the student in his/her studying to learn implies that the teacher has enough content knowledge, enjoys a positive relationship with the student, and uses pedagogical knowledge to present the content in such a way that the student will learn optimally" (Kansanen, this issue). PCK is considered to be one important part of this interaction. Figure 1 shows a reproduction of a figure from Kansanen (2003) depicting the didactical relation in the didactic triangle, in order to clarify the position of PCK within the didactic triangle.

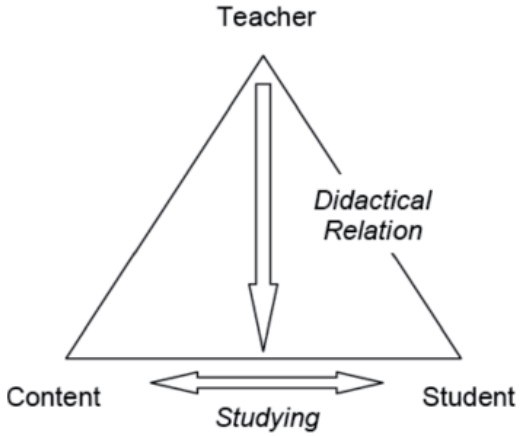

Figure 1. The didactic relation in the didactic triangle (reproduction from Kansanen, 2003, p. 230)

Additionally, Kansanen presents a number of different considerations concerning the nature of PCK. Two issues that remain underexposed in the text seem relevant for our understanding of the considerations that are presented. The first point is that these considerations are based on two different perspectives on PCK: PCK as a body of knowledge existing independent of the teacher, that can be represented as abstract ideas in teacher education and textbooks, and PCK as a subjective representation – an element of teachers' personal professional knowledge (cf. Bromme, 1995). Kansanen starts by considering PCK from the first perspective, a general knowledge domain. He assumes that there is a big difference when PCK is considered from the viewpoint of the student or the teacher. If the focus is on the teacher "it seems common that content is mainly analysed, and only for the teacher's use. The purpose seems to be to organise the content in such a way as to make it easy for the teacher to teach it to the students, and for the students to learn the content as easily as possible" (Kansanen, this issue). Kansanen observes further that: "A fruitful viewpoint, apparently, is that the problems of the content are dealt with by taking the expertise of the teacher into consideration."These considerations concerning PCK as a general body of knowledge then lead to a discussion of PCK as teacher knowledge.

The reasons for choosing this approach toward understanding PCK from the first perspective are not explicated by the author. Furthermore, it is not made sufficiently clear exactly what insights this approach provides for our understanding of PCK. In my opinion it is foremost the discussion of the second perspective on PCK that contributes to our understanding of PCK. The problems for empirical research of PCK are rooted in the fact that PCK is *personal* teacher knowledge. Moreover, PCK is personal teacher knowledge that involves the *transformation* of other types of knowledge. This makes it so difficult to conceptualize PCK and to understand how certain factors like other knowledge categories, orientations, and teaching experience influence the development of PCK.

An additional issue concerns the definition of PCK that underlies the considerations that are presented. Kansanen more than once describes PCK as an *intersection* of content knowledge and pedagogical knowledge. For example, he observes that: "If the definition is taken earnestly, we quite soon realise that both parts of the intersection are very large." However, this definition is not compatible with Shulman's descriptions of PCK (presented above). Shulman described PCK as the ways of representing and formulating the subject that makes it comprehensible to others, the most powerful analogies, illustrations, examples, explanations, and demonstrations. Within these examples the content knowledge and pedagogical knowledge are blended or merged. The development of PCK is not just the summation of these two knowledge domains; it involves the *transformation* of content and pedagogical knowledge into instruction. It is this transformed knowledge that can be observed in the classroom. Kansanen's theoretical considerations appear to be rooted in an understanding of PCK that is very different from Shulman's ideas. When combined with empirical studies that aim to elaborate on the construct of PCK as defined by Shulman, like the study of Ball et al. (2008), this different perspective forms a hurdle for the development of an understanding of the nature of PCK.

Personal Teacher Knowledge

Ball et al. (2008) present a practice-based theory of content knowledge for teaching built on Shulman's notion of PCK. Within the domain of 'mathematical knowledge for teaching' Ball et al. describe two subject matter knowledge categories, 'common content knowledge' (CCK) and 'specialized content knowledge' (SCK), and two pedagogical content knowledge categories, 'knowledge of content and students' (KCS) and 'knowledge of content and teaching' (KCT). They define these knowledge categories as: (1) CCK: the mathematical knowledge and skill used in settings other than teaching, (2) SCK: the mathematical knowledge and skill unique to teaching, (3) KCS: knowledge that combines knowing about students and knowing about mathematics, (4) KCT: knowledge that combines knowing about teaching and knowing about mathematics. In order to clarify the subtle differences between the first three categories they add that: "recognizing a wrong answer is common content knowledge (CCK), whereas sizing up the nature of an error, especially an unfamiliar error, typically requires nimbleness in thinking about numbers, attention to patterns, and flexible thinking about meaning in ways that are distinctive of specialized content knowledge (SCK). In contrast, familiarity with common errors and deciding which of several errors students are most likely to make are examples of knowledge of content and students (KCS)" (Ball et al., 2008, p. 401).

In relation to the work of Ball et al. Kansanen (this issue) observes that: "The difficult point here is how to restrict ourselves to pedagogical content knowledge, and specifically, taking it to the letter, only to pedagogical content knowledge." In light of the development of the concept of PCK in the last two decades this is indeed

a matter of concern. By taking PCK to the letter, Kansanen comes to the conclusion that the KCS concept is not a category of PCK. Because KCS is the intersection of two knowledge domains, namely knowledge of content and students (Shulman's knowledge of learners) and not a combination of content and pedagogy it becomes more than PCK. In my opinion Kansanen is mistaken in his definition of KCS. Ball et al. (2008, p. 402) state that the KCS and KCT domains "coincide with the two central dimensions of pedagogical content knowledge identified by Shulman": (1) the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons" and (2) the ways of representing and formulating the subject that make it comprehensible to others. KCS is, thus, not defined as the *intersection* of knowledge of content and students but as the *transformation* of the knowledge of content and students into an understanding of the topic specific conceptions that students bring into the classroom.

The considerations concerning the definition of KCS and SCK bring us to the heart of the issue concerning the nature of PCK. With respect to the SCK category Kansanen observes that it is difficult to understand why Ball et al. use a new term when this is actually original PCK. Indeed, it is an interesting question why SCK is not, in addition to KCS and KCT, contained in PCK (see also Van Dijk, & Kattmann, 2007). In an earlier paper Ball together with Bass (2000, p. 87) described PCK as a body of bundled knowledge.

> "Pedagogical content knowledge – representations of particular topics and how students tend to interpret them and use them, for example, or ideas or procedures with which students often have difficulty – describes a unique subject-specific body of pedagogical knowledge that highlights the close interweaving of subject matter and pedagogy in teaching. Bundles of such knowledge are built up by teachers over time as they teach the same topics to children of certain ages."

Ball and Bass (2000, p. 88) observed further that: "a body of such bundled knowledge may not always equip the teacher with the flexibility needed to manage the complexity of practice. Teachers also need to puzzle about the mathematics in a student's idea, analyze a textbook presentation, consider the relative value of two different representations in the face of a particular mathematical issue. To do this, we argue, requires a kind of mathematical understanding that is pedagogically useful and ready". In their more recent paper Ball and colleagues (2008, p. 398) develop this idea of pedagogically useful mathematical understanding further:

> "What caught us by surprise, however, was how much special mathematical knowledge was required, even in many everyday tasks of teaching – assigning student work, listening to student talk, grading or commenting on student work. Despite the fact that these tasks are done with and for students, close analysis revealed how intensively mathematical the tasks were. We were surprised to see that many of the component tasks of teaching require mathematical knowledge apart from knowledge of students or teaching. For instance, deciding whether a

> method or procedure would work in general requires mathematical knowledge and skill, not knowledge of students or teaching."

Ball et al., thus, view SCK as a form of mathematical problem solving used in the work of teaching that requires no knowledge of students or teaching.

Research on knowledge for teaching is an applied research field and we should ask ourselves what this research could contribute to teacher education. A model of PCK development would provide us with a basis for the improvement of teacher education. Hypothesizing new constructs like SCK raises questions as to their role in the knowledge development process. By splitting up the realm of 'mathematical knowledge for teaching' in a subject matter knowledge domain, that contains among others SCK, and a PCK domain, Ball and colleagues diminish the value of the C(ontent) within PCK. Defining PCK as just a familiarity with students' conceptions and ways to react to these conceptions excludes from the definition the special content knowledge that is necessary for understanding the ideas that students bring into the classroom and for developing good examples that can be used to explain the topic at hand. It is therefore not surprising that Ball et al. (2008, p. 404) observe that: "it can be difficult at times to discriminate specialized content knowledge from knowledge of content and students."

Conclusion

Kansanen observes that the increasing use of PCK may likely show the way to a more heterogeneous usage of this concept in the future. For empirical research of PCK, however, it is important to reach consensus on the conceptualization of PCK. In order to improve teacher education, we have to be able to describe and analyse case studies of PCK and to identify the different factors that influence the development of PCK.

The paper by Kansanen addresses a number of relevant issues concerning the nature of PCK. The discussion of these issues, however, appears to be rooted in an understanding of PCK that is not compatible with Shulman's, and this raises the question as to how the considerations that are presented can help us find the core of PCK. The paper by Ball and colleagues makes a valuable contribution to our understanding of PCK. But more practice-based studies on other subjects are necessary to clarify the notion of PCK further.

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