# What is the nature of university professors' discipline-specific pedagogical knowledge? A descriptive multicase study

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# ABSTRACT

This research project investigates the nature of university professors' discipline-specific pedagogical knowledge (DPK). Traditionally, DPK has been examined with the help of constructs from two distinct lines of research: the knowledge base for teaching and disciplinary specificity in university teaching. Yet, the two lines of research have seldom been combined to explore DPK. Furthermore, linkages between those two lines of research point to the potential contribution of research on personal epistemologies. Therefore, the aim of this research is to describe empirically the phenomenon of DPK using constructs from these three lines of research.

The research project takes the form of an instrumental multicase study of four university professors from four different disciplines. Each professor was interviewed five times, thus providing insight into their thinking about teaching, their discipline and their knowledge in general. Transcripts were analysed using a mixed *a priori*/emerging coding scheme.

The data analysis led to the identification of components and dimensions of DPK corresponding to constructs from each line of research. Simultaneously, relationships between those components and dimensions were identified. Furthermore, the analysis singled out components, dimensions, and relationships common to the four professors, thus providing information about elements of DPK university professors share, regardless of their discipline of instruction.

Overall, the findings provide an empirical framework of university professors' DPK that captures the phenomenon more accurately than has been the case with previous approaches. Therefore, from a theoretical standpoint, the DPK framework furthers our

understanding of the difficulties faced by university professors when attempting to relate their pedagogical knowledge to the specific characteristics of their discipline of instruction. From an educational standpoint, the DPK framework points to specific aspects of the learning experience of university professors that need to be supported by academic development efforts.

# RESUME

Ce projet de recherche examine la nature du savoir pédagogique disciplinaire (SPD) des professeurs d'université. Traditionnellement, le SPD a été examiné à l'aide de concepts provenant de deux champs de recherches distincts: celui portant sur la base de connaissances pour l'enseignement et celui portant sur la spécificité disciplinaire dans l'enseignement universitaire. Pourtant, ces deux champs de recherches ont rarement été combinés de façon à examiner le SPD. En outre, les liens entre ces deux champs de recherches soulèvent la question d'une contribution potentielle du champs de recherches portant sur les épistémologies personnelles. Le but de ce projet de recherche est donc de décrire de façon empirique le phénomène du SPD à l'aide de concepts de ces trois champs de recherches.

Ce projet de recherche prend la forme d'une étude multi-cas de nature instrumentale portant sur quatre professeurs d'universités provenant de quatre disciplines différentes. Chaque professeur a été interviewé cinq fois, fournissant ainsi accès à ses pensées au sujet de ses enseignements, de sa discipline et du savoir en général. Les transcriptions ont été analysées à l'aide d'un système de codage mixte comprenant des catégories pré-établies et des catégories émergeantes.

L'analyse des données a conduit à l'dentification de composantes et de dimensions relatives au SPD qui correspondent aux concepts provenant des trois champs de recherche. Simultanément, les relations entre ces composantes et dimensions ont été identifiées. De plus, l'analyse a fait émerger un certain nombre de composantes, dimensions et relations communes aux quatre professeurs, fournissant des renseignements au sujet des éléments du SPD qui sont partagés par les professeurs d'université,

indépendemment de leur discipline.

Globalement, les résultats fournissent un cadre empirique pour l'étude du SPD des professeurs d'université qui capture ce phénomène plus adéquatement que ne le faisaient les approches antérieures relatives à ce phénomène. Ainsi, au plan théorique, le cadre du SPD approfondit notre compréhension des difficultés rencontrées par les professeurs d'université lorsque ceux-ci relient leur savoir pédagogique aux caractéristiques spécifiques de leur discipline. Au plan éducationnel, le cadre du SPD identifie les aspects spécifiques de l'expérience d'apprentissage des professeurs d'université qui devraient être soutenus par l'entremise du développement pédagogique.

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# CHAPTER 1

## PROBLEM STATEMENT

In educational research, teaching is generally seen as a complex cognitive activity (e.g., Berliner, 1986; Clark & Lampert, 1986; Glaser, 1989; Leinhardt & Greeno, 1986; Sternberg & Horvath, 1995). This is because teaching requires, on the part of the teacher, extensive awareness of a variety of factors each affecting a number of specific cognitive processes. Some of these factors have an impact on processes associated with learning and teaching or what is known as "pedagogy". Other factors influence processes associated with the actual object of instruction, that is, the "content" or "subject matter". Yet other factors affect the environment in which the processes mentioned above take place. Therefore, teachers are continuously juggling with a variety of factors that have an impact on a variety of cognitive processes.

The description of teaching above is not specific to any level of education. This interaction of diverse factors from various sources affecting various cognitive processes is observed in elementary, secondary, and tertiary teaching. Therefore, teaching at the university level is generally believed to involve some of these factors and processes (Biggs, 1999; Cranton, 1998; Hannan & Silver, 2000; Prosser & Trigwell, 1999; Ramsden, 2003). For instance, university professors[1] have to think about the "content" they teach; more specifically, they have to think about how they structure it, how they present it to students, and how to deal with students' reactions to that content.

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[1] The label "university professor" is used here in a very loose way in order to include all staff members teaching at the university level, be they employed full-time or part-time. The term "university professor" is also used to include staff of various academic rank (e.g., assistant, associate, or full professor) or other titles used in different countries (e.g., *Lecturer* in the United Kingdom, *Maître de conférences* in France, or *Privat-Dozent* in Germany).

Simultaneously, university professors have to consider a variety of other factors while teaching. Some of those are environmental (such as the physical layout of the class, lighting or sound quality, temperature levels) or temporal (the length of the class and its timing during the day or week).

Yet, there is something quite different about university professors. Most of them are actually considered "disciplinary specialists" because what they teach – the "content" or "subject matter" – corresponds very closely to actual academic disciplines. Therefore, university professors deal with an object of instruction that is complex both in terms of the quantity and nature of the material covered, and in terms of the implicit norms, rules, or practices associated with knowledge in such academic disciplines.

One problem often faced by university professors is their lack of preparation to face such complex instructional tasks. The education of university professors – as disciplinary specialists – focuses almost exclusively on the development of knowledge related to their academic discipline and, within that discipline, of research capabilities related to a specific sub-area of knowledge. As such, large numbers of university professors worldwide still receive no education in the area of pedagogy. Yet, a considerable portion of their professional time is spent on teaching. And, in that capacity, university professors are dealing with factors that affect learning and teaching – pedagogical processes. The resulting situation is that, more often than not, university professors are left developing pedagogical knowledge without any form of educational support.

Fortunately, some positive scenarios are encountered in university teaching worldwide. For instance, university professors in certain countries can take part in

organized learning opportunities in the area of pedagogy.[2] In such situations, university professors receive some support towards their development of pedagogical knowledge. However, this often translates into pedagogical knowledge being developed independently from the specific characteristics of the discipline taught by those professors. Such a situation is what happens in the "generic pedagogical training" of university professors, that is, training that might not foster pedagogical knowledge that is discipline-specific (Healey & Jenkins, 2003; Jenkins, 1996; Lenze, 1996). In such cases, university professors could be faced with the formidable challenge of relating their pedagogical knowledge to the specific characteristics of their instructional discipline on their own, something easier said than done.

This situation poses a particularly serious problem for university professors as they are expected to teach effectively, that is, to lead to meaningful learning within specific disciplinary environments. Left to their own devices, university professors might take years to "discover" which instructional strategies work best in their academic discipline and why. Others might actually become discouraged earlier on and not even attempt to make such "discoveries". As an academic developer – someone who helps university professors develop their teaching skills – I see that this gap in their preparation often results in significant challenges in dealing with the teaching aspect of their professorial role. For some time now, I have wondered how to better help university professors develop pedagogical knowledge, and how to develop this in a way that is specifically adapted to their academic discipline.

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[2] One example can be found in the United Kingdom where most newly-appointed university professors (i.e., lecturers) register in accredited programs aimed at introducing them to general notions of pedagogy and at developing their instructional skills.

This pondering has led me to an examination of research in the broad area of learning and instruction, and in the more specific area focusing on the link between pedagogy and academic disciplines in university teaching. In this respect, I have found research that has explored disciplinary differences in university teaching and learning (e.g., Becher, 1989; Donald, 2002; Hativa & Marincovich, 1995; Neumann, 2001; Smeby, 1996). This research has enabled me, an academic developer, to know more about the various characteristics of specific academic disciplines or groupings, how certain academic disciplines differ from others in terms of their teaching or learning, and how learning and teaching should be undertaken in response to that. Thus, this research has strengthened my belief that we need to support university professors in understanding learning and teaching that is discipline specific.

Yet, my examination of this body of research has also led me to discover that little research has been undertaken on how university professors develop pedagogical knowledge that is particularly adapted (i.e., specific) to their academic discipline. Instead, the research that does exist on the "disciplinary specificity" of pedagogical knowledge focuses on comparing groups of disciplines and, at times, formulating recommendations about how teaching should be carried out in those groupings. Therefore, existing research on the disciplinary specificity of pedagogical knowledge does not totally clarify the relationship between the pedagogical knowledge of university professors and the specific characteristics of their discipline.

For this reason, I have decided to examine more closely the relationship between professors' pedagogical knowledge and the specificity of their discipline. In particular, I posit that university professors develop what can be called discipline-specific pedagogical knowledge (DPK), that is, the knowledge that is specific to teaching a given academic

discipline at the university level.[3] My overall intent in this study is to clarify the nature of DPK. Such a construct would enable academic developers like me to examine the thinking of university professors with regard to the teaching of their discipline, and identify better ways to support their professional development. Issues that particularly call for clarification include the various elements of DPK, particularly any which are common to university professors of different disciplines, the role played by personal epistemology in situations where university professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction, and the actual composition of disciplinary specificity in university teaching.

The remaining portion of this document is divided into four parts. The literature review, conceptual framework and specific research questions guiding this study are presented first (Chapter 2). Then, the methods used for data collection and analysis are described in detail (Chapter 3). Thirdly, the various findings are presented in relation to the research questions (Chapter 4). Finally, a discussion of the findings is presented in which conclusions are drawn, implications for both theory and practice are identified, and recommendations for research and practice are formulated (Chapter 5).

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[3] To my knowledge, Lenze (1995) was the first to publish on the concept of DPK. However, she attributes to it the meaning of pedagogical content knowledge (PCK) applied to higher education. As will be explained in the next chapter, I use DPK more broadly than she does.

# CHAPTER 2

## LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

In this study, I explore the relationship between the pedagogical knowledge of university professors and the specific characteristics of the academic disciplines they teach. More specifically, I describe how university professors relate their pedagogical knowledge to the characteristics of their discipline[4] of instruction. I do so through an investigation of the empirical nature of what can be called discipline-specific pedagogical knowledge (DPK) or the knowledge associated with teaching a given academic discipline at university level.

The link between pedagogical knowledge and disciplinary specificity in university teaching has been examined, directly or indirectly, in various ways in research on learning and instruction or in research on university teaching. A review of how the topic has been addressed in these examinations will show the reader the timeliness of my research. It will also clarify the conceptual framework that underlies this study.

Therefore, in this section, I explain how I went about discovering what is and what is not known about the disciplinary specificity of pedagogical knowledge. This leads me to explain how combining various lines of research provides a richer conceptual framework for the examination of DPK than what has been used so far. In turn, the explanation of the conceptual framework will pave the way for the presentation of the sub-questions underlying this research.

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[4] In her most recent book on disciplinary differences in learning to think, Donald (2002) emphasizes how difficult it can be to come up with a consensual definition of a "discipline". This is because people with different epistemologies might see the characteristics of disciplines quite differently. In the context of this study, academic disciplines are seen as domains of knowledge around which a community has formed. This means that people belonging to a discipline study related ideas or phenomena, most often share a language to talk about these, and might even share views about these ideas and phenomena.

## Finding a starting point

To find out more about the relationship between the pedagogical knowledge of university professors and the specific characteristics of the academic discipline they teach I began by looking at research on learning and instruction, starting from the cognitive period all the way to more recent socio-cultural approaches to teaching thus excluding materiel from before the 1970s. This is because the focus of my research is on the knowledge of university professors. I therefore examined research on teacher thinking along with research on the professional development of teachers.

Simultaneously, I examined research on university teaching as that research takes into consideration aspects of teacher thinking and professional development that relate more specifically to the university context. There again, I focused on research that began within the cognitive paradigm of learning and instruction, which became prominent in the 70's, all the way to more recent socio-cultural approaches to teaching, and I likewise excluded research that had been conducted prior to the 1970s. Again, this is because I am focusing in this study on the knowledge developed by university professors. And, in relation to that research, I also looked at the more recent body of research on academic (faculty) development, since my research is about the professional development of university professors.

Examining these various bodies of research has enabled me to identify a starting point in the idea that certain aspects of pedagogical knowledge might be specific to the content that is being taught. Using this platform, I began to examine the various lines of research identified above in order to find out what was known and what was not yet known about my topic of research.

## The content specificity of pedagogical knowledge

Although the idea of content specificity of pedagogical knowledge has been considered for some time in Anglo-Saxon educational research literature, Shulman (1986, 1987) was the first to articulate it clearly with his notion of "Pedagogical-Content Knowledge" (PCK), something that can be described as an amalgam of pedagogical and content knowledge that is the domain of experienced teachers. Shulman began investigating this topic in reaction to what he termed the "missing paradigm" in research on learning and instruction, that is, the gap he saw in research literature with regard to the role of content or subject matter in learning and teaching (Shulman & Quinlan, 1996).

Relying on both historical work and empirical studies conducted in the area of teacher education, Shulman identified various categories of knowledge that are the domain of skillful teachers, one of which is PCK. His results have led him to argue that, through a process of "pedagogical reasoning", teachers merge specific types of knowledge, namely knowledge of pedagogy, knowledge of content, and knowledge of educational contexts, in order to form PCK (Shulman, 1986, 1987). The latter is thus a type of knowledge in its own right, one that focuses on the idea of teaching particular subjects in particular contexts.

The response to Shulman's notion of PCK has been overwhelmingly positive. His construct has been adopted widely in the educational research community as a way of conceptualizing the content-specific pedagogical knowledge of teachers. For instance, further investigations have been conducted concerning the application of PCK to various domains such as social studies (e.g., Gudmundsdottir & Shulman, 1987), physical education (e.g., Amade-Escot, 2001), or science education (e.g., Gess-Newsome &

Lederman, 1999). In addition, operational models of PCK have been developed for primary and secondary level education (e.g., Magnusson, Krajcik, & Borko, 1999), thus providing even more basis for a construct that was initially quite theoretical. Consequently, there is now general agreement in research literature on learning and instruction, and more specifically on teacher education, that PCK is quite useful, particularly with regards to the training of primary and secondary school teachers.

Yet, some authors have been more critical of PCK. For instance, in a philosophical piece on the nature of knowledge used in teaching, McEwan and Bull (1991) argue that all subject matter knowledge that is taught comprises, by definition, some pedagogical dimensions. Therefore, they argue that the notion of PCK is artificial and, as such, constitutes a superfluous construct, one that is of little use in understanding the knowledge of teachers. However, this critique has not been developed much further from an empirical standpoint, thus leaving PCK as the most precise construct to date to explain the relationship between pedagogical and content knowledge in teaching.

To situate it more globally, the construct of PCK fits within the teacher thinking research which is predominantly concerned with how teachers process information and make decisions in their day-to-day teaching activities. This line of research includes studies on various aspects of teacher cognition such as the knowledge base used by teachers (e.g., Donmoyer, 1986; Hiebert, Gallimore, & Stigler, 2002; Munby, Russell, & Martin, 2001), cognitive processes related to teaching (e.g., Berliner, 1986; Kagan, 1988; Leinhardt, 1988; Minstrell, 1999; Sternberg & Horvath, 1995), and issues of metacognition in teaching (e.g., Artzt & Armour-Thomas, 1998; Sparks-Langer & Colton, 1991).

PCK fits within teacher-thinking educational research because it is viewed as a specific type of knowledge structure related to teaching that is the result of a process of pedagogical reasoning (Shulman, 1987). In this reasoning process, teachers go through phases of comprehension, transformation, instruction, evaluation, and reflection. It is through the thinking achieved at each of these phases that various forms of knowledge, such as PCK, are formed, used, and refined. Thus, this construct seemed a crucial starting point in my quest toward further understanding of the relationship between the pedagogical knowledge of university professors and the specific characteristics of their discipline of instruction.

## PCK and the content specificity of pedagogical knowledge at university level

The construct of PCK has achieved importance and status in recent research on learning and instruction. Although this construct was originally discussed in relation to primary and secondary school teaching, some research on university teaching has already used the notion of PCK to examine the knowledge structures of university professors. For instance, Lenze (1995) has used the construct, in the context of a multicase study, to examine the pedagogical knowledge of university professors that is specific to the fields of Linguistics and Spanish. In her work she renamed "pedagogical content knowledge" (PCK) "discipline-specific pedagogical knowledge" (DPK). According to her argument, pedagogy that is specific to content, as envisaged by Shulman in the context of primary and secondary teaching, could be replaced by pedagogy that is specific to a given discipline in the context of university teaching. This is because, according to Lenze, the content taught by university professors actually corresponds to academic disciplines

themselves. Therefore, "content" and "discipline" are envisaged as equivalent constructs that can be used interchangeably.

The notion of discipline-specific pedagogical knowledge seemed to me quite promising for considering how professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction. If DPK could be considered synonymous with PCK, then perhaps all the thinking behind PCK could be applied to teaching at the university level. More specifically, operational models of PCK derived from Shulman's work, as well as applications of PCK to specific fields, could be imported into research on learning and instruction at the university level.

One particular benefit of understanding how university professors relate their pedagogical knowledge to the specific characteristics of their disciplines is the fact that this would enable us to envisage better ways to support university professors in their development. As Lenze (1996) argues, understanding the nature of DPK – her higher education version of PCK – might lead us to adopting a discipline-specific approach to academic development. This line of thinking is supported by the view that academic development activities should be brought closer to the professors themselves, by locating such activities within their departments (Gibbs, 1996) or within their discipline (Jenkins, 1996).

However, in order to be able to use the construct of PCK – or its higher education equivalent DPK – in the context of university teaching, its robustness needed to be checked in that context. The empirical studies Shulman used to devise PCK focused exclusively on primary and secondary school teachers. Furthermore, applications of the construct to specific areas of knowledge were also limited to those two educational levels.

Therefore, although PCK has been useful in clarifying the knowledge structures of teachers at primary and secondary school levels, its relevance at the university level remained untested. The construct thus required examination to see if it would hold up when applied to an instructional context that is quite different from the one from which it has been derived.

I thus undertook an exploratory study to check the robustness of PCK in the context of university teaching (Berthiaume, 2003). Using the operational model of PCK devised by Magnusson, Krajcik, and Borko (1999), I examined interview transcripts in which a university professor discusses general issues of learning and teaching. These interviews had been conducted in the context of a research program on reflective teaching at university level (McAlpine & Weston, 2000, 2001; McAlpine, Weston, Beauchamp, Wiseman, & Beauchamp, 1999). The six interviews carried out with this particular professor were conducted at different times during the period of one semester, namely, before the course started, before and after each of two classes, and at the end of the course. These six interview transcripts focused mainly on issues of teaching and learning, and, as such, were directly relevant to my attempt to validate PCK's robustness in the university context.

In the model by Magnusson et al. (1999), PCK is broken down into four categories of knowledge contributing to its formation, namely knowledge of instructional strategies, knowledge of assessment, knowledge of curriculum, and knowledge of student understanding. In turn, each of these categories are broken down into subcategories identifying more specific aspects of teachers' knowledge that contribute to the formation of PCK.

In light of this, checking the robustness of PCK for higher education took the form of applying the Magnusson et al. categories and subcategories to data based on university teaching. Therefore, three coders examined the transcripts and reliably identified passages where the professor discussed issues related to pedagogical content knowledge. These passages were in turn examined in further detail in an attempt to identify elements that would fit in the categories and subcategories of the operational model devised by Magnusson et al. (1999). In the end, evidence of each of the four categories was reliably found by the three coders. However, no evidence was reliably found for the subcategories, despite multiple attempts. The conclusion of this exploratory study was that the widely used construct of PCK – based on primary and secondary teaching – did not hold up when applied to the context of university teaching. This required a reconsideration of whether PCK could be applied to university teaching.

Various issues supported such reconsideration. For instance, one dimension that appears particularly problematic with regard to the direct application of PCK to university teaching is the notion of content. In Shulman's notion of PCK, content corresponds to the curricular formatting of knowledge that is observed in primary and secondary education whereas, at university level, content corresponds most often to disciplinary knowledge. The two are quite different. For instance, disciplinary knowledge at university level tends to be rather complex and monodisciplinary, whereas content in primary and secondary education is simplified and often multidisciplinary (i.e., at those levels, one tends to deal with "the sciences", "the social studies", or "the arts" rather than, say, "chemistry", "anthropology", or "music").

Another dimension that is problematic is the training of teachers themselves. At university level, professors are normally trained as disciplinary specialists and not as teachers. At primary and secondary level, teachers are trained as teaching specialists, with a disciplinary specialization contextualizing that training. Therefore, the relationship to content that both groups entertain is quite different. This is reflected in the fact that strong discipline-specific allegiances prevail in the case of university professors (Menges & Austin, 2001), and not necessarily in the case of primary and secondary teachers.

Therefore, I concluded that the argument that DPK is the higher education equivalent of PCK could not be supported. So while the label discipline-specific pedagogical knowledge corresponds to an important idea, the concept actually needs to be reconceptualized. To do this, it is necessary to step back and examine other aspects of research literature on learning and instruction that might contribute to explaining how university professors relate their pedagogical knowledge to the specific characteristics of their discipline.

## Resituating DPK in research literature on learning and instruction

The failure to confirm PCK for university teaching and to accept DPK as its equivalent led me to believe that a new, better adapted construct might need to be devised in order to more accurately represent how university professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction. Therefore, I began to re-examine literature on teacher thinking more closely to identify other elements that might be important to consider. From this re-examination, two specific areas of research emerged at first: research on the knowledge base for teaching, and research on

issues of disciplinary specificity in university teaching. As I explored these two areas of research, a third one emerged as important in articulating the relationship between them, namely issues of personal epistemology. This is because, as will be explained, most of the research on disciplinary specificity in university teaching assumes that the relationship between the knowledge base for teaching and disciplinary specificity is a direct one. Yet, research on personal epistemology points to the fact that that relationship can be mediated by how one sees knowledge and issues of knowing. Each of these lines of research and how they contribute to my study are described as follows.

### *Research on the knowledge base for teaching*

The first element that emerged is the knowledge base for teaching itself. Several authors who write about teacher thinking argue that the knowledge base for teaching plays a crucial role in teaching (e.g., Clark & Lampert, 1986; Dill, 1990; Hiebert, Gallimore, & Stigler, 2002; Munby, Russell, & Martin, 2001; Turner-Bisset, 1999). According to this line of thinking, the knowledge base is used to fuel the cognitive and metacognitive processes associated with teaching. Therefore, the knowledge base for teaching would necessarily play a big role for professors developing pedagogical knowledge that is specific to a given discipline since that would require calling upon both cognitive and metacognitive processes. I thus took a closer look at the knowledge base for teaching to see what its components were and how they might relate to DPK.

*Knowledge structures.* A first component encountered in research literature on the knowledge base for teaching is the actual *knowledge structures* related to teaching that an individual teacher has. As emphasized in the literature, knowledge structures constitute a

body of dynamic, relatively consensual, cognitive understandings that inform skillful teaching (Calderhead, 1988; Clark & Peterson, 1986; Gess-Newsome, 1999; Kane, Sandretto, & Heath, 2002; Thompson, 1985). Other authors further describe such cognitive understandings as taking various forms, ranging from more factual or declarative knowledge to more strategic or procedural knowledge (L. W. Anderson et al., 2001; Farnham-Diggory, 1994; Haskell, 2001; McNamara, 1994).

In the research literature on teacher thinking, knowledge structures related to teaching have generally been examined from two different angles. On one hand, knowledge structures are seen as the product of educational researchers' thinking about what teachers know. This is what Fenstermacher (1994) calls "formal knowledge", a normative approach to the types of knowledge that would be essential to effective teaching. On the other hand, knowledge structures are viewed as the product of teachers thinking about what they know. This is what Fenstermacher calls "practical knowledge", or the realization by teachers of the knowledge they have. When examining the relationship between the pedagogical and disciplinary knowledge of university professors, the "formal knowledge" line of research is more informative than that on "practical knowledge" mainly because research on "formal knowledge" has deconstructed the knowledge of teachers into more specific dimensions, whereas research on the "practical knowledge" of teachers has tended to examine it as a whole (e.g., Carter, 1990; Clandinin & Connelly, 1987; Elbaz, 1983).

In the "formal knowledge" line of research, several types of knowledge used in effective teaching are identified. Although the nomenclature sometimes differs from author to author, those types of knowledge generally include knowledge of the content, of

pedagogy, of assessment, of the learners, of the curriculum, of instructional contexts, and of the self as a teacher (Grossman, 1990, 1991; Grossman, Wilson, & Shulman, 1989; Hativa & Goodyear, 2002; Morine-Dershimer & Kent, 1999; Turner-Bisset, 1999). This is actually where research on PCK fits, the latter being considered a type of knowledge used alongside others within one's knowledge structures (Shulman, 1986, 1987).

*Beliefs.* A second component of the knowledge base for teaching corresponds to *beliefs* a teacher entertains in relation to teaching. As was the case with knowledge structures related to teaching, beliefs are generally described in literature as having multiple dimensions or types (Calderhead, 1996; Fang, 1996; Pajares, 1992). For instance, beliefs related to teaching can be about teaching itself, about learners and learning, about one's confidence to affect students' learning, about the nature of knowledge, about the subject matter, about causes of teacher and student performance, about perceptions of self and feelings of self-worth, or about the confidence to perform specific tasks.

As is emphasized in the research literature, beliefs related to teaching are generally seen as personal and most often untested assumptions, premises, suppositions, or commitments about instruction that guide one's teaching actions (Calderhead, 1996; Clark & Peterson, 1986; Fang, 1996; Goodyear & Hativa, 2002; Kane, Sandretto, & Heath, 2002; Nespor, 1987; Pajares, 1992). This is mainly because beliefs comprise important affective and evaluative dimensions. As a result, beliefs tend to be static, stable, and highly resistant to change. Furthermore, beliefs related to teaching tend to be non-consensual and stored episodically in the teacher's mind, as opposed to being consensual and stored semantically in the case of knowledge structures (Nespor, 1987; Pajares, 1992;

Thompson, 1985). Therefore, beliefs are quite different from knowledge structures related to teaching.

Yet, some authors within that line of research argue that the difference between knowledge structures and beliefs related to teaching is not always clear (Calderhead, 1996; Gess-Newsome, 1999; Nespor, 1987; Pajares, 1992). This is because both affective and cognitive components are sometimes present in beliefs, which makes the latter intimately linked with knowledge structures. As such, beliefs related to teaching play a very important role in the decision-making process of teacher. Therefore, an examination of the relationship between the pedagogical knowledge of university professors and the specific characteristics of their discipline of instruction would not be complete if it did not include a consideration of both knowledge structures and beliefs related to teaching.

*Goals.* A third component of the knowledge base for teaching is *goals* related to teaching. The latter are generally associated with what a teacher is trying to accomplish, thus comprising expectations and intentions about instruction (Hativa & Goodyear, 2002; McAlpine, Weston, Beauchamp, Wiseman, & Beauchamp, 1999; Minstrell, 1999; Pratt, 1992). Such expectations or intentions can be situated in the context of a class, a course or even a degree program. And, whereas some goals might be quite constant in the short-term, others might be less constant and evolve in the long-term.

One important aspect of goals related to teaching is, as Hativa and Goodyear (2002) emphasize, the fact that they have a great impact on knowledge structures and beliefs related to teaching. For instance, as Pratt (1992) also explains, goals make teaching actions purposeful, that is, the motivational dimension behind teaching goals serves as the impetus that turns knowledge and beliefs into teaching actions. Therefore,

the relationship between goals related to teaching and knowledge structures or beliefs is a very close one. The boundaries between these three components are sometimes seen as rather permeable. For instance, practical teacher knowledge has a lot in common with various types of beliefs related to teaching. Also, the latter are often not too different from many types of teaching goals. This view is supported by various authors who actually merge aspects of knowledge, beliefs, or goals related to teaching into a larger construct, that of "conceptions" related to teaching (e.g., Gow & Kember, 1993; Kember, 1997; Pratt, 1992; Samuelowicz & Bain, 1992; Thompson, 1985; Zeichner & Liston, 1996).

Envisaging the source of DPK as located solely within a professor's knowledge base for teaching does not account for characteristics of the discipline which may influence that thinking. As mentioned earlier, professors have strong disciplinary allegiances and this means that the specific characteristics of a given discipline might influence the thinking of a professor about teaching within that discipline. In light of that, I determined that there was a need to look beyond the teacher's knowledge structures, beliefs or goals related to teaching, in order to consider specific disciplinary characteristics that might affect the professor's use of his/her knowledge base.

### *Research on disciplinary specificity in university teaching*

It is reasonable to imagine that certain disciplinary characteristics could affect knowledge structures, beliefs, and goals related to teaching. Therefore, I needed to know what those characteristics are and how they are related. From the research on disciplinary specificity in university teaching, I was able to see that disciplinary characteristics can be located on what appears to be a continuum that ranges from being predominantly socio-

cultural (i.e., characteristics that are socially constructed through the establishment of norms, practices or rules within a group of individuals) to being predominantly epistemological (i.e., characteristics that directly depend upon the epistemological structure of the field).

*Socio-cultural characteristics of the discipline.* The development of thinking on teaching in the past 20 years or so has brought about views of teaching that would qualify as being "socio-cultural". According to this line of thinking, teaching can hardly be seen as something happening in a vacuum, void of any external influences. For instance, as envisaged by socio-constructivist thinkers, learning takes place in a specific social and cultural environment which influences how learners construct knowledge (Fosnot, 1996; Greeno, 1998; Lave & Wenger, 1991; Palincsar, 1998; Shotter, 1995; Von Glasersfeld, 1996).

Simultaneously, as is emphasized in some research on teacher thinking (e.g., Calderhead, 1992; Grimmett, Erickson, Mackinnon, & Riecken, 1990; Zeichner & Liston, 1996), teachers can themselves be considered learners at what they do, learning about teaching through the process of reflection. This is particularly true at university level, where professors seldom receive training in teaching, thus possibly learning about teaching only through reflective practice (McAlpine & Weston, 2000, 2001; McAlpine, Weston, Beauchamp, Wiseman, & Beauchamp, 1999).

Therefore, it is possible to imagine that large portions of the DPK developed by university professors is done through reflective practice. It is also possible to see that that reflective learning, taking place in a specific socio-cultural environment, would be influenced by said environment, namely, the disciplinary context in which university

professors operate. Therefore, the disciplinary context could end up affecting a university professor's teaching decisions.

But what is a disciplinary environment about? What does it comprise? How does it affect a teacher? These are questions that intrigued me. Examining research literature on university teaching and learning, I found that Becher (1989) – later with Trowler (Becher & Trowler, 2001) – had examined the notion of disciplinary environments in higher education and how these influence the knowledge of professors. Using the Biglan (1973) classification of academic disciplines, Becher examined the characteristics that are specific to various disciplinary groupings. Through ethnographic work, he found that academic disciplines comprised significant cultural dimensions such as norms, practices or rules, making them akin to specific cultural groups or tribes. Furthermore, he found that beliefs or knowledge structures of professors representing specific disciplines were intimately related to the characteristics and structures of the type of knowledge associated with those disciplines. Becher thus derived that experts in certain disciplines would be brought to think along similar lines with regard to teaching.[5]

In light of that, academic disciplines could be seen as socio-cultural environments in which university professors are socialized into certain ways of thinking, which, in turn, affect how they teach. This view would be supported by the description of higher education as an environment in which teachers develop strong allegiances to their discipline, even before their institutions (Menges & Austin, 2001). Therefore, it would be

[5] This is the position of the first edition (1989) of *Academic Tribes and Territories*. The second edition, written in collaboration with Paul Trowler (2001) no longer makes such generalisations as regard the homogeneous thinking of professors within a given academic discipline. This issue will be addressed later in this chapter.

reasonable to envisage that DPK has roots beyond the professor's knowledge base, that is, that it depends upon the specific characteristics of the discipline itself.

*Epistemological structure of the discipline.* Other researchers have examined disciplines from a more epistemological standpoint, examining how knowledge is structured in specific fields and how that influences people evolving in those fields. For instance, Kolb (1981) examined the relationship between inquiry norms in given disciplines and the learning style of students evolving in those disciplines. He found that there were disciplinary differences in how knowledge is reported, in inquiry methods, and in criteria for evaluating knowledge. That led him to generalize that disciplinary traits would apply to people belonging to certain disciplines by virtue of the epistemological structure of these disciplines.

Working more specifically with university professors, Donald has explored knowledge structures and processes of validation in academic disciplines (Donald, 1983, 1987, 1995, 2002). Working with large numbers of professors, Donald has determined not only that knowledge is structured in different ways, but also that the processes of determining what constitutes valid knowledge also differs from discipline to discipline. This, she found, has major implications for both learning and teaching. On one hand, learners end up developing ways of thinking that are specific to their academic field. On the other hand, teachers end up teaching for the development of those ways of thinking in students. Therefore, the epistemological structure of a discipline itself does affect both processes of learning and teaching, and not necessarily through social interaction.

*The two components of disciplinary specificity in university teaching.* Studies along both the socio-cultural and epistemological routes as were just described has given

rise to a line of research on disciplinary specificity in university teaching. The notion of disciplinary specificity can be described as a particular set of characteristics that are associated with a given academic discipline. Such characteristics can either be predominantly epistemological, such as how the field is structured and how knowledge is validated within it, or predominantly socio-cultural, such as norms, practices or rules that prevail in relation to knowing in that field. In both cases, the disciplinary characteristics are believed to influence the decisions of university professors with regard to teaching. This means that how a university professor uses his/her knowledge base in teaching is influenced by disciplinary characteristics, either predominantly epistemological or predominantly socio-cultural.

This line of research has investigated extensively the various differences in teaching and learning between specific groups of disciplines. For instance, Cashin and Downey (1995) have examined the relationship between the characteristics of specific disciplines and the nature of teaching and learning in those disciplines. Entwistle and Tait (1995) have looked at the relationship between disciplines and the kind of learning that happens within them. Hativa (1997) has examined professors' conceptions of teaching within different academic disciplines. Murray and Renaud (1995) have looked at how specific teaching behaviors are more predominant in specific disciplines than in others, whereas Smeby (1996) has examined differences in the time spent on teaching and preparation for different disciplines. Finally, in an integrative study, Neumann (2001) has examined the various factors associated with teaching identified by the research described above in relation to specific groups of disciplines. She concludes, like the other authors cited above, that academic disciplines have specific characteristics that lead them to be

taught differently by university professors. Therefore, disciplinary specificity has an impact on university teaching.

However, this line of research alone does not explain how university professors end up relating their pedagogical knowledge to the specific characteristics of their discipline. Rather, it describes how people teach or learn in certain academic fields. Sometimes, it even goes as far as recommending ways of teaching or learning in specific disciplines. Yet, on its own, research on disciplinary specificity in university teaching does not clarify the nature of discipline-specific pedagogical knowledge used since it does not deal with the actual thought processes of university professors. To do that, it would seem necessary to envisage a way of thinking about DPK that would encompass both the professor's knowledge base for teaching and the disciplinary context – socio-cultural and epistemological characteristics – in which that professor operates.

A DPK approach which combines the "knowledge base for teaching" view with the "disciplinary specificity" view might lead to a more accurate representation of how university professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction. I thus decided to combine findings from research on the knowledge base for teaching and findings from research on disciplinary specificity to develop a framework that might represent more accurately the phenomenon of DPK. However, most of the literature on disciplinary specificity in teaching assumes that the link between one's knowledge base for teaching and the disciplinary specificity of his/her field is a direct one. This is why much of the research on disciplinary specificity in university teaching is able to make sweeping generalizations and recommendations about

teaching in given academic disciplines (e.g., that all physics professors teach or should teach in a given way or that all history professors teach or should teach in another way).

Yet, something else might be mediating that relationship. As was explained earlier, the knowledge base for teaching comprises more than knowledge structures related to teaching. In fact, goals related to teaching as well as beliefs related to teaching are also extremely important in situations of pedagogical reasoning and decision-making. This is because, as research has found, beliefs reach much further than only teaching. For instance, not only do teachers entertain beliefs about pedagogical matters such as learners and learning or teachers and teaching, but they entertain beliefs about knowledge and knowing in general (Hofer & Pintrich, 1997, 2002). Simultaneously, disciplines are laden with issues of knowledge and knowing as they are "fields of knowledge" and, as was just seen, they have specific characteristics related to the development of knowledge through teaching. Thus, if the most representative approach to DPK is one which combines a professor's knowledge base for teaching and disciplinary specificity, then beliefs related to knowledge in general would play an important role. It is therefore important to bring issues of personal epistemology into the DPK approach that joins the "knowledge base for teaching" with "disciplinary specificity" views in order to clarify the relationship between those two.

### *Research on issues of personal epistemology*

Recent educational research has examined the place of personal epistemology in learning. For instance, various authors have examined how individual learners see or relate to knowledge (e.g., Hofer & Pintrich, 1997, 2002; Magolda, 2002; Perry, 1998;

Schommer-Aikins, 2002). This line of research has found that knowers may entertain various views or beliefs about knowledge and knowing which, in turn, affect how they understand or make meaning of information they encounter or use. Using such a line of thinking, it can be assumed that how a professor perceives specific aspects of his/her academic discipline will depend upon how s/he views knowledge and knowing since academic disciplines are laden with these issues of knowledge and knowing. Therefore, it would appear essential to consider issues of personal epistemology when examining the relationship between a university professor's knowledge base and the specific characteristics of his/her discipline.

More specifically, research on personal epistemology has examined the relationship between one's belief system and knowledge under various angles. For instance, Perry (1998) has examined the development of thinking with regard to knowledge of undergraduate students. This has led him to devise a continuum that emphasizes stages in such development. Along similar lines, Magolda (2002) has conducted longitudinal work on the evolution of assumptions with regard to the knowledge and knowing of university students. Kitchener and King (2002; , 1990) have examined the epistemic development of learners through their ability to reflect on their assumptions about knowledge. Schommer-Aikins (1990, 2002) has inventoried the various beliefs of learners with regard to knowledge and how those affect learning in areas such as reading comprehension. Finally, other authors have examined the relationship between gender and ways of thinking and knowing (e.g., Belenky, Clinchy, Goldberger, & Tarule, 1986; Clinchy, 2002).

What the research described above emphasizes, in one way or another, is the presence of a continuum along which learners can be situated in terms of how they view knowledge and knowing. At one end, people tend to see knowledge as dualistic, or right or wrong, while at the other end, they tend to see knowledge as something that is much more relative or contextual. What this says is that people do not necessarily have set views of knowledge matters. Rather, those views evolve over time and according to the context in which people find themselves.

But in addition to the continuum, it seems that this research has focused on three specific aspects or components of personal epistemology. The first component comprises issues of personal epistemology related to *beliefs about knowledge and knowing*. This component is about how people view what constitutes knowledge and the various actions associated with being able to know. The second component comprises issues of personal epistemology related to *beliefs about knowledge construction.* This component is about how people come to know, and how they develop or accumulate knowledge. Finally, the third component comprises issues of personal epistemology related to *beliefs about the evaluation of knowledge*. This component is about how people attribute more value to certain forms of knowledge over others.

These findings about personal epistemology shed a new light on the idea of a DPK approach joining the knowledge base for teaching with issues of disciplinary specificity. To begin with, they reinforce the idea that examining the entire knowledge base for teaching rather than only knowledge structures when considering one's pedagogical knowledge is appropriate. This is because certain aspects of the knowledge base such as beliefs or goals related to teaching might change with time or according to the context in

which the teaching takes place. Additionally, they point to the fact that something could mediate the relationship between a professor's thought processes and the disciplinary characteristics of his/her discipline.

This latter point is particularly important. In literature on disciplinary specificity in teaching, either socio-cultural or epistemological considerations are believed to lead teachers to think and act in certain ways. Although various authors perceive the deterministic nature of such external factors differently, the general consensus is that like disciplines are interpreted similarly by professors who belong to those. Yet, in light of the literature on personal epistemologies described above, that is not exactly the case since it can be demonstrated that different people entertain different beliefs about knowledge at different points in time. This could mean that people who teach within the same discipline might react differently to socio-cultural or epistemological factors specific to their discipline.

This is something that Becher, when working with Trowler (Becher & Trowler, 2001), changed from his earlier findings. To say that all professors from the same academic discipline think the same way with regard to teaching is just not realistic. This would amount to what Trowler termed "epistemological essentialism"[6], or the fact that the epistemological structure of disciplines forces the homogeneous thinking of university professors within a given discipline. Since we know that this is not the case for research – as many people from the same field might entertain different views about their own academic discipline – it is hard to conceive that it would be the case with regard to teaching.

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[6] As per a communication given in the context of a conference on disciplinary differences in university teaching, held at the University of Edinburgh, United Kingdom, in May 2005.

In that sense, a discussion of the relationship between one's pedagogical knowledge and the specific characteristics of his/her discipline cannot ignore issues of personal epistemology as the latter would tend to act as a mediator in the relation between the knowledge base and the discipline. Therefore, in this study, I challenge the view that the link between one's knowledge base for teaching and the disciplinary specificity of his/her field is a direct one – as emphasized in much of the literature on disciplinary specificity. Rather, I posit that issues of personal epistemology play a much greater role in the relationship between a professor's knowledge base for teaching and the specific characteristics of his/her discipline of instruction. Therefore, the representation of the phenomenon of DPK suggested in this study is one that moves beyond the notion of combining the professor's knowledge base for teaching and the disciplinary specificity of his/her field towards an expanded notion that integrates one's personal epistemology in teaching. This seems a more accurate representation of the relationship between the pedagogical knowledge of university professors and the specific characteristics of their discipline of instruction, that is, their discipline-specific pedagogical knowledge.

## DPK as an integrative framework

So far, I have explained how Shulman's notion of pedagogical content knowledge (PCK) is not the most appropriate construct for explaining how university professors relate their pedagogical knowledge with the specific characteristics of their discipline. This is the case despite earlier attempts at using the construct in higher education, through the notion of discipline-specific pedagogical knowledge (DPK) (i.e., Lenze, 1995, 1996).

This has led me to envisage a reconceptualization of the construct of DPK, one that would take into consideration aspects not already considered in the construct of PCK.

Returning to research literature on learning and instruction, I found that research on the knowledge base for teaching was quite informative in examining the relationship between pedagogical knowledge and disciplinary characteristics. I particularly found that aspects other than knowledge structures related to teaching, namely beliefs and goals, also play a very important role in the development and use of a teaching knowledge base. This has led me to think that these three components could play an important role in clarifying the relationship between the pedagogical knowledge of university professors and the specific characteristics of their discipline of instruction.

The line of research on disciplinary specificity in university teaching was also quite informative with regard to aspects of the professor's discipline that could influence decision-making in the context of teaching. More specifically, I discovered that both socio-cultural aspects and epistemological aspects of academic disciplines are thought to influence teaching. I thus decided to integrate the lines of research on disciplinary specificity and on the knowledge base for teaching in order to devise a framework that more accurately represents the notion of discipline-specific pedagogical knowledge.

Most research on disciplinary specificity in university teaching tends to adopt a deterministic outlook and, as such, tends to attribute homogeneous, permanent characteristics to professors teaching within similar disciplines. However, research on personal epistemology emphasizes the relative nature of people's views of knowledge. Bringing constructs from the personal epistemology research literature, namely notions such as people's beliefs about knowledge and knowing, about knowledge construction, and about knowledge evaluation, thus expands the conceptual framework to suggest a

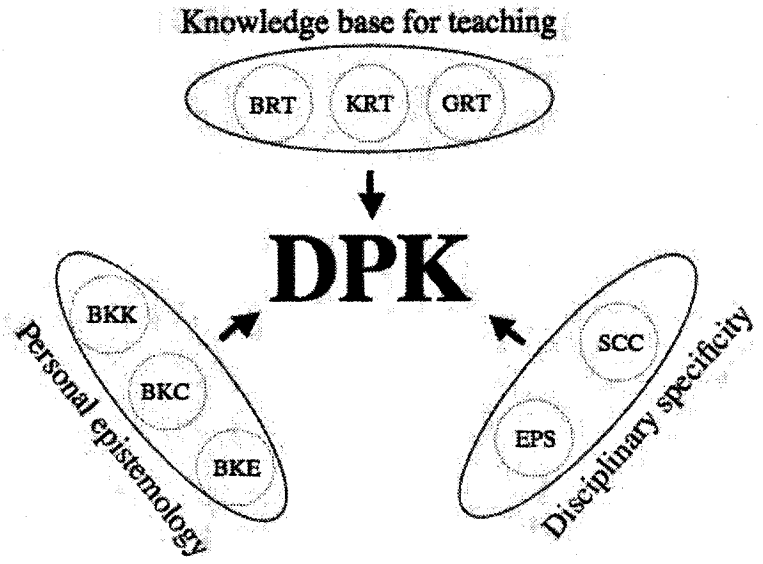
role for personal epistemology in the relation between university professors' pedagogical knowledge and the specific characteristics of their discipline of instruction.

Therefore, the conceptual framework underlying this study is one which integrates three distinct lines of research, namely research on the knowledge base for teaching, on disciplinary specificity in university teaching, and on personal epistemology. These three lines of research act as sources of DPK in that they provide lenses to examine elements of a professor's thinking about teaching that might contribute to the formation of DPK. As such, the conceptual framework for this study draws simultaneously on the aforementioned three lines of research in order to describe how university professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction. The conceptual framework is now described in detail, in order to introduce the specific research questions underlying this study.

As shown in Figure 1 (on p. 33), the conceptual framework for this study positions DPK at the junction of three sources, namely the professor's knowledge base for teaching, the disciplinary specificity or characteristics of his discipline, and the professor's personal epistemology. As such, DPK is not dependent upon only one of these sources but upon the three of them concurrently. Therefore, the professor's knowledge base for teaching, the disciplinary specificity of his/her field, and his/her personal epistemology influence the decisions made about teaching.

Figure 1

DPK: A form of knowledge at the junction of three sources




As was emphasized in the earlier examination of these three lines of research, specific components can be derived from existing literature in relation to each of these three sources. For instance, in research on the knowledge base for teaching, the professor's knowledge structures related to teaching (KRT), his/her beliefs related to teaching (BRT), and his/her goals related to teaching (GRT) are identified as the main components. Hence, in the conceptual framework underlying this study, they constitute the three components associated with the "knowledge base for teaching" source of DPK.

In research on disciplinary specificity in university teaching, socio-cultural characteristics (SCC) and the epistemological structure (EPS) of a professor's discipline

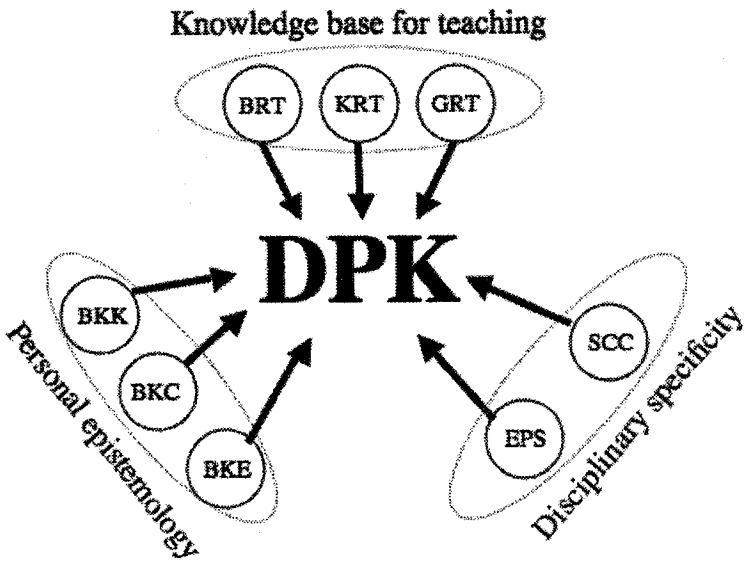
are identified as the main components. Thus, in the conceptual framework underlying this study, these constitute the two components associated with the "disciplinary specificity" source of DPK.

Finally, in research on personal epistemology, a person's beliefs about knowledge and knowing (BKK), about knowledge construction (BKC), and about the evaluation of knowledge (BKE) are identified as the main components. Therefore, in the conceptual framework underlying this study, these constitute the three components associated with the "personal epistemology" source of DPK.

Having specified the various components corresponding to each of the three sources of DPK, the latter can be envisaged as a form of knowledge that is more complex than the intersection between three sources. Rather, DPK can be viewed as knowledge found at the junction of eight components derived from these three sources. Figure 2 (on p. 35) provides an illustration of the simultaneous influence of each component on DPK. It shows how each of the eight components, derived from the three sources, contribute to DPK.

Figure 2

DPK: A form of knowledge at the junction of eight components

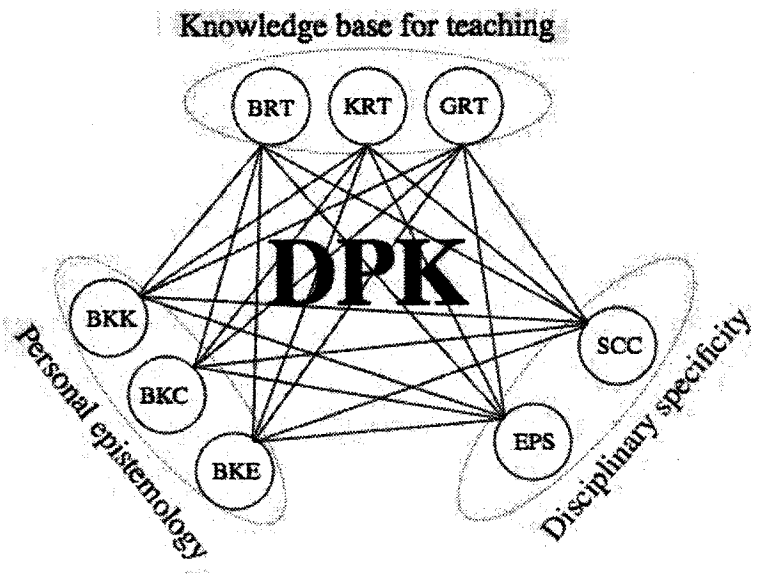



As has been emphasized in the description of the research literature, the strength of the conceptual framework underlying this study resides with the fact that it enables me to merge various lines of research. This means providing an overall lens for the phenomenon of DPK that takes into consideration issues related to the professor's knowledge base for teaching, the disciplinary specificity of his/her field, and his/her personal epistemology. Hence, as those three sources can be broken down into two or three main components each, DPK would also be dependent upon the relationships existing between the corresponding components. This means that, as shown in Figure 3 below, the construct of DPK envisaged in this study is one that depends not only upon

eight components derived from three sources, but also on the various relationships existing between those eight components. As such, I posit that DPK is a form of knowledge that corresponds to a complex web of relationships found between various components of a professor's knowledge base for teaching, of the specificity of his/her discipline, and of his/her personal epistemology.

Figure 3

DPK: A form of knowledge corresponding to a web of relationships between components




The conceptual framework underlying this study thus sees DPK as knowledge that depends upon eight components – i.e., knowledge structures, beliefs, and goals related to teaching; socio-cultural characteristics and epistemological structure of the discipline; and beliefs about knowledge and knowing, knowledge construction, and knowledge

evaluation – and the web of relationships among them. Many of these components have not been operationalized in the context of higher education, at least with relation to one another. Therefore, we do not know the dimensions or characteristics of these components, nor the kind of relationships that might exist between them. This is the focus of the current study: developing a new way to conceptualize discipline-specific pedagogical knowledge (DPK).

## Specific research questions

This study intends to fill the gap identified above by answering the overall research question: "What is the nature of university professors' discipline-specific pedagogical knowledge (DPK)?" In light of the conceptual framework described above, two specific research questions will be answered:

- What are the dimensions/characteristics associated with the components of the DPK conceptual framework?
- What relationships exist between the components of the DPK conceptual framework?

The next chapter describes methods I used to collect and analyze data with relation to those specific questions and, therefore, with relation to the overall research question.

# CHAPTER 3

# METHODS

Having described the conceptual framework and the research questions underlying this study, this chapter describes the methods employed to collect and analyze data. It does so by discussing successively the overall design of the study, issues of validity and trustworthiness, participant selection and data sources, data collection instruments, data collection procedures, and the process of data analysis.

## Overall design of the study

The overall design of this study is one of analytic induction whereby a conceptual framework is first derived from the literature and then documented with the help of data (Bogdan & Biklen, 1998; Deslauriers, 1997; Paillé, 1996; Pires, 1997). The study also draws from content analysis in that the discourse of participants, in the form of interview transcripts, is analyzed in order to identify empirical evidence of components derived from the conceptual framework, as well as relationships between those components (Krippendorff, 2004).

In order to proceed according to the principles of both analytic induction and content analysis, a mixed a priori/emerging coding scheme was used (Maxwell, 1996; Van der Maren, 1996).[7] This is because, on one hand, the conceptual framework underlying this study provided the more general categories used in the coding scheme – i.e., the a priori sources and components of DPK derived from the conceptual framework.

[7] QSR NVivo 2.0 was used to keep track of coding thoughout the analysis phase of the study.

On the other hand, the data itself provided the more fine-grained categories of the coding scheme – i.e., the emerging dimensions associated with components of DPK.

In this context, I proceeded to collect data with an instrumental/interpretive multicase study approach (Creswell, 1998; Karsenti & Demers, 2000; Merriam, 1998; Mucchielli, 1996a; Stake, 2000; Yin, 1994). That approach seemed to be the most appropriate for three reasons. First, I was examining how individuals deal with a phenomenon that is quite specific and "bounded", that is, the relationship between a university professor's pedagogical knowledge and the knowledge of his/her discipline of instruction as it is embodied in the construct of discipline-specific pedagogical knowledge (DPK). A case study approach thus enabled me to explore the phenomenon in depth, looking at both the phenomenon itself and the setting in which it takes place.

Second, this research is multicase in that I examined four distinct instances of the same phenomenon, that is, the DPK of four university professors from four different academic disciplines, in order to capture potential variations of the phenomenon following a logic of saturation (Bogdan & Biklen, 1998; Merriam, 1998). Simultaneously, following a logic of replication (Yin, 1994), I was also able to identify "core elements" of DPK, that is, dimensions of components of DPK and relationships between components that are likely to be encountered in university professors.

Third, this research is "instrumental" (Karsenti & Demers, 2000; Mucchielli, 1996a; Stake, 2000) or "interpretive" (Merriam, 1998) in that I examined the four cases not for the cases themselves but rather because they all provided access to the phenomenon of DPK. As such, examining these four cases served to develop a framework to describe the notion of DPK as well as to identify "core elements" of that framework, was instrumental

to drawing theoretical conclusions about the phenomenon of interest, that is, discipline-specific pedagogical knowledge (DPK).

## My profile as a researcher

I am particularly interested in the topic of this study because of my background as a university professor and as an academic developer. In the first instance, I have become interested in issues of disciplinarity and interdisciplinarity when I completed my first Master's degree in International Relations, a program that combined courses in Political Science, Economics, Law, and Management. During that program of study, I was exposed to teaching in a variety of disciplines which drew my attention to the difference in strategies used by professors to facilitate learning. I later completed the first year of a PhD program in Political Science and began teaching in that field,. This is where I became aware of the importance of developing a repertoire of teaching strategies that is particularly adapted to one's field of instruction – i.e., discipline-specific pedagogical knowledge (DPK).

I then changed fields of study to Education Psychology, first completing a Master's degree then a PhD degree, specializing in Instructional Psychology and Applied Cognitive Science. As I completed these degrees, I became involved in both research and academic development activities at the Centre for University Teaching and Learning (CUTL) of McGill University. Through these activities, I was able to test some of the assumptions I had about the role and importance of DPK in the professional development of university professors.

My academic background is thus predominantly from the Social Sciences and Humanities. Furthermore, my research orientation within this area of study is mainly

interpretive and naturalistic, meaning that I am more interested in the lived experience of individuals rather than exploring the various characteristics of large samples of individuals. This probably comes from the ethnographic tradition to which I was introduced as part of my studies in Political Science. As such, with regard to the notion of DPK, I am interested in finding out how individuals develop such form of knowledge, that is, what sources they draw from in order to construct DPK.

## Issues of validity and trustworthiness

This study is one that focuses on discovery and description. It is discovery-oriented because I seek to find out what DPK is really about from an empirical point of view. At the same time, it is descriptive in that the findings provide illustrations of the various components and relationships associated with DPK. In light of this, specific aspects of validity and trustworthiness[8] needed to be checked throughout the data collection and analysis phases of the study. These are now explained in detail as follows.

### *Validity*

In the context of this study, two aspects of validity particularly needed to be checked, namely construct and external validity (Yin, 1994). The former means making sure that I captured the right phenomenon with the data collection instruments that I used

[8] The underlying epistemological assumptions of this study are post-positivistic, meaning that "reality" might be manifest but that such "reality" can only be captured partially, even with the help of elaborate methodological procedures (Eisner, 1991; Guba & Lincoln, 1998). Consequently, it is more important here to be consistent and transparent throughout the analysis rather than seeking replicability. Therefore, issues of reliability are envisaged in this study as issues of trustworthiness.

whereas the latter means interpreting the phenomenon properly, with particular regard to potential generalizations.

Four specific strategies were used to prevent threats to such forms of validity. The first strategy was to ensure that data collection instruments took into account multiple perspectives on the phenomenon. For instance, as will be explained in more detail in the description of data collection instruments, interview protocols focused on the participants' thinking at various stages in the teaching process (i.e., before a course, before a class, after a class, and after a course). Also, interview protocols focused on both what participants reported and what they actually did, thus reducing the potential gap between their *espoused-theories* – what they report – and their *theories-in-use* – what they actually do (Argyris & Schön, 1977).

As a second strategy, member checking (Maxwell, 1996; Van der Maren, 1999) was used at various stages in the analysis process. For instance, I had a telephone discussion with each of the four professors after one round of coding to ensure that certain aspects of the categorization were representative of their thinking. Later on, in conjunction with the production of each professor's narrative summary, I met with everyone individually to discuss the empirical dimensions associated with DPK components and ensure that these were representative of their thinking. Such discussions confirmed the dimensions associated with DPK components that emerged from the transcripts. In turn, they enabled me to work on identifying the relationships between DPK components.

As a third strategy, I tried to stay as close as possible to the language used by the participants. This was not always easy as many opportunities for inference occurred throughout the process of analysis. However, whenever possible, I used the participants'

terms to name specific dimensions associated with DPK components and to describe them. Similarly, I looked for low inference terms or passages when identifying relationships dimensions associated with DPK components.

Finally, as a fourth strategy, I used the replication logic embedded in multicase studies to confirm and refine findings. On one hand, each new case was used to confirm the elements of the preceding one, that is, DPK components and relationships between them. On the other hand, each new case was compared to the preceding one to see if new components or relationships would emerge. This approach allows for what some have termed "analytic generalizations" (Yin, 1994) or "fuzzy generalizations" (Bassey, 1999), that is, the idea of gaining insight into a more universal phenomenon with the help of a few, purposefully-chosen cases.

### *Trustworthiness*

In a study like this one, it is more important to ensure that findings are credible rather than being replicable. This is because the study is interpretive in nature and, as such, would be quite difficult to replicate with the exact same findings. The strategies for preventing threats to validity described above contributed in some ways to ensuring the credibility of the findings. For instance, seeking multiple perspectives of the phenomenon, checking results with participants, using their words to categorize their experience, and comparing various instances of the phenomenon all contributed to making the findings trustworthy. Nonetheless, I used two additional strategies to ensure that I analyzed the phenomenon consistently, thus further safeguarding the credibility of the findings.

The first strategy was to verify my own consistency in coding. Following general guidelines related to coding (Krippendorff, 2004; Van der Maren, 1996), I checked my interpretation after coding a single transcript from one case, and then after coding all five transcripts for the same case. In both instances, I refined the coding scheme until my interpretation was consistent. Once the coding scheme was stabilized across one participant, I applied the same procedures to the remaining three participants – i.e., the remaining 15 transcripts – this to ensure that my interpretation was consistent across all four participants.

The second strategy was to check with colleague to see if our interpretations were consistent. She therefore examined 10% of all the passages I had coded. I then compared her coding with mine, and adjusted the coding scheme until it became stable. This strategy required two rounds of coding and adjustment until she and I were consistent in our interpretation of the data. Therefore, not only have I made sure that the data is as close as possible to the participants' experience but I have ensured that my interpretation of the data remained as consistent as possible throughout the analysis process, thus making the findings trustworthy.

## Participant selection and data sources

### *Participant selection*

When using an instrumental or interpretive multicase study approach, the selection of participants is particularly important. This is because participants are not selected randomly, but rather purposefully. In this study, the selection of participants was based on two rationales. The first was logistical. Participants were selected from a pool of

university professors who had been interviewed as part of the Reflection in Teaching (RIT) research project (McAlpine & Weston, 2000, 2001; McAlpine, Weston, Beauchamp, Wiseman, & Beauchamp, 1999; Weston et al., 2000). The RIT project had generated a considerable body of data that was sufficiently general to be used for the purpose of this study. This limited the amount of additional data that needed to be collected to investigate the notion of DPK in university teaching.[9]

The second rationale was theoretical. Because of the "disciplinary" nature of the phenomenon under study, the sampling strategy needed to provide for maximum variation among the participants along disciplinary lines. This is to increase the validity of findings by strengthening the potential for "analytic" or "fuzzy" generalizations to be derived from this study. To that effect, the most widely used categorization for university disciplines, originally devised by Biglan (1973) and later refined by Becher (1989), was used. This categorization divides disciplines according to their paradigmatic cohesion, on one hand, and according to the nature of knowledge on the other. As regards paradigmatic cohesion, the Biglan-Becher categorization describes *hard* disciplines as those in which certain paradigms dominate thinking and knowledge development, whereas *soft* disciplines are described as ones in which no paradigm clearly dominates thinking or knowledge development. Concerning the nature of knowledge, the Biglan-Becher categorization describes *pure* disciplines as those that draw predominantly on theoretical, fundamental knowledge whereas *applied* disciplines are described as ones that draw predominantly on practical, professional knowledge. The relationship between these two dimensions of the

[9] In the context of the RIT research project, between six and eight in-depth, semi-structured interviews were conducted with participating professors. Of those, I selected four interviews per professor to be used in my study, namely the pre-course and post-course interviews, as well as one pre-class and one post-class interviews.

Biglan-Becher categorization is illustrated in Figure 4 (Biglan-Becher categorization of university disciplines) below. That figure also shows the position of the disciplines represented by the four professors participating in this study.

Figure 4

Biglan-Becher categorization of university disciplines

| | **Pure**<br>(Fundamental knowledge) | **Applied**<br>(Professional knowledge) |
|---|---|---|
| **Hard**<br>(Dominant paradigm) | (Dominant paradigm)<br>(Fundamental knowledge)<br>*HP - Mathematics* | (Dominant paradigm)<br>(Professional knowledge)<br>*HA - Civil Engineering* |
| **Soft**<br>(No dominant paradigm) | (No dominant paradigm)<br>(Fundamental knowledge)<br>*SP - Political Theory* | (No dominant paradigm)<br>(Professional knowledge)<br>*SA - Social Work* |

Participants in this multicase study were thus selected to represent each of the four cells of the Biglan-Becher categorization – i.e., *hard-pure*, *hard-applied*, *soft-pure*, *soft-applied*. For instance, HP, a professor of Mathematics, belongs to the *hard-pure* disciplinary grouping whereas HA, a professor of Civil Engineering, belongs to the *hard-applied* disciplinary grouping. Simultaneously, SP, a professor of Political Theory, belongs to the *soft-pure* disciplinary grouping whereas SA, a professor of Social Work, belongs to the *soft-applied* disciplinary grouping.

*Characteristics of participants*

It is interesting to note that, although it was not intended, the selection of participants reflects other types of variation. First, gender variations as two of the professors are male, and two of them female. Second, the participants also represent a broad spectrum of possibilities in terms of class size since HP and HA were teaching groups made of under 20 students at the time the interviews whereas SA was teaching a group of over 30 students while SP had a group of over 100 students.

However, this is the extent of variation among participants to my study. With regard to other aspects of their personal and/or professional lives, the four participants had similar backgrounds. For instance, the four participants were all "junior" professors at the time of the interviews in that they all had fewer than 10 years of experience in university teaching. Also, all participants went through similar faculty development activities in which they were encouraged to reflect on their teaching in order to develop a more learner-centered approach to teaching. Furthermore, all of them taught at a North American research-intensive university. Finally, if some of them were not originally from a North American cultural context, the four participants were educated in British-inspired university systems.

*Data sources*

Five interviews per participant were used in this study: four that were conducted in the context of the Reflection in Teaching (RIT) research project and a longer, main interview conducted directly for the purpose of this research. The main interviews were conducted during academic year 2003-2004. The interviews conducted in the context of the RIT research project took place during academic years 2000-01 and 2001-02. In the

latter case, two interviews were conducted at course level (before and after a course) and two were conducted at class level (before and after a class). The main interview focused on aspects that had not been addressed in the interviews conducted in the context of the RIT research project. Table 1 below provides information on data sources, in particular the length, focus, nature, and timing of each interview.

Table 1. Description of data sources

| Professor | Interview data | Length of interview | Focus of interview | Nature of interview | Timing of interview |
|---|---|---|---|---|---|
| SP | Main interview | 2 hours | General teaching<br>Disciplinary specificity<br>Personal epistemology | Semi-structured with stimulated recall | Summer 2004 |
| | RIT precourse | 1 ½ hours | General teaching (before action, course level) | Semi-structured | Autumn 2000 |
| | RIT preclass | ½ hours | General teaching (before action, class level) | Semi-structured | Autumn 2000 |
| | RIT postclass | 2 hours | General teaching (during / after action, class level) | Semi-structured with stimulated recall | Autumn 2000 |
| | RIT postcourse | 1 ½ hours | General teaching (after action, course level) | Semi-structured | Winter 2001 |
| HP | Main interview | 2 hours | General teaching<br>Disciplinary specificity<br>Personal epistemology | Semi-structured with stimulated recall | Autumn 2004 |
| | RIT precourse | 1 ½ hours | General teaching (before action, course level) | Semi-structured | Autumn 2001 |
| | RIT preclass | ½ hours | General teaching (before action, class level) | Semi-structured | Autumn 2001 |
| | RIT postclass | 2 hours | General teaching (during / after action, class level) | Semi-structured with stimulated recall | Autumn 2001 |
| | RIT postcourse | 1 ½ hours | General teaching (after action, course level) | Semi-structured | Autumn 2001 |
| SA | Main interview | 2 hours | General teaching<br>Disciplinary specificity<br>Personal epistemology | Semi-structured with stimulated recall | Autumn 2004 |
| | RIT precourse | 1 ½ hours | General teaching (before action, course level) | Semi-structured | Autumn 2001 |
| | RIT preclass | ½ hours | General teaching (before action, class level) | Semi-structured | Autumn 2001 |
| | RIT postclass | 2 hours | General teaching (during / after action, class level) | Semi-structured with stimulated recall | Autumn 2001 |
| | RIT postcourse | 1 ½ hours | General teaching (after action, course level) | Semi-structured | Autumn 2001 |
| HA | Main interview | 2 hours | General teaching<br>Disciplinary specificity<br>Personal epistemology | Semi-structured with stimulated recall | Autumn 2004 |
| | RIT precourse | 1 ½ hours | General teaching (before action, course level) | Semi-structured | Autumn 2000 |
| | RIT preclass | ½ hours | General teaching (before action, class level) | Semi-structured | Autumn 2000 |
| | RIT postclass | 2 hours | General teaching (during / after action, class level) | Semi-structured with stimulated recall | Autumn 2000 |
| | RIT postcourse | 1 ½ hours | General teaching (after action, course level) | Semi-structured | Winter 2001 |

## Data collection instruments

Having described both the overall design of the study, as well as the participants selection and data sources, I now turn to the various types of instruments used to collect data for this study. These instruments include a participant profile, a course and class information sheet, a video excerpt from the RIT research project, transcribed comments from the RIT research project, and a main interview protocol.[10]

### *Participant profile*

The participant profile was constructed with the help of transcribed interviews from the RIT research project. More specifically, the pre-course interview transcripts, as well as the pre-class transcript for the class in which the video excerpt was taken were analyzed to identify relevant information. Both transcripts – their uncoded versions – were read with the conceptual framework in mind and passages corresponding to sources of DPK – i.e., the professor's knowledge base for teaching, the specificity of his/her discipline, and his/her personal epistemology – were identified. Each passage was then cut and pasted from the original transcript into a new document called "participant profile" – see Appendix A (Participant profile – SP).

The participant profile achieved two specific aims. On one hand, it enabled me to see where gaps appeared in the existing body of data from the RIT research project. This is because the RIT research data I selected to use in my study – i.e., four interview transcripts per professor – was general enough to cover some aspects of what I was investigating but not specific enough to cover all aspects. As such, the participant profile

[10] In this section, I do not describe how the interviews from the RIT research project were conducted. Information on that can be obtained by reading McAlpine & Weston (2001) or McAlpine et al. (1999).

pointed to what topics really needed to be covered in the main interview protocol so as to ensure that the various sources and components of DPK found in the conceptual framework were addressed. More specifically, issues related to the professor's personal epistemology and to the specificity of his/her discipline needed to be explored further in the main interview.

On the other hand, the participant profile enabled me to gain a better understanding of each of the four professors participating in this study, putting me on somewhat equal footing to interview each of them. This is because I knew the four professors in different capacities and to different extents. Therefore, I was "entering" their lives with different levels of understanding of who they were as professors, their history, their conceptions of teaching and learning, how they taught, or what they thought of their discipline. The participant profile thus provided an equivalent mode of entry for each of the four professors.

### *Course and class information sheet*

The course and class information sheet instrument was prepared with information found in the transcribed interviews from the RIT project data. The idea was to be able to have, on one page, information that would nicely summarize both the course that was being taught by the professor, as well as the particular lesson that would be the focus of the second part of the interview. Therefore, the sheet – see Appendix B (Course and class information sheet - SP) – contained information about the title of the course, its description, and the overall goals the professor had for the course. It also contained the main subject of the class in question, its timing during the semester, and the goals the

professor had for the class. The sheet thus served to stimulate recall by the professor of the circumstances in which decisions were made at a specific point in time.

### *Video excerpt from RIT data*

The video excerpt, lasting approximately three minutes, came from one of the interviews conducted with each of the professors in the context of the RIT research project. The rationale for including it was to increase the level of specificity in the stimulated recall provided to the professor. Whereas the course and class sheet provided some base for the stimulated recall, they remained quite detached from the situations in which the original actions had taken place. Therefore, additional information, in the form of the video excerpt, contributed to reminding the professor of the exact context in which certain comments were made.

The excerpt came from a video that was made with each of the four participants in the context of the RIT research project. The entire video captured a one-hour class given by each participant. It was used, in the context of the RIT project, to stimulate recall and thus lead participants to talk about their reflection-in-action – i.e., what they saw or experienced while teaching. The excerpt that was used in the context of my study was one segment from that video. The excerpt focused specifically on one instance during which the professor appeared to be drawing upon some form of pedagogical content knowledge.

### *Transcribed comments*

The transcribed comments came from the post-class interviews conducted in the context of the RIT research project. Each interview was conducted while a professor was watching his/her own performance (i.e., the one-hour class video described above). This

form of stimulated recall led the professor to explain his/her rationale for doing certain things in certain ways with regard to teaching – see Appendix C (Transcribed comments – SP). The transcribed comments themselves thus corresponded to a transcribed audio clip lasting approximately 30 seconds during which the professor explained his/her rationale for doing what s/he performed on the video excerpt. The comments were chosen, in the case of each professor, because they constituted good illustrations of pedagogical content knowledge (PCK)[11], according to elements of the operational definition of PCK for higher education that was built in an earlier pilot research project (Berthiaume, 2003). Each transcript was read with the various aspects of PCK in mind so as to identify a passage that could be used during the main interview. As such, the transcribed version of the professor's comments is used to lead them to think about PCK in more specific terms.

### *Main interview protocol*

The main interview protocol was used in the context of a semi-structured interview. The protocol was carefully built to encompass theoretical considerations, prior findings about disciplinary specificity in university teaching, as well as insight from my personal practice as an academic developer. As for theoretical considerations, the protocol draws from the three lines of research identified in the conceptual framework, that is, the three sources of DPK – i.e., the professor's knowledge base for teaching, the specificity of his/her discipline, and his/her personal epistemology – and corresponding components of DPK. These three lines of research thus guided the formulation and

[11] I used the construct of PCK and statements corresponding to it during the interview because it was the most readily available construct to tap into the participants' DPK. As explained in the conceptual framework chapter, the two constructs are similar although they should not be seen as interchangeable – i.e., DPK is a much broader construct than PCK in that it draws upon sources that are beyond the knowledge base for teaching.

organization of questions in the protocol. Some of the questions pertaining mainly to the knowledge base for teaching and to the interaction between the knowledge base for teaching and personal epistemology – e.g., about conceptions of teaching and learning – were covered in the RIT research project data transcripts. Therefore, questions in the main interview protocol needed to address other dimensions brought forth by the disciplinary specificity, as well as personal epistemology literatures – see Appendix D (Main interview protocol).

The protocol was also organized in a way that began with more general discussion at first, bearing on topics that may have been easier to address by the participants, and progressively leading to more complex ones. This was done because, as was explained in the description of the conceptual framework, the construct of DPK is highly complex and the various sources contributing to it may need to be examined in isolation before discussing them in interaction with one another. Therefore, through a discussion of general topics related to the sources of DPK, the participants became aware of various dimensions which they may not have considered in the past, and became able to discuss increasingly complex issues related to the link between their pedagogical and disciplinary knowledge.

The protocol was thus divided into two parts. One part was generic and required the participant to discuss general situations related to the use of DPK or its various components. The second part was more specific in that the participants were asked questions related to a specific situation in which PCK was being used. The purpose of this dual type of questioning was to ensure that the participants' thinking in a generic setting was compatible with their thinking in a specific setting. The justification for this lies with the fact that, on the one hand, teacher thinking can be intimately linked to specific

contexts (McAlpine, Weston, Timmermans, Berthiaume, & Fairbank-Roch, 2006). I thus needed to ensure stability of observations across contexts. On the other hand, as *espoused-theories* do not necessary always reflect *theories-in-use* (Argyris & Schön, 1977), asking participants about both instances led them to reconcile the two types of theories, thus increasing the validity of data collected.

## Data collection procedures

The data collection instruments described above were used in a specific sequence since they were designed to be complementary to one another. The first instrument used for data collection in the context of this study was the participant profile. As explained previously, it enabled me to develop the main interview protocol, as well as better prepare for interviewing each of the four professors.

Then, the main interview protocol was used in conjunction with the course and class information sheet, the video excerpt from the RIT research project, and the transcribed comments from the RIT research project. The interview protocol was designed in such a way as to progressively lead the participant to increasingly complex concepts and, to that effect, was comprised of two parts. In the first part, questions were decontextualized and remained fairly generic, covering each of the three sources of DPK at first separately and then together. Hence, the discussion during the first part of the interview might have tapped more into the participants' *espoused-theories* related to DPK.

In the second part of the interview, in order to ensure that information collected was representative of the professor's *theories-in-use*, the discussion covered a specific

example associated with a situation in which pedagogical and disciplinary knowledge are combined. This was, in a way, leading the participant to describe a situation according to his/her theory-in-use as opposed to his/her espoused-theory. The second part of the interview thus began with me presenting the professor with the course and class information sheet. After having read it and clarified its content, the professor was presented with a short video excerpt of one of the classes that were recorded as part of the RIT research project. Then, the professor was presented with transcribed comments s/he had made about that particular video excerpt, in the context of that particular class/course. The professor was then asked a series of questions about that particular video excerpt and what s/he had said about it. The idea was to use a specific, concrete example to get the professor to talk about his/her DPK – i.e., how s/he came about to formulate the principles discussed in the transcribed comments. The course and class information sheet, video excerpt, and transcribed comments served to stimulate recall, in particular as some of the original interviews had been conducted as far back as four years prior to the time of the actual interview. This main interview produced extensive data that, in conjunction with the selected RIT project data, provided insight into the four professors' DPK.

## The data analysis process

Having described data collection instruments and procedures, I now turn to the data analysis process. As was explained earlier, the general approach of this study is one of analytic induction whereby a conceptual framework is first derived from literature and then documented with the help of data (Bogdan & Biklen, 1998; Deslauriers, 1997; Paillé, 1996; Pires, 1997). The study also draws from content analysis in that the discourse of

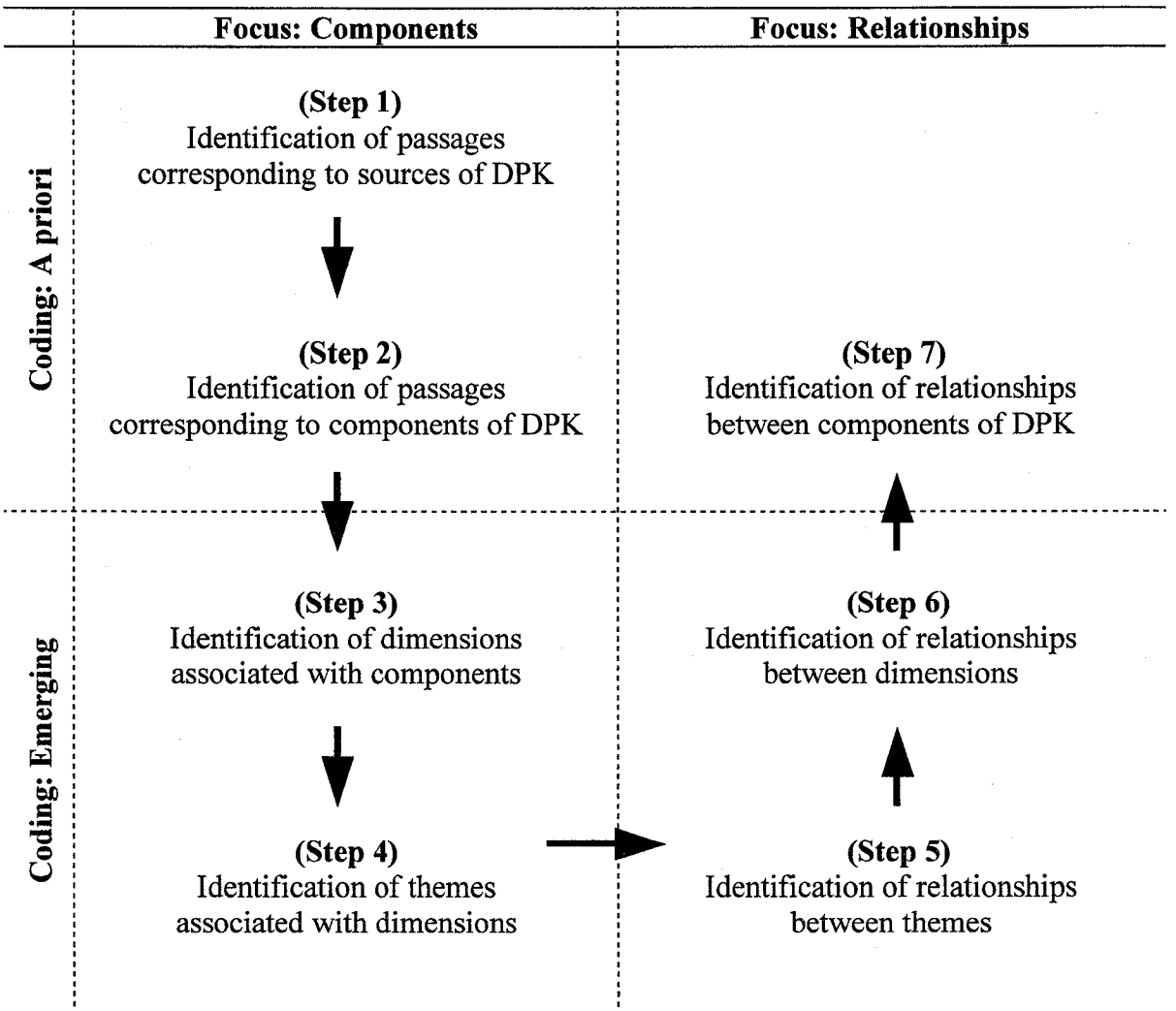
participants, in the form of interview transcripts, is analyzed in order to identify empirical evidence of components derived from the conceptual framework, as well as relationships between these components (Krippendorff, 2004).

Accordingly, I proceeded to analyze the data with the help of a mixed a priori/emerging coding scheme was used (Maxwell, 1996; Van der Maren, 1996). This is because, on one hand, the conceptual framework underlying this study provided the more general categories used in the coding scheme – i.e., the sources and components of DPK derived from the conceptual framework. On the other hand, the data itself provided the more fine-grained categories of the coding scheme – i.e., the emerging dimensions associated with components of DPK. Coding categories emerging from the data – i.e., the dimensions or characteristics associated with components of DPK – were then used to clarify relationships among components of DPK. This approach enabled me to document empirically the two main elements of DPK, namely, the components of DPK and relationships between them.

Figure 5 on the following page provides an overview of the data analysis process and its various steps. As illustrated, I first focused on a priori constructs – i.e., sources and components of DPK – and then moved onto emerging ones – i.e., dimensions and themes. Then, I focused on the relationships between components of DPK, beginning with constructs emerging from the data – i.e., themes, dimensions –, then moving back to a priori constructs – i.e., components. I now describe each step of the analysis process in order to explain how it was undertaken and how it fits in the data analysis process as a whole.

Figure 5

Data analysis process




*Step 1 – Identification of passages corresponding to sources of DPK*

The starting point of the data analysis process was the identification of passages corresponding to the sources of DPK outlined in the conceptual framework – i.e., the professor's knowledge base for teaching, the disciplinary specificity of his/her field, and his/her personal epistemology. In order to do that, the four main interviews conducted specifically for this study were transcribed verbatim using the transcription conventions

devised for the RIT research project – see Appendix E (Transcription conventions from RIT project). The four transcribed interviews were verified by a qualified coder from the RIT research project to ensure that the transcripts represented accurately what the participants said. These four interview transcripts, along with the 16 other interview transcripts from the RIT research project, were combined into a pool of 20 transcripts to be analyzed – i.e., five interview transcripts per participant: the main interview for this study, as well as four interviews conducted in the context of the RIT research project (one pre-course, one pre-class, one post-class, and one post-course). The length of each transcript varied between 10 to 35 pages.

The first step in analyzing the data was to identify a unit of analysis that would single out relevant chunks of text in the 20 transcripts. That unit of analysis needed to point to passages of text that were highly informative about DPK, in light of the conceptual framework. Therefore, I interpreted passages in a similar fashion to how Tomlin, Forrest, Pu, and Kim (1997) define an episode of discourse, that is, "a semantic unit subsumed under a macroproposition, (...) the textual manifestation of a memory chunk which represents sustained attentional effort and endures until an episode boundary is reached. Attention shifts when the processing of the episode is completed." (p. 81). With that in mind, I searched for passages that were related to at least one of the three sources of DPK identified in the conceptual framework – i.e., the professor's knowledge base for teaching, the disciplinary specificity of his/her field, and his/her personal epistemology.

This was the first step in the creation of a coding scheme for the analysis of DPK– see Appendix F (Coding scheme). As for the working of the coding scheme, as was explained earlier, I hypothesized that each of the three sources of the conceptual

framework contributed to DPK in interaction with one another. Therefore, each "source passage" could be double-coded or even triple-coded with regard to sources of DPK since such passages could be informative about more than one a priori source of DPK. This first round of analysis resulted in the identification of approximately 750 "source passages" across the 20 transcripts.

*Step 2 - Identification of passages corresponding to components of DPK*

Having completed the identification of passages corresponding to the three a priori sources of DPK conceptual framework, I needed to identify in these passages shorter, more focused segments that corresponded to components of DPK as outlined in the conceptual framework. In the case of the professor's knowledge base for teaching, the three corresponding components outlined in the conceptual framework were his/her goals related to teaching, his/her knowledge structures related to teaching, and his/her beliefs related to teaching. In the case of the specificity of a professor's discipline, the two corresponding components of DPK outlined in the framework were the socio-cultural characteristics of the discipline as well as the epistemological structure of the discipline. And in the case of the professor's personal epistemology, the three corresponding components of DPK outlined in the framework were his/her beliefs about knowledge and knowing, his/her beliefs about knowledge construction, and his/her beliefs about knowledge evaluation – see Appendix F (Coding scheme). An example of the process of segmenting "source passages" into "component passages" is provided in Appendix G (Example of segmenting and coding – SP).

One thing to note with regard to the identification of "component passages" is that, as was the case with "source passages", "component passages" could also be double-

or triple-coded. The logic for this is the same as for coding "source passages": three sources are posited to contribute to DPK – i.e., the knowledge base for teaching, the personal epistemology, and disciplinary specificity – in relation to one another. Therefore, "source passages" that were double- or triple-coded could also be segmented into "component passages" that corresponded to more than one DPK component. However, double- or triple-coding of components meant that those components came from different sources of DPK. This was to remain coherent with the conceptual framework underlying this study, which posits that three independent sources, and components derived from those three sources, contribute to the formation of DPK.

This also meant that if more than one component code was used to characterize a "component passage", those codes needed to come from different sources. Failure to do so would have constituted a threat to the validity of the coding scheme in the sense that it would no longer have taken into account the nature of the conceptual framework. As the latter is informed by three lines of research – each constituting a source of DPK –, findings from these lines of research needed to be considered when using the coding scheme. For instance, as the knowledge base for teaching is seen in the literature as comprising relatively discrete categories such as goals, knowledge structures and beliefs related to teaching, I could not code a "component passage" as both "Goals related to teaching" and "Beliefs related to teaching". That would be contrary to the essence of the research underlying the conceptual framework.

In addition, double- or triple-coding within a given component of the conceptual framework would have constituted a threat to trustworthiness as it would have weakened the discrete nature of codes corresponding to components of DPK. As such, both intra- and inter-rater consistency in interpretation would have been greatly reduced because the

stability of the coding scheme as an instrument to categorize passages and make sense of them would have been limited.

*Step 3 – Identification of dimensions associated with components of DPK*

Having identified passages for analysis and having reduced them to smaller, more focused segments, I then examined these passages with the intent of characterizing what they were about. The idea, at that point, was to examine "component passages" to see what the phenomenon of DPK was about from an empirical point of view. For instance, what was the professor talking about in a passage coded as "Knowledge structures related to teaching"? Or, what was the professor talking about in a passage coded as "Socio-cultural characteristics of the discipline"? I was thus trying to see what dimensions associated with components of DPK emerged from the data.

To characterize each "component passage", another even more fine-grained category of codes was devised – see Appendix F (Coding scheme). The difference between this category and the previous two – i.e., at the level of sources and components – is that this one emerged from the data, using the constant comparative method (Glaser & Strauss, 1969). Accordingly, the most salient idea emerging from a "component passage" was used as a code for that passage. Ideas emerging from subsequent passages were compared to existing codes. If new ideas could not be linked to existing codes, a new code was created – see Appendix G (Example of segmenting and coding - SP).

At that point, I was able to combine the various dimensions that emerged from interviews of each of the four professors to form an aggregated list of dimensions. That list in turn provided me with an idea of the various characteristics or dimensions of DPK

components. Simultaneously, I could begin to observe patterns or similarities across the four professors, thus pointing to "core" components of DPK.

*Step 4 – Identification of themes associated with dimensions*

Having identified DPK components and their characteristics – i.e., the emerging dimensions –, I began to look for relationships between the components. This is because, as was emphasized in the presentation of the conceptual framework, I thought of DPK as the result of interaction between the eight components derived from the three described sources. Therefore, I needed to find out not only what the components are about from an empirical nature, but also what relationships exist among those components. This is because both elements combined constitute DPK.

The identification of emerging dimensions/codes had generated extremely rich data in that a fairly large number of passages from the various interview transcripts were then associated with each emerging dimension/code – see Appendix H (Example of aggregated information per participant – SP). Yet, the sheer magnitude of the data meant that further reduction was needed in order to identify relationships between DPK components. Therefore, I further examined the transcript excerpts associated with each emerging dimension/code – see Appendix H (Example of aggregated information per participant – SP) and identified themes also emerging from such passages. Sticking as closely as possible to the words of the professor, each excerpt was summarized in a few key points. Themes associated with each emerging dimension/code were then consolidated using a procedure inspired by the constant comparative method (Glaser & Strauss, 1969), meaning that similar ideas were grouped under similar wording. For instance, each time a professor spoke of his/her course-level goals related to teaching,

these were compared to prior instances in which the professor spoke of such goals. Any new themes were added to existing ones while repetitions of themes previously expressed were discarded. This is because the purpose of this operation was to reduce the number of themes to a manageable number, while maintaining the richness and representativeness of the data.

To ensure that validity remained high throughout this operation, the emerging themes were then discussed with each of the professors in a member-checking discussion (Maxwell, 1996; Mucchielli, 1996b) that lasted approximately 1 ½ hours. These discussions provided an opportunity to clarify some of the participants' thinking and to ensure that the emerging dimensions/codes and themes truly captured the reality of their experience.

Yet, despite all these efforts, the data remained fairly exhaustive due to the nature of the artefacts – i.e., 20 transcripts ranging from 10 to 35 pages each. The data thus needed to be reduced even further in order to become more manageable for the identification of relationships. This is why a narrative summary was prepared for each participant. That summary provided a shortened yet rich description of the various dimensions/codes and themes that emerged from the data for each professor – see Appendix J (Narrative summary of emerging dimensions – SP). Producing the four narrative summaries enabled me to consolidate similar emerging themes per professor and, most importantly, to contextualize them. The result consisted in four 12- to 16-page documents describing each of the four professors. These descriptions covered each emerging dimension of the participants' experience.

Throughout the production of the narrative summaries, I used two mechanisms to maintain the integrity of the participants' comments and ideas. Firstly, I stayed as close as

possible to the language used by each professor. This meant using the participants' own terms even if those terms did not appear to be compatible with the conceptual framework. This was done to ensure that I did not "force" the fitting of findings with the conceptual framework but rather to let the findings inform and even alter the conceptual framework. Secondly, I went back to the four professors with the corresponding narrative summary and had each of them approve its content prior to beginning the identification of relationships between themes/dimensions. This form of member-checking was used to ensure that everything that appeared in the narrative summary truly captured each professor's lived experience. It was also used to ensure that anything that might not appear in the narrative summary be re-integrated in it. These operations were essential to preventing threats to the validity and trustworthiness of findings.

*Step 5 - Identification of relationships between themes*

Having described the components of DPK both theoretically and empirically – i.e., through the identification of emerging dimensions and themes – , the task that lay ahead was to identify the various relationships between these components. The idea was to search for relationships between emerging dimensions associated with components of DPK. And, in order to remain as close as possible to the data, I proceeded with a comparison of the emerging themes found in the narrative summary. I favoured such an approach because the emerging themes found in each of the four narrative summaries were the most precise empirical illustrations of the dimensions associated with components of DPK.

In light of what I was hoping to achieve, I proceeded with a systematic comparison of each of the paragraphs in the narrative summary with one another. Proceeding

sequentially and according to the theoretical framework, every paragraph of each summary – which encompasses one emerging theme – was compared with each of the others. Since this study examines the relationship between components of DPK derived from three distinct sources – i.e., the professor's knowledge base for teaching, the specificity of his/her discipline, or his/her personal epistemology – , themes associated with components derived from one source were only compared with themes corresponding to components derived from the other two sources. This is because, in this study, I am focusing on the interaction between the three sources of the conceptual framework and the components derived from them as opposed to the interactions between components coming from the same DPK sources.

For this step of the analysis process, I proceeded with labeling a first paragraph in the narrative summary with "1" and then looked for paragraphs that were linked to this first paragraph. Paragraphs that matched in other sections of the narrative summary were then marked with "1A", "1B", "1C", etc. Once all combinations for that first paragraph had been tried, I moved to the next paragraph, which I labeled "2" and proceeded as with the first paragraph, identifying corresponding relationships with "2A", "2B", "2C", etc. In the end, as per the conceptual framework underlying this study, all possible relationships between sources and components of DPK were examined – see the numbers and letters attached to each paragraph in Appendix K (Example of matching between emerging themes – SP).

*Step 6 – Identification of relationships between dimensions*

The step described above led to the production of four lists of relationships between emerging dimensions/codes, one per professor – see Appendix L (List of relationships between emerging dimensions – SP). Each of these four lists provided evidence of which dimension is related to which other dimension for one particular professor. This is because specific themes identified in the previous step of the analysis process came from specific dimensions. As an example, a relationship was found in SP's narrative summary between two emerging themes: on the one hand, SP believes that mastery involves the ability to make distinctions and, on the other hand, SP entertains the goal of helping learners think critically. Linking these themes back to their associated emerging dimension, a relationship could be found, in the case of SP, between the "Course-level goals" emerging dimension and the "Beliefs about the act of knowing" emerging dimension. Therefore, I interpreted this as the fact that SP's course-level goals are at times related to his beliefs about the act of knowing. This relationship is only one of many which, taken together, provide a picture of the relationships between dimensions of DPK for SP, that is, the relationships I found between characteristics associated with DPK components in his case. Similar operations of linking the themes back to their associated emerging dimensions were conducted for each of the four professors.

*Step 7 – Identification of relationships between components of DPK*

Having identified relationships between emerging dimensions, I was then able to identify relationships between *a priori* components of DPK. This is because an earlier step of the process of analysis had established associations between a priori components and emerging dimensions. Therefore, using the similar process of association,

relationships between dimensions could be used to identify relationships between components. For instance, in the example presented in step 6 above, a relationship was found, in the case of SP, between the emerging dimension "Course-level goals" and the emerging dimension "Beliefs about the act of knowing" because of the relationship found between themes underlying these two dimensions. Therefore, linking these back to DPK components associated with the emerging dimensions, I could identify a relationship, in the case of SP, between his "Goals related to teaching" component of DPK and his "Beliefs about knowledge and knowing" component.

Appendix M (Web of relationships between sources and components of DPK – SP) provides an illustration of the relationships I found between components, in SP's case. The three matrices in Appendix M correspond to relationships among the sources and components of DPK identified in the conceptual framework. I built similar appendices for each professor participating in the study, thus outlining the relationships among their components of DPK.

The various relationships found with each of the four professors were then combined to form an aggregated list of relationships between components. That list provided an idea of the various relationships between DPK components for each professor. As such, that list provided the second, essential part of the framework for understanding the composition of university professors' DPK. Simultaneously, patterns or similarities could be observed across the four professors. These similarities point to "core" relationships among components of DPK, that is, relationships among components of DPK that are likely to be encountered in university professors.

## Concluding remarks

Building upon the conceptual framework and the research questions underlying this study, this chapter describes the overall design of the study, selection of participants and data sources, data collection instruments, data collection procedures, as well as the process of data analysis. This has led to the emergence of two sets of findings that are presented in the next chapter.

# CHAPTER 4

# FINDINGS

As has been explained in previous chapters, this study aims to describe the nature of university professors' discipline-specific pedagogical knowledge (DPK). Chapter 1 describes the importance of finding out how university professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction. Chapter 2 presents the conceptual framework underlying this study and introduces the two specific research questions I undertook to answer. These are:

- What are the dimensions/characteristics associated with the DPK components of conceptual framework?
- What relationships exist between the DPK components of the conceptual framework?

Chapter 3 describes how I went about collecting and analyzing data in order to answer these two questions. More specifically, I used a multicase study approach in order to collect empirical evidence of DPK components and relationships between them from a group of four university professors coming from four different disciplines (i.e., SP, HP, SA, HA).

All of this has led to the emergence of two sets of findings which, taken together, provide a framework describing the nature of DPK:

1) empirical illustrations of DPK components, emerging dimensions, and relationships among them; and
2) generic or theoretical descriptions of DPK components, emerging dimensions, and relationships among them.

As the DPK components were originally derived from the conceptual framework for this study, working with the four professors has led to the emergence of dimensions that characterize the components empirically. In turn, these emerging dimensions were used to identify relationships between components. Therefore, the first set of findings is made of empirical illustrations of the components of DPK, their associated emerging dimensions, as well as the relationships among components for each case. As such, it provides an operationalization of the framework of DPK, that is, an explanation of what each of the DPK components, emerging dimensions, and relationships, translate into from an empirical point of view.

Drawing upon the first set of findings, the second set of findings provides generic descriptions of all DPK components, emerging dimensions, or relationships aggregated from the four cases, as well as commonalities found across the four participants as concerns these elements. This second set of findings thus lists and describes the various elements of DPK that could be encountered in university professors in general. It also provides a description of what could constitute the "core" elements of DPK (i.e., components, emerging dimensions, and relationships that are likely to be present in university professors since they were present in the four very different professors from this study).

The presentation of findings mirrors this structure by first presenting the four cases to provide empirical evidence of the various components, dimensions and relationships of DPK. Subsequently, an aggregate of all components and dimensions of DPK, as well as relationships that emerged from each of the four cases, is presented, thus summarizing the various categories found in the framework. Finally, commonalities

among the four cases both in terms of components and emerging dimensions, as well as relationships between components, are presented.

## First set of findings:

## Empirical illustrations of DPK elements

The first set of findings draws from the four cases in this study to provide empirical illustrations of DPK. It does so in the manner of a multicase study report, drawing from Stake (1995) and Yin (1994). This means that empirical illustrations of DPK components, dimensions, and relationships between components emerging from the interviews conducted with one professor are presented first. Then, components, dimensions, or relationships that emerged from other cases are presented only if they did not emerge in the previous cases.

The first case presented is that of SP. I chose to lead with this case for two reasons: First, because SP was the first of the four professors to be interviewed; secondly, because the discipline taught by SP is political philosophy, the one discipline among the four studied with which I am the most familiar – the others are mathematics, social work, and civil engineering.

Throughout the description of SP's DPK, words or expressions he used during the various interviews are included along with vignettes corresponding with larger sections of interview transcripts. My intention is to provide insight into SP's thinking as a university professor, more specifically with regard to the nature of his DPK. Therefore, the various

aspects of SP's DPK are described in a sequence that preserves the relative importance[12] of components, emerging dimensions, and relationships for him. However, the relative importance of components, emerging dimensions, or relationships is only a rough estimate based on frequency of occurrence, in the context of this research. Elements found to be relatively more important are elements that emerged more often from the various interviews conducted with that professor. This description reveals how DPK is structured for SP and serves to illustrate empirically some of the components, emerging dimensions, and relationships described in the first category of findings.

After SP, a second case is presented, namely that of HP. The presentation of findings for HP is the same as for the first case. The nature of DPK documented for HP is presented first in terms of components of DPK and emerging dimensions, then in terms of relationships found among those components. As was the case with SP, the description proceeds in a sequence that preserves the relative importance of components, emerging dimensions, and relationships for HP. However, not all of the components and relationships of DPK observed in HP are described. Rather, following a logic of replication used in multicase studies (Eisenhardt, 2002; Yin, 1994), HP's case is used to support findings from SP and to expand upon those. As such, only new components, emerging dimensions, or relationships are described.

Then, the third (SA) and fourth (HA) cases are considered successively. Again, the cases are described in a sequence that preserves the relative importance of components, emerging dimensions, and relationships for them. The purpose is to build upon the description of previous cases in order to enrich our understanding of the nature

[12] The notion of "relative importance" is used only to provide a naturalistic picture of each participant. However, it is not used in the analysis as it is too dependent upon the choice of unit of analysis, as well as the nature of the data and the context in which it was collected, for inferences to be drawn from it.

of DPK. Therefore, only new components, emerging dimensions, or relationships are described in the case of either SA or HA.

For each of the four cases, a visual representation and two tables are included. The visual representation provides a snapshot of all DPK components, emerging dimensions and relationships among components found for this professor. Then, the first table presents all DPK components and emerging dimensions observed in that particular case, in descending order of relative importance, whereas the second table presents the types of relationships between components of DPK found in that case, again in descending order of relative importance.

### *SP*

SP teaches political philosophy in the department of political science of a large North American, research-intensive university. At the time of the first interview (in 2000), he had been teaching at university level for seven years. SP's teaching experience has spanned two continents, he having taught at a British university prior to teaching in North America.

The particular undergraduate course that is the focus of the interviews is an introductory course to political theory. At the time of the first interview, SP had taught it for at least three years and his classes normally attracted between 200 to 300 students.

An analysis of the five interview transcripts reveal that, in terms of components and emerging dimensions of DPK, SP draws predominantly from his knowledge structures related to teaching. Then, SP draws from a group of three components, namely the socio-cultural characteristics of his discipline, his beliefs related to teaching, and his goals related to teaching. Finally, SP draws in a limited fashion on remaining

components, namely the epistemological structure of his discipline, his beliefs about knowledge evaluation, his beliefs about knowledge and knowing, and his beliefs about knowledge construction.

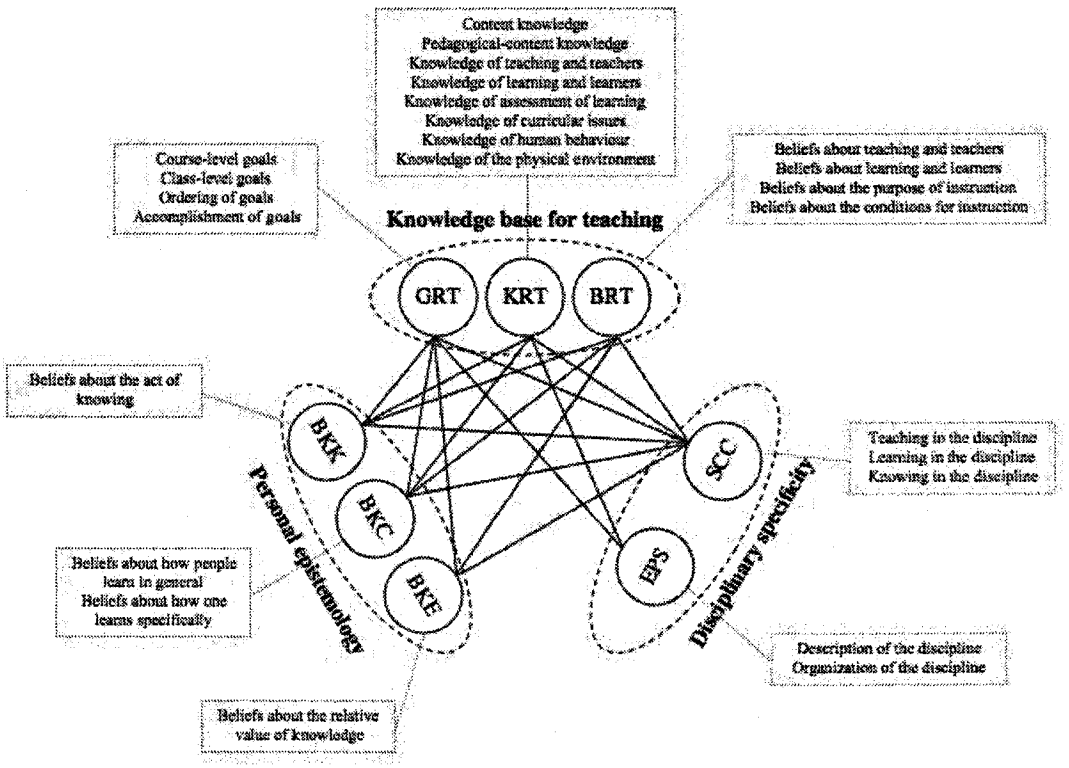
In terms of relationships between components, certain pairs of components seemed to produce richer[13] relationships than other pairs by virtue of the variety of types of relationships encountered between emerging dimensions associated with those components. For instance, richer relationships were found between SP's knowledge structures related to teaching and the socio-cultural characteristics of his discipline, and between his goals related to teaching and the socio-cultural characteristics of his discipline. Other pairs seem to provide for rich relationships between components, although to a lesser extent. Those include relationships between SP's knowledge structures related to teaching and his beliefs about knowledge and knowing; between his knowledge structures related to teaching and his beliefs about knowledge construction; and between his beliefs related to teaching and the specificity of his discipline. The remaining pairs of components provided weaker relationships or no relationships at all.

Figure 6 on the following page provides an overview of all the components, emerging dimensions, and relationships found in SP's DPK.

[13] The notion of "richness" is used only to provide a naturalistic picture of each participant. However, it is not used in the analysis as it is too dependent upon the choice of unit of analysis, as well as the nature of the data and the context in which it was collected, for inferences to be drawn from it.

Figure 6

SP's DPK components, emerging dimensions, and relationships between components




*SP's DPK components and associated emerging dimensions*

The components of DPK encountered in the various interviews conducted with SP, as well as the dimensions that emerged in relation to those components are now described in a sequence that emphasizes their relative importance. Table 2 on the following page lists components and emerging dimensions that characterize SP's DPK (in descending order of relative importance). A description of those components and emerging dimensions in the case of SP follows.

Table 2. SP's DPK components and emerging dimensions

| A priori component | Emerging dimensions |
|---|---|
| Knowledge structures related to teaching | Knowledge of teaching and teachers |
| | Knowledge of learning and learners |
| | Knowledge of assessment of learning |
| | Knowledge of the content |
| | Knowledge of physical environment |
| | Knowledge of human behaviour |
| | Pedagogical content knowledge |
| | Knowledge of curricular issues |
| Socio-cultural characteristics of the discipline | Teaching in the discipline |
| | Learning in the discipline |
| | Knowing in the discipline |
| Beliefs related to teaching | Beliefs about teaching and teachers |
| | Beliefs about learning and learners |
| | Beliefs about the purpose of instruction |
| | Beliefs about the conditions for instruction |
| Goals related to teaching | Course-level goals |
| | Class-level goals |
| | Ordering of goals |
| | Accomplishment of goals |
| Epistemological structure of the discipline | Organization of the discipline |
| | Description of the discipline |
| Beliefs about knowledge evaluation | Beliefs about the relative value of knowledge |
| Beliefs about knowledge and knowing | Beliefs about the act of knowing |
| Beliefs about knowledge construction | Beliefs about how people learn in general |
| | Beliefs about how one learns specifically |

*SP's knowledge structures related to teaching:* During the various interviews conducted with SP, the most important component of DPK was his knowledge structures for teaching. In one of the follow-up member-checking interviews, SP described such knowledge as "the accumulation of different lessons we've learned about what works and what doesn't in terms of producing the outcomes that we want" and "the established body of evidence and collective practice that supports doing things in a certain way". SP added that knowledge structures related to teaching constitute "the accumulated collective evidence-based experience that I draw on, not only my own teaching past but my own perception of what the community teaching in my area have discovered works best." These passages emphasize the fact that, for SP, knowledge is shared and established through consensus, as opposed to more personal or less established forms of experiencing. Using those ideas to define knowledge structures related to teaching in the case of SP, a range of dimensions emerged from the five interviews in relation to that component of DPK.

The most important dimension that emerged from SP's interviews was that of *knowledge of teaching and teachers*. In that regard, SP explained that, for him, teaching comprises three distinct elements: the organization of the materiel in his mind before class; the presentation of materiel to the students; and the interaction with the students. Therefore, SP finds that clarity of presentation is important but does not constitute the whole story when it comes to teaching. Rather, he says that one must also take into consideration "the students' point of departure" in order to "stimulate their interest by showing the relevance of concepts", "motivate them", and "prod them to think critically about the materiel".

Furthermore, when designing instruction, SP tries to organize the material and to select materials in a way that will maximize learning. In doing so, he emphasizes "clarity and simplicity of organization" although he makes sure not to be "sacrificing the complexity of the ideas". But SP feels that it is important for him to know the materiel well in order to make judgments about simplifying the exposition. Not knowing the materiel could potentially lead to organization problems, such as incompleteness, inconsistency, or lack of flow. Also, as he intends to give students "a point of departure for the discussion", SP feels that the selection and ordering of materiel for class depends on the state of the students' knowledge about the subject matter. Therefore, any decision about topics for discussion needs to be made with relation to what would be useful for the students' understanding.

One illustration of this is the use of examples. SP explains that these are sometimes carefully in advance and sometimes chosen on the spot. The problem he sees with the latter is that they may not be best or most appropriate at times. However, SP feels that this is what happens when one allows for interaction, and he is quite happy to entertain questions, challenges, and/or discussion during his teaching. Nevertheless, he feels that it may at times "interrupt a little bit" or interfere with the flow of the lecture.

What SP finds particularly important is to "start with the teaching goals or learning outcomes". Then, he looks for ways "to unlock the doors into the students' understanding" – e.g., through examples. As such, he reinforces what he is trying to do "by connecting strategies to specific outcomes or goals". This is also why SP tries to clarify the relationship between assignments – e.g., essays – and the explanations he provides in class. But such a line of thinking does not prevent him from including

something different perhaps halfway through the lecture. Rather, this is something he seeks to do in order to interest the students.

Overall, SP says that he is open to tactical changes in his instructional strategies. For instance, he reviews notes from previous years and chooses "what worked well" over "what did not work well". Most technical changes are made before the course actually starts. However, most content changes are made during the actual course. Very often, changes are based on students' comments from previous years. And to accommodate for such changes, SP leaves room to fall behind in the course – i.e., he has built a whole day for catching up.

SP also feels that the biggest part of the course is related to "work done by students on their own". Accordingly, he structures his classes in a way to help the students develop as much autonomy as possible. For instance, the conferences are there "to help students communicate their ideas orally in an effective fashion". Also, conferences enable students to work with texts in small groups. SP feels that the ideal scenario would be "one, at the most two presentations each time and other activities which get all the students participating".

With regard to choosing instructional strategies, SP feels that he has learned the utility of certain tools and methods over the years. For instance, he uses either overheads or PowerPoint slides as a "visual counterpart". He also uses questions, interesting details, examples, or anecdotes to engage the students. Simultaneously, SP is very concerned about not upsetting "the logic of presentation". This is why he constantly reminds the students of the materiel covered previously. For SP, connecting to other materiel in the course gives coherence to the subject matter being presented to the students.

However, among all those instructional strategies, lecturing is an important one for SP. This is because some of his goals/outcomes are concerned with knowledge and understanding of the materiel. So, he would normally start off by looking at a text and providing "an exposition of some author's views". During such exercises, SP tries to model skills to be acquired by the students. One such skill is the ability to identify positions and contrasting among authors. To model this, SP often introduces "contemporary controversies" to remind students that such issues are not obvious or clear-cut – i.e., that there are normally two sides to each issue.

When lecturing, SP feels that pacing is a very important factor leading to effectiveness. He feels that a good pace is when he is "not rushing over anything important", when he can "repeat points to accentuate certain aspects", and when he can "give illustrations of the points he makes". SP feels that the right pacing enables him to go back to a topic if he feels that it was not covered appropriately/sufficiently. And if he senses that things do not go well, he might spend more time and "re-articulate it so that it is clear".

In addition to the lecturing portion of every class, SP normally invites students to criticize/object to/challenge the class materiel. He uses this mode of questioning/interaction because he is not sure "how much good a discussion would do in a class of 300". Therefore, he lets students ask questions and tries to answer them. SP feels that accepting those questions allows him to make a point that he wanted to make. He also feels he can refer back to a question if needed. That being said, SP feels a little unsure about how to handle "incorrect" answers from students during class time. He may say that the answer is "not quite right" or he may redirect it to the whole class. The latter is something he feels he should be doing more often.

The second most important dimension that emerged from SP's interviews is that of *knowledge of learning and learners*. In that regard, SP feels that knowing who the students are involves knowing what their background is, "what their points of reference are", "what examples are meaningful to them", and "what gears up their enthusiasm". He finds this to be a particularly difficult task as there is a variety of backgrounds among students. However, SP is pretty confident about certain dimensions. For instance, he can expect that second year students will be able to write an essay. This is because students would have "picked [up] some notions or concepts" prior to coming to his course or class. In addition, students already have opinions on which they can draw. And on that matter, SP feels that students tend to have "fairly strong opinions" about certain issues. He adds that this may be because students tend to be "quite goal-oriented".

Simultaneously, SP finds that a lot of students are not necessarily good at "extracting points from a conversation or a seminar". Whereas some students listen to fellow students and come to the next class with questions or quick criticisms, other students sometimes "turn off" during their colleagues' questions. And SP finds it easy to see when students are not engaged. In such instances, there tends to be "less eye contact", "less note taking", "more rustling", and "less concentration".

SP believes that students "accumulate knowledge gradually, over the course of their degree". He finds that there is a noticeable difference between their knowledge at the start of their degree and upon graduation. Yet, SP feels that learning is not necessarily easy. Some students find it particularly difficult in this course because "the modes of reasoning are different in the case of a theory course". For instance, students "cannot memorize a bunch of facts nor reproduce those facts in a multiple choice exam". Rather, students have to read the text over and over again "to figure out what the arguments are".

As for evidence of learning on the part of students, SP feels that he has access to a wide variety of artefacts, ranging from more instantaneous ones – i.e., student questions during and after class –to some that are more long-term – e.g., how students perform at the various activities in which they are being assessed. SP feels that short-term evidence provides him with a sense whether students "are struggling or not" whereas longer-term evidence of learning gives him feedback on the students' level of "understanding and engagement".

The third most important dimension that emerged from SP's interviews is that of *knowledge of assessment of learning*. In this concern, SP's approach is to examine "how well students are achieving the goals of the course" as opposed to merely getting them to "reproduce the material of the course". As such, SP has deep reservations about the use of multiple choice exams – particulary in political theory – that would encourage the students simply "to learn facts". Rather, SP uses essays. However, essays are not normally used in large classes because having students write three essays puts a lot of strain on him and his TAs. And on that SP feels that, too often, lack of resources leads university professors to a second best option like using poorly designed multiple choice exams.

SP's approach to assessing learning is a bit more time-consuming than that of some of his colleagues. This is because he is quite concerned with the reliability of assessment – i.e., making sure all who are involved in the assessment evaluate with similar standards. In the past, SP has encountered issues of reliability among the graders, which he has settled in two ways. First of all, he now has the same TA grade all of a student's essays, and secondly, he has established procedures for reliability in grading. For instance, he uses a feedback sheet that has six or seven criteria of a good essay. In

addition, he grades essays with TAs and discusses general patterns or weaknesses with them, thus building high reliability, prior to the TA assessing the students' assignments.

To SP, assessment has to be "part of the planning process of instruction". For instance, at the final exam, it is important for him to connect his expectations back to the aims of the course. SP feels that he communicates those expectations throughout the course, mainly through feedback to the students, both oral – i.e., in class – and written – i.e., on the standardized feedback sheet. And through those various assessment methods, SP has been able to identify two usual weaknesses of students in his classes, namely "the inadequate use of primary texts" and "a tendency not to support statements with references or citations".

The fourth most important dimension that emerged from SP's interviews is that of *knowledge of content.* In this regard, SP described the overall theme of the course as "the relationship between the individual and the community". To him, the purpose of the course is "to examine three prominent political theorists – i.e., Plato, Rousseau, and Mill – who have conceptualized that relationship" and identify similarities and differences among them. This is particularly important as the standpoint of each of those authors is quite different. For instance, Plato and Rousseau adopt a pro-censorship position in the name of public interest whereas Mill challenges that way of thinking about expression.

Overall, SP had intended the content to have "some logical progression" and thought that it would make sense to cover the authors in chronological or historical order. The idea was to contrast theoretical perspectives that each of the authors offers. For instance, Plato's view would seem odd today whereas Mill's view is much more compatible with what courts would say.

And of the three authors, SP feels that Mill is the one that can be rather dry, in particular the connection between his form of utilitarianism and his advocacy of the harm principle, as there could be some tension between being a utilitarian and being a liberal who favours the harm principle. However, SP feels that the arguments in Mill's work are not very complicated "past a certain point".

The fifth most important dimension that emerged from the interviews with SP is *knowledge of the physical environment.* In that regard, SP feels quite frustrated with the classroom in which he teaches. To him, the room is "too big and wide". In addition, the hallway produces noise and he cannot ensure that doors remain shut. Therefore, SP finds it difficult to teach in that classroom for various reasons. First, it is "harder to sustain students' attention as they are spread out all over the place". Second, the width of the auditorium makes it difficult to establish eye contact with people on both left and right. Third, calling the class to order is also much more of a challenge. And fourth, he feels constrained to use the overhead projector rather than the board as not everyone can see the latter.

The sixth most important dimension that emerged from SP's interviews is *knowledge of human behaviour.* In relation to that, SP feels that the size of the class does affect his sense of what is going on in the class, his ability to interact with the individuals in front of him. This has to do with how students react to what he says and whether he is "losing them or not". In large classes, SP feels that there is much more "doodling and chatting". Furthermore, as students tend to spread out in class, SP feels "less connected with them as a result". And this constitutes a problem for him because, for instance, "eye contact is important in terms of visual cues" – i.e., one's interlocutor looking perplexed or not. In a large class, SP feels he is losing some of that eye contact. Also, large groups are

also problematic for SP because he has students do presentations. And, as such, he feels that the presentations do not foster genuine discussions as the audience "tends to tune out". Overall, SP feels that large group lectures do not enable him "to be impressed by how smart the students actually are".

The next dimension that emerged from interviews with SP is *pedagogical content knowledge*. SP feels that the nature of the content of his course calls for certain specific instructional strategies. For instance, he emphasized a form of "chronological sequence" in his approach to the authors – i.e., Plato, Rousseau, and Mill. This enabled him to contextualize the authors with relation to one another. Furthermore, it enabled him to contextualize the topics relative to controversies of today.

The last dimension that emerged from SP's interviews is *knowledge of curricular issues*. As regards this dimension, SP finds that both the acts of designing and delivering a course have "a collective nature". This is because the choice of course materiel has to be done with relation to the broader curriculum – i.e., what colleagues would end up teaching in their courses. So, these thoughts guide his thinking when designing and delivering instruction.

*The socio-cultural characteristics of SP's discipline:* During the various interviews conducted with SP, the second most important component of DPK was the socio-cultural characteristics of his discipline. The most important dimension that emerged from interviews in relation to that component is *teaching in the discipline.* In this regard, SP talked about the fact that he has been teaching in political theory/philosophy since 1994 and that, throughout those years, he has taught occasional courses that overlap into other areas of political or the social sciences. His training with regard to teaching political theory includes: exposure to "materials other people think are

important and are part of the curriculum of teaching"; exposure to "positive and negative examples of teaching practice"; attending a certificate program in university teaching when he was teaching in the United Kingdom; and attending a series of workshops on pedagogy offered at the North American university where he was teaching at the time of the interviews.

In addition, SP explained that his experience as a graduate student in political theory was "one source of information about the teaching of his discipline". There, he saw that most professors' approach was "to treat a class just like giving a paper at an academic conference". Therefore, the main mode of teaching was one that really emphasized "passing on knowledge without a lot of thinking about how best to communicate that knowledge". Today, SP feels that he has probably drawn on that since it probably is the heavy bias in his discipline in terms of how people think about teaching.

In addition to learning about teaching political theory through more formal channels, SP says that he has learned from experience by seeing "what works in his classroom and what does not". He also talks to colleagues in a more sustained way about "how they do certain things". With regard to that, he feels that it is acceptable in his field to ask how one's course is going but it would not be acceptable to criticize one another. Over the years, SP found that people in his field like to talk about their students – i.e., what they think of them – which tends to reveal some of their thinking about teaching.

Also, SP feels that the emphasis is more on the acquisition of tools and less on imparting knowledge. According to him, three elements would constitute good teaching in general – i.e., across the university – : knowledge, tools, and motivation. SP would expect that different disciplines would put "more or less weight on each of those". However, SP feels that in political theory "giving students tools and exciting them about

the subject is more important than the knowledge". Examples of such tools include critical reasoning and communications, both oral and written.

And SP adds that this is particularly in line with the age-old debate, in the humanities, between, on one side, knowledge and wisdom, and, on the other side, eloquence – i.e., what one knows versus the presentation of what that individual knows. This means that knowledge of one's discipline is "a necessary but not a sufficient condition to be able to teach the discipline well". For instance, one has to be able to "intelligently select and organize the material to be presented to the students". This is actually one thing SP feels his teachers were particularly good at, which he came to value a lot: "the idea of striving for clarity of expression, clarity of exposition" in both research and teaching. Therefore, teaching itself requires one to think about a whole set of issues related to the students' experience of what one is doing.

SP also feels that knowing the materiel well has led to "less negative teaching experiences for him". More specifically about the content of the course, SP feels that there are "typical questions and criticisms", or "standard points about and reactions to" the works examined. For instance, Mill is generally taught as a distinct view and that is accomplished probably by contrasting his view with those of other well known theorists, but not necessarily with Plato's or Rousseau's works.

The second most important dimension that emerged from interviews with SP is *learning in the discipline*, particularly as SP emphasizes the preponderant role of reading in studying political theory. He argues that most people in his field would tend to learn about the subject matter through readings and, to a much lesser extent, through "hearing people discuss various topics". This would explain why people in political theory are somewhat dismissive of the value of conferences.

Simultaneously, SP adds that he does not know if learning through reading is specific to his field. However, most people teaching in his field do try to get the students to read more in order to learn. This is because, he emphasizes, certain "questions or foundation concepts" are essential for learners in this field. And those pieces of fundamental knowledge – conceptual tools – should thus be learned first, mainly through reading.

SP also explains that the nature of political theory means that the teaching and learning of it is quite different from other fields. He compares it to economics, a field he has taught at the early undergraduate level. SP argues that economics is more about building blocks – i.e., learning takes place in a cumulative fashion – whereas political theory does not work quite like that. Rather, political theory is learned through a series of fundamental concepts that run parallel to one another.

The last dimension that emerged from interviews with SP in relation to socio-cultural characteristics is *knowing in the discipline*. Here, SP emphasizes the fact that reasoning in political theory is different from that of many other fields or even other sub-fields of political science. This is because, in the case of other fields, the model is to formulate hypotheses and then proceed with empirical testing of those hypotheses. Thus, knowing takes the form of empirical confirmation or verification. However, in a theory-inclined field such as political theory, people are most often dealing with questions that are basic concepts or tools that will go into hypothesis or propositions for empirical tests. So, the modes of knowing are rather detached from anything empirical. One example in political theory is the notion of "thought experiment" as a form of reasoning or knowing.

*SP's beliefs related to teaching:* During the various interviews conducted with SP, the third most important component of DPK was his beliefs related to teaching. In the

same member checking interview in which SP discussed his perception of knowledge structures related to teaching, he described beliefs related to teaching as "propositions about what works in relation to teaching that are more like hypotheses" or "personal hypotheses based on my own personal experience". SP added that he tends to distinguish between beliefs and knowledge "according to the degree of evidence or proof that one has for particular propositions". In the case of beliefs, SP feels that "there isn't an accumulated body of evidence that this necessarily works." He also described beliefs related to teaching as "my hypotheses about what works best, not so much based on perception of collective practice or body of evidence but rather based on own experience and common sense of what I think will produce results."

Using this definition of beliefs related to teaching as something much more personal than knowledge structures, a few dimensions emerged from SP's interviews. The most important of these is *beliefs about teaching and teachers.* In this regard, SP sees the role of the university teacher as being predominantly about "motivating and exciting students". He thinks that "imparting knowledge" is not the most important part of university teaching; it is more important to give students certain "lifelong tools or skills". But to do that, it is essential to clearly identify "the point of departure of students", where they are at when coming into your classroom.

In addition, SP feels that good university teaching includes "turning one's goals into specific expectations" and linking those expectations to assessment. To him, this is particularly important as students tend to be goal-oriented. Therefore, making goals concrete would encourage/help students learn.

The second most important dimension that emerged from interviews with SP with regard to his beliefs related to teaching is *beliefs about learning and learners.* SP believes that it is not so important that learners "remember facts". Rather, he tries to get students to think about the materiel by asking them what they think, so that "their brain starts to work in a different way". SP also feels that another way to help learners think is to get them involved in grading as this encourages them to be more objective about written work which, hopefully, can be reflected back onto their own work.

That being said, SP believes that, for learning to happen, university learners must do certain aspects of the course "in a conscientious way". To him, this would include doing the readings, attending the seminars, and "adopting a positive attitude to fellow students". This is why SP puts a lot of emphasis on the discussion of course materiel among learners, either formally or informally. More specifically, SP believes that this helps students learn from their peers' comments, especially since they may obtain clarification of their own understanding. However, when engaged in small group discussions, SP believes that some students will tune out. He thus feels that it comes down to their responsibility to "participate or contribute to their community of learning".

The third most important dimension that emerged from interviews with SP, although to a much lesser extent than the previous two, is *beliefs about the purpose of instruction.* In this regard, SP emphasized that the main purpose may not be to remember content but rather for students to acquire certain tools. One of such tools is curiosity as a habit of mind.

The last dimension that emerged from SP's interviews is *beliefs about the conditions for instruction.* For instance, SP seems to find that the size of a class plays an

important role in instruction. To him, the ideal size for a seminar is "about 12 or 15 students".

*SP's goals related to teaching:* During the various interviews conducted with SP, the fourth most important component of DPK was his goals related to teaching. In the same member-checking interview in which SP described his understanding of knowledge structures and beliefs related to teaching, he described goals related to teaching as "the outcomes that I want to achieve with the students" or "something that is forward-looking." SP clarified this notion by adding that goals are "something I don't expect all the students to have at the start of the course and I hope they will develop it by the end of the course" or "something I want them to be doing or learning." The notion of goals is thus clearly centered on the learners for SP.

Using the elements above to define goals related to teaching, four dimensions emerged from the interviews with SP, the most important of these being *course-level goals.* For SP, this breaks down into two sets of goals. First, he has goals that are closely related to the content. These include introducing students to political theory by looking at classic texts, and helping students learn to interpret texts, which involves getting them "to pay attention to the detail of texts", and comparing them. Additionally, SP entertains goals that are specific to student learning. These include wanting learners to "engage with ideas"; helping learners "set ideas out in an analytical way"; helping learners "think critically about ideas"; and helping learners develop effective written and oral communication skills.

The second most important dimension that emerged from interviews with SP in relation to the component of goals related to teaching is *class-level goals.* When SP

focuses on class-level goals, he again has two sets of goals that parallel his course level goals: a focus on content and a focus on student learning. He is interested in going over the content he "has set out to do". In the particular class that was the context of the interviews, he wishes to cover Mill's harm principle and his views on freedom of expression. Relative to this goal he expresses two goals related to student learning: he wants to emphasize to the students how "interesting and important the topic is", and attempts to do that by "connecting it with issues of interest to the students". SP's goals are quite interrelated as issues pertaining to course-level goals re-emerge while he discusses class-level issues. For instance, he talks about helping the students to "think critically about aspects of arguments"; helping students "make distinctions between different elements in the argument"; and "engaging students a little".

The third most important dimension that emerged from interviews with SP in relation to the component of goals related to teaching, although to a much lesser extent, is *ordering of goals*. Here, SP finds it particularly difficult to order his goals, as each goal is "important in its own ways". Yet, SP agrees to rank them – as requested by the interviewer – and describes three goals that appear particularly important to him, namely for the students to be able "to communicate effectively, both orally and in writing"; to have "basic knowledge of different ideas and issues"; and "to be able to think critically".

The last dimension that emerged from interviews with SP corresponding to goals related to teaching is *accomplishment of goals*. For instance, SP talks about feeling that "students understood well the materiel covered" in the particular class and that he "did what he was set out to do". However, SP says that he finds it hard to accomplish his goals in one lecture or even a series of lectures. This is mainly due to the difficulty of

"assessing achievement in such a short period of time". Rather, SP feels that accomplishment of goals can only be measured at the end of a course.

*The epistemological structure of SP's discipline:* During the various interviews conducted with SP, the fifth most important component of DPK was the epistemological structure of his discipline. In relation to this, the most important dimension that emerged from interviews is the *organization of his discipline.* In that regard, SP explains that political theory is a subfield of political science and that it is very close to political philosophy, a subfield of philosophy. However, he adds that the two fields differ physically, in that they are normally located in different departments, and methodologically, in that political theorists tend to work on empirical questions whereas political philosophers tend to work on theoretical or analytical questions.

The only other dimension that emerged relative to this component of DPK, although to a much lesser extent than the previous one, is *description of the discipline.* Here, SP emphasizes the fact, throughout several of the five interviews, that political theory can be "dry" – in particular that pertaining to Mill – and abstract. He adds that materiel in the field can at times be "fairly difficult". This may be why, in the follow-up, member-checking interview, SP says that students of political theory often "think that they have a good understanding of issues at first glance". However, those issues are not necessarily as easy as students may believe. However, in the same interview, SP adds that the notion of difficulty is not specific to political theory. Other parts of political science – e.g., modeling – can be dry and abstract but not in the same way.

*SP's beliefs about the evaluation of knowledge:* During the various interviews conducted with SP, the sixth most important component of DPK in evidence was his beliefs about the evaluation of knowledge. Relative to this component, the only

dimension that emerged from the interviews is *beliefs about the relative value of knowledge.* SP appears to value quite highly the notion of experiential knowledge or what he describes as "knowledge acquired through trial and error" or "through the absorption of others' models". However, he says that he finds it hard to compare experiential knowledge with more formal knowledge – i.e., knowledge acquired through a formal course.

Also, SP recognizes that experiential knowledge cannot be achieved simply through reading. Yet, he is still "biased towards learning by reading" because he finds it to be "a more effective" – i.e., efficient and faster – way of learning. In this sense, with regards to teaching political theory, SP values experiential knowledge probably more than the knowledge he would obtain from reading a book on the topic. However, he is not discounting what he could learn from a book or workshop on teaching political theory.

*SP's beliefs about knowledge and knowing:* During the various interviews conducted with SP, the seventh most significant component of DPK was his beliefs about knowledge and knowing. The only dimension that emerged from the interviews in relation to this component of DPK is *beliefs about the act of knowing.* An example of this dimension is when SP talks about knowing as the mastery of a subject or discipline, which involves: the "ability to make distinctions", to "cut through complexity", to "grasp an issue by its roots", and not to be "dazzled by details or superficial components".

*SP's beliefs about knowledge construction:* During the various interviews conducted with SP, the least significant component of DPK that emerged was his beliefs about knowledge construction. In line with this component, the most significant dimension that emerged is *beliefs about how people learn in general.* SP believes that it is "less useful or interesting" for a learner to be told about the structure of some piece of

knowledge ahead of time. Rather, he believes that it would be "better to see what's there, and then go back and see what the structure was". For instance, SP believes that it is better to examine the differences in arguments after having looked at the actual arguments.

The other dimension that emerged from the interviews relative to the beliefs about knowledge construction component is *beliefs about how one learns in particular.* Here, SP believes that he has a "reading and responding approach to learning". This is because of what he describes as an "academic mindset". As an example, SP explained that his first reaction in trying to learn golf was to read a book about golfing. However, he does not feel this is the best way to learn golf because he would need to "train his body in the actual motions involved in golfing".

*SP's relationships between DPK components*

Having identified emerging dimensions associated with the components of DPK, these dimensions were then used to identify and characterize relationships between components of DPK. In this section, relationships are presented and described in a sequence that emphasizes their relative importance or richness as they emerged from the various interviews conducted with SP. Table 3 below provides a list of all relationships between components that emerged from interviews with SP (in descending order of relative importance). A description of those relationships in the case of SP follows.

Table 3. SP's relationships between DPK components

| Between | And |
|---|---|
| Knowledge structures related to teaching | Socio-cultural characteristics of the discipline |
| Goals related to teaching | Socio-cultural characteristics of the discipline |
| Knowledge structures related to teaching | Beliefs about knowledge and knowing |
| Knowledge structures related to teaching | Beliefs about knowledge construction |
| Beliefs related to teaching | Socio-cultural characteristics of the discipline |
| Socio-cultural characteristics of the discipline | Beliefs about knowledge and knowing |
| Socio-cultural characteristics of the discipline | Beliefs about knowledge construction |
| Socio-cultural characteristics of the discipline | Beliefs about knowledge evaluation |
| Goals related to teaching | Beliefs about knowledge and knowing |
| Goals related to teaching | Beliefs about knowledge construction |
| Goals related to teaching | Beliefs about knowledge evaluation |
| Goals related to teaching | Epistemological structure of the discipline |
| Knowledge structures related to teaching | Epistemological structure of the discipline |
| Beliefs related to teaching | Beliefs about knowledge and knowing |
| Beliefs related to teaching | Beliefs about knowledge construction |
| Beliefs related to teaching | Beliefs about knowledge evaluation |

The most significant relationship between two components in the case of SP emerged between his knowledge structures related to teaching and the socio-cultural characteristics of his discipline. In the interviews with SP, nine types of relationships between emerging dimensions could be identified.[14] An illustration of relationships between these two DPK components can be found in the relationship between SP's knowledge of assessment of learning and his views of teaching in his discipline. SP's approach to assessment is to examine how well students are achieving the goals of the course, as opposed to merely getting them to "reproduce" the material of the course. As such, SP says that he has deep reservations about the use of multiple choice exams, especially in political theory, as that would encourage the students "only to learn facts". Simultaneously, SP feels that the emphasis in teaching political theory is more on "giving students tools", such as critical reasoning and communications, and "exciting them about the subject" rather than on imparting knowledge. Therefore, there appears to be a relationship between the type of learning SP wishes to assess and the methods generally used by him and his colleagues to teach political theory.

The second most significant relationship between two components, in the case of SP, emerged between his goals related to teaching and the socio-cultural characteristics of his discipline. In all, seven types of relationships between emerging dimensions could be identified from the interviews with SP. An illustration of relationships between these two components can be found in the relationship between SP's course-level goals and his views of teaching in the discipline. SP entertains goals that include: wanting learners to "engage with ideas", helping learners "set ideas out in an analytical way", helping

[14] Further information on all types of relationships that emerged in interviews conducted with SP can be found in Appendix M (Web of relationships between components of DPK – SP).

learners "think critically about ideas", and helping learners develop effective written and oral communication skills. Simultaneously, SP feels that three elements would constitute good teaching in general: the "knowledge", the "tools", and the "motivation". He would expect that different disciplines would put "more or less weight on each of those". In political theory, SP feels that "giving them tools" and "exciting them about the subject" is more important than the knowledge itself, and such tools comprise critical reasoning and communication, both oral and written. Hence, there appears to be a relationship between SP's emphasis on course-level goals that are associated with the use of tools and the fact that those are central to the teaching of political theory.

The third most significant set of relationships between two components emerged from three pairs of components, namely: (1) between SP's knowledge structures related to teaching and his beliefs about knowledge and knowing; (2) between his knowledge structures related to teaching and his beliefs about knowledge construction; and (3) between his beliefs related to teaching and the socio-cultural characteristics of his discipline. For each of those pairs, three types of relationships between emerging dimensions could be identified from the interviews with SP.

An illustration of the relationship between SP's knowledge structures related to teaching and his beliefs about knowledge and knowing can be found in the relationship between his knowledge of the content and his beliefs about the act of knowing. For instance, SP discusses how he thought that it would make sense to cover the authors in chronological or historical order to contrast theoretical perspectives that each of the authors offers. Simultaneously, SP believes that mastery of a subject or discipline involves the ability, among other things, "to make distinctions". Therefore, there appears

to be a relationship between how SP envisages specific portions of the content and what knowing that content would entail.

An illustration of the relationship between SP's knowledge structures related to teaching and his beliefs about knowledge construction can be found in the relationship between SP's knowledge of teaching and teachers, and his beliefs about how people learn in general. In that case, SP discusses his approach to teaching and explains that, to him, the biggest part of the course is related to "work done by students on their own". He also says that this is why he structures his classes in a way to help the students develop as much autonomy as possible. Simultaneously, SP believes that it is less useful or interesting for a learner to be told about the structure of the content before the learning takes place. Rather, he believes that it would be better to "see what's there, and then go back and see what the structure was". Therefore, there appears to be a relationship between how SP structures his class for autonomous, meaningful construction of knowledge and his views of how meaningful learning happens for most people.

An illustration of the relationship between SP's beliefs related to teaching and the socio-cultural characteristics of his discipline can be found in the relationship between his beliefs about the purpose of instruction and his views of teaching in the discipline. In that regard, SP explains that the main purpose of instruction at the university level may not be for students to remember content but rather for them to acquire certain tools, such as the ability to organize and communicate one's thoughts clearly and coherently, something that is modeled by the teacher. Simultaneously, SP talks about the "age-old debate" in the humanities between knowledge and wisdom versus eloquence, that is, what one knows and the presentation of what one knows. SP argues that, for instance, knowledge of one's discipline is "a necessary but not a sufficient condition to be able to teach the discipline

well". This is particularly true if one is to "intelligently select and organize the material to be presented to the students". Therefore, there appears to be a relationship between how SP envisages the purpose of instruction at the university level and his understanding of what guides teaching in the humanities, particularly in political theory.

The fourth most significant set of relationships between two components, in the case of SP, emerged from five pairs of components, namely: (1) between the socio-cultural characteristics of SP's discipline and his beliefs about knowledge and knowing; (2) between the socio-cultural characteristics of his discipline and his beliefs about knowledge construction; (3) between the socio-cultural characteristics of his discipline and his beliefs about knowledge evaluation; (4) between his goals related to teaching and his beliefs about knowledge and knowing; and (5) between his goals related to teaching and his beliefs about knowledge construction. For each of those pairs, two types of relationships between emerging dimensions could be identified from the interviews.

An illustration of the relationship between the socio-cultural characteristics of SP's discipline and his beliefs about knowledge and knowing can be found in the relationship between SP's beliefs about the act of knowing and his views of learning in the discipline. In that regard, SP explains that knowing means mastery of a subject or discipline which, in turn, involves the "ability to make distinctions", to "cut through complexity", to "grasp an issue by its roots", and "not to be dazzled by details or superficial components". Simultaneously, SP explains that learning and teaching are quite different in political theory compared to other fields. He compares political theory to economics, a field he has taught at the early undergraduate level. SP argues that learning in economics takes place in a cumulative fashion, whereas political theory is learned through a series of fundamental concepts that run parallel to one another. Therefore, there

appears to be a relationship between SP's view that knowing requires that one be able to make distinctions and the fact that he sees political theory as being learned through the differentiation of parallel fundamental concepts.

An illustration of the relationship between the socio-cultural characteristics of SP's discipline and his beliefs about knowledge construction can be found in the relationship between SP's beliefs about how one learns specifically and his views of learning in his discipline. Relative to this, SP says that he believes he has a "reading and responding approach to learning". As an example, he explains that his first reaction in trying to learn golf was to read book about golfing, despite the fact that he acknowledges that that would not be the best way to learn golf. Simultaneously, SP talks about learning in political theory and says that he does not know if learning through reading is specific to his field. However, SP says that most people teaching in his field do try to get the students to read more in order to learn. This is because certain fundamental concepts are essential for learners in this field and these pieces of fundamental knowledge — conceptual tools — should be learned first, mainly through reading. Therefore, there appears to be a relationship between SP's beliefs about how he best learns and how he sees learning in political theory in general.

An illustration of the relationship between the socio-cultural characteristics of SP's discipline and his beliefs about knowledge evaluation can be found in the relationship between SP's beliefs about the relative value of knowledge and his views of learning in his discipline. In this concern, SP recognizes that experiential knowledge, being acquired through "trial and error", as well as through "absorption of others' models", cannot be achieved simply through reading. Yet, he says that he is still "biased towards learning by reading" because he finds it to be a "more effective" – i.e., efficient

and faster – way of learning. Simultaneously, SP emphasizes the preponderant role of reading in learning in political theory. He argues that most people in his field would tend to learn about the subject matter through readings and, to a much lesser extent, through "hearing people discuss various topics". This would explain why people in political theory are somewhat dismissive of the value of conferences. Therefore, there appears to be a relationship between the relative value SP gives to knowledge acquired through reading and SP's view that most people in the field would favour reading as their way of learning.

An illustration of the relationship between SP's goals related to teaching and his beliefs about knowledge and knowing can be found in the relationship between SP's course-level goals and his beliefs about the act of knowing. In this case, SP entertains course goals that include, among others, helping learners "think critically about ideas". Simultaneously, SP talks of knowing in a subject or discipline as involving the ability "to make distinctions". That critical thinking is generally believed to involve the ability to make distinctions points to a relationship between SP's course-level goals and his beliefs about the act of knowing.

Finally, an illustration of the relationship between SP's goals related to teaching and his beliefs about knowledge construction can be found in the relationship between SP's class-level goals and his beliefs about how people learn in general. In this case, SP wants learners to think actively and not be passive. Simultaneously, he believes that it is less useful or interesting for a learner to be told about the structure before the learning takes place. Rather, he believes that it would be better to "see what's there, and then go back and see what the structure was". Hence, SP's goal of making the students active

learners appears to be related to his belief that meaningful learning takes place through active construction on the part of the learner.

The fifth most significant set of relationships between two components emerged from six pairs of components, namely: (1) between SP's goals related to teaching and his beliefs about knowledge evaluation; (2) between his goals related to teaching and the epistemological structure of his discipline; (3) between his knowledge structures related to teaching and the epistemological structure of his discipline; (4) between his beliefs related to teaching and his beliefs about knowledge and knowing; (5) between his beliefs related to teaching and his beliefs about knowledge construction; and (6) between his beliefs related to teaching and his beliefs about knowledge evaluation.

An illustration of the relationship between SP's goals related to teaching and his beliefs about knowledge evaluation can be found in the relationship between SP's course-level goals and his beliefs about the relative value of knowledge. For instance, SP entertains course-level goals of introducing students to political theory by looking at classic texts and of helping students learn to interpret texts. Simultaneously, SP says that he values experiential knowledge probably more than the knowledge he would obtain from reading a book on teaching political theory. Yet, he is not discounting what he could learn from a book or workshop on teaching political theory. In this case, there appears to be a relationship, even though it is divergent[15], between the use of text as a goal and the relative value of texts as a source of knowledge.

An illustration of the relationship between SP's goals related to teaching and the epistemological structure of his discipline can be found in the relationship between his

[15] The divergent nature of the relationship may have to do with the fact that SP is talking about knowing political theory in one case and teaching political theory in the other.

class-level goals and the description of his discipline. For instance, SP says that, as a goal, he is interested in going over what he has "set out to do". In the case of this particular class, he wishes to go over Mill's harm principle and his views on freedom of expression. With regard to this specific goal, SP wishes to emphasize to the students how "interesting and important the topic is", in particular by connecting it with issues of interest to the students. Simultaneously, SP describes political theory as a field that can be "dry", "abstract", and "difficult", particularly in Mill's case. Therefore, there appears to be a relationship between SP's view that political theory is complex and his goal of emphasizing its importance and connecting it to the students' interests.

An illustration of the relationship between SP's knowledge structures related to teaching and the epistemological structure of his discipline can be found in the relationship between his knowledge of the content and the description of his discipline. For instance, SP says that he feels that the content, Mill in particular, can be "rather dry". For instance, he explains that the connection between Mill's form of utilitarianism and his advocacy of the harm principle is not an easy one to see as there could exist some tension between being a utilitarian and being a liberal who favours the harm principle. Simultaneously, SP describes political theory as "dry", "abstract", and "difficult", with particular reference to Mill. He adds that students of political theory often think that they have "a good understanding of issues at first glance". However, those issues are not necessarily as easy as students may believe. Therefore, there appears to be a relationship between how SP understands and explains the content of his course and what he perceives as the level of complexity of some aspects of political theory as a field of knowledge.

An illustration of the relationship between SP's beliefs related to teaching and his beliefs about knowledge and knowing can be found in the relationship between his beliefs

about learning and learners and his beliefs about the act of knowing. In this regard, SP believes that it is not so important that learners in his courses remember "facts". Rather, he tries to get them to "think" about the materiel. Simultaneously, SP discusses knowing as the "ability to make distinctions", to "cut through complexity", to "grasp an issue by its roots", and "not to be dazzled by details or superficial components". Therefore, SP's beliefs about learning and learners in a university context appear to be related to his views of knowing as something that is deep and meaningful, as opposed to superficial and meaningless.

An illustration of the relationship between SP's beliefs related to teaching and his beliefs about knowledge construction can be found in the relationship between his beliefs about learning and learners and his beliefs about how people learn in general. For instance, SP discusses how he tries to get students to "think" about the materiel by asking them their opinions. This, he argues, leads them to use their brain "in a different way". Simultaneously, SP believes that it is less useful or interesting for a learner to be told about the structure before the learning takes place. Rather, he believes that it would be better to "see what's there, and then go back and see what the structure was". For instance, SP believes that it is better to examine the differences in arguments after having looked at the actual arguments first. Therefore, SP's beliefs about learning and learners in a university context appear to be related to his views of learning as something that requires active engagement on the part of the learner in general.

Finally, an illustration of the relationship between SP's beliefs related to teaching and his beliefs about knowledge evaluation can be found in the relationship between his beliefs about learning and learners and his beliefs about the relative value of knowledge. In that regard, SP feels that for learning to happen in his class, students must perform

certain aspects of the course "in a conscientious way". This includes reading assigned texts, attending the seminars, and "adopting a positive attitude to fellow students" during classroom discussions. Simultaneously, SP values experiential knowledge probably more than the knowledge he would obtain from reading a book on teaching political theory. However, he is not discounting what he could learn from a book or workshop on teaching political theory. Therefore, SP's views about the tasks of the learner and his views about the relative value of various sources of knowledge both point to the importance of an appropriate mix of experiential and book-based learning, thus emphasizing a relationship between the two dimensions.

*HP*

HP teaches applied mathematics in the mathematics department of a large North American university. At the time of the first interview – in 2001 – , she had been teaching at the university level for approximately seven or eight years, both as a professor and as a postgraduate teaching assistant. Her knowledge of teaching comes from both formal courses taken through various mathematics departments and through experience of teaching mathematics.

The particular focus of the interviews is an undergraduate course entitled Matrix Computations. As such, it constitutes a logical extension of another course on numerical analysis in which students begin to see both how to compute scientifically and how to design or analyze algorithms.

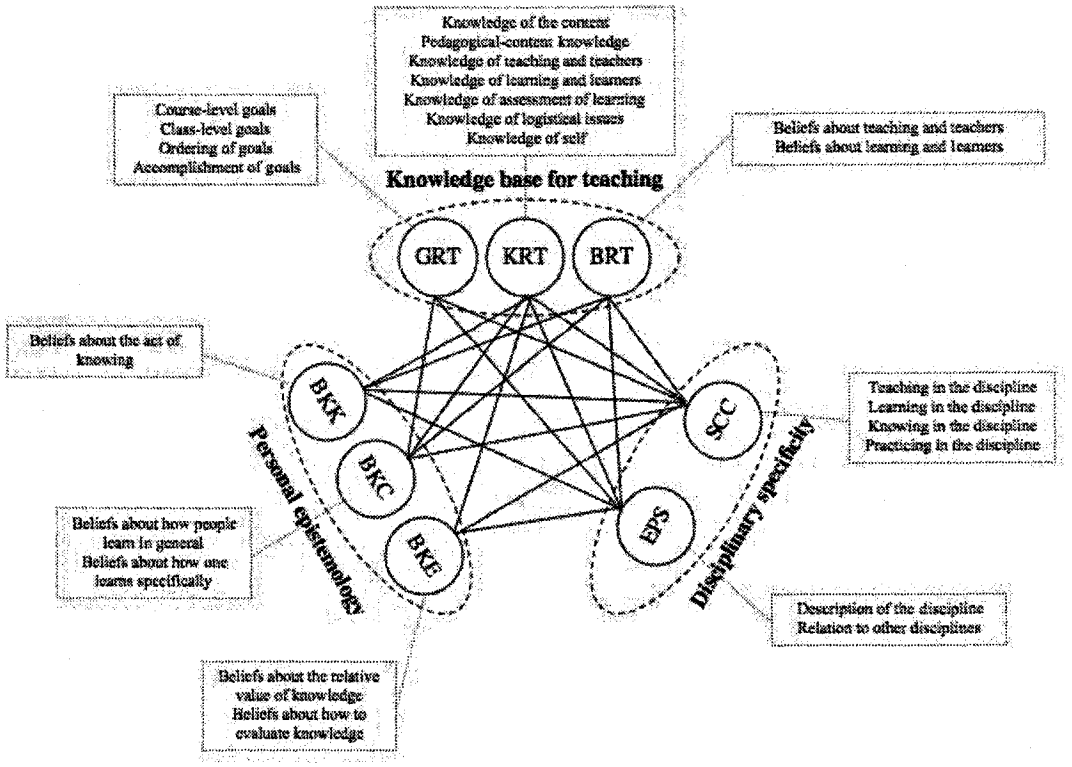
The class comprises a rather small number of students — approximately 13. However, those students come from both major and honours mathematics programs, which tends to complicate the process a little. For HP, this means in reality teaching two classes, with different assignments for each group. Regardless of this, she feels quite comfortable with the content of the course as this is her area of specialization.

In terms of components and emerging dimensions of DPK, HP draws predominantly from her knowledge structures related to teaching. Then, HP draws from the socio-cultural characteristics of her discipline and from her goals related to teaching. To a much lesser extent, she draws from a group of three components, namely her beliefs related to teaching, her beliefs about knowledge construction, and the epistemological structure of her discipline. Finally, HP draws in a limited fashion upon remaining components, namely her beliefs about knowledge and knowing, as well as her beliefs about knowledge evaluation.

In terms of relationships between components, certain pairs of components seemed to constitute much more significant or richer relationships than did other pairs by virtue of the number of types of relationships encountered between emerging dimensions associated with those components. For instance, by far the most significant relationship was between HP's knowledge structures related to teaching and the socio-cultural characteristics of her discipline. Other important relationships, although to a lesser extent, include: (1) between her goals related to teaching and the socio-cultural characteristics of her discipline; (2) between her knowledge structures related to teaching and her beliefs about knowledge construction; (3) between her knowledge structures related to teaching and the epistemological structure of her discipline; and (4) between the socio-cultural characteristics of her discipline and her beliefs about knowledge construction. The remaining pairs of components provided fewer rich or significant relationships or no relationships at all.

Figure 7 on the following page provides a view of all the components, emerging dimensions, and relationships found in HP's DPK.

Figure 7
HP's DPK components, emerging dimensions, and relationships between components




*HP's DPK components and emerging dimensions*

The DPK components encountered in the various interviews conducted with HP, as well as the emerging dimensions associated with those components are now described with relation to findings that emerged in the case of SP. This means that only components and emerging dimensions that were not encountered in the previous case are described in detail in the case of HP. Table 4 on the following page provides a list of all components and emerging dimensions encountered in interviews with HP (in descending order of relative importance). Further information on components and emerging dimensions encountered in the case of HP can be found in Appendix N (Narrative summary of

emerging dimensions – HP). A description of new components and dimensions follows the table.

Table 4. HP's DPK components and emerging dimensions

| A priori component | Emerging dimensions |
|---|---|
| Knowledge structures related to teaching | Knowledge of teaching and teachers |
| | Knowledge of learning and learners |
| | Knowledge of self |
| | Knowledge of the content |
| | Knowledge of logistical issues |
| | Pedagogical content knowledge |
| | Knowledge of assessment of learning |
| Socio-cultural characteristics of the discipline | Teaching in the discipline |
| | Learning in the discipline |
| | Knowing in the discipline |
| | Practicing in the discipline |
| Goals related to teaching | Course-level goals |
| | Class-level goals |
| | Accomplishment of goals |
| | Ordering of goals |
| Beliefs related to teaching | Beliefs about teaching and teachers |
| | Beliefs about learning and learners |
| Beliefs about knowledge construction | Beliefs about how one learns specifically |
| | Beliefs about how people learn in general |
| Epistemological structure of the discipline | Description of the discipline |
| | Relation to other disciplines |
| Beliefs about knowledge evaluation | Beliefs about the relative value of knowledge |
| | Beliefs about how to evaluate knowledge |
| Beliefs about knowledge and knowing | Beliefs about the act of knowing |

*HP's knowledge structures related to teaching:* A first component for which new dimensions emerged from interviews with HP is her knowledge structures for teaching. In one of the follow-up, member-checking interviews, HP described knowledge structures related to teaching as something that is "clearly defined as an entity in mathematics", "a bunch of concepts, mathematical concepts which build upon another set of concepts" and "an easy source of information when developing a class." HP also describe knowledge structures related to teaching as "information about what concepts are inherent to what I was trying to convey." These passages emphasize the fact that, for HP, knowledge is something that is established objectively, that exists independently of the person teaching.

Such a view of knowledge structures related to teaching departs slightly from that of SP. However, one could argue that they are highly compatible. This may explain why many of the dimensions that emerged in relation to knowledge structures relative to teaching in the case of SP also emerged from the interviews conducted with HP. However, two new dimensions related to knowledge structures emerged from the interviews with HP.

The most significant of those two dimensions is *knowledge of self.* In this regard, HP says that she considers herself to be a mathematician because she is from a math department and because mathematics has affected "who she is as a person" (i.e., has influenced her attitudes). Also, HP says that she really enjoys mathematics and wants to convey it to other people. She claims not to be "sloppy" as a mathematician and adds that

she doesn't believe in the argument that "fantastic researchers can't talk to students". Rather, she says that if one understands research, one should communicate effectively.

HP says that she enjoys people and talking to people. Yet, she does not feel the need "to be popular". She reports to be very conscious of her strengths and weaknesses, at every point. In particular, HP reports having a "fairly strong self-esteem", which makes her "willing to take risks in terms of engaging with the students". Such strong self-esteem gives her intellectual confidence. Yet, HP reports that the influence of personality on teaching is something that is "mind-boggling" to her.

The other dimension related to knowledge structures that emerged from HP's interviews is that of *knowledge of logistical issues.* As to that, HP feels that administrative issues related to teaching a course can make it difficult to be "an enthusiastic teacher". For instance, she feels that large classes (i.e., 600 students) become "administrative things" rather than actual teaching. This is because, among other things, the system brings in students who have difficulty, particularly through service courses. In such instances, HP feels that the presence of TAs can make a difference, as can the presence of computers. However, HP is prevented from doing computer-based demonstration because her NSERC grant does not allow her to get a license through the institution where she works.

*The socio-cultural characteristics of HP's discipline:* A second component for which new dimensions emerged from interviews with HP is the socio-cultural characteristics of her discipline. As regards this DPK component, three of the dimensions that had emerged in the case of SP also emerged from the numerous interviews conducted with HP. However, a fourth dimension emerged in relation to the socio-cultural characteristics, namely the idea of *practicing in the discipline.*

Relative to this dimension, HP explains that practicing mathematics means "writing codes", which includes having to spend time "debugging them". As such, mathematicians "proceed in small blocks" and then "put them together". This is why, HP feels, mathematicians cannot be "sloppy". Simultaneously, HP feels that a large number of mathematicians can be "opiniated", "solitary", and "arrogant". In addition, she says that some mathematicians "do not function well in groups", in particular those she identifies as "theorem provers".

*The epistemological structure of HP's discipline:* A third component for which a new dimension emerged from interviews with HP is the epistemological structure of her discipline. As was the case with SP, the dimension of *description of the discipline* emerged from the five interviews with HP. However, a new dimension emerged from HP's interviews, namely that of *relation to other disciplines.* For instance, HP feels that the field of computer science is a subpart of applied mathematics. This is because, she says, "people who do theoretical computer science are mathematicians" and mathematicians "use scientific computing as a tool". When talking about her institutions, HP explains that computer science is a separate school but that members of that school publish in mathematics journals. Therefore, to her, they are mathematicians.

*HP's beliefs about knowledge evaluation:* A fourth component for which a new dimension emerged from interviews with HP has to do with her beliefs about knowledge evaluation. Similarly to SP, the dimension of *beliefs about the relative value of knowledge* emerged from the interviews conducted with HP. However, a new dimension also emerged, namely HP's *beliefs about how to evaluate knowledge*. In this particular instance, it would appear that, for HP, one useful criterion for the evaluation of knowledge is the level of formality of that particular knowledge. For instance, in

answering a question about how comfortable she would be sharing knowledge about teaching she has acquired through experience, HP said that she would not be comfortable doing so because her knowledge is not "formal enough".

*HP's relationships between DPK components*

Having identified emerging dimensions associated with the DPK components, such dimensions were then used to identify and characterize relationships between those same components. As was the case with SP, various relationships emerged between DPK components. Some of those were similar to the relationships that emerged in the case of SP, whereas some were different. In this section, only the four new relationships between DPK components emerged in the interviews with HP are presented and described. However, table 5 on the following page provides a full list of relationships between components that emerged from interviews with HP (in descending order of relative importance). Additional information on relationships can be found in Appendix P (Web of relationships between components of DPK – HP).

Table 5. HP's relationships between DPK components

| Between | and |
|---|---|
| Knowledge structures related to teaching | Socio-cultural characteristics of the discipline |
| Socio-cultural characteristics of the discipline | Beliefs about knowledge construction |
| Goals related to teaching | Socio-cultural characteristics of the discipline |
| Knowledge structures related to teaching | Beliefs about knowledge construction |
| Knowledge structures related to teaching | Epistemological structure of the discipline |
| Beliefs related to teaching | Socio-cultural characteristics of the discipline |
| Goals related to teaching | Beliefs about knowledge construction |
| Goals related to teaching | Epistemological structure of the discipline |
| Knowledge structures related to teaching | Beliefs about knowledge and knowing |
| Knowledge structures related to teaching | Beliefs about knowledge evaluation |
| Beliefs related to teaching | Beliefs about knowledge construction |
| Socio-cultural characteristics of the discipline | Beliefs about knowledge and knowing |
| Socio-cultural characteristics of the discipline | Beliefs about knowledge evaluation |
| Beliefs related to teaching | Beliefs about knowledge and knowing |
| Beliefs related to teaching | Epistemological structure of the discipline |
| Epistemological structure of the discipline | Beliefs about knowledge and knowing |
| Epistemological structure of the discipline | Beliefs about knowledge evaluation |

The first new relationship that emerged between DPK components in the case of HP was between her knowledge structures related to teaching and her beliefs about knowledge evaluation. In that regard, two types of relationships emerged. An illustration of these can be found in the relationship between HP's knowledge of teaching and teachers and her beliefs about how to evaluate knowledge: while HP says that she is not prepared to say that the way she teaches is "more successful" than the way others do it she also says that knowledge can be evaluated according to its level of "formality" and "subjectivity". It would appear that HP does not feel capable of evaluating her own knowledge of teaching because she feels it is not formal enough or because it is too subjective.

A second new relationship that emerged concerning DPK components in the case of HP was between her beliefs related to teaching and the epistemological structure of her discipline. More specifically, the focus of that relationship was between SP's beliefs about teaching and teachers and the description of her discipline. An illustration of that relationship can be found when HP said that the role of the mathematics teacher is not only to convey the content of the course, but also to convey "a way of thinking rigorously", that is, to be extremely careful about what one says or does. Simultaneously, HP says that mathematics requires "rigorous thinking" or, what she calls "strength". She adds that this is because mathematics is a field in which things are "either right or wrong". Therefore, it seems that HP's understanding of her role as a mathematics teacher is linked to her view of the centrality of rigour or exactitude in mathematics.

A third new relationship that emerged relative to DPK components in the case of HP was between her *beliefs about knowledge and knowing* and the *epistemological structure of her discipline*. In this regard, one type of relationship emerged from the

interviews, namely between HP's beliefs about the act of knowing and the description of her discipline. More specifically, HP talks about the notion of subjectivity in knowing. For instance, she feels that thinking about teaching can be rigorous. However, rigorous thinking about teaching constitutes a hard task because of the subjectivity involved. In contrast, HP argues that thinking about mathematics is not subjective at all. Simultaneously, HP believes that mathematics requires "rigorous thinking" or what she calls "strength". She feels that in mathematics things are "right or wrong". Therefore, one can see how HP's views about her field can be linked to her views about knowing and the notion of subjectivity.

Finally, a fourth new relationship that emerged between DPK components in the case of HP was between her *beliefs about knowledge evaluation* and the *epistemological structure of her discipline*. Here, one type of relationship emerged, namely between beliefs about the relative value of knowledge and description of the discipline. An illustration of this is HP's claim that she would not feel "confident" sharing her ideas on teaching and learning with anybody else trying to teach and learn mathematics. HP says that she is not prepared to say that her way of teaching is "more successful" than other teachers' way. She would want to have more experience in order to be able to do that. Simultaneously, HP believes that mathematics requires "rigorous thinking" or what she calls "strength". She feels that in mathematics things are "right or wrong". Therefore, one can see how HP's understanding of her field as one where things are right or wrong may prevent her from feeling comfortable providing teaching guidance to colleagues. In many ways, HP does not seem to feel that she has the "right" knowledge about teaching.

*SA*

SA teaches in the school of social work of a large North American University. At the time of the first interview – in 2001 – , she had been teaching at this particular university for just over one year. However, SA had been formally teaching for over two years at another university. In addition, her 17 years experiences as a social worker in hospital settings has led her to do some informal teaching. Therefore, SA feels that her knowledge of teaching comes predominantly from experience both as a social worker and as a university teacher.

The particular focus of the interviews is an undergraduate course on social work in the health field. It is an elective in which students are introduced to theoretical models that address individual and family responses to illness. At the time of the interview, SA had taught the course twice already.

The class is made up of about thirty students, mostly in their third or last year of the Bachelor of Social Work degree or in a special program for students with other degrees. Hence, SA feels the student population in her class is quite diverse.

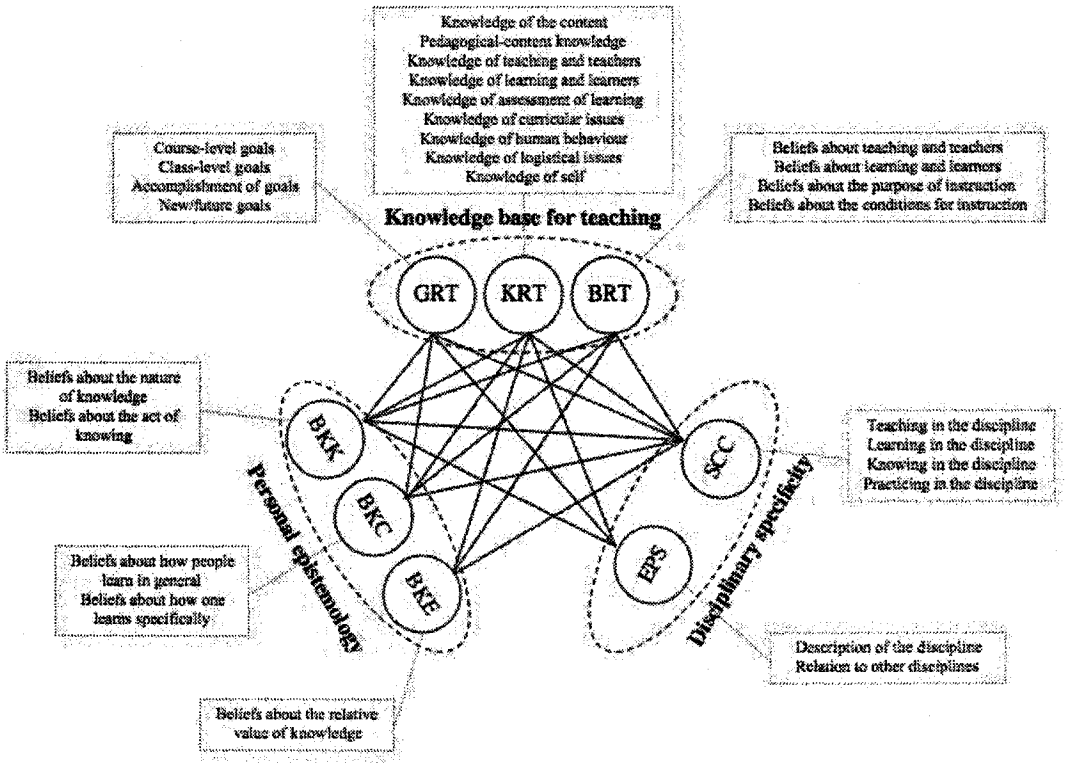
In terms of components and emerging dimensions of DPK, SA draws predominantly from her knowledge structures related to teaching. Next, SA draws extensively from the socio-cultural characteristics of her discipline. Then, although to a lesser extent, SA draws from a group of four DPK components, namely her goals related to teaching, her beliefs related to teaching, her beliefs about knowledge construction, as well as the epistemological structure of her discipline. Finally, SA draws in a limited fashion upon the two remaining components, specifically her beliefs about knowledge and knowing, and her beliefs about knowledge evaluation.

In terms of relationships between components, the richest or most significant relationship in SA's case is between her knowledge structures related to teaching and the socio-cultural characteristics of her discipline. Other rich relationships, although to a lesser extent, include a connection between her knowledge structures related to teaching and her beliefs about knowledge construction, as well as interconnectivity between the socio-cultural characteristics of her discipline and her goals related to teaching, her beliefs related to teaching, and her beliefs about knowledge and knowing. The remaining pairs of components provided less-rich relationships or no relationship at all.

Figure 8 on the following page provides a view of all the components, emerging dimensions, and relationships found in SA's DPK.

Figure 8

SA's DPK components, emerging dimensions, and relationships between components




*SA's DPK components and emerging dimensions*

The components of DPK and emerging dimensions encountered in the various interviews conducted with SA are now described in relation to findings that emerged in the cases of SP and HP. This means that only newly emerging dimensions – two in the case of SA – , as well as components associated with them, that were not encountered in the previous two cases are described in detail in the case of SA. Table 6 on p. 123 provides a list of all components and emerging dimensions encountered in interviews with SA (in descending order of relative importance). Further information on components and emerging dimensions encountered in the case of SA can be found in Appendix Q

(Narrative summary of emerging dimensions – SA). A description of new dimensions and associated components follows the table.

Table 6. SA's DPK components and emerging dimensions

| A priori component | Emerging dimensions |
|---|---|
| Knowledge structures related to teaching | Knowledge of teaching and teachers |
| | Knowledge of learning and learners |
| | Knowledge of the content |
| | Knowledge of self |
| | Knowledge of assessment of learning |
| | Knowledge of curricular issues |
| | Knowledge of logistical issues |
| | Pedagogical content knowledge |
| | Knowledge of human behaviour |
| Socio-cultural characteristics of the discipline | Practicing in the discipline |
| | Teaching in the discipline |
| | Learning in the discipline |
| | Knowing in the discipline |
| Goals related to teaching | Class-level goals |
| | Course-level goals |
| | Accomplishment of goals |
| | New/future goals |
| Beliefs related to teaching | Beliefs about teaching and teachers |
| | Beliefs about learning and learners |
| | Beliefs about the conditions for instruction |
| | Beliefs about the purpose of instruction |
| Beliefs about knowledge construction | Beliefs about how people learn in general |
| | Beliefs about how one learns specifically |
| Epistemological structure of the discipline | Description of the discipline |
| | Relation to other disciplines |
| Beliefs about knowledge and knowing | Beliefs about the act of knowing |
| | Beliefs about the nature of knowledge |
| Beliefs about knowledge evaluation | Beliefs about the relative value of knowledge |

*SA's goals related to teaching:* One component of DPK for which a new dimension emerged is SA's goals related to teaching. In the same member checking interview in which she discussed her perception of knowledge structures related to teaching, SA described goals related to teaching as "what I want the students to acquire, or learn or grasp as a result of what I am presenting to them or getting them to engage in." SA adds that goals related to teaching constitute "something action-oriented (...) something to do with what students are going to get or what I'm going to do."

The passages above point to a view of goals related to teaching in the case of SA that is quite similar to those of both SP and HP. This would explain why some dimensions that had emerged in the cases of SP and HP also emerged from the interviews with SA. However, a new dimension emerged in relation to *new or future goals*. An illustration of that newly emerging dimension can be found when SA says that, for the future, she hopes the students will "challenge some of the ways in which their role is prescribed". Also, she talks about how, eventually, she would like to give students more of an opportunity "to get some practice", something that is based on feedback she gets from the students. So, these goals were not part of SA's repertoire prior to or during teaching of the course. They are new goals or goals SA entertains for the future.

*SA's beliefs about knowledge and knowing:* Another component for which a new dimension emerged from interviews with SA was her beliefs about knowledge and knowing. In turn, a dimension related to her *beliefs about the nature of knowledge* emerged. For instance, SA says that she does not see social work "as a science" or that she "would not use the word science" to describe social work. To her, a profession (like social work) has a "body of knowledge" and a "code of ethics". As such, SA says that people think in terms of "knowledge, skills, and values" in social work. And, she adds,

one cannot assume that "if you have knowledge, you'll know what to do" (i.e., have the skills). So, here SA talks about the difference between knowledge and skills or, to some extent, theoretical versus practical knowledge. Although she gets to that point through a discussion of her field, her ideas do not seem to be specific to social work. Rather, they are about the nature of knowledge in general.

*SA's relationships between DPK components*

Having identified emerging dimensions associated with the components of DPK described above, such dimensions were then used to identify and characterize relationships between DPK components. All relationships between components that emerged in the case of SA had already emerged in the case of either SP or HP, or both. Therefore, no new relationships are described in the case of SA. However, Table 7 on the following page provides a full list of relationships between components that emerged from interviews with SA (in descending order of relative importance). Additional information on relationships that emerged in the case of SA can also be found in Appendix R (Web of relationships between components of DPK – SA).

Table 7. SA's relationships between DPK components

| Between | and |
|---|---|
| Knowledge structures related to teaching | Socio-cultural characteristics of the discipline |
| Goals related to teaching | Socio-cultural characteristics of the discipline |
| Knowledge structures related to teaching | Beliefs about knowledge construction |
| Beliefs related to teaching | Socio-cultural characteristics of the discipline |
| Socio-cultural characteristics of the discipline | Beliefs about knowledge and knowing |
| Knowledge structures related to teaching | Beliefs about knowledge and knowing |
| Socio-cultural characteristics of the discipline | Beliefs about knowledge construction |
| Goals related to teaching | Beliefs about knowledge and knowing |
| Epistemological structure of the discipline | Beliefs about knowledge and knowing |
| Knowledge structures related to teaching | Epistemological structure of the discipline |
| Beliefs related to teaching | Beliefs about knowledge and knowing |
| Goals related to teaching | Beliefs about knowledge construction |
| Goals related to teaching | Epistemological structure of the discipline |
| Beliefs related to teaching | Beliefs about knowledge construction |
| Knowledge structures related to teaching | Beliefs about knowledge evaluation |
| Beliefs related to teaching | Beliefs about knowledge evaluation |
| Socio-cultural characteristics of the discipline | Beliefs about knowledge evaluation |

*HA*

HA teaches in the department of civil engineering of a large North American University. At the time of the first interview – in 2001 – , he had been teaching at that particular university for close to ten years. In addition, HA has teaching experience in non-formal (i.e., non-university) settings. Therefore, he feels that his knowledge of teaching comes predominantly from experience both as a university teacher and as a teacher in non-formal settings.

The particular focus of the interviews is an undergraduate course on Municipal Systems. It is a key course for civil engineering students, and is often referred to as a capstone course in that it encompasses all major areas of engineering in the design of systems for communities. The course is one among a series of courses students in Civil Engineering choose to complement their core courses. At the time of the interview, it was the eighth time HA had taught that course.

The size of the class had varied considerably in the past, from a dozen students to close to 100. The year the interviews took place, the group comprised just over twenty students, most of whom were in their last year of study for the Bachelor of Civil Engineering. That year – as is often the case at this university – a few of the students came from overseas, France in particular.

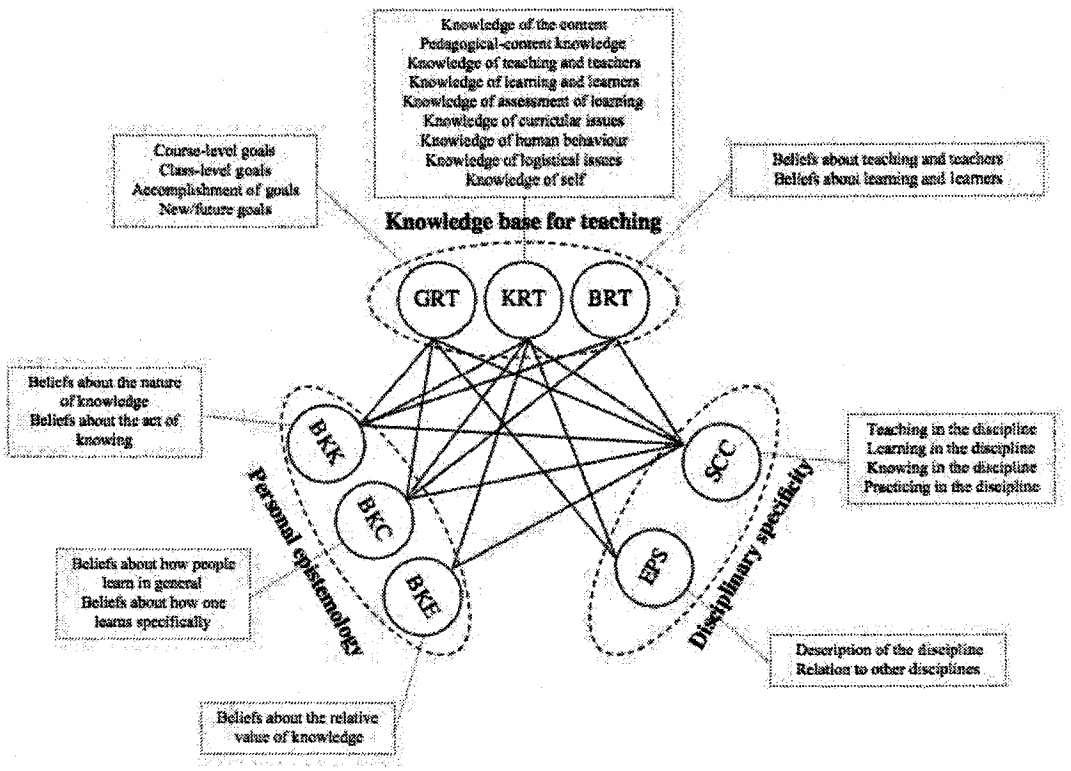
In terms of components and emerging dimensions of DPK, HA draws predominantly from his knowledge structures related to teaching. Next, HA draws extensively from the socio-cultural characteristics of his discipline. Then, albeit to a lesser extent, HA draws from two DPK components, namely his beliefs related to teaching and his goals related to teaching. Finally, HA draws in a limited fashion upon the four remaining components, namely his beliefs about knowledge construction, about

knowledge and knowing, and about knowledge evaluation, as well as the epistemological structure of his discipline.

In terms of relationships between components, the richest or most significant relationship in the case of HA was found between his knowledge structures related to teaching and the socio-cultural characteristics of his discipline. Another very rich relationship emerged between HA's goals related to teaching and the socio-cultural characteristics of his discipline. Other rich relationships, although to a lesser extent, include connections: (1) between HA's knowledge structures related to teaching and his beliefs about knowledge and knowing; (2) between his knowledge structures related to teaching and his beliefs about knowledge construction; and (3) between his knowledge structures related to teaching and the epistemological structure of his discipline. The remaining pairs of components provided less-rich relationships or no relationship at all.

Figure 9 on the following page provides a view of all the components, emerging dimensions, and relationships found in HA's DPK.

Figure 9
HA's DPK components, emerging dimensions, and relationships between components




*HA's DPK components and emerging dimensions*

The components of DPK encountered in the various interviews conducted with HA, as well as the dimensions that emerged in relation to those components, were all components and dimensions that had already emerged in the cases of SP, HP, or SA. Therefore, no detailed description of components or emerging dimension is presented in the case of HA. However, Table 8 on the following page provides a list of all components and emerging dimensions encountered in interviews with HA (in descending order of relative importance). Further information on components and emerging dimensions encountered in the case of HA can be found in Appendix S (Narrative summary of emerging dimensions – HA).

Table 8. HA's DPK components and emerging dimensions

| A priori component | Emerging dimensions |
|---|---|
| Knowledge structures related to teaching | Knowledge of teaching and teachers |
| | Knowledge of learning and learners |
| | Knowledge of the content |
| | Knowledge of self |
| | Knowledge of curricular issues |
| | Pedagogical content knowledge |
| | Knowledge of assessment of learning |
| | Knowledge of human behaviour |
| | Knowledge of logistical issues |
| Socio-cultural characteristics of the discipline | Practicing in the discipline |
| | Teaching in the discipline |
| | Knowing in the discipline |
| | Learning in the discipline |
| Beliefs related to teaching | Beliefs about teaching and teachers |
| | Beliefs about learning and learners |
| Goals related to teaching | Course-level goals |
| | Class-level goals |
| | New/future goals |
| | Accomplishment of goals |
| Beliefs about knowledge construction | Beliefs about how one learns specifically |
| | Beliefs about how people learn in general |
| Beliefs about knowledge and knowing | Beliefs about the nature of knowledge |
| | Beliefs about the act of knowing |
| Beliefs about knowledge evaluation | Beliefs about the relative value of knowledge |
| Epistemological structure of the discipline | Description of the discipline |
| | Relation to other disciplines |

*HA's relationships between DPK components*

Having identified emerging dimensions associated with the components of DPK described above, such dimensions were then used to identify and characterize relationships between components of DPK. All relationships between components that emerged in the case of HA had already emerged in the case of either SP, HP, or SA. Therefore, no new relationships are described in the case of HA. However, Table 9 on the following page provides a full list of relationships between components that emerged from interviews with HA (in descending order of relative importance). Additional information on relationships that emerged in the case of HA can also be found in Appendix T (Web of relationships between components of DPK – HA).

Table 9. HA's relationships between components of DPK

| Between | and |
|---|---|
| Knowledge structures related to teaching | Socio-cultural characteristics of the discipline |
| Goals related to teaching | Socio-cultural characteristics of the discipline |
| Knowledge structures related to teaching | Beliefs about knowledge construction |
| Knowledge structures related to teaching | Beliefs about knowledge and knowing |
| Knowledge structures related to teaching | Epistemological structure of the discipline |
| Goals related to teaching | Beliefs about knowledge construction |
| Beliefs related to teaching | Socio-cultural characteristics of the discipline |
| Goals related to teaching | Beliefs about knowledge and knowing |
| Beliefs related to teaching | Beliefs about knowledge and knowing |
| Socio-cultural characteristics of the discipline | Beliefs about knowledge and knowing |
| Knowledge structures related to teaching | Beliefs about knowledge evaluation |
| Beliefs related to teaching | Beliefs about knowledge construction |
| Goals related to teaching | Epistemological structure of the discipline |
| Socio-cultural characteristics of the discipline | Beliefs about knowledge construction |
| Socio-cultural characteristics of the discipline | Beliefs about knowledge evaluation |

## Second set of findings:

## Generic description of DPK elements and commonalities between professors

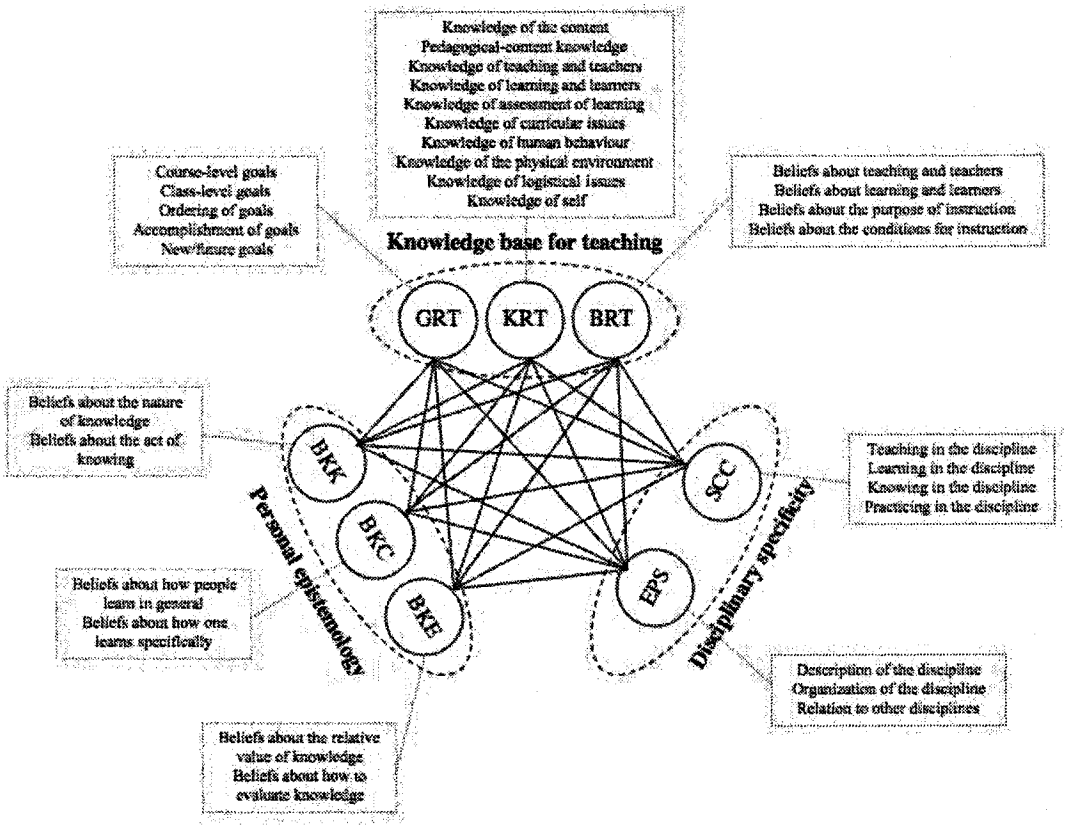
Drawing from the first set of findings, DPK components, emerging dimensions and relationships between components were aggregated from the four professors in order to identify the various elements of DPK that can potentially be encountered in university professors in general. The second set of findings is thus made of generic descriptions of all DPK components, emerging dimensions, or relationships between components aggregated from the four cases. This set of findings also comprises commonalities found across the four professors, that is, DPK components, emerging dimensions, and relationships between components identified as likely to be encountered in university professors in general.

The findings of this set are presented in a similar fashion to the previous set of findings. This means that findings about components of DPK and their associated emerging dimensions are presented first, followed by findings about relationships between components of DPK. This is done first for findings aggregated across the four cases are presented, followed by findings common to the four cases. In all instances, visual representations and tables are presented. The visual representations provide a view of DPK components, emerging dimensions and relationships between components, either aggregated across the four cases or common to the four cases. The tables list the various components, emerging dimensions, and relationships aggregated from the four cases or common to the four cases. Taken together, these visual representations, tables and accompanying descriptions form the framework of DPK.

Figure 10 below provides a view of the DPK components, emerging dimensions, and relationships between components aggregated from the four cases.

Figure 10

DPK components, emerging dimensions, and relationships aggregated from the four cases




*The DPK components and their associated emerging dimensions*

As was explained in the description of the conceptual framework, the problem with the *a priori* components of DPK is that they were not necessarily well defined from an empirical standpoint (i.e., constructs such as "beliefs related to teaching" or "socio-cultural characteristics of a discipline" could have different meanings for different people). Therefore, drawing from the empirical illustrations presented in the first set of

findings, detailed description of the components of DPK, their associated dimensions, and the relationships between components that emerge from the experience of four university professors are presented in this second set of findings. The DPK framework that this constitutes outlines the various components, emerging dimensions, and relationships of DPK that can potentially be observed in university professors in general.

Table 10 on the following page provides a list of the DPK components and emerging dimensions from the four cases.[16] The list is an aggregate of the various components and dimensions encountered in each of the four cases. It shows the variety of components and emerging dimensions associated with each component. A full description of each component and emerging dimension follows the table.

[16] Elements in Table 10 and the following tables are not presented in relative order of importance. Rather, their presentation reflects the conceptual framework of this study to facilitate comparisons across tables.

Table 10. DPK components and emerging dimensions (aggregated from four professors)

| A priori component | Emerging dimensions |
|---|---|
| Goals related to teaching | Course-level goals |
| | Class-level goals |
| | Ordering of goals |
| | Accomplishment of goals |
| | New/future goals |
| Knowledge structures related to teaching | Knowledge of the content |
| | Pedagogical content knowledge |
| | Knowledge of self |
| | Knowledge of teaching and teachers |
| | Knowledge of learning and learners |
| | Knowledge of assessment of learning |
| | Knowledge of curricular issues |
| | Knowledge of human behaviour |
| | Knowledge of physical environment |
| | Knowledge of logistical issues |
| Beliefs related to teaching | Beliefs about the purpose of instruction |
| | Beliefs about the conditions for instruction |
| | Beliefs about teaching and teachers |
| | Beliefs about learning and learners |
| Socio-cultural characteristics of the discipline | Teaching in the discipline |
| | Learning in the discipline |
| | Knowing in the discipline |
| | Practicing in the discipline |
| Epistemological structure of the discipline | Description of the discipline |
| | Organization of the discipline |
| | Relation to other disciplines |
| Beliefs about knowledge and knowing | Beliefs about the nature of knowledge |
| | Beliefs about the act of knowing |
| Beliefs about knowledge construction | Beliefs about how people learn in general |
| | Beliefs about how one learns specifically |
| Beliefs about knowledge evaluation | Beliefs about the relative value of knowledge |
| | Beliefs about how to evaluate knowledge |

*Goals related to teaching*

The professor's goals related to teaching, derived from the "knowledge base for teaching" source of DPK, correspond to expectations or intentions that a professor entertains about his/her teaching. As such, goals are seen as relatively constant but are affected by knowledge and beliefs related to teaching. Simultaneously, goals may affect knowledge and beliefs related to teaching. Goals related to teaching seem to make teaching actions purposeful. As such, the motivational dimension behind teaching goals would serve as the impetus that turns knowledge and beliefs into teaching actions. Five dimensions have emerged from the four cases in relation to goals related to teaching.

*Course-level goals:* This dimension is associated with goals or objectives at the level of the course – as opposed to the levels of a class or a program. For instance, the professor may address this topic by making explicit references to what s/he wanted to achieve during the course or by talking about what the course is designed to achieve.

*Class-level goals:* This dimension is associated with goals or objectives at the level of the class – as opposed to the levels of a course or a program. For instance, the professor may address this topic by making explicit references to what s/he wanted to achieve during a given class or by talking about what the class is designed to achieve. It may also accompany a discussion of content to be covered, especially if the participant seems to adopt a more content-centered approach to teaching and learning.

*Ordering of goals:* This dimension is associated with the professor's ordering of – or reported inability to order – goals for his/her course, class, program, etc. For instance, the professor may discuss the respective precedence or importance of certain goals, or the impossibility of determining any kind of ordering among goals.

*Accomplishment of goals:* This dimension is associated with the attainment of the professor's goals, at the course- or class-level. This may include a discussion of the means by which the goals were accomplished or a discussion of the end result/product.

*New/future goals:* This dimension is associated with goals related to future iterations of the course or goals that may have arisen during one of the interviews. The important distinction is that the professor did not entertain those goals while s/he was teaching the course or class. The goals actually arose after the course or class was over.

*Knowledge structures related to teaching*

The professor's knowledge structures related to teaching, also derived from the "knowledge base for teaching" source of DPK, can be defined as a body of dynamic, relatively consensual, cognitive understandings that contribute to skillful teaching. It is at the root of teacher thinking in that it fuels its underlying cognitive and metacognitive processes. Such cognitive understandings can take various forms ranging from more factual or declarative knowledge to more strategic or procedural knowledge. A total of ten dimensions have emerged from the four cases in relation to knowledge structures related to teaching.

*Knowledge of the content:* This dimension is associated with the knowledge the professor has of his/her discipline. S/he may discuss certain dimensions of the subject matter to be taught and/or learned. The professor thus provides insight into his/her knowledge of the discipline that s/he teaches and/or how s/he will go about further learning within his/her discipline.

*Pedagogical-content knowledge:* This dimension is associated with the knowledge the professor has of teaching specific aspects of the content in specific contexts. Unlike

knowledge of content or knowledge of teaching, the knowledge here is multi-dimensional and integrated, which makes it impossible to break it down into subcomponents without inferring what those would be.

*Knowledge of self:* This dimension is associated with certain aspects of the professor's persona that may impact on his/her teaching. In this sense, s/he may discuss a specific feeling or state of mind. The professor may also discuss how s/he perceives his/her own role or functions in a very general way.

*Knowledge of teaching and teachers:* This dimension is associated with the knowledge the professor has of teaching and teachers in general. The professor may discuss various aspects of his/her experience of teaching or dealing with teachers in the university context. For instance, this may include a discussion of years of experience, size of classes taught or number of students per class. It may also include specific examples of how one approaches instruction or how one actually implements instruction, including a discussion/description of strategies or methods used.

*Knowledge of learning and learners:* This dimension is associated with the knowledge the professor has of learning and learners. For instance, comments can be related to learner characteristics, comprising a description of the demographics – i.e., age, entry knowledge, etc. – or of specific actions by students or sub-groups of students. Comments can also be related to what constitutes evidence of learning on the part of students or merely expectations with regard to the students' learning.

*Knowledge of assessment of learning:* This dimension is associated with the knowledge the professor has of assessing the learning to be achieved by the students. The reference to principles of assessment can be either explicit or implicit. It can also refer to either an approach or an actual strategy/method for assessing learning.

*Knowledge of curricular issues:* This dimension is associated with the knowledge the professor has of how a given topic or course fits within a larger educational program. Comments may include a discussion of educational programs in general or of one specific program. They may also include a discussion of the relationship between one's specific course or courses and the courses taught by colleagues.

*Knowledge of human behaviour:* This dimension is associated with the knowledge the professor has of how human relations or reactions may affect teaching and/or learning. For instance, this may include a discussion of group dynamics such as how the size of a group and/or its composition may affect teaching and/or learning at the university level. It may also include a discussion of general issues of interpersonal relations such as the verbal and non-verbal attitudes and/or actions on the part of the teacher or the learner. The knowledge displayed here is not specific to either the teacher or the learner, it is about individuals in general.

*Knowledge of the physical environment:* This dimension is associated with the knowledge the professor has of how the physical arrangements or the location of the class may affect teaching and/or learning. The professor's comments may either be positive or negative, or even a mix of both.

*Knowledge of logistical issues:* This dimension is associated with the knowledge the professor has of how administrative dimensions may impact teaching and/or learning.

*Beliefs related to teaching*

The professor's beliefs related to teaching, also derived from the "knowledge base for teaching" source of DPK, are made of highly personal and most often untested assumptions, premises, suppositions, or commitments about instruction that guide a

professor's teaching actions. Beliefs tend to be static, stable, and highly resistant to change, as well as comprising important affective and evaluative dimensions. Beliefs for teaching differ from knowledge structures for teaching mainly in that beliefs tend to be non-consensual, that is, they are not necessarily shared by others. Also, beliefs do not necessarily include an explicit rationale, unlike knowledge structures, as the professor may not articulate why s/he does or thinks something. Rather, s/he may "just know" why. Four dimensions have emerged from the four cases in relation to this component.

*Beliefs about the purpose of instruction:* This dimension is associated with the professor's views about the long-term purposes of university instruction. This may include a discussion of the finalities of higher education systems. It may also include a discussion of what the expectations directed at graduates should be many years after they have terminated their formal studies.

*Beliefs about conditions for instruction:* This dimension is associated with the professor's views about the basic requirements or conditions for effective university teaching and/or learning to take place. These requirements or conditions seem to be external to both the teacher and the learner and, thus, are beyond the control of either.

*Beliefs about teaching and teachers:* This dimension is associated with the professor's views about the role of the university teacher in general – i.e., his/her responsibilities. This can take the form of a generic discussion – i.e., "the university professor must..." – or be specific to him/herself – i.e., "as a professor, I...". The professor may also discuss what "good" university teaching is, or what university teaching that is regarded positively would entail. This can refer to a generic discussion of what university professors ought to do, or refer to what the participant has chosen to do because s/he feels it is the "right" way of doing things.

*Beliefs about learning and learners:* This dimension is associated with the professor's views about the roles and responsibilities of the learner in a university context. For instance, the professor may discuss the processes by which students acquire or construct new knowledge in the university setting. The professor's comments are directed learners in university settings, as opposed to being directed at learners or learning in general.

*Socio-cultural characteristics of the discipline*

The socio-cultural characteristics of the professor's discipline, derived from the "disciplinary specificity" source of DPK, refers to social and/or cultural aspects of a professor's discipline that may influence his/her teaching decisions. Such characteristics have to do with how the discipline is socially constructed by its members or contributors. Four dimensions have emerged from the four cases in relation to socio-cultural characteristics.

*Teaching in the discipline:* This dimension is associated with the professor's views on norms, conventions, or rules about teaching that seem to prevail among his/her colleagues teaching within the same discipline and/or students learning that discipline – e.g., the skills targeted by the university teacher for acquisition or development by the learner. This could also include any kind of discussion of the training that the professor has received in order to teach in a given discipline: training in teaching *per se* – i.e., participation in faculty development activities – or training within a given discipline – i.e., doctoral education – as long as the focus is on how this helps him/her teach.

*Learning in the discipline:* This dimension is associated with the professor's views on norms, conventions, or rules about learning that seem to prevail among his/her

colleagues teaching the same discipline and/or students learning that discipline. It is related to what learning in that given discipline generally entails – e.g., skill development by the learner. This may also include a discussion of how the professor goes about learning new materiel related to his/her discipline or field of knowledge.

*Knowing in the discipline:* This dimension is associated with the professor's views on norms, conventions, or rules about knowing that seem to prevail among his/her colleagues of the same discipline and/or students learning that discipline. It is about how knowing or thinking is generally seen within his/her discipline or how certain forms of knowledge or thinking are valued more than others within his/her discipline.

*Practicing in the discipline:* This dimension is associated with the professor's views on norms, conventions, or rules about practicing that seem to prevail among his/her colleagues teaching the same discipline and/or students learning that discipline. It is about how people who are members of his/her discipline act specifically as members of the field/discipline/profession.

*Epistemological structure of the discipline*

The epistemological structure of the professor's discipline, derived from the "disciplinary specificity" source of DPK, refers to characteristics of a professor's discipline that do not appear to be socially constructed but that may affect his/her teaching decisions. These characteristics would appear fundamental to the discipline. Three dimensions have emerged from the four cases in relation to epistemological structure.

*Description of the discipline:* This dimension is associated with the professor's views on the nature of his/her discipline or what his/her discipline is about. More specifically, it can be about the level of complexity or difficulty of the discipline.

*Organization of the discipline:* This dimension is associated with the professor's views on what the main branches and/or sub-branches of the discipline are, and how those may have evolved over time.

*Relation to other disciplines:* This dimension is associated with the professor's views on how his/her discipline relates or compares to other disciplines. For instance, this may include a discussion of similarities and/or differences, or it may simply be a discussion of changes in the relative status of the professor's discipline in relation to that of other fields.

*Beliefs about knowledge and knowing*

The professor's beliefs about knowledge and knowing, derived from the "personal epistemology" source of DPK, is about how a professor views or relates to the concept of knowledge. Two dimensions have emerged from the four cases in relation to beliefs about knowledge and knowing.

*Beliefs about the nature of knowledge:* This dimension is associated with the professor's views on what constitutes knowledge. This is not specific to his/her discipline. Rather, it is a general statement about the notion of knowledge.

*Beliefs about the act of knowing:* This dimension is associated with the professor's views on what people do when they know or how people know. Again, this is not specific to his/her discipline but rather remains general. Also, this is not about acquiring knowledge but rather the mere action of knowing.

*Beliefs about knowledge construction*

The professor's beliefs about knowledge construction, also derived from the "personal epistemology" source of DPK, is about how a professor views the development or expansion of knowledge. It is about the process of learning in general, not specifically in a university setting. In addition, there is no explicit mention of the specific discipline one teaches. Two dimensions have emerged from the four cases in relation to beliefs about knowledge construction.

*Beliefs about how people learn in general:* This dimension is associated with the professor's views on issues of learning and knowledge construction that are applicable to all individuals – i.e., not just about him/her.

*Beliefs about how one learns specifically:* This dimension is associated with the professor's views on issues of learning and knowledge construction that are specific to him/her only – i.e., how one believes s/he learns.

*Beliefs about knowledge evaluation*

The professor's beliefs about knowledge evaluation, also derived from the personal epistemology source of DPK, is about how one establishes the value of certain forms of knowledge in relation to others. Two dimensions have emerged from the four cases in relation to beliefs about knowledge evaluation.

*Beliefs about the relative value of knowledge:* This dimension is associated with the professor's views on the ordering or relative importance of certain types or sources of knowledge. This could include a discussion of willingness or not of sharing one's knowledge as this provides an idea of the level of confidence one has in his/her knowledge, thus an insight into the notion of the "relative value" of knowledge.

*Beliefs about how to evaluate knowledge:* This dimension is associated with the professor's views on how one goes about making judgments on the relative importance of certain types or sources of knowledge. It could include a discussion of how the professor him/herself goes about evaluating knowledge or how people in general do so.

### *The relationships between components of DPK*

The generic description alone of DPK components does not provide a full picture of DPK since it does not include relationships between those components. In this regard, the four cases also contributed to clarifying which relationships exist between *a priori* DPK components. Table 11 on the following page provides a list of the relationships between DPK components that emerged from the four cases. The list is an aggregate of the various relationships encountered in each of the four cases. It thus shows the variety of relationships that could potentially be encountered in university professors in general. A full description of each relationship follows the table.

Table 11. Relationships between DPK components (aggregated from four professors)

| Between | And |
|---|---|
| Goals related to teaching | Socio-cultural characteristics of the discipline |
| | Epistemological structure of the discipline |
| | Beliefs about knowledge and knowing |
| | Beliefs about knowledge construction |
| | Beliefs about knowledge evaluation |
| Knowledge structures related to teaching | Socio-cultural characteristics of the discipline |
| | Epistemological structure of the discipline |
| | Beliefs about knowledge and knowing |
| | Beliefs about knowledge construction |
| | Beliefs about knowledge evaluation |
| Beliefs related to teaching | Socio-cultural characteristics of the discipline |
| | Epistemological structure of the discipline |
| | Beliefs about knowledge and knowing |
| | Beliefs about knowledge construction |
| | Beliefs about knowledge evaluation |
| Socio-cultural characteristics of the discipline | Beliefs about knowledge and knowing |
| | Beliefs about knowledge construction |
| | Beliefs about knowledge evaluation |
| Epistemological structure of the discipline | Beliefs about knowledge and knowing |
| | Beliefs about knowledge construction |
| | Beliefs about knowledge evaluation |

*Between the professor's goals related to teaching and the socio-cultural characteristics of his/her discipline*

This relationship is associated with instances in which the professor draws upon his/her expectations or intentions related to teaching in combination with his/her views of the social and/or cultural aspects of his/her discipline that may influence his/her teaching decisions.

*Between the professor's goals related to teaching and the epistemological structure of his/her discipline*

This relationship is associated with instances in which the professor draws upon his/her expectations or intentions related to teaching in combination with his/her views of the characteristics of his/her discipline that are not socially constructed but that may affect his/her teaching decisions.

*Between the professor's goals related to teaching and his/her beliefs about knowledge and knowing*

This relationship is associated with instances in which the professor draws upon his/her expectations or intentions related to teaching in combination with his/her views on the concepts of knowledge or knowing.

*Between the professor's goals related to teaching and his/her beliefs about knowledge construction*

This relationship is associated with instances in which the professor draws upon his/her expectations or intentions related to teaching in combination with his/her views on the development or expansion of knowledge.

*Between the professor's goals related to teaching and his/her beliefs about knowledge evaluation*

This relationship is associated with instances in which the professor draws upon his/her expectations or intentions related to teaching in combination with his/her views on how one establishes the value of certain forms of knowledge in relation to other forms.

*Between the professor's knowledge structures related to teaching and the socio-cultural characteristics of his/her discipline*

This relationship is associated with instances in which the professor draws upon his/her cognitive understandings that contribute to skillful teaching in combination with his/her views of the social and/or cultural aspects of his/her discipline that may influence his/her teaching decisions.

*Between the professor's knowledge structures related to teaching and the epistemological structure of his/her discipline*

This relationship is associated with instances in which the professor draws upon his/her cognitive understandings that contribute to skillful teaching in combination with his/her views of the characteristics of his/her discipline that are not socially constructed but that may affect his/her teaching decisions.

*Between the professor's knowledge structures related to teaching and his/her beliefs about knowledge & knowing*

This relationship is associated with instances in which the professor draws upon his/her cognitive understandings that contribute to skillful teaching in combination with his/her views on the concepts of knowledge or knowing.

*Between the professor's knowledge structures related to teaching and his/her beliefs about knowledge construction*

This relationship is associated with instances in which the professor draws upon his/her cognitive understandings that contribute to skillful teaching in combination with his/her views on the development or expansion of knowledge.

*Between the professor's knowledge structures related to teaching and his/her beliefs about knowledge evaluation*

This relationship is associated with instances in which the professor draws upon his/her cognitive understandings that contribute to skillful teaching in combination with his/her views on how one establishes the value of certain forms of knowledge in relation to other forms.

*Between the professor's beliefs related to teaching and the socio-cultural characteristics of his/her discipline*

This relationship is associated with instances in which the professor draws upon his/her assumptions, premises or suppositions about teaching in combination with his/her

views of the social and/or cultural aspects of his/her discipline that may influence his/her teaching decisions.

*Between the professor's beliefs related to teaching and the epistemological structure of his/her discipline*

This relationship is associated with instances in which the professor draws upon his/her assumptions, premises or suppositions about teaching in combination with his/her views of the characteristics of his/her discipline that are not socially constructed but that may affect his/her teaching decisions.

*Between the professor's beliefs related to teaching and his/her beliefs about knowledge and knowing*

This relationship is associated with instances in which the professor draws upon his/her assumptions, premises or suppositions about teaching in combination with his/her views on the concepts of knowledge or knowing.

*Between the professor's beliefs related to teaching and his/her beliefs about knowledge construction*

This relationship is associated with instances in which the professor draws upon his/her assumptions, premises or suppositions about teaching in combination with his/her views on the development or expansion of knowledge.

*Between the professor's beliefs related to teaching and his/her beliefs about knowledge evaluation*

This relationship is associated with instances in which the professor draws upon his/her assumptions, premises or suppositions about teaching in combination with his/her views on how one establishes the value of certain forms of knowledge in relation to others.

*Between the socio-cultural characteristics of the professor's discipline and his/her beliefs about knowledge and knowing*

This relationship is associated with instances in which the professor draws upon his/her views of the social and/or cultural aspects of his/her discipline that may influence his/her teaching decisions in combination with his/her views on the concepts of knowledge or knowing.

*Between the socio-cultural characteristics of the professor's discipline and his/her beliefs about knowledge construction*

This relationship is associated with instances in which the professor draws upon his/her views of the social and/or cultural aspects of his/her discipline that may influence his/her teaching decisions in combination with his/her views on the development or expansion of knowledge.

*Between the socio-cultural characteristics of the professor's discipline and his/her beliefs about knowledge evaluation*

This relationship is associated with instances in which the professor draws upon his/her views of the social and/or cultural aspects of his/her discipline that may influence

his/her teaching decisions in combination with his/her views on how one establishes the value of certain forms of knowledge in relation to other forms.

*Between the epistemological structure of the professor's discipline and his/her beliefs about knowledge and knowing*

This relationship is associated with instances in which the professor draws upon his/her views of the characteristics of his/her discipline that are not socially constructed but that may affect his/her teaching decisions in combination with his/her views on the concepts of knowledge or knowing.

*Between the epistemological structure of the professor's discipline and his/her beliefs about knowledge construction*

This relationship is associated with instances in which the professor draws upon his/her views of the characteristics of his/her discipline that are not socially constructed but that may affect his/her teaching decisions in combination with his/her views on the development or expansion of knowledge.

*Between the epistemological structure of the professor's discipline and his/her beliefs about knowledge evaluation*

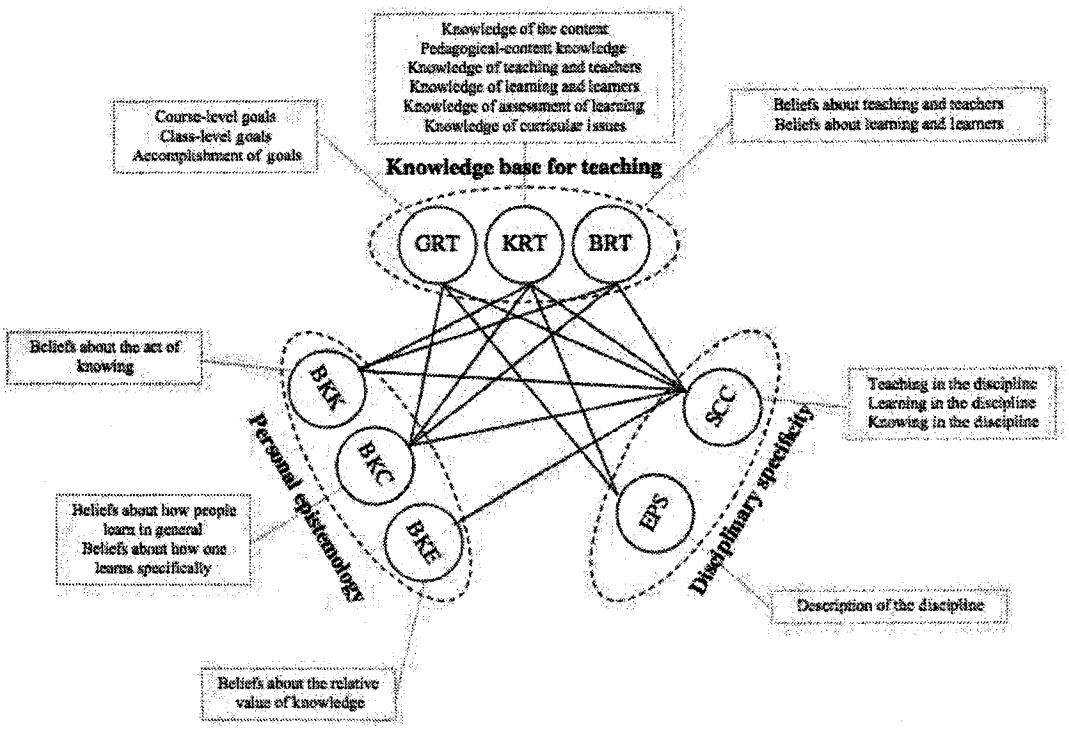
This relationship is associated with instances in which the professor draws upon his/her views of the characteristics of his/her discipline that are not socially constructed but that may affect his/her teaching decisions in combination with his/her views on how one establishes the value of certain forms of knowledge in relation to other forms.

*Commonalities across cases*

An important aspect of describing DPK components, emerging dimensions, and relationships between components is to provide an indication of what may be seen as the "core" elements of discipline-specific pedagogical knowledge in university teaching. Such core elements constitute what university professors would share with regard to DPK. In other words, this core constitutes the "generic" or "trans-disciplinary" aspects of DPK, that is, aspects of DPK that are likely to be encountered in university professors in general, regardless of the discipline they teach. Figure 11 on the following page provides a view of the DPK components, emerging dimensions, and relationships between components that were common to the four cases.

Figure 11

DPK components, emerging dimensions, and relationships between components that are common to the four professors




*Core components of DPK and emerging dimensions*

The theoretical framework for this study posits that DPK is formed of eight components derived from three sources of influence, namely a professor's knowledge base for teaching, the disciplinary specificity of his/her field, and his/her personal epistemology. Those eight *a priori* components were then examined with the help of four professors from very different disciplines to identify dimensions that characterize the components from an empirical point of view. This has led to the emergence of 32 dimensions that describe various aspects of the nature of DPK for university professors. Table 12 on page 157 provides a list of the eight *a priori* components, along with the 32

emerging dimensions that are associated with them, and identifies the dimensions that are common to the four professors.[17]

[17] The sequence in which these findings are presented does not reflect any notion of relative importance. It reproduces the sequence used at the beginning of this chapter – see Table 2.

Table 12. DPK components and emerging dimensions (across the four professors)

| A priori component | Emerging dimensions | SP | HP | SA | HA |
|---|---|---|---|---|---|
| Goals Related to teaching | Course-level goals | ■ | ■ | ■ | ■ |
| | Class-level goals | ■ | ■ | ■ | ■ |
| | Ordering of goals | ■ | ■ | | |
| | Accomplishment of goals | ■ | ■ | ■ | ■ |
| | New/future goals | | | ■ | ■ |
| Knowledge structures related to teaching | Knowledge of the content | ■ | ■ | ■ | ■ |
| | Pedagogical content knowledge | ■ | ■ | ■ | ■ |
| | Knowledge of self | | ■ | ■ | ■ |
| | Knowledge of teaching and teachers | ■ | ■ | ■ | ■ |
| | Knowledge of learning and learners | ■ | ■ | ■ | ■ |
| | Knowledge of assessment of learning | ■ | ■ | ■ | ■ |
| | Knowledge of curricular issues | ■ | ■ | ■ | ■ |
| | Knowledge of human behaviour | ■ | | ■ | ■ |
| | Knowledge of physical environment | ■ | | | |
| | Knowledge of logistical issues | | ■ | ■ | ■ |
| Beliefs related to teaching | Beliefs about the purpose of instruction | ■ | | ■ | |
| | Beliefs about the conditions for instruction | ■ | | ■ | |
| | Beliefs about teaching and teachers | ■ | ■ | ■ | ■ |
| | Beliefs about learning and learners | ■ | ■ | ■ | ■ |
| Socio-cultural characteristics of the discipline | Teaching in the discipline | ■ | ■ | ■ | ■ |
| | Learning in the discipline | ■ | ■ | ■ | ■ |
| | Knowing in the discipline | ■ | ■ | ■ | ■ |
| | Practicing in the discipline | | ■ | ■ | ■ |
| Epistemological structure of the discipline | Description of the discipline | ■ | ■ | ■ | ■ |
| | Organization of the discipline | ■ | | | |
| | Relation to other disciplines | | ■ | ■ | ■ |
| Beliefs about knowledge and knowing | Beliefs about the nature of knowledge | | | ■ | ■ |
| | Beliefs about the act of knowing | ■ | ■ | ■ | ■ |
| Beliefs about knowledge construction | Beliefs about how people learn in general | ■ | ■ | ■ | ■ |
| | Beliefs about how one learns specifically | ■ | ■ | ■ | ■ |
| Beliefs about knowledge evaluation | Beliefs about the relative value of knowledge | ■ | ■ | ■ | ■ |
| | Beliefs about how to evaluate knowledge | | ■ | | |

We can see in Table 12 that commonalities across the four professors can be found for each of the eight *a priori* components. These commonalities are presented in this chapter, with their interpretation being addressed in the subsequent chapter.

From the component "goals related to teaching", three dimensions emerged from interviews conducted with each of the four professors, namely the professor's "course-level goals", "class-level goals", and "accomplishment of goals".

As for "knowledge structures related to teaching", six dimensions emerged from interviews conducted with each of the four professors. Those include the professor's "knowledge of the content", "pedagogical content knowledge", "knowledge of teaching and teachers", "knowledge of learning and learners", "knowledge of assessment of learning", and "knowledge of curricular issues".

As regards the component "beliefs related to teaching", two dimensions emerged from interviews conducted with each of the four professors, namely the professor's "beliefs about teaching and teachers", and his/her "beliefs about learning and learners".

In relation to "socio-cultural characteristics" of the discipline, three dimensions emerged from interviews conducted with each of the four professors, namely the professor's views on "teaching in the discipline", "learning in the discipline", and "knowing in the discipline".

Relative to the component "epistemological structure of the discipline", only one dimension emerged from interviews conducted with each of the four professors, namely the professor's "description of the discipline".

With regard to "beliefs about knowledge and knowing", only one dimension emerged from interviews conducted with each of the four professors, namely the professor's "beliefs about the act of knowing".

In relation to "beliefs about knowledge construction", two dimensions emerged from interviews conducted with each of the four professors, namely "beliefs about how people learn in general" and "beliefs about how one learns specifically".

With regard to "beliefs about knowledge evaluation", only one dimension emerged from interviews conducted with each of the four professors, namely the professor's "beliefs about the relative value of knowledge".

Table 13 on the following page provides a list of DPK components and emerging dimensions that were common to the four professors involved in this study. It can thus be envisaged that these components and emerging dimensions constitute the core of university professors' DPK.

Table 13. Core DPK components and emerging dimensions (common to four professors)

| A priori component | Emerging dimensions |
|---|---|
| Goals related to teaching | Course-level goals |
| | Class-level goals |
| | Accomplishment of goals |
| Knowledge structures related to teaching | Knowledge of the content |
| | Pedagogical content knowledge |
| | Knowledge of teaching and teachers |
| | Knowledge of learning and learners |
| | Knowledge of assessment of learning |
| | Knowledge of curricular issues |
| Beliefs related to teaching | Beliefs about teaching and teachers |
| | Beliefs about learning and learners |
| Socio-cultural characteristics of the discipline | Teaching in the discipline |
| | Learning in the discipline |
| | Knowing in the discipline |
| Epistemological structure of the discipline | Description of the discipline |
| Beliefs about knowledge and knowing | Beliefs about the act of knowing |
| Beliefs about knowledge construction | Beliefs about how people learn in general |
| | Beliefs about how one learns specifically |
| Beliefs about knowledge evaluation | Beliefs about the relative value of knowledge |

*Core relationships between components of DPK*

In the conceptual framework guiding this study, DPK is envisaged as a form of knowledge that combines eight components derived from the three sources of influence listed earlier. As such, the relationships between those components are an important contributor to the DPK university professors develop. In this sense, DPK is a form of knowledge emerging from the combination of a variety of components from various sources.

In this study, emerging dimensions associated with *a priori* DPK components were used to identify relationships between those components. This led to the emergence of 21 relationships that can serve to describe various aspects of the nature of DPK for any given university professor. Table 14 on the following page provides a list of the 21 relationships between DPK components, and identifies the relationships that were common to the four professors.

Table 14. Relationships between DPK components (across the four professors)

| Between | and | SP | HP | SA | HA |
|---|---|---|---|---|---|
| Goals related to teaching | Socio-cultural characteristics of the discipline | ■ | ■ | ■ | ■ |
| | Epistemological structure of the discipline | ■ | ■ | ■ | ■ |
| | Beliefs about knowledge and knowing | ■ | | ■ | ■ |
| | Beliefs about knowledge construction | ■ | ■ | ■ | ■ |
| | Beliefs about knowledge evaluation | ■ | | | |
| Knowledge structures related to teaching | Socio-cultural characteristics of the discipline | ■ | ■ | ■ | ■ |
| | Epistemological structure of the discipline | ■ | ■ | ■ | ■ |
| | Beliefs about knowledge and knowing | ■ | ■ | ■ | ■ |
| | Beliefs about knowledge construction | ■ | ■ | ■ | ■ |
| | Beliefs about knowledge evaluation | | ■ | ■ | ■ |
| Beliefs related to teaching | Socio-cultural characteristics of the discipline | ■ | ■ | ■ | ■ |
| | Epistemological structure of the discipline | | ■ | | |
| | Beliefs about knowledge and knowing | ■ | ■ | ■ | ■ |
| | Beliefs about knowledge construction | ■ | ■ | ■ | ■ |
| | Beliefs about knowledge evaluation | ■ | | ■ | |
| Socio-cultural characteristics of the discipline | Beliefs about knowledge and knowing | ■ | ■ | ■ | ■ |
| | Beliefs about knowledge construction | ■ | ■ | ■ | ■ |
| | Beliefs about knowledge evaluation | ■ | ■ | ■ | ■ |
| Epistemological structure of the discipline | Beliefs about knowledge and knowing | | ■ | ■ | |
| | Beliefs about knowledge construction | ■ | | | |
| | Beliefs about knowledge evaluation | | ■ | | |

We can see in Table 14 that 13 relationships are present across the four professors. These commonalities are presented below in relation to the four main interconnecting DPK components, while their interpretation will be addressed in the next chapter.

With regard to the "goals related to teaching" of a professor, three relationships emerged from interviews conducted with each of the four professors, namely with the "socio-cultural characteristics of the discipline", with the "epistemological structure of the discipline", and with the professors' "beliefs related to knowledge construction".

Concerning the "knowledge structures related to teaching" of a professor, four relationships emerged from interviews conducted with each of the four professors. Those relationships are with the "socio-cultural characteristics of the discipline", the "epistemological structure of the discipline", the professor's "beliefs about knowledge and knowing", as well as the professor's "beliefs about knowledge construction".

From the component the professor's "beliefs related to teaching", three relationships emerged in interviews conducted with each of the four professors, namely with the "socio-cultural characteristics of the discipline", the professor's "beliefs about knowledge and knowing", and the professor's "beliefs about knowledge construction".

As for the "socio-cultural characteristics" of a professor's discipline, three dimensions emerged from interviews conducted with each of the four professors (in addition to the ones already listed above), namely with the professor's "beliefs about knowledge and knowing", his/her "beliefs about knowledge construction", and his/her "beliefs about knowledge evaluation".

Table 15 below provides a list of relationships between DPK components that are common to the four professors involved in this study. It can thus be envisaged that these relationships between components constitute the core of university professors' DPK.

Table 15. Core relationships between DPK components (common to four professors)

| **Between** | **and** |
|---|---|
| Goals related to teaching | Socio-cultural characteristics of the discipline |
| | Epistemological structure of the discipline |
| | Beliefs about knowledge construction |
| Knowledge structures related to teaching | Socio-cultural characteristics of the discipline |
| | Epistemological structure of the discipline |
| | Beliefs about knowledge and knowing |
| | Beliefs about knowledge construction |
| Beliefs related to teaching | Socio-cultural characteristics of the discipline |
| | Beliefs about knowledge and knowing |
| | Beliefs about knowledge construction |
| Socio-cultural characteristics of the discipline | Beliefs about knowledge and knowing |
| | Beliefs about knowledge construction |
| | Beliefs about knowledge evaluation |

# CHAPTER 5

# DISCUSSION OF FINDINGS AND CONCLUSIONS

In this study, I have aimed to describe the nature of university professors' discipline-specific pedagogical knowledge (DPK). More specifically, I have examined how the pedagogical knowledge of university professors is related to the specific characteristics of their discipline of instruction. To do so, I have aimed to answer two specific questions:

- What are the dimensions/characteristics associated with the DPK components of the conceptual framework?
- What relationships exist between the DPK components of the conceptual framework?

To answer these questions, a multicase study approach was used and empirical evidence of DPK components and relationships between them was collected from a group of four university professors coming from four different disciplines. This has led to two sets of findings – one comprising empirical illustrations and one comprising generic definitions and commonalities. Taken together, these findings provide a framework describing the nature of university professors' discipline-specific pedagogical knowledge (DPK).

From these findings, four contributions can be identified with regard to the discipline-specific pedagogical knowledge (DPK) of university professors. First and foremost, a new conceptualization of DPK is provided, one that is empirically rooted in university teaching, and that describes the nature of university professors' DPK. Second, core elements of DPK are identified, that is, aspects of DPK that can be seen as common

to university professors regardless of their discipline of instruction. Third, issues of personal epistemology emerged as an important link between a professor's knowledge base for teaching and the disciplinary specificity of his/her field of instruction. And fourth, the relative importance of certain aspects of disciplinary specificity in university teaching are clarified.

At this point, findings presented in the previous chapter are now discussed to explore how this study contributes to the advancement of understanding how university professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction. As such, a summary of the findings and their meaning is first presented. Then, conclusions related to the general research question and the two specific questions are drawn and explained in detail. This is followed by a discussion of implications for both research/theory and practice, of the strengths and limitations of this study, and of recommendations relative to both future research and practice.

## Discussion of findings

The overall research question for this study was "What is the nature of university professors' discipline-specific pedagogical knowledge (DPK)?" Based upon my findings, I would answer that DPK is a complex web of components, dimensions, and relationships between them that describe how a professor relates his/her pedagogical knowledge to what s/he perceives as the specific characteristics of his/her discipline of instruction. The eight components are derived from three sources: the university professor's knowledge base for teaching, the disciplinary specificity of his/her field of instruction, and his/her

personal epistemology. Each component is further characterized by specific dimensions which thus clarify the nature of the relationships between each other.

Simultaneously, I respond to the overall research question with the idea that certain components, dimensions and relationships between components seem to be common to university professors, regardless of their academic discipline. Therefore, the DPK of university professors would comprise elements that are present in most university professors at the same time as comprising elements that are specific to each individual university professor.

In addition, although issues of personal epistemology are not generally considered in literature to be part of the relation between the pedagogical knowledge of university professors and the specific characteristics of their discipline, I would answer the overall research question by saying that DPK encompasses important issues of personal epistemology and that more attention should be devoted to those. This is compatible with the idea that not all university professors from one discipline think the same way as regards teaching in their academic discipline.

Finally, I would reply to the overall research question that issues of disciplinary specificity, recognized in literature as crucial in clarifying the relationship between a university professor's pedagogical knowledge and the specific characteristics of his discipline of instruction, have put too much emphasis on aspects of epistemological structure and not enough on socio-cultural aspects. Therefore, DPK should be thought of as a form of knowledge that is more socially constructed than epistemologically determined.

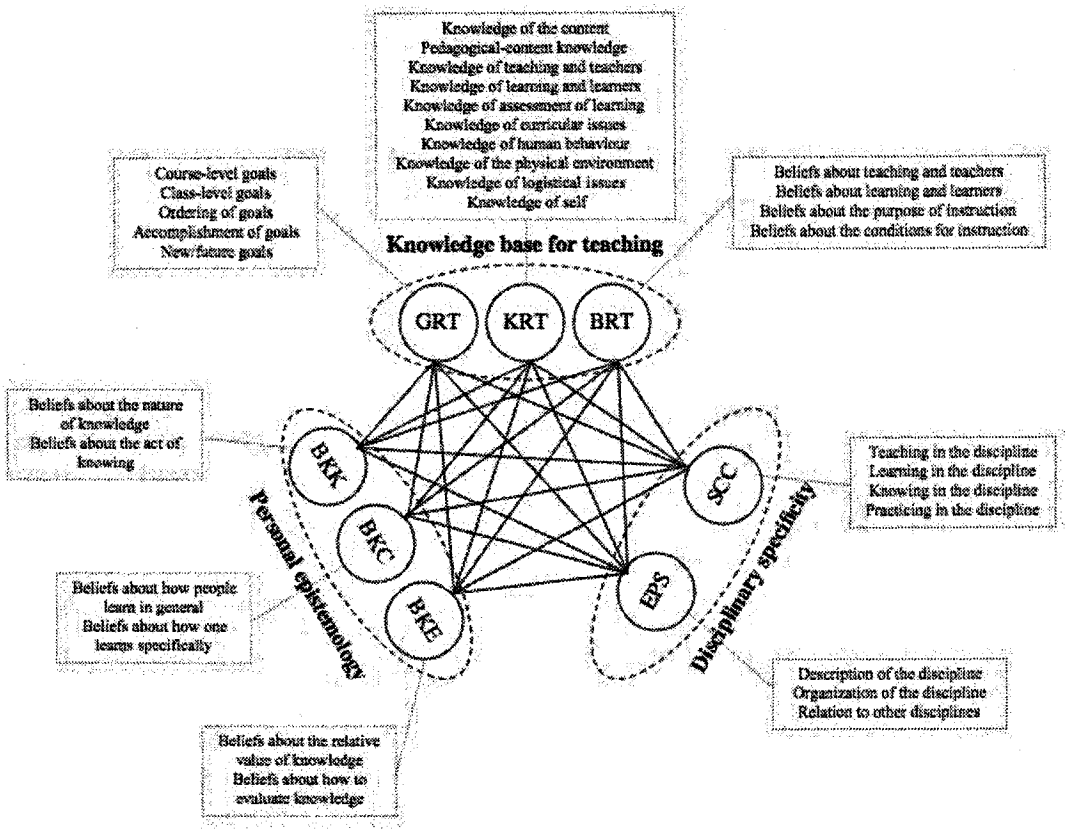
These answers to the overall research question are now further detailed with the help of answers to the two specific research questions.

*What are the dimensions/characteristics associated with the DPK components of the conceptual framework?*

Findings from this study answer the specific research questions by describing in detail the DPK components, their dimensions, and the relationships between components. It does so by identifying the various elements of DPK that were found when aggregating the experience of the four university professors participating in this study. For instance, the eight components of the conceptual framework underlying this study were *a priori* or theoretical constructs derived from research literature (see Figure 12 on the following page). These components comprise goals related to teaching (GRT), knowledge structures related to teaching (KRT), beliefs related to teaching (BRT), socio-cultural characteristics of the discipline (SCC), epistemological structure of the discipline (EPS), beliefs about knowledge and knowing (BKK), beliefs about knowledge construction (BKC), and beliefs about knowledge evaluation (BKE). As these components were derived from the general research literature on learning and instruction, they were not necessarily specific to university teaching, but rather applicable to all levels of instruction. As such, these eight components had neither been empirically defined in the context of university teaching nor related to one another in the context of university teaching. Thus, through this study, I obtained empirical evidence of these eight components in the context of university teaching and with relation to one another.

Figure 12

Framework of discipline-specific pedagogical knowledge (DPK)




*General observations from the four cases*

In addition to finding empirical evidence of the eight components of DPK, I found that each of these eight components has associated emerging dimensions (represented by the boxes in Figure 12 above). I further identified and defined 32 emerging dimensions that characterize the eight DPK components. These dimensions contribute to providing an empirical definition of each component of DPK in the context of university teaching. And, as will be explained later, these dimensions also serve to clarify the relationships between DPK components.

In my exploration of the components derived from the knowledge base for teaching (i.e., goals, knowledge structures, and beliefs related to teaching), new dimensions emerged that had not previously been encountered in general literature on learning and instruction. With relation to knowledge structures, new dimensions include knowledge of human behaviour, of the physical environment, of logistical issues, and of self as a teacher. With relation to goals, new dimensions include the ordering of goals and new/future goals. And with relation to beliefs (related to teaching), new dimensions include beliefs about the purpose of instruction and beliefs about the conditions for instruction. These new dimensions expand existing literature on the goals, beliefs and knowledge structures related to teaching of university teachers. In particular, they point to the fact that existing general taxonomies of goals, knowledge structures and beliefs related to teaching may need to be better adapted to the specific nature of university teaching.

In my exploration of the components derived from the disciplinary specificity of the professor's discipline, new dimensions emerged that were not found in existing literature. This is mainly because epistemological and socio-cultural dimensions of disciplinary specificity had seldom been jointly explored previously. Therefore, the novel way underlying my study of conceptualizing disciplinary specificity gave rise to new dimensions. For instance, it emerged that the socio-cultural aspects of disciplinary specificity can be divided among issues related to teaching, learning, knowing or practicing in the discipline. Simultaneously, it emerged that the epistemological aspects of disciplinary specificity can be divided among issues related to the description of the discipline, its organization or its relationships to other disciplines.

These seven dimensions provide an interesting way of envisaging disciplinary specificity in university teaching. The dimensions are less detailed than what is normally seen in existing teaching literature, but they clarify what is socio-cultural and what is epistemological. In literature on this topic, issues of disciplinary specificity can generally be positioned on a continuum from epistemological to socio-cultural, which has led educational researchers to look mainly at one or the other of these aspects, or to look at both simultaneously but in a blurred way. Separating them into discrete components enabled me to investigate them in the same study and see which fits where. This therefore helped to clarify the nature of disciplinary specificity in university teaching, particularly in situations where university professors attempt to relate their pedagogical knowledge to the specific characteristics of their discipline of instruction.

During my exploration of the components derived from the professor's personal epistemology, six empirical dimensions describe a given professor's views about knowledge. As was the case with issues of disciplinary specificity, this new way of conceptualizing issues of personal epistemology provides a broader view of the professor's personal epistemology while detailing what dimensions are present for that professor. For instance, in the case of beliefs about knowledge and knowing, findings from my study clearly separate views related to knowledge from views related to the act of knowing. In the case of beliefs about knowledge construction, they separate views related to how one constructs knowledge from views related to how people construct knowledge in general. And in the case of beliefs about knowledge evaluation, findings from my study separate views related to how one goes about evaluating knowledge from views related to the relative value of knowledge. As such, the conceptualization of personal epistemology that emerged from my study is compatible with existing literature

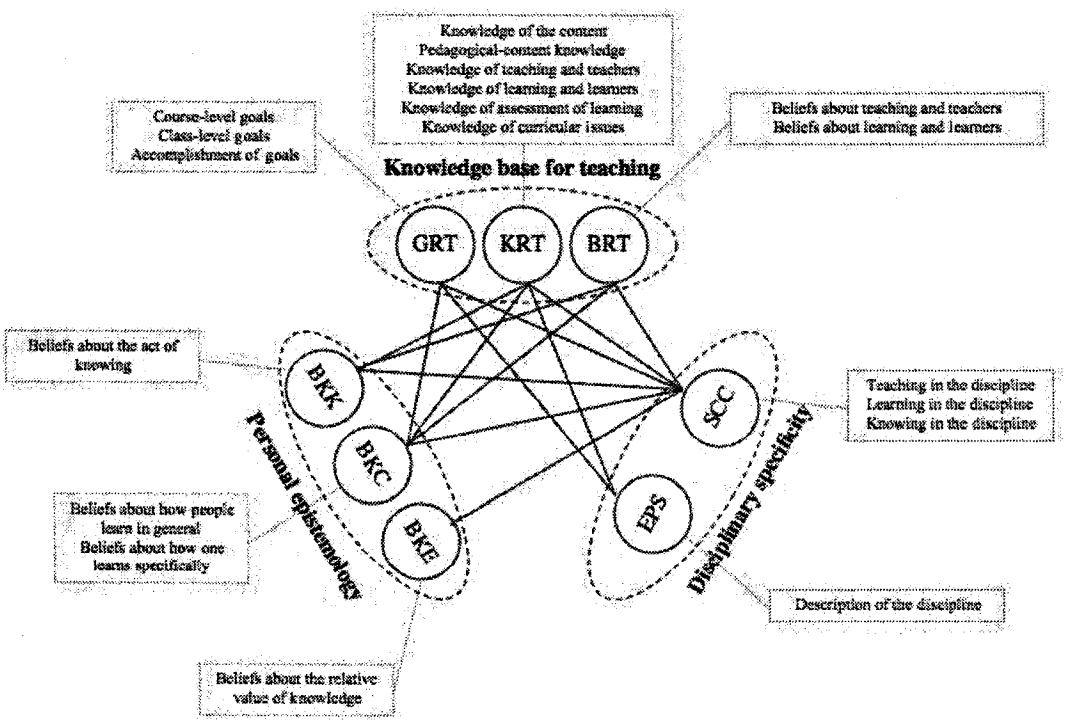
on the topic. Yet, at the same time, it refines issues of personal epistemology when encountered in the context of university teaching.

*Commonalities across the four cases*

Findings from this study also answer the specific research questions by identifying core elements of DPK, that is, elements of DPK that were simultaneously found in each of the four university professors participating in this study. Figure 13 below shows components, dimensions, and relationships of DPK that were common to the four professors.

Figure 13

Core DPK components, dimensions and relationships



We can see in Figure 13 that 19 core dimensions were common across the four professors. As regards the knowledge base for teaching of the university professors, the dimensions that emerged across the four professors are dimensions which are generally encountered in the research literature on the knowledge base for teaching. With relation to knowledge structures, dimensions that emerged include knowledge of the content, of teaching/teachers, of learning/learners, of assessment, of curricular issues, and pedagogical-content knowledge. Relative to goals, dimensions that emerged include course-level and class-level goals, as well as issues related to the accomplishment of goals. And in relation to beliefs (related to teaching), dimensions that emerged include beliefs about teaching/teachers and beliefs about learning/learners.

With regard to issues of disciplinary specificity, dimensions emerged across the four professors as regard both socio-cultural and epistemological aspects. In relation to socio-cultural characteristics of the discipline, three of the four dimensions that emerged were present in the four professors. These include issues related to teaching, learning and knowing in the discipline. The only dimension that was not found across the four professors was that of practicing in the discipline. This latter dimension was predominantly observed in the case of the two professors coming from professional fields. Simultaneously, only one of the three dimensions associated with the epistemological structure of the discipline emerged across the four professors, namely that related to the description of the discipline (i.e., the level of complexity of the material being taught or learned). The other two dimensions, concerning the organization of the discipline and the relationships to other disciplines, were not omnipresent across the four professors.

These findings point to the fact that epistemological aspects of disciplinary specificity might not be as important as is portrayed in the literature on that topic. The findings also point to the fact that socio-cultural aspects of disciplinary specificity might be more important than epistemological aspects when university professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction. The reason that these findings are contrary to research literature might have to do with the way epistemological and socio-cultural aspects of disciplinary specificity have been defined in my study. Certain "epistemological" aspects of disciplinary specificity identified in previous research might actually be more "socio-cultural" than what other researchers have envisaged.

As for issues of personal epistemology, only four of the six dimensions emerged across the four university professors. In relation to beliefs about knowledge and knowing, beliefs about the act of knowing emerged across the four professors, but not beliefs about knowledge. Relating to beliefs about knowledge construction, both dimensions (i.e., beliefs about how one constructs knowledge and beliefs about how people construct knowledge in general) emerged across the four professors. Finally, with relation to beliefs about knowledge evaluation, beliefs about the relative value of knowledge emerged across the four professors whereas beliefs about how to evaluate knowledge did not.

These findings are very interesting in that the two dimensions that did not emerge across the four professors – beliefs about the nature of knowledge and beliefs about how to evaluate knowledge – are dimensions that would be seen as central to many models of personal epistemology. Yet, findings from my study point to the fact that they are not so central to situations in which university professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction. This might be because issues

that are grouped in literature on personal epistemology are actually addressed separately in my study. For instance, in some models of personal epistemology, beliefs about knowledge and beliefs about the act of knowing are grouped together just as are beliefs about how to evaluate knowledge and beliefs about the relative value of knowledge. Therefore, findings from my study point to the necessity to break down those categories in order to describe the nature of aspects of personal epistemology at play when professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction.

### *What relationships exist between the DPK components of the conceptual framework?*

As was explained in previous chapters, the DPK framework comprises two main elements. To begin with, components and emerging dimensions contribute to clarifying the nature of DPK. Additionally, the relationships between those components (and dimensions) also contribute to clarifying the nature of DPK. This is because DPK is derived from three sources – the professor's knowledge base for teaching, the disciplinary specificity of his/her field, and his/her personal epistemology. Therefore, clarifying the relationships between components is essential to describing the nature of university professors' DPK.

#### *General observations from the four cases*

The process of analysis has led to the emergence of 21 relationships between DPK components when aggregating findings from the four professors (see Figure 12, p. 169). This was done by first identifying relationships between the 32 emerging dimensions

(through themes). Emerging dimensions were then linked back to their associated DPK components, thus identifying relationships between components. As the conceptual framework for my study posited that DPK is derived from the interaction of eight components from three sources, I was expecting to find empirical evidence of relationships between all components of the conceptual framework, which, in fact, is what happened. These findings thus contribute to clarifying the nature of university professors' DPK by outlining and illustrating all the relationships between DPK components.

*Commonalities across the four cases*

In addition to relationships found when aggregating the four cases, findings from this study also answer the specific research questions by identifying core relationships between components of DPK, that is, relationships that were simultaneously found in each of the four university professors participating in this study (see Figure 13, p. 172). Of the 21 relationships found when aggregating findings from the four cases, 13 emerged simultaneously from each of the four cases. This means that the remaining eight relationships may not be crucial to university professors when relating their pedagogical knowledge to the specific characteristics of their discipline. These include relationships between:

- beliefs about knowledge evaluation and goals related to teaching
- beliefs about knowledge evaluation and knowledge structures related to teaching
- beliefs about knowledge evaluation and beliefs related to teaching
- the epistemological structure and beliefs about knowledge and knowing
- the epistemological structure and beliefs about knowledge construction

- the epistemological structure and beliefs about knowledge evaluation
- the epistemological structure and beliefs related to teaching
- goals related to teaching and beliefs about knowledge and knowing

Regarding the relationships between DPK components derived from the professor's personal epistemology and those derived from either the knowledge base for teaching or the disciplinary specificity of the field, findings from my study show that beliefs about knowledge evaluation are not related to any of the components associated with the knowledge base for teaching (i.e., beliefs, goals and knowledge structures related to teaching). Simultaneously, the three components of the personal epistemology are not related to the epistemological aspects of disciplinary specificity. Therefore, it appears that relationships that involve beliefs about knowledge evaluation and/or epistemological aspects of the discipline do not play such a crucial role when professors relate their pedagogical knowledge to the specific characteristics of their discipline.

As for the relationships between DPK components derived from the disciplinary specificity of the field and those derived from either the knowledge base for teaching or the disciplinary specificity of the field, findings from my study show that socio-cultural aspects of disciplinary specificity are linked to all other DPK components whereas the epistemological aspects of disciplinary specificity are only linked to two other DPK components. These findings point, first of all, to the importance of socio-cultural characteristics in situations where university professors relate their pedagogical knowledge to the specific characteristics of their discipline and, secondly, to the lesser importance of the epistemological structure. According to existing research literature on disciplinary specificity, I was expecting to find the opposite result since disciplinary

specificity is most often portrayed as "epistemological" rather than "socio-cultural". There might be two explanations for this: Perhaps epistemological aspects might not be as important as has been assumed by other researchers thus far; or perhaps it may be that issues that have generally been considered "epistemological" are actually "socio-cultural". That the framework underlying this study clarifies what is epistemological and what is socio-cultural in issues of disciplinary specificity would allow findings like this to emerge.

## Conclusions

From the findings described above, four grand conclusions can be drawn with regard to the discipline-specific pedagogical knowledge (DPK) of university professors. First and foremost, a new conceptualization of DPK is provided, one that is empirically rooted in university teaching, and that provides a more accurate picture of pedagogical knowledge which is related to a specific discipline than previous approaches. Second, core elements of DPK are identified, that is, aspects of DPK that can be seen as common to university professors regardless of their discipline of instruction. Third, personal epistemology emerges as a crucial element in the link between a professor's knowledge base for teaching and the disciplinary specificity of his/her field of instruction. And fourth, the relative importance of certain aspects of disciplinary specificity in university teaching are clarified. These four conclusions are now discussed in more detail.

### *A new conceptualization to describe the nature of DPK*

Findings from this study are compatible with existing approaches to disciplinary specificity in university teaching. Yet, the operational framework of DPK that results

from this study provides a more detailed description of how university professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction. So, while the DPK framework incorporates elements of other approaches to this phenomenon, it goes much further. For instance, rather than only providing insight into a professor's knowledge base for teaching or into the disciplinary specificity of his/her field, the DPK framework provides insight into each of these two sources, as well as into that professor's personal epistemology. But, most importantly, the DPK framework describes the relationships between those three sources. This provides a much more detailed description of a university professor's discipline-specific pedagogical knowledge than other approaches do.

For instance, the DPK framework enables us, in the case of SP (see Figure 6, p. 76), to see that relationships exist between components associated with his knowledge base for teaching and the disciplinary specificity of his field, between components associated with his knowledge base for teaching and his personal epistemology, and between components of his personal epistemology and the disciplinary specificity of his field. Simultaneously, the framework enables us to be even more specific by clarifying that the three components of SP's knowledge base for teaching – his goals, knowledge structures, and beliefs related to teaching – are all related to the socio-cultural characteristics of his discipline but that only two of those are related to the epistemological structure of his discipline. Simultaneously, we can see in Figure 6 that most components of SP's knowledge base for teaching are related to the components of his personal epistemology, except for his knowledge structures related to teaching, which are not related to his beliefs about knowledge evaluation. Finally, all components of SP's personal epistemology are related to the socio-cultural characteristics of his discipline but

not to the epistemological structure of his discipline. So, in the case of SP, the DPK framework provides us with extensive information about the architecture of his pedagogical knowledge that is discipline-specific, particularly since each component is further characterized by dimensions and that relationships between dimensions can be identified.

Similarly, the DPK framework enables us to see, in the case of HP (see Figure 7, p. 110), that relationships are present between all the components of her knowledge base for teaching and the disciplinary specificity of her field. However, only a few relationships are present between components associated with her personal epistemology and her knowledge base for teaching or between her personal epistemology and the disciplinary specificity of her field. For instance, HP's goals related teaching are only related to her beliefs about knowledge construction whereas her beliefs related to teaching are related to both beliefs about knowledge/knowing, and her beliefs about knowledge construction. Finally, there are more links between components associated with personal epistemology and disciplinary specificity than is the case with SP. However, no relationship exists between HP's beliefs about knowledge construction and the epistemological structure of her discipline.

The DPK framework provides for similar descriptions in the cases of SA (Figure 8, p. 121) and HA (Figure 9, p. 129). The main point here is that the DPK framework clarifies what components, associated dimensions, and relationships between components are present in the case of a university professor relating his/her pedagogical knowledge to the specific characteristics of his/her discipline. As such, the DPK framework clarifies which aspects of a professor's knowledge base for teaching, personal epistemology or the disciplinary specificity of his/her field play a more important role in such a situation, and

how those various aspects intermingle. Therefore, while the DPK framework incorporates elements of other approaches to this phenomenon, it goes much further.

More specifically, as was explained in the literature review chapter, three approaches have been used so far to examine the idea that pedagogical knowledge used in university teaching might become discipline-specific. These comprise Shulman's notion of pedagogical content knowledge (Shulman, 1986, 1987; Shulman & Quinlan, 1996), Becher's notion of socio-cultural aspects of disciplines (Becher, 1989, 1994; Becher & Trowler, 2001), and Donald's notion of disciplinary knowledge structures (Donald, 1987, 1995, 2002). The DPK framework goes beyond these approaches since it preserves more of the complexity found in situations where university professors relate their pedagogical knowledge to the specific characteristics of their discipline. Similarities and differences between these approaches and the DPK framework are now examined. This is done to emphasize how the DPK framework contributes to furthering our understanding of the phenomenon.

*The Pedagogical content knowledge approach:* A first approach to DPK is Shulman's notion of pedagogical content knowledge (PCK) which corresponds to the knowledge of teaching particular subjects in particular contexts (Shulman, 1986, 1987). The DPK framework emerging from my study is broader and, as such, more representative of the discipline-specific pedagogical knowledge of a given university professor compared to the PCK approach.

Transposed directly to university teaching, PCK has been envisaged as the knowledge of teaching a given academic discipline at university level – what has been termed discipline-specific pedagogical knowledge (Lenze, 1995). Extensive research on PCK has led to the identification of elements contributing to the formation of PCK,

namely knowledge of subject-specific student understanding, instructional strategies, assessment, and curriculum (Magnusson, Krajcik, & Borko, 1999). The DPK framework is similar to that approach in that it looks at various types of knowledge involved in university teaching, and compares them to one another. More specifically, the "knowledge structures related to teaching" component of DPK – derived from the professor's knowledge base – takes into consideration the various types of knowledge identified by this line of research. Furthermore, the DPK framework is compatible with the PCK approach in that it includes the notion of PCK within the "knowledge structures related to teaching" of the university professor.

However, the DPK framework goes beyond the PCK approach. This is mainly because the notion of PCK is not an entirely adequate concept for examining the disciplinary specificity of pedagogical knowledge in higher education. As is explained in the literature review chapter, prior research has identified shortcomings related to the application of both theoretical and empirical models of PCK to university teaching (Berthiaume, 2003). The limitations of the PCK approach seem to be related to the fact that it focuses upon elements of the professor's knowledge base for teaching. According to this approach, the disciplinary specificity of pedagogical knowledge is seen as the integration of pedagogical and disciplinary knowledge. Yet, academic disciplines comprise fairly elaborate socio-cultural and epistemological characteristics which are not solely dependent upon one individual's understanding of his/her discipline. These characteristics are most often shared within a given community and, as such, are not necessarily associated with a professor's knowledge base for teaching.

The framework for discipline-specific pedagogical knowledge (DPK) emerging from this study enables us to go beyond a view of disciplinary specificity that is limited to

the knowledge base for teaching. In effect, the DPK framework brings together both the professor's knowledge-base for teaching and the socio-cultural and epistemological characteristics of his/her discipline, and shows how interrelations between these two contribute to DPK. So, instead of focusing only on the contribution to DPK of the professor's knowledge structures related to teaching, the DPK framework identifies dimensions of other components derived from the knowledge base for teaching – i.e., goals or beliefs related to teaching – and from the specific nature of the discipline that contribute to DPK. The DPK framework also includes issues of personal epistemology which could affect the relationship between one's academic discipline and his/her pedagogical knowledge. The resulting web of components, dimensions, and relationships is thus broader and, as such, more representative of the discipline-specific pedagogical knowledge of a given university professor.

*The Socio-cultural characteristics approach:* A second approach to DPK is that of Becher – later joined by Trowler – on the socio-cultural characteristics of disciplines (Becher, 1989, 1994; Becher & Trowler, 2001). The DPK framework emerging from my study enables us to capture an image of the relationship between a university professor's pedagogical knowledge and the specific characteristics of his/her discipline much more accurately than Becher's socio-cultural characteristics approach. For instance, this approach associates the phenomenon of disciplinary specificity in university teaching essentially with socio-cultural or socially-constructed aspects. For instance, the socio-cultural characteristics approach focuses on socially-constructed characteristics of disciplines that can affect how one goes about teaching in that discipline. It thus examines notions such as norms or implicit rules related to the pedagogy of any given discipline. In this case, disciplinary specificity is not so much the product of one's knowledge base for

teaching but something that is shared, discussed, and even negotiated by a group of individuals evolving within a given discipline.

The socio-cultural approach to DPK is limited because it does not examine aspects of disciplinary specificity that are predominantly associated with the professor's knowledge base for teaching and that examine only aspects that are socially constructed. This would not prove sufficient to clearly describe how university professors make teaching decisions that are specific to their academic discipline of instruction, that is, how they use their pedagogical knowledge in a discipline-specific way. This might be why this approach has been quite successful at outlining variations among disciplines but not necessarily at explaining why these variations exist or how they come about.

The framework for discipline-specific pedagogical knowledge (DPK) emerging from my study enables us to go beyond a view that associates disciplinary specificity only with socio-cultural aspects of the discipline. By bringing together components corresponding to the socio-cultural characteristics of a given discipline and the knowledge structures, goals, and beliefs related to teaching of a professor working in that discipline, the DPK framework allows us to examine how these components relate to one another and contribute to forming DPK. Furthermore, bringing in issues of personal epistemology, that is, how the professor views knowledge, its construction, and its evaluation, permits us to take into consideration factors that can alter the relationship between one's pedagogical knowledge and his/her discipline. Therefore, the DPK framework enables us to view the relationship between a university professor's pedagogical knowledge and the specific characteristics of his/her discipline much more accurately than Becher's socio-cultural characteristics approach.

*The knowledge structures approach:* A third approach to the disciplinary specificity of pedagogical knowledge in university teaching is that of Donald on knowledge and epistemological structures of disciplines (Donald, 1987, 1995, 2002). In the context of this approach, disciplinary specificity in teaching is examined by linking knowledge structures related to teaching with the epistemological structure of the disciplines being taught. However, the "knowledge structures" approach to disciplinary specificity does not capture the phenomenon as fully as the DPK framework.

The "knowledge structures" approach is associated neither solely with the professor's knowledge base nor solely with socially-constructed or epistemological aspects of disciplinary specificity. Rather, the DPK framework and this approach thus have in common the joining up of sources contributing to the disciplinary specificity of pedagogical knowledge in university teaching, thus shedding some light on how university professors relate their pedagogical knowledge to the disciplinary characteristics of their discipline of instruction. Yet, the "knowledge structures" approach to disciplinary specificity does not capture the phenomenon as fully as the DPK framework does for two reasons: For one, this approach does not directly take into consideration the socially-constructed aspects of disciplinary specificity. Rather, aspects of DPK that are not associated with the knowledge base for teaching are attributed almost exclusively to the epistemological structure of the discipline, that is, to how the discipline is organized and how the body of knowledge is developed in this field. The second reason is that it does not take into consideration individual variations in personal epistemologies, that is, the fact that two professors teaching in one discipline may think differently to the epistemological structure of their discipline. Therefore, although this approach articulates the relationship between the professor's knowledge base for teaching and his/her

discipline better than the previous two approaches, Donald's approach appears to favour a rather deterministic view of disciplinary specificity – i.e., professors from one discipline are believed to think about their discipline, and therefore think about teaching in that discipline, in a homogeneous fashion. This problem was also found in the PCK and socio-cultural approaches to disciplinary specificity in university teaching, although to a lesser extent.

The DPK framework emerging from this study thus differs from the knowledge structures approach in that it goes beyond linking the professor's knowledge structures related to teaching uniquely with the epistemological structure of his/her discipline. Rather, it brings together the professor's knowledge structures, beliefs, and goals related to teaching; the epistemological and socio-cultural characteristics of the discipline s/he teaches; and his/her views of knowledge and knowing, knowledge construction, and knowledge evaluation. Unlike the "knowledge structures" approach to disciplinary specificity, the DPK framework thus adopts a more relativistic approach to the relationships between the professor's knowledge structures related to teaching and the epistemological structure of his/her discipline. Factoring in the professor's personal epistemology enables us to view the relation between disciplinary specificity and pedagogical knowledge more realistically since it does not lump every professor into the same category. Rather, additional elements related to the professor's personal epistemology are examined in order to understand what disciplinary specificity implies in terms of that university professor's pedagogical knowledge.

The framework for DPK emerging from this study thus allows us to look at disciplinary specificity in university teaching, and how it relates to the pedagogical

knowledge constructed by university professors, in a more complex, complete, and realistic way than previous approaches to this phenomenon.

*The core or common elements of DPK*

The second conclusion derived from the findings of this study is that certain elements of DPK appear to be shared among university professors from different disciplines. This means that, regardless of disciplinary differences, DPK can be developed in a group of university professors as long as core elements are targeted. For instance, Figure 13 (p. 172) outlines the 19 dimensions characterizing components and 13 relationships between components present in the DPK of the four university professors participating in this study. It is interesting to note that although these professors were chosen with the intent of maximizing disciplinary differences, important commonalities persist between them. These might point to the existence of some "generic" aspects to DPK, that is, aspects of DPK that constitute a core and that are likely to be present in university professors in general, regardless of their discipline of instruction.

This finding furthers the thinking on disciplinary-specificity since the latter is most often seen as something exclusive to each discipline. Yet, findings from my study point to the fact that there may be generic elements to disciplinary-specificity. This would mean that it is possible to construct discipline-specific pedagogical knowledge even in generic learning environments. In other words, it would not be necessary for university professors to work solely with professors from the same discipline in order to develop DPK. Instead, professors could work with professors coming from other disciplines as long as their learning experience involves addressing DPK components, dimensions and relationships between components, even in a comparative way. The crucial element here

is to address issues which most often remain unaddressed, to make explicit what most often remains implicit in regard to teaching in a given academic discipline at university level.

*The role of personal epistemologies in DPK*

The third conclusion from my study is that issues of personal epistemology are very important in articulating the link between a professor's knowledge base for teaching and the disciplinary specificity of his/her field of instruction. For instance, the four professors' beliefs about knowledge construction were all related to elements of the disciplinary specificity of their field of instruction – mostly to the socio-cultural characteristics of their discipline and not to the epistemological structure, as was just explained. Simultaneously, the four professor's beliefs about knowledge construction were all related to their knowledge structures, beliefs, and goals related to teaching. Therefore, although there exists a direct relationship between the professor's knowledge base for teaching and the disciplinary specificity of their field of instruction, aspects of personal epistemology – more specifically beliefs about knowledge construction – could be related simultaneously to those two sources, thus possibly playing a role of mediator between the two in situations where university professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction.

For instance, looking at core elements of DPK identified in Figure 13 (p. 172), it is possible to see that relationships were observed, in the case of the four professors, between their knowledge structures related to teaching and the socio-cultural characteristics of their discipline, between their knowledge structures related to teaching and their beliefs about knowledge construction, and between the socio-cultural

characteristics of their discipline and their beliefs about knowledge construction. This co-occurrence of relationships means, in the case of the four professors, that they draw upon their cognitive understandings which support skillful teaching, in combination with their views of the social and/or cultural aspects of their discipline which may influence teaching decisions; that they draw upon their cognitive understandings which support skillful teaching in combination with their views on the development or expansion of knowledge; and that they draw upon their views of the social and/or cultural aspects of their discipline which may influence teaching decisions in combination with their views on the development or expansion of knowledge.

In more practical terms, this would mean that a professor uses knowledge structures that are adapted to his/her discipline while using knowledge structures that take into consideration his/her views about knowledge construction. And, as the professor also draws upon his/her views about knowledge construction to interpret the socio-cultural characteristics of his/her discipline, we can see how the link between the knowledge base for teaching and the disciplinary specificity of the field might not be as exclusive as is often imagined. In light of this, it becomes difficult to envisage the relationship between a professor's knowledge base for teaching – or more specifically his/her pedagogical knowledge – and the specific characteristics of his/her discipline as the sole determinant of pedagogical decisions and actions which are discipline-specific. Rather, although issues of personal epistemology are not the main contributor to DPK according to the findings from this study, it becomes apparent that the web of components, dimensions, and relationships constituting DPK includes one's personal epistemology when a professor relates his/her pedagogical knowledge to the specific characteristics of his/her discipline of instruction.

This finding prompts a reconsideration of the research on disciplinary specificity in university teaching which tends to lump all professors coming from similar disciplines into the same category (e.g., Donald, 2002; Neumann 2001; Neumann & Becher, 2002). Findings from my this study would instead support a view of disciplinary specificity that is much less deterministic. Based on those findings, it would be extremely difficult to talk about how, for instance, mathematicians or political scientists teach. Although some characteristics might be shared by professors teaching in a given discipline, those similarities would not prevent individual professors from adopting different views with regard to teaching in their discipline in light of their personal epistemology.

This result is compatible with findings by Brew (1999, 2001a, 2001b). While investigating university professors' views of research, she found, on the one hand, that the relationship between teaching and research is seen to be different depending on how knowledge is viewed and, on the other hand, that a great variety of views of research exist among professors, but that those views do not necessarily mirror disciplinary differences. Brew's findings would thus support the findings from my study that views of knowledge – issues of personal epistemology – do affect other cognitive processes and that disciplinary determinism is not necessarily applicable to all thinking by university professors. This latter point is the object of a fourth conclusion derived from this study.

### *The composition of disciplinary specificity*

The fourth conclusion from my study is that certain aspects of disciplinary specificity in university teaching are more important than others. More specifically, socio-cultural aspects of disciplinary specificity appear to significantly outweigh aspects related to the epistemological structure of the discipline. For instance, all four university

professors' DPK draw more often from the socio-cultural characteristics of their discipline – i.e., the socially-constructed norms, rules, or practices surrounding teaching, learning and knowing in their field – than on its epistemological characteristics – i.e., the non-socially constructed aspects. For instance, as illustrated in Figure 13 (p. 172), only two categories of relationships are found between the epistemological structure of the discipline (EPS) and other DPK components, namely the goals (GRT) and knowledge structures related to teaching (KRT). Meanwhile, relationships were found between the socio-cultural characteristics of the discipline (SCC) and the three components derived from the knowledge base for teaching and from the personal epistemology. Therefore, socio-cultural aspects of disciplinary specificity would appear to play a more important role in the construction of DPK than would aspects related to the epistemological structure itself.

This finding expands some of the research on disciplinary specificity in university teaching. For instance, although some have looked at disciplinary specificity as something that tends to be socially constructed (e.g., Becher & Trowler, 2001), others have looked at it as something belonging more to the domain of the "epistemological" and, therefore, less malleable aspects of a discipline (e.g., Donald, 1987, 1995, 2002). Traditionally, the later is invoked as the "core nature" of disciplinary specificity, thus justifying certain learning and/or teaching approaches. University professors themselves often invoke the epistemological structure of their academic discipline as a rationale for their choice of learning and teaching strategies. Yet, findings from my study emphasize that these "perceived epistemological requirements" might actually be socially constructed, that is, they might actually be norms, rules or practices related to learning and teaching – possibly implicit – that have become embedded in the discipline and, as

such, greatly influence the pedagogical knowledge of university professors teaching that discipline. Findings also emphasize the fact that "real" epistemological requirements might be much less important than is traditionally envisaged.

Overall, findings from my study point to the fact that disciplinary specificity, as it is related to the pedagogical knowledge of university professors, is a rather complex phenomenon. As such, the framework for DPK emerging from this study captures the relationship between disciplinary specificity and the pedagogical knowledge of university professors better than other approaches. The findings from my study also indicate that DPK might depend upon many more variables than might have been envisaged thus far; this is what differentiates DPK from PCK. Yet, as is emphasized in my findings, certain dimensions of disciplinary specificity appear to be common to university professors regardless of their discipline of instruction. Also, findings from my study seem to emphasize the relativistic nature of the link between disciplinary specificity and pedagogical knowledge in university teaching. Finally, the findings highlight the predominant role played by socially-constructed norms, rules and practices in the development of DPK over more epistemological aspects of disciplinary specificity.

## Implications for research/theory and practice

Having discussed the conclusions that can be drawn from my study's findings, I now explain the actual implications of these conclusions, first from the point of view of research or theory, and then from the point of view of practice. The intent is to show how findings from this study enable us to move forward on both fronts.

*Implications for research/theory*

Through a multicase study of four university professors, I developed a framework that clarifies how university professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction. Capitalizing on the dual logic of saturation and replication embedded in a multicase study, findings from my study identify elements potentially contributing to the discipline-specific pedagogical knowledge (DPK) of university professors – elements aggregated from the four professors participating in the study – as well as elements most likely to contribute to it – elements that were common to the four of them.

As such, the DPK framework can serve as a tool for the examination of issues of disciplinary specificity with relation to university teaching. Both from a conceptual and a methodological standpoint, the framework facilitates examining such situations in their full complexity, drawing the examiner's attention to the various components at play, the dimensions that characterize those components, as well as the potential relationships between them. Up to now, the various lines of research informing disciplinary specificity in university teaching could not easily be linked to one another when examining the relationship between a professor's pedagogical knowledge and the specific characteristics of his/her discipline. Rather, researchers found themselves examining issues of disciplinary specificity from only one angle, thus oversimplifying the phenomenon under observation. The DPK framework enables us to examine the phenomenon at a level of complexity that is more closely related to reality. This has major implications regarding the notion of disciplinary specificity as it is encountered in university teaching in general, and particularly in relation to pedagogical knowledge.

The first implication emerges from the joining of the knowledge base for teaching with the socio-cultural and epistemological perspectives on disciplinary specificity introduced in the DPK framework. As was explained, research has tended to describe disciplinary specificity as being associated predominantly with a professor's knowledge base for teaching or predominantly with the socio-cultural characteristics of that professor's discipline. In response to that, one particular approach – Donald's (1987, 1995, 2002) idea of knowledge structures – integrated the two dimensions in a coherent whole, but overlooked other significant aspects of the phenomenon. The DPK framework from this study brings both these dimensions together, thus offering a joint perspective on disciplinary specificity.

Such an integrated approach is compatible with a socio-constructivist outlook to instruction (e.g., Engeström, 1987; Palincsar, 1998) whereby learning and teaching are seen as highly dependent upon the context in which they take place. Furthermore, they are highly dependent upon the interaction between the individual and his/her environment. The DPK framework could thus be described as a socio-constructivist approach to disciplinary specificity in university teaching, linking the characteristics of the individual professor and his/her environment in order to explain why teaching in a given disciplinary context may happen the way it does.

The second implication emerges from the clarification of the role of ones' personal epistemology in the relationship between disciplinary specificity and pedagogical knowledge. Findings point to the presence of issues related to how a professor views knowledge, its construction, and its evaluation in the articulation of the relationship between that professor's knowledge base for teaching and the characteristics of his discipline. This inevitably alters how we can approach the notion of disciplinary

specificity. In the past, broad generalizations were often made about the teaching or learning of given academic disciplines. This is because the relationship between disciplinary specificity and pedagogical knowledge was conceived in a deterministic fashion. Yet, findings from this study point to the relativistic nature of disciplinary specificity in light of the presence of issues of personal epistemology. This means that we need to be a little more cautious when exploring issues of disciplinary specificity in university teaching and/or learning. In other words, we should refrain from making broad generalizing statements about how people in a given discipline teach or learn at university level. Issues of personal epistemology remind us that we do not always think in the same fashion even if it seems that we share fundamental characteristics.

The third implication emerges from the clarification of the relationship between socio-cultural – i.e., socially-constructed – characteristics of a given discipline and its epistemological – i.e., structural – characteristics. Traditionally, researchers have adopted either one or the other approach, partly because of their own conceptual and epistemological preferences, partly because no instrument facilitated the linking of the two dimensions. This has led to research which can be, at times, "overly socio-cultural" or, at other times, "overly epistemological". The DPK framework emerging from this study considers both socio-cultural and epistemological issues in characterizing disciplinary specificity and, as such, provides a way to bring together those two types of characteristics. Simultaneously, the framework delineates what belongs more to the socio-cultural end of the spectrum and what belongs more to the epistemological end of the spectrum. As such, it enables researchers to look at disciplinary characteristics in a complex way, but also allows them to take that complex whole apart and examine its various elements.

*Implications for practice*

As the focus of this study is on the pedagogical knowledge of university professors, practice could be examined from two perspectives. On the one hand, practice can be envisaged from the perspective of the university professor him/herself, striving to develop pedagogical knowledge that is adapted to the specific characteristics of his/her discipline of instruction. In this case, the study contributes to discipline-specific university teaching as a field of practice. On the other hand, practice can be envisaged from the perspective of the academic developer, that is, the person who helps university professors develop pedagogical knowledge that is discipline-specific. In that case, the study contributes to academic development as a field of practice. Each of those contributions are now examined in more detail.

*University teaching:* The DPK framework emerging from this study facilitates the detailed examination of a university professor's DPK. The framework does so by bringing researchers' attention to specific elements that contribute to disciplinary specificity in the case of that professor. But just as the framework can guide the attention of researchers, it can also guide the attention of that very professor. The idea is that the DPK framework can serve as an outline of the possibilities in the case of that university professor developing pedagogical knowledge in relation to his/her discipline. As such, it can help to develop both guiding and diagnostic tools for the university professor wishing to improve his/her understanding of the most effective ways to teach in his /her discipline.[18]

[18] I wish to clarify here that I do not necessarily envisage leaving university professors working with the DPK framework on their own as is. Rather, a lot of structuring would be needed to ensure that the DPK framework is used in a way to fosters learning on the part of the university professor.

This would be particularly useful as most university professors do not get any training in the area of teaching, and those who do tend to be trained in generic environments – i.e., alongside colleagues from disciplines that are quite different from theirs. As a result, most university professors are left alone to develop their own pedagogical knowledge that is specific to their discipline of instruction. This tends to be happening through experiential learning whereby professors draw lessons from their experience and use those lessons to guide future practice. An example would be when a mathematics professor like HP discovers that specific ways of presenting material on the blackboard might be more effective than others in fostering learning on the part of students.

One way to foster such experiential learning by university professors is through the process of reflection or reflective practice (Calderhead, 1992; Kolb, 1984; Kremer-Hayon, 1991; McAlpine & Weston, 2000; Moon, 1999; Schön, 1983). It is generally believed that, by analyzing what they do before, during or after their teaching, university professors can develop pedagogical knowledge. Therefore, if experiential learning were structured in a way to lead professors to reflect on the discipline-specific aspects of their teaching, they might develop pedagogical knowledge that is specific to their discipline. And this is where the DPK framework can make a contribution. Because it identifies the various components of DPK and the relationships between them, the DPK framework could be used to structure reflection so that DPK rather than generic pedagogical knowledge becomes the result of reflection. As such, the DPK framework could serve to orient the process of reflection towards the development of DPK by outlining questions to be used by professors to reflect on the various components of DPK and their relationships with one another. Such questions would cover components associated with each

professor's knowledge base for teaching, the specific characteristics of his/her discipline, and his/her personal epistemology. They would also target specific dimensions associated with each of the components as needed. Furthermore, the questions would focus on the relationships between specific components and/or dimensions associated with them.

What the DPK framework does is to help draw one's attention to components of DPK, their dimensions, and the relationships between components. As such, the DPK framework can be used to clarify the various components and dimensions associated with DPK for a given professor. Once those components and dimensions are made explicit, it becomes easier for the professor to reflect upon potential relationships between them, thus working towards linking components or dimensions that might have otherwise seemed somewhat unrelated. The guidance provided by the DPK framework could thus contribute to the identification of strategies that are most effective in this particular disciplinary context. Such an approach would contribute to the development of discipline-specific pedagogical knowledge.

*Academic development:* Helping university professors develop as teachers is one of the main activities of academic developers. This entails helping professors construct an elaborate knowledge base for teaching so that they can become autonomous practitioners in the field of university teaching. This can often be done in a generic fashion, whereby teaching is not embedded in any specific disciplinary context, or in a discipline-specific fashion, whereby teaching is embedded in a specific disciplinary context. The latter, because of its proximity to the specific needs of university professors, is generally seen as essential to their development (Healey, 2000; Jenkins, 1996).

Just as the DPK framework emerging from this study can help individual professors in their own attempts towards developing DPK, it can also guide people who

plan activities designed to help university professors. The various components and dimensions of DPK and the potential relationships identified in the framework could serve to guide the thinking of academic developers when designing learning activities. It might be that our struggle in designing academic development activities which foster discipline-specific pedagogical knowledge might be related to the fact that we do not always know the kind of thinking to elicit on the part of university professors. It might also be that we do not always know how to facilitate the integration of elements – e.g., someone's knowledge base for teaching, the specific characteristics of a given discipline, or someone's personal epistemology – which appear disjointed to us. As the DPK framework outlines the elements involved in DPK, through the components and their dimensions, and how those can be integrated, through the potential relationship, it can contribute to fostering pedagogical knowledge that is more discipline-specific. It just needs to be integrated into our practice as academic developers either in the design of activities or in their implementation, or in both.

One example of this can be found in the design of mentoring schemes about teaching, bringing together experienced and novice university professors. Such schemes are often an integral part of more formal programs for the development of teaching skills by new university professors. One of the objectives of such mentoring schemes is often to ground the pedagogical knowledge acquired through experience by novice professors in the academic discipline from which they come. Yet, the discussion between mentor and learner may not necessarily be conducive to developing DPK. This might be because the issues upon which mentors and learners focus during their discussion might not be directly related to issues of disciplinary specificity and its relationship with pedagogical knowledge. Therefore, the mentoring scheme might be made more discipline-specific by

outlining issues or questions to consider during mentoring meetings. For instance, mentors and learners may be encouraged to discuss the often implicit norms, practices, or rules related to teaching, learning, knowing, or practicing in their discipline. They could then discuss how those might affect general pedagogical principles. They could also discuss how they respectively see knowledge and how they feel compelled to abide or not by those rules. It would seem that such discussions would target the development of DPK more specifically.

But what might also be quite useful in the DPK framework are those core elements of DPK that were identified in the four university professors participating in this study – i.e., the potentially "shared" aspects of DPK. As most academic development activities involve working with groups of people coming from different disciplines, activities fostering the development of DPK could focus on the components, dimensions and relationships that have been identified as common across professors. This might help university professors develop pedagogical knowledge that is specific to their discipline, even if the learning environment is generic. It might also enable us to move closer to providing discipline-specific academic development without entirely changing what we do or how we do it.

## Strengths and limitations of the study

As is the case with any study of this nature, certain strengths and limitations need to be mentioned at this point. This is to show how critical some of the findings of this study are and how the very nature of the study reinforces these findings. At the same

time, this is to prevent anyone from going too far with the findings emerging from the study, such as drawing conclusions that might not be solidly supported in the study.

### *Strengths of the study*

Three aspects of my study reinforce its findings. One of these pertains more to the conceptual/theoretical framework of the study, whereas the other two pertain more to its methodological framework.

The first strength of my study rests with the fact that it brings together three lines of research that have in the past very seldom been related to one another (i.e., the knowledge base for teaching, disciplinary specificity, and personal epistemology). As such, it greatly expands our ability to conceptualize the various issues surrounding how university professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction. The framework of DPK that emerges from my study thus enables us to go beyond what has been achieved so far in each of these three lines of research. Combining them into one coherent approach has multiplied our ability to use those lines of research to examine DPK and, as such, provides a new lens to look at this phenomenon.

The second strength of my study has to do with the nature of the data collected. The various interviews conducted with each professor have enabled me to tap into their thinking in different contexts (i.e., class-level, course-level, general level) and in different zones of thinking (i.e., conceptual, strategic, tactical, enactive). Recent research on university teaching has emphasized the importance of examining the thinking of university professors in different contexts and zones in order to be representative of the actual experience of those individuals (McAlpine, Weston, Berthiaume, Fairbank-Roch,

& Owen, 2004; McAlpine, Weston, Timmermans, Berthiaume, & Fairbank-Roch, 2006). In light of that research, findings from my study would be particularly valid in terms of how university professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction.

The third strength of my study has to do with its qualitative or interpretative nature. Examining four cases in depth provided very detailed information about the phenomenon of DPK, particularly since previous approaches to the phenomenon did not seem to picture it fully or most accurately. It was necessary, in order to describe the phenomenon in a new, more complete way, to let new information emerge from the data but, at the same time, to look for similar instances in different cases. The dual logic of saturation (i.e., searching for variations of the phenomenon until nothing new emerges) and replication (i.e., examining in depth a few cases to consolidate findings from one) that is associated with multicase studies was particularly useful in strengthening the findings. As regards the DPK framework, it has greatly contributed to clarifying the generic description of components, dimensions, and relationships between components. It has also contributed to identifying commonalities or core elements of DPK.

### *Limitations of the study*

Five main limitations affect the claims that I or anyone can make on the basis of findings from this study. One limitation pertains to the conceptual/theoretical framework of the study, whereas the remaining four pertain to its methodological framework. These five limitations are now discussed.

The first limitation has to do with the overall orientation of the study. The conceptual/theoretical framework of this study was partially *a priori* and, thus, was used

to guide both the data collection and analysis process. Therefore, the way the conceptual framework was organized affected the kinds of findings obtained in the study. For instance, the way socio-cultural and epistemological characteristics of disciplinary specificity are differentiated from one another in the conceptual framework – which is derived from my specific understanding of the literature on disciplinary specificity – has led to the identification of specific dimensions associated with components of DPK and relationships between them. Had socio-cultural and epistemological characteristics been differentiated somewhat in another fashion, emerging dimensions and relationships would appear differently in the findings. Therefore, as the conceptual framework for this study was partially *a priori* as opposed to being entirely emerging, findings and conclusions are highly dependent upon that framework.

The second limitation has to do with the sampling strategy. Findings from this study are based on a sample of only four university professors. Whereas the sampling was purposeful and covered the four grand disciplinary areas of university teaching identified by Biglan (1971) and Becher (1989), it cannot lead to statistical generalizations. In order to be able to make claims that are applicable to all university professors, a much larger sample would need to be examined. However, examining a larger sample at the level of detail that was done in this study would require years of work by a fairly large team of researchers.

Furthermore, the idea of using one professor to represent a whole disciplinary area is at odds with the actual findings from this study. For instance, the fact that so many dimensions and relationships can be present in any given university professor makes it impossible to find any sort of prototypical professor for any given disciplinary area. Furthermore, the very role of personal epistemologies in articulating the link between

one's knowledge base for teaching and the disciplinary specificity of his/her field would make it impossible to claim that one individual can be "representative" of a given disciplinary area.

Hence, in the case of this study, the only generalizations that can be drawn are what some have termed "fuzzy generalizations" (Bassey, 1999) or "analytic generalizations" (Yin, 1994). This means that theoretical ideas about how a given phenomenon is observed in detail in a few instances can be used to examine the same phenomenon in other instances. The purpose of generalizing from that sample is therefore not to explain or predict a given phenomenon in all other instances – what is known as "statistical generalization" (Yin, 1994) – but rather to inform one's examination of those new instances, to draw our attention to what is likely to be relevant or informative. The generalization simply serves as a theoretical lens to examine other instances of the same phenomenon.

The third limitation of this study has to do with the interpretative and inferential nature of the analysis process. As was explained in the chapter describing methods, the various steps of the analysis required a certain degree of interpretation and inference. Various strategies aimed at keeping trustworthiness were used to ensure that findings were interpreted consistently and as closely as possible to the actual experience of the participants. However, the detailed level of analysis required a very deep understanding of both the phenomenon observed and the actual data. Therefore, whereas intra-rater consistency could be checked and maintained throughout the analysis process, inter-rater consistency could not. Other strategies were used in an attempt to keep the analysis as consistent as possible – i.e., staying as close to the words of participants as possible, member checking – however those can only be of some utility as regards trustworthiness

or more traditional issues of reliability. It must therefore be acknowledged that findings are interpretative and inferential, and that inter-rater consistency could not be obtained for a portion of them.

The fourth limitation is intimately related to the previous one and has to do with the multiple instances of data reduction involved in the analysis process. Again, as was explained in the chapter describing methods, the data had to be reduced from approximately 150 pages of raw transcript per professor to approximately 15 pages of narrative summary per professor in order to identify relationships between dimensions/components. Inevitably, the reduction in precision and detail would affect anyone's ability to detect subtleties in the data. However, in order to maintain accuracy, the number of instances of member-checking was multiplied during the analysis process. Those took place at various stages of data reduction and, as such, should have prevented the appearance of too many distortions in the data. Still, in the end, the data remain affected by the number of instances of reduction. Therefore, the validity of both the findings and conclusions might be affected by that as well.

The fifth limitation has to do with the representativeness of the sample used in my study. It was described in Chapter 3 that the four participants were representative of variations existing in higher education in terms of disciplinary affiliation, gender, and class size. However, the four participants all had fewer than 10 years of university teaching experience, went through faculty development activities fostering a more learner-centered approach to teaching, work at a North American research-intensive university, and have received their university education in British-inspired university systems. The impact of such characteristics on DPK would need to be investigated further

to determine if findings from my study can be used beyond the boundaries of this specific context.

## Recommendations for future research and practice

In light of the conclusions, implications and limitations discussed above, I can now formulate some recommendations for future research and practice.

### *Recommendations for future research*

As was emphasized in the limitations, the DPK framework emerging from this study rests on a sample of only four university professors. One way to strengthen the findings would be to undertake to validate the DPK framework with a much larger sample of university professors. This would mean more professors corresponding to each of the four categories of disciplines, but also a more diverse group of professors in each category. For instance, the four professors participating in this study all had less than ten years' experience at the time of the interviews. Furthermore, they all had participated in some form of academic development activity that had raised their awareness of who they are as university teachers. A larger sample of professors would need to comprise people who differ from those original four professors, that is, people with a different set of characteristics related to experience and exposure to academic development activities.

Working with a large sample of participants would enable us to verify or refine two specific aspects of the DPK framework. This would first of all enable us to verify that the current DPK components, dimensions, and relationships between components truly capture the reality of how university professors relate their pedagogical knowledge to the specific characteristics of their discipline of instruction. If it is not the case, the

components, dimensions and relationships could be refined to reflect the phenomenon more accurately. Additionally, a larger sample would allow us to verify the stability of the core components, dimensions, and relationships identified in the DPK framework. This would enable us to move from a logic of "analytic" generalization towards one of "statistical" generalization (Yin, 1994). Yet, this would require that our sample incorporates as many different variables as possible in order to ensure that the sample takes into consideration the variety of experiences of teaching at the university level.

On a slightly different research tack, working with a larger sample would let us begin to look into the nature of those disciplinary groupings identified by Biglan (1971) and Becher (1989). A larger pool of professors in each disciplinary category would enable us to do two things: First, identify commonalities in terms of components, dimensions or relationships for members of each specific grouping; it might be that professors from some groupings draw more on certain components or dimensions when constructing DPK, or that certain relationships are more present in their case. It would thus be interesting to clarify that. Secondly, the identification of stable commonalities within disciplinary groupings could lead to the identification of variations across disciplinary groupings. Developing the DPK framework along those lines would enlighten us on what leads certain university professors to teach in certain ways. This would take us one step further than where we are with the current disciplinary variation literature, which limits itself to describing differences in teaching according to disciplinary grouping.

Also, and more specifically on the notion of disciplinary specificity, the DPK framework emphasizes the role of socially-constructed aspects in determining the nature of disciplinary specificity. Therefore, it might prove quite useful to look into those aspects with the help of analytical tools used in cognate fields such as social psychology

or sociology. For instance, research on notions of social representation (e.g., Farr & Moscovici, 1984; Jodelet, 1993; Moscovici, 2000) could prove useful in identifying what the socially-constructed aspects of most disciplines are made of and how those aspects are actually constructed. This is something Shulman (2005) has begun looking into through the notion of "signature pedagogies" or the pedagogies that are associated with the training of people for specific professions. If one considers university teaching within a given discipline as a specific profession, notions like social representations and signature pedagogies might help us to understand how people are socialized into that role and into thinking like people within that role. And this would inevitably tap into issues of linking research with teaching (e.g., Brew, 2001a, 2001b; Jenkins & Healy, 2005), or how one affects the other, as most academics are socialized as researchers before being socialized as teachers.

Finally, a more longitudinal look at DPK needs to be taken to examine how university professors develop DPK over time. As it stands, the DPK model describes which components, dimensions, and relationships are present when DPK is constructed. However, it does not examine how the composition and/or construction of DPK might evolve over time. As the outlook university professors have towards their career tends to change throughout their years of teaching, it would be useful to investigate potential differences in DPK composition (i.e., the components, dimensions or relationships that are present) at various stages of a university professor's career. This would enable us to understand better the applicability of the DPK framework.

*Recommendations for future practice*

As the DPK framework provides a new way to envisage the development of university professors as teachers, approaches which reflect the framework could be adopted by university professors themselves or by academic developers. For instance, university professors could use elements of the DPK framework to guide their reflection, using components, their dimensions, and relationships between them as triggers of reflection, with relation to their teaching. Simultaneously, academic developers could use elements of the DPK framework to guide the way they design, implement, and evaluate developmental activities. In both cases, using the DPK framework as an inspiration could help us advance towards improved discipline-specific development for university professors.

To make such endeavours as fruitful as possible, they would need to be documented and disseminated. Taking the form of practitioner, developmental, or evaluative research (e.g., G. L. Anderson & Herr, 1999; G. L. Anderson, Herr, & Nihlen, 1994; Brown, 2004; Loiselle, 2001), projects could aim at examining the application of the DPK framework to a variety of settings and activities. This would enable us, as a community of researchers and practitioners, to see what works and what does not. But to get a true feel for the effective integration the DPK framework into reflective practice or academic development, we might want to adopt a more phenomenological approach, looking at how people experience the application of the DPK framework. This is because the DPK framework is neither simple, deterministic nor predictive, but rather complex, relativistic, and descriptive.

This is what I intend to do in my own practice as an academic developer in the coming few years. I have already begun to structure academic development activities I

provide to university professors according to the DPK framework. The activities upon which I have focused range from guidelines for mentoring and individual reflective practice to group-based workshops. In all these activities, I have used the DPK framework to help participants develop pedagogical knowledge that is adapted to their specific discipline of instruction. I have documented the changes that I have made to my practice and will continue to do so for the next few years. Simultaneously, I shall report on these changes at specialized conferences and in scholarly journals in order to support as much as possible the development of DPK by university professors through the work of my fellow academic developers.

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**General information on course :**

Name of course : Political Theory I

Frequency of course : three times a week

Size of course : between two to three hundred students

**Pedagogical knowledge :**

Experience :
- close to ten years at university, over seven years at McGill.

Nature of course :
- not really a required course except for small category of students (honours political theory);
- prerequisite for all subsequent political theory courses.

Description of course :
- designed to introduce students to political theory by looking at three classic texts in political theory (Plato, Rousseau, Stuart Mill);
- supposed to familiarize students with some of the basic ideas and ideologies found in those texts;
- also meant to give students other tools by means of reading and working through texts (thinking critically about the texts themselves and interpretations of others, developing written and oral communications skills.

Course goals :
- I'm not sure I would necessarily rank these; they are five distinctive aims and each of these is important in its own way; I suppose I don't really rank these different aims in any particular order;
- I want them to have some knowledge of the different texts and issues that they tacitly raise;
- develop the ability to read, understand, and interpret texts for which the context is sometimes totally different—you have to learn to contextualize what you're reading and extract what the most important points are and maybe filter out some things that are less important for our particular goal;
- understanding what an argument is like in political theory because you don't necessarily present facts in order to prove or refute a point
- to get them to think critically and independently; they read or hear me make an argument, to be able to stand for that and say « OK. What are the assumptions here? » « Do I agree with all the assumptions or does the conclusion fall from the assumptions? »;
- to get them to learn how to communicate their ideas both orally and in particular in the written form.

Knowledge of learners :

- between a half and two thirds are in their first year at McGill;
- they may have read some philosophical texts or some theoretical texts;
- I would say that three quarters probably don't have that background;
- they're coming at it as a new thing and some of them find it quite difficult because the modes of reasoning are a little bit different for a theory course than they would be for other social sciences courses;
- students often say they are surprised that they find they can' just memorise a bunch of facts and then reproduce those in a multiple choice exam;
- I find that the students tend to be quite goal-oriented and so if you can make the goals fairly concrete then that encourages the learning.

*Evidence of learning :*

Knowledge of teaching strategies :

*Lecturing two hours a week :*

- main idea of that strategy is trying to impart some knowledge and maybe also try to impart some enthusiasm or excitement for the material so it can encourage them to go off and do more on their own and not just think of the course or the lectures;
- In the lectures, I encourage them to ask questions or I even ask questions of them;
- I might present an argument and then get them to criticise the argument or identify what the different assumptions of the argument are and think critically about that;
- There is an interactive element which I guess is maybe emphasising some of the goals other than knowledge like critical thinking or interpretation of texts.

*Conferences :*

- much more oriented towards getting them to effectively communicate their ideas in an oral way;
- also meant to consolidate some of the knowledge they've got from the reading and from the lectures;
- to make time for those, we do certain exercises and so forth that are part of the conferences;
- maybe they'll look at a small piece of text and come up to their interpretation or a criticism in the small group, and then compare that with other small groups;
- that works on the textual interpretation and critical skills.

*Three essays :*

- what's hopefully the biggest part of the course for them is all the work they're going to do on their own and a lot of that ends up geared around the three essays they write;
- we look at three authors in the course and they have to write an essay on each one of the authors on two pre-assigned questions that they can choose.

Knowledge of group dynamics :

- you don't really have as much sense of what's going on in class, or how students are reacting to what you're saying;
- whether you're loosing them because the group is so massive.

Knowledge of assessment :
- if the goal of the course is very abstract, try to make that fairly specific in terms of what you expect of them as far as that dimension of the course is concerned and how that will be tied to their assessment;

*Formative assessment and feedback :*
- there is not a lot of point in grading essays unless you put comments;
- the students tend to feel very comfortable complaining to the teaching assistants;
- some of the teaching assistants will report to me sort of what the students are saying;
- the students feel very comfortable I think putting criticisms in the course evaluation.

**Pedagogical conceptions :**

Role of university teacher :
- to impart knowledge to the students, although not the most important task from the stand point of the humanities;
- most important task is to give students certain tools that they can hopefully use throughout their lives (i.e., being able to read and interpret texts, making arguments, critical reasoning, communications.

Good university teaching :
- excites the students about what they are doing and about thinking in a certain way so that they don't just regard it as a dreary hurdle they have to cross on the way to something else;
- students come to see a certain way of thinking about the world as interesting, fun, and important;
- encourages students to start acquire some of these different skills discussed above;
- gets students to be critical.

Task of the learner :
- doing the various aspects of the course in a conscientious way;
- doing readings;
- attending the seminars;
- the learner has the responsibility to have a certain attitude to fellow students (i.e., as if they really have nothing to learn from their fellow students);
- listening to fellow students and situating what they think vis-à-vis what others have said;
- to participate in and contribute to a kind of community of learning.

How people learn :

- students learn best when you tell them as specifically as you can what your expectations are and link those expectations with the assessment of the course so they know...
- for many students, an important part of the learning process is to have a somewhat simplified version of what they are expected to learn set before them that they can at least start from;
- there is a kind of stage in the learning process which involves some simplification of the material; some students don't go beyond that—unfortunately, some don't even get to this part, but some students use that as a step for full understanding of the materiel;
- some students are able to learn from each other so if you can get students to engage in discussion, for instance in smaller group setting, then—although some students will sort of turn off—others will learn from either the positives of what their fellow students are saying or sometimes... clarified by hearing versions of the materiel that are not the hottest;
- I think it does help for some students to have that kind of informal discussion of the material; many students have told me how that helps to consolidate what they've got from the readings;
- I expect that a lot of the learning actually takes place when they sit down and have to synthesize all the material.

Approach to designing instruction :

- I start from the teaching goals—what sort of goals do you have, what kinds of outcomes do you want to achieve;
- then, what are the most appropriate strategies for realizing those outcomes—which are subject to huge constraints of resources (i.e., class size, size of conferences, etc).

**Personal epistemology :**

**Disciplinary epistemology (structure) :**

Difficulty of discipline :

- I teach political philosophy which can be fairly abstract and at time could be fairly difficult;

Nature of discipline :

- theoretical arguments work in different ways; you use examples and counterexamples; they sometimes set up through experiments;
- there is a different mode of reasoning;

**Disciplinary culture :**

Learning to be achieved by students :

- I want students to know what Plato thought about democracy or what we mean when we say Stuart Mill was a liberal;
- I guess it's a foundation of a lot of political science and political thinking in Western societies—you need to have some basic conceptual tools;

**Disciplinary knowledge :**

(from SP Pre-Course and Pre-Class 2 interviews)

Course information:

Title: Political Theory I

Semester: Fall 2001 (three times one hour per week)

Description:

- designed to introduce students to political theory by looking at three classic texts in political theory (Plato, Rousseau, Stuart Mill);
- supposed to familiarize students with some of the basic ideas and ideologies found in those texts;
- also meant to give students other tools by means of reading and working through texts (thinking critically about the texts themselves and interpretations of others, developing written and oral communications skills.

Overall goals:

- to have some knowledge of the different texts and issues that they tacitly raise;
- to develop the ability to read, understand, and interpret texts for which the context is sometimes totally different;
- to understand what an argument is like in political theory because you don't necessarily present facts in order to prove or refute a point;
- to think critically and independently;
- to learn how to communicate their ideas both orally and in particular in the written form.

Class information:

Timing of class: First half of November (post mid-term)

Focus of class : Mills' harm principle and the notion of freedom of expression

**Excerpt from Post-Class 2 interview**

**Excerpt begins at 33:39**

**SP:** Here I'm trying to kind of motivate them in the discussion a little bit. Relate it to um... every day things we cov- that are that are controversies, uh... maybe through win back or ?

**Interviewer:** How do you choose your examples? Do you think of them in advance, or... do you think of them on the spot?

**SP:** Um... sometimes I think of them in advance and sometimes I think of them on the spot. I think in this case, uh... I... when I'd gone through my notes before the lecture, you know they're, they're all sort of typed, but I, I often hand-write a few extra things. I think I may have hand-written these examples this time, uh... at this particular point.

**Interviewer:** And you choose your examples based on –

**SP:** Things I hoped they'd be able to kind of identify with maybe, you know, for example, the example I just mentioned was um... whether or not some controversial person should be able to come and speak on the, on the campus because... uh... I mean I remember from being a student that there were these debates all the time... uh... a student mentioned to me in fact that they're having one in September, some anti-abortion group leader wanted to come and speak, and there was a controversy about whether they should be allowed to speak, etc. etc., so I mention that example, then, hopefully when the students themselves were talking about it... uh... they were already articulating some of the... kind of theoretical, uh... considerations that were involved and so they can make that sort of connection with it.

**Watching Video (35:13-36:28)**

**SP:** This is something I should have mentioned earlier. I, I had intended to go... you know, first contextualize it in Plato and Rousseau, then contextualize it in Mill's own time, and then contextualize it in... controversies of today.

**Interviewer:** Mm-hm.

**SP:** I ended up doing that in the... wrong order because I, I forgot, uh... ....

**Interviewer:** *laughs*

**SP:** It's probably... uh... keep keep your notes closely at hand.

**Interviewer:** Sort of get more in the flow of where you were-

**SP:** Well I just had completely forgotten. Moved right directly from you know censorship in Plato and Rousseau up to contemporary controversies.

**Interviewer:** And so how did that go?

**SP:** Ah... it didn't seem to, didn't seem to – it just didn't have the sort of logical progression that I... in, intended when I was planning it.

**Interviewer:** Mm-hm.

**Excerpt ends at 37:12**

**How do university professors construct discipline-specific pedagogical knowledge?**

## Main interview protocol

Participant: _____ Date: _____ Location: _____

Introduction:

Welcome/thank the professor for agreeing to be a participant/informant in this research project.

State the objective of the research and the purpose of this interview:

- Main objective of the research is to develop a conceptual framework explaining how university professors from various disciplinary areas develop pedagogical knowledge that is specifically adapted to their disciplinary area of instruction.

- Purpose of the first interview is to provide an opportunity for participants to talk about how they develop strategies for teaching their subject matter at the university level.

Explain that I envisaged the interview to have two parts:

- First, I would like to ask you a few questions about your discipline, about knowledge and its development, and about teaching your discipline.

- Second, we will look at a brief videotaped excerpt from the Reflection in Teaching research project; we will also examine transcribed comments you made about that excerpt when viewing it 24 hours after the class. After that, I will ask you a few questions about how you ended up formulating the principle(s) you discuss in the transcribed interview.

**[START RECORDING]**

First part:

1. For the purpose of this interview, I am consulting you as a disciplinary expert in the area of ___(disciplinary area)___. How do you feel about that? (Are you comfortable with that? Would you associate more with other disciplinary areas? Which ones?)

2. How long have you been teaching in this disciplinary area? (In other disciplinary areas?)

3. What would you say are the main characteristics of a prototypical professor in the disciplinary area of ___(disciplinary area)___? (What appears striking to you from the point of view of that disciplinary area?)

4. How compatible are those characteristics with your own set of beliefs, values, or aspirations as a professor of ___(disciplinary area)___?

5. What kind of training have you received that has contributed to your sense of competence in teaching in that disciplinary area?

6. Do you make a distinction between knowledge of your discipline and knowledge of teaching your discipline? (What are the differences/similarities? Why do you say so?)

7. How do you feel you develop/acquire knowledge about your discipline? About teaching your discipline?

8. Think of the strategies you use for teaching in your disciplinary area.

   - Which ones do you feel are most appropriate for teaching in that disciplinary area?

   - Why do you say/feel so?

   - How did you come to this realization? (Lead to critical incident.)

Second part:

- We will now review a videotaped excerpt of a class from ____(name of course)____ you gave during the _____ semester, as well as comments you made about that class in an interview conducted the following day.
- The purpose is for you to talk about how you ended up formulating the principle(s) you discuss in the transcribed interview.
- We can watch the video and read your transcribed comments again if you would like to do so.

Let's view the videotaped excerpt.

1. What strikes you about the video excerpt? (What makes you say that?)

Let's read the transcript of your comments.

2. What strikes you in your transcribed comments? (What makes you say that? Does it still represent your thinking?)

3. What relationship, if any, do you see between the video excerpt and your transcribed comments?

4. In your transcribed comments, you seem to talk about a principle/idea for teaching in your disciplinary area, namely ___(describe the principle)___. How did you come up with that principle/idea?

5. Think of the knowledge you draw from to formulate that principle/idea.
   - What aspects of disciplinary knowledge contributed to that?
   - What aspects of knowledge about teaching and learning contributed to that?

6. You just described how disciplinary knowledge and pedagogical knowledge came together to formulate a principle about teaching in your disciplinary area. How representative is this of what happens in general in terms of how you learn to teach in your disciplinary area? (Why do you say so?)

7. How would you say you normally learn new things, in your disciplinary area or in life in general? (Why do you say so?)

8. Think of the knowledge you develop/acquire through the means you just discussed.
   - How much confidence do you have in that knowledge? (Why do you say so?)
   - How much legitimacy do you feel such knowledge would have among your colleagues? (Why do you say so?)

9. Is there anything else you would like to add about the video excerpt and/or your transcribed comments?

Closing

1. Is there anything we have not talked about that you would like to bring up?

**[STOP RECORDING]**

- Plan meeting for short interview.
- Remind the professor that data will be coded and depersonalized to ensure anonymity and stored in a locked filing cabinet with restricted access to ensure confidentiality.
- Remind the professor that he/she may withdraw from the research project without penalty or prejudice at any point and for any reason by contacting me or my advisor.
- Thank the professor again for accepting to be a participant/informant.

| Mark | Significance | Example |
|---|---|---|
| . | Period: Used between 2 complete thoughts with a pause of less than 3 seconds between them. Usually utterances have a normal (falling) intonation. | *I'll start that now.* |
| , | Comma: Used to indicate a clause or a phrase, also used between words or phrases that are repeated. | *I was trying to explain it to them, but they kept asking questions.*<br>*OR*<br>*They, they, they tried their best.* |
| ? | Question mark: Used with interrogative (rising) intonation. | *What word am I looking for?*<br><br>*The subject was just, you know, not very clear for them?* |
| ! | Exclamation mark: Used with exclamatory (sharp rise at end of word) intonation. | *That is so confusing!* |
| ... | Three periods (elipsis): Used to indicate a silent hesitation or a short, silent pause (less than 3 seconds) that occurs after an incomplete thought. | *That gives the reader...a little bit of an overview.*<br>*OR*<br>*Now, I...I'm not trying to get them to come to some definite conclusion about this.* |
| ... . | Elipsis with a period: Used to indicate a short, silent pause and a complete trailing off of voice after an incomplete thought. Then a new, complete thought occurs. | *I didn't even want to do... . I realized that it was fine.* |
| **text – text** | Long-dash (long hyphen): Used to indicate a rapid change in thought, as though the speaker is editing him or herself. **No pause and no dropping off of the voice.** | *I'm basing that on – it's just a guess, because time was running out.* |

| | | |
|---|---|---|
| **text –** | Long hyphen following text: Used with utterances that are cut off, **with no pause.** | *A: So, did you –*<br>*B: I thought of it!* |
| **– text** | Long hyphen preceding text: Used with remaining portions of cut off utterances, **with no pause.** | *B: I thought of it!*<br>*A: – ask them about their feelings?* |
| **//text//** | Two slashes bracketing the word or words: Used to denote two speakers speaking at the same time. Can be the same words or different – write the words they actually said if you can hear it. | *A: //at long last.//*<br>*B: //One more question//*<br><br>*A: //at long last//*<br>*B: //?//* |
| **text** | Underlined text: Used with utterances that are stressed with loudness or highly pitched. | *They don't quite insist on having them abandon it!* |
| **syllable** | Underlined syllable: Used to indicate prolongation of syllables. | *The emphasis was put on the first portion of the course.* |
| **, "text"** | Quotation marks: Used to indicate the speaker relating a dialogue or utterance made by someone else, or his own inner dialogue. | *So he said, "Oh, it was wonderful." And I said, "You liked that?"* OR<br><br>*I asked myself, "Did I really need to know this?"* |
| **text-** | Hyphen following text: Used to indicate an unfinished word. Also used to indicate compound words. | *They were won- , wondering what to do next.* OR<br><br>*I had sort of second-guessed myself.* |

| | | |
|---|---|---|
| **((text))** | Double parentheses with text: Used where transcription may not be accurate, or when transcriber cannot understand the exact word(s) or sentence. | *It was a book about ((psychometric biology)).* |
| **(( ? ))** | Double parentheses without text: Used when transcriber cannot understand the exact word(s) or sentence. | *It was a book about (( ? )) biology.* |
| ***comment*** | Bracketing asterisks: Used for all comments made by the transcriber. | **watching video one minute** OR<br>**phone rings** |
| **... *pause x sec*** | Three periods, the word pause, a number and word sec: Indicates a pause of more than 2 seconds (number of seconds is indicated). | *I was wondering ... *pause 10 sec* what we should do.*<br>*OR*<br>*This was, I guuuuuuuess ... *3 sec* five years ago.* |
| **.... *pause x sec*** | Four periods, the word pause, a number and word sec: Indicates a pause of more than 2 seconds after an incomplete thought. Voice trails off, then a new and complete thought occurs. | *The students had not yet .... *pause 4 sec* The students took a long time to settle down.* |
| **, uh...** | Pause with sound: Used to indicate a pause (less than 3 seconds) during which the speaker makes sound with mouth open. | *It was a new, uh...system for me.* |
| **, um...** | Pause with sound: Used to indicate a pause (less than 3 seconds) during which the speaker makes sound with mouth closed. | *That is when I realised that, um...it was not working.* |

| BASED ON THE DPK FRAMEWORK | | EMERGING FROM THE DATA |
|---|---|---|
| **Sources** | **Components** | **Emerging dimensions** |
| Knowledge base for teaching (KBT) | Goals related to teaching (KBT/GRT) | Course-level (KBT/GRT/cou) |
| | | Ordering (KBT/GRT/ord) |
| | | Class-level (KBT/GRT/cla) |
| | | Accomplishment (KBT/GRT/acc) |
| | | New/Future (KBT/GRT/new) |
| | Knowledge structures related to teaching (KBT/KRT) | Content (KBT/KRT/con) |
| | | Pedagogical-content (KBT/KRT/pco) |
| | | Self (KBT/KRT/sel) |
| | | Teaching and teachers (KBT/KRT/tat) |
| | | Learning and learners (KBT/KRT/lal) |
| | | Assessment of learning (KBT/KRT/aol) |
| | | Curricular issues (KBT/KRT/cur) |
| | | Human behaviour (KBT/KRT/hum) |
| | | Physical environment (KBT/KRT/phy) |
| | | Logistical issues (KBT/KRT/log) |
| | Beliefs related to teaching (KBT/BRT) | Purpose of instruction (KBT/BRT/pur) |
| | | Conditions for instruction (KBT/BRT/con) |
| | | Teaching and teachers (KBT/BRT/tat) |
| | | Learning and learners (KBT/BRT/lal) |
| Personal epistemology (PEP) | Beliefs about knowledge and knowing (PEP/BKK) | Nature of knowledge (PEP/BKK/nat) |
| | | Act of knowing (PEP/BKK/act) |
| | Beliefs about knowledge construction (PEP/BKC) | How people learn in general (PEP/BKC/gen) |
| | | How one learns in specifically (PEP/BKC/spe) |
| | Beliefs about knowledge evaluation (PEP/BKE) | Relative value of knowledge (PEP/BKE/rel) |
| | | How to evaluate knowledge (PEP/BKE/eva) |
| Disciplinary specificity (DIS) | Socio-cultural characteristics (DIS/SCC) | Teaching in the discipline (DIS/SCC/tea) |
| | | Learning in the discipline (DIS/SCC/lea) |
| | | Knowing in the discipline (DIS/SCC/kno) |
| | | Practising in the discipline (DIS/SCC/pra) |
| | Epistemological structure (DIS/EPS) | Description of the discipline (DIS/EPS/des) |
| | | Organisation of the discipline (DIS/EPS/org) |
| | | Relation to other disciplines (DIS/EPS/rel) |

**Excerpt from raw transcript – SP Interview**

***298:*** *INTERVIEWER: OK. I'd like to ask you to... I guess ask you the same question but this time if you were to focus strictly on the subject matter itself, um... the content of these um... three thinkers or um... with regards to the issues here. Anything that would have influenced you to order them in that way?*

***300:*** *SP: Mmhhh. Chronologically Plato and Mill, um... Plato and Rousseau come before Mill and they're certainly um... authors and perspectives that Mill himself would have been familiar with. I'm not sure it would be quite right to say that he was responding to them but they had already contributed to a kind of cultural beliefs about censorship and expression, which was the context in which Mill was -*

***302:*** *INTERVIEWER: And would you say the same about Rousseau with regards to Plato?*

***304:*** *SP: Um... so Plato - that whether or not Rousseau was drawing on Plato?*

***306:*** *INTERVIEWER: Yes.*

***308:*** *SP: Probably. Certainly in general Rousseau was drawing on Plato.*

***310:*** *INTERVIEWER: OK.*

***312:*** *SP: His views on censorship are slightly different but not dramatically.*

***314:*** *INTERVIEWER: Any other aspect with regards to the subject matter that may have...*

***316:*** *SP: The order in which I mention the three theorists? Um... well I guess the other thing to emphasize is I think part of presenting material clearly sometimes is also where the over-simplification comes in, or simplification comes in, is um... trying to point to all positions and contrasts. So, the point I was trying to make in the lecture was that um... Plato and Rousseau*

*really adopt a... to simplify a little - sort of a pro-censorship position in the name of the public interest and um... one thing to help us sort of clarify or make distinct what Mill's contribution to the debate is by seeing Mill as really challenging that whole way of thinking about expression. So um, you know, it's helpful I think to lay out those authors because they starkly contrast these ((views)).*

**Identification of source passages from same transcript excerpt – SP Interview**

In the raw excerpt on the previous page, two passages provided information about one of the sources of DPK identified in the conceptual framework, namely "Knowledge base for teaching":

1st source passage - Knowledge base for teaching (KBT)

***300:*** *SP: Mmhhh. Chronologically Plato and Mill, um... Plato and Rousseau come before Mill and they're certainly um... authors and perspectives that Mill himself would have been familiar with. I'm not sure it would be quite right to say that he was responding to them but they had already contributed to a kind of cultural beliefs about censorship and expression, which was the context in which Mill was -*

***302:*** *INTERVIEWER: And would you say the same about Rousseau with regards to Plato?*

***304:*** *SP: Um... so Plato - that whether or not Rousseau was drawing on Plato?*

***306:*** *INTERVIEWER: Yes.*

***308:*** *SP: Probably. Certainly in general Rousseau was drawing on Plato.*

***310:*** *INTERVIEWER: OK.*

***312:*** *SP: His views on censorship are slightly different but not dramatically.*

2nd source passage - Knowledge base for teaching (KBT)

***316:*** *SP: The order in which I mention the three theorists? Um... well I guess the other thing to emphasize is I think part of presenting material clearly sometimes is also where the over-simplification comes in, or simplification comes in, is um... trying to point to all positions and contrasts. So, the point I was trying to make in the lecture was that um... Plato and Rousseau really adopt a... to simplify a little - sort of a pro-censorship position in the name of the public interest and um... one thing to help us sort of clarify or make distinct what Mill's contribution to the debate is by seeing Mill as really challenging that whole way of thinking about expression. So um, you know, it's helpful I think to lay out those authors because they starkly contrast these ((views)).*

**Identification of component passages in each source passage above**

Each of the two source passages from the previous page also provided information about a corresponding component of DPK outlined in the conceptual framework, namely "Knowledge structures related to teaching":

1st source passage:

Only one component passage was identified in the first source passage. As such, the whole source passage is coded as a component passage associated with "Knowledge structures related to teaching" (KBT/KRT).

***300:*** *SP: Mmhhh. Chronologically Plato and Mill, um... Plato and Rousseau come before Mill and they're certainly um... authors and perspectives that Mill himself would have been familiar with. I'm not sure it would be quite right to say that he was responding to them but they had*

*already contributed to a kind of cultural beliefs about censorship and expression, which was the context in which Mill was -*

***302:*** *INTERVIEWER: And would you say the same about Rousseau with regards to Plato?*

***304:*** *SP: Um... so Plato - that whether or not Rousseau was drawing on Plato?*

***306:*** *INTERVIEWER: Yes.*

***308:*** *SP: Probably. Certainly in general Rousseau was drawing on Plato.*

***310:*** *INTERVIEWER: OK.*

***312:*** *SP: His views on censorship are slightly different but not dramatically.*

2nd source passage:

Two component passages were identified in the second source passage because the focus of discourse shifts throughout the source passage. Therefore, the source passage is segmented into two component passages and each of these is coded separately. This is because, although they both provide information about the same component, ideas expressed are rather different.

*Component passage 1: Knowledge structures related to teaching* (KBT/KRT)

***316:*** *SP: So, the point I was trying to make in the lecture was that um... Plato and Rousseau really adopt a... to simplify a little - sort of a pro-censorship position in the name of the public interest and um... one thing to help us sort of clarify or make distinct what Mill's contribution to the debate is, is by seeing Mill as really challenging that whole way of thinking about expression.*

*Component passage 2: Knowledge structures related to teaching* (KBT/KRT)

***316:*** *SP: The order in which I mention the three theorists? Um... well I guess the other thing to*

*emphasize is I think part of presenting material clearly sometimes is also where the over-simplification comes in, or simplification comes in, is um... trying to point to all positions and contrasts.*

**Identification of emerging dimensions in each component passage above**

Each of the component passages above was examined independently from the others in order to identify a dimension that would characterise with precision the professor's experience.

1st source passage – only one component passage:

***300:*** *SP: Mmhhh. Chronologically Plato and Mill, um... Plato and Rousseau come before Mill and they're certainly um... authors and perspectives that Mill himself would have been familiar with. I'm not sure it would be quite right to say that he was responding to them but they had already contributed to a kind of cultural beliefs about censorship and expression, which was the context in which Mill was -*

***302:*** *INTERVIEWER: And would you say the same about Rousseau with regards to Plato?*

***304:*** *SP: Um... so Plato - that whether or not Rousseau was drawing on Plato?*

***306:*** *INTERVIEWER: Yes.*

***308:*** *SP: Probably. Certainly in general Rousseau was drawing on Plato.*

***310:*** *INTERVIEWER: OK.*

***312:*** *SP: His views on censorship are slightly different but not dramatically.*

In this passage associated with the a priori "Knowledge structures related to teaching" (KBT/KRT) component, the professor clearly focuses on the content of the course. Therefore,

the emerging dimension "Knowledge of the content" (KBT/KRT/con) was attached to this passage.

2nd source passage – 1st component passage:

***316:*** *SP: So, the point I was trying to make in the lecture was that um... Plato and Rousseau really adopt a... to simplify a little - sort of a pro-censorship position in the name of the public interest and um... one thing to help us sort of clarify or make distinct what Mill's contribution to the debate is, is by seeing Mill as really challenging that whole way of thinking about expression.*

In this passage associated with the a priori "Knowledge structures related to teaching" (KBT/KRT) component, the professor focuses again on the content of the course. Therefore, the emerging dimension "Knowledge of the content" (KBT/KRT/con) was also attached to this passage.

2nd source passage – 2nd component passage:

***316:*** *SP: The order in which I mention the three theorists? Um... well I guess the other thing to emphasize is I think part of presenting material clearly sometimes is also where the over-simplification comes in, or simplification comes in, is um... trying to point to all positions and contrasts.*

In this passage associated with the a priori "Knowledge structures related to teaching" (KBT/KRT) component, the professor focuses on the act of teaching. Therefore, the emerging dimension "Knowledge of teaching and teachers" (KBT/KRT/tat) was attached to that passage.

| Code | Theme(s) | Excerpt(s) |
|---|---|---|
| **Knowledge base for teaching**<br>**Goals related to teaching**<br>**Course-level goals**<br><br>The professor discusses goals or objectives at the level of the course (as opposed to class or program). The professor may address this topic by making explicit reference to what s/he wanted to achieve or by talking about what the course is designed to achieve. | Some ongoing goals (beyond understanding ideas):<br>- want learners to engage with ideas<br>- set ideas out in analytical way<br>- think critically about ideas<br><br>Write effective essay. | **SP RIT Post-Class Interview**<br><br>42: CW: -sort of ongoing ones that you have-<br>44: SP: Exac, exactly. You know, going beyond just understanding the basic ideas. I want them to sort of engage with the ideas and-<br>46: CW: Right.<br>48: SP: -maybe learn how to... set them out in an analytical way and uh... think critically about them. *pause 3 sec* Also I mean and a further goal which wouldn't be accomplished in the lecture would be um... them, for them to re-articulate them in their essays, writing an effective essay. |
| | Because goals linked to core aspects of discipline not likely to change easily. | **SP RIT Post-Course Interview**<br><br>3: So, I, I guess I see the goals of the course as being focused on uh... pretty core aspects of the the, of the discipline and therefore they're not likely to uh... change. I wouldn't change them um... easily or readily. I'd be reluctant. |
| | Resources (teaching assistants) affect goals. | 11: SP: I, I think just one qualification, and that is that there is the biggest strain every year... is on the extent to which the goals, the way that I... pursue the goals of the course puts strain on the resources that I have in teaching assistants, and so forth. So that's the one thing that I could imagine... forcing me to then make adjustments in the future to the - |
| | Getting students to pay attention to detail of texts.<br><br>Learning to interpret texts.<br><br>Want learners to think actively, not be passive. | **SP RIT Pre-Class Interview**<br><br>61: another goal of the course is to actually get them to... get into the habit of really paying attention to the details of what, what's in a text and learning to interpret, learning to interpret that.<br><br>61: I do want them to try to approach the material not in a passive way, but um... you know to be sort of actively thinking about it as much as possible |
| | To introduce student to political theory by looking at classic texts.<br><br>Give students familiarity with content but also develop skills, such as:<br>- interpreting texts<br>- compare contexts of texts | **SP RIT Pre-Course Interview**<br><br>104: The course is designed to introduce students to political theory and it does so by looking at three classic texts in political theory, a text by Plato, Rousseau, and John Stuart Mill,<br><br>104: it [the course] is supposed to familiarise them I guess with some of the basic ideas and ideologies that you find in these texts but also to give them, to give students, by means of reading and working through these texts, some of the other tools that I talked about earlier. Um...interpreting texts that were written in very different times, compare different contexts, um...thinking critically about the texts themselves and about the interpretations that others are... have offered um... of those |

| Code | Theme(s) | Excerpt(s) |
|---|---|---|
| | - think critically<br>- developing written and oral communication skills.<br><br>Have knowledge of texts and issues raised.<br><br>Read, understand, and interpret texts (in particular contexts).<br><br>Understanding what an argument is like in political theory.<br><br>To think critically and independently.<br><br>To learn to communicate both orally and in written form. | texts, and developing written and oral communication skills.<br><br>264: the first and most basic goal is, I do want them to have some knowledge of the different texts and issues that they tacitly raise. So, at the end of the course, I guess I want students to know what Plato thought about democracy, or what, what we mean when we say that John Stuart Mill was a liberal, and I want them to have some knowledge of these basics sorts of issues, the concepts, the content of what these different theorists thought<br><br>264: The second goal is um… ability to read and understand and interpret texts that are sometimes, you know, if you read something that was written in Classical Greece, the context is totally different from something that would be written today and there's all sorts of odd things that are happening and you have to learn to contextualize what you're reading and extract what the most important points are and maybe filter out some things that are less important for our particular goal. So, reading a text.<br><br>264: Third is understanding what an argument is like in political theory because you don't necessarily present facts in order to prove a point or in order to refute a point.<br><br>264: The forth aim is to get them to think critically and independently. So, they read an argument or hear me make an argument, to be able to stand for that and say OK what are the assumptions here? Do I agree with all the assumptions or does the conclusion fall from the assumptions, etc… etc… So that's the fourth aim. The fifth aim is to get them to learn how to communicate both orally and um… in particular in the written form um… their, their ideas. |
| **Knowledge base for teaching**<br>**Goals related to teaching**<br>**Class-level goals**<br><br>The professor discusses goals or objectives at the level of the class (as opposed to course or program). The professor may address this topic by making explicit reference to what s/he wanted to achieve or by talking about what the class is designed to achieve. It may also accompany a discussion of content to be covered, especially if the professor seems to adopt a more content-centred Approach to teaching and learning. | See how interesting and important the topic is.<br><br>Connect with issues that interested them.<br><br>Go over Mill's harm principle and his views on freedom of expression.<br><br>At the same time, continue to reinforce other goals:<br>- thinking critically about aspects of arguments | **SP Long Interview**<br><br>296: So I want them to see that it is an interesting and important topic and it is connected with issues that they've thought about probably and perhaps even gotten excited about in the past.<br><br>**SP RIT Post-Class Interview**<br><br>25: CW: Now uh... just to summarize, what were you trying to accomplish in this particular<br>26: class?<br>27: SP: Um... *pause 3 sec* well, first of all in terms of content uh... I wanted to um... go over<br>28: some of the themes relating to Mill's harm principle and then um... progress onto introducing some aspects of Mills' views on freedom of expression.<br><br>28: And in the process of presenting that content I wanted to... uh... you know continue to reinforce some of the other goals, of the, goals of the course so, thinking in terms of an interpretation of what, |

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| | - make distinctions between different elements in the argument<br>- engage them a little bit.<br><br>Cover the materiel: finish the harm principle and begin freedom of expression | uh... what it says I guess we look at several... passages from the text and uh... getting them to think... uh... getting them to, to think I suppose critically about some aspects of the argument and to make distinctions between different elements in the, in the argument. *pause 3 sec* Uh... also to engage them a little bit.<br><br>630: I wanted to get the material in.<br><br>**SP RIT Pre-Class Interview**<br><br>3: SP: Uh... there are two topics, because uh... we didn't quite get to the end of um... what I half hoped to cover on Monday... uh... it's not very, not serious that we didn't. Um... so in the first half of the lecture I'll finish talking about... uh... John, we're, we're on John Stuart Mill now and I'll finish talking about his... harm principle or finish introducing his harm principle, uh... which is a principle about when it's legitimate for the state to interfere with the individual's liberty.<br><br>3: And uh... then in the second half of the lecture, talk about, uh... start talking about um... Mill's views about freedom of expression.<br><br>3: so I guess the... the overall goal is to... uh... in terms of the material I'd like to cover is to finish finish the harm... principle and um... you know at least make a dent into the next, the next topic.<br><br>5: I: So you're hoping to accomplish... completing the harm principle and-<br>7: SP: -And and entering into this uh... related but distinguishable... topic which is Mill's views about freedom of expression. |
| **Knowledge base for teaching**<br>**Goals related to teaching**<br>**Ordering of goals**<br><br>The professor discusses his/her ordering of (or inability to order) goals for his course, class, program, etc. This may mean discussing the respective precedence or importance of certain goals, or discussing the impossibility of determining any kind of ordering amongst goals. | Difficult to rank different goals as each is important in its own ways.<br><br>Would be a shame if learners not able to communicate effectively (orally and in writing).<br><br>Have basic knowledge of different ideas and issues.<br><br>Be able to think critically. | **SP RIT Pre-Course Interview**<br><br>272: SP: The most important thing or things um… I'm not sure I would necessarily rank these… I mean these are five distinctive aims and each of these is important in its own way. So, I would think it would be a shame if students graduated from the university without being able to write effectively or communicate orally effectively. So, it's definitely an aim that this contributes to that, but also that they have some basic knowledge of their different ideas and issues, that they be able to think critically etc… etc… So I don't really… I suppose I don't really rank these different aims, in any particular order. |

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| **Knowledge base for teaching**<br>**Goals related to teaching**<br>**Accomplishment of goals**<br><br>The professor discusses the accomplishment of goals (class-level or course-level). This may include a discussion of the means by which the goals were accomplished or a discussion of the end result/product.<br><br>This code is used as opposed to codes for course-level or class-level goals if the essence of the statement is about accomplishment. | Hard to accomplish goals in one lecture or even series of lectures.<br><br>Felt that students understood well.<br><br>SP did what he was set out to do.<br><br>Hard to assess in such period of time (after class).<br><br>Can only measure at end of course. | **SP RIT Post-Class Interview**<br><br>73: SP: Yeah, in so fa-, I mean in a modest... way that you can hope to accomplish such grand goals in one particular lecture of, what twenty, twenty-five lectures. Um... but... I, I think that there was uh... I, I felt that there was a reasonably good connection with the students in terms of... understanding the material. Uh... and... um... in terms of *pause 7 sec* well, I, I felt that I did what... I had set out to do as far as uh... demonstrating you know an analytical Approach to the argument and trying to engage them critically. It's very hard to asses you know to what extent they internalize that... in a space of... such a short period of time. *pause 3 sec* I think that's kind of the thing you can only measure way at the end of the course. |
| **Knowledge base for teaching**<br>**Knowledge for teaching**<br>**Knowledge of content**<br><br>This category of knowledge refers to the knowledge the professor has of his/her discipline. S/he may discuss certain dimensions of the subject matter to be taught and/or learned. The professor thus provides insight into his/her knowledge of the discipline that s/he teaches. and how s/he goes about further learning within his/her discipline. | Materiel can be dry (Mill).<br><br>Relationship amongst the three authors (Plato, Rousseau, Mill).<br><br>Plato and Rousseau adopt a pro-censorship position in the name of public interest.<br><br>Mill challenges that way of thinking about expression. | **SP Long Interview**<br><br>202: What else influences you when you select or use these strategies?<br>204: SP: So, to know the discipline<br><br>296: Because actually when you read Mill, it's rather dry. The style with which he develops his argument is sort of crisp logical distinctions that he makes.<br><br>300: SP: Mmhhh. Chronologically Plato and Mill, um... Plato and Rousseau come before Mill and they're certainly um... authors and perspectives that Mill himself would have been familiar with. I'm not sure it would be quite right to say that he was responding to them but they had already contributed to a kind of cultural beliefs about censorship and expression, which was the context in which Mill was -<br>302: DB: And would you say the same about Rousseau with regards to Plato?<br>304: SP: Um... so Plato - that whether or not Rousseau was drawing on Plato?<br>306: DB: Yes.<br>308: SP: Probably. Certainly in general Rousseau was drawing on Plato.<br>310: DB: OK.<br>312: SP: His views on censorship are slightly different but not dramatically.<br><br>316: So, the point I was trying to make in the lecture was that um... Plato and Rousseau really adopt a... to simplify a little - sort of a pro-censorship position in the name of the public interest and um... one thing to help us sort of clarify or make distinct what Mill's contribution to the debate is, is by seeing Mill as really challenging that whole way of thinking about expression. |

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| | The connection between Mill's utilitarianism and his advocacy of the harm principle.<br><br>Tension between being utilitarian and being a liberal who favors the harm principle.<br><br>Intended the content to have some logical progression.<br><br>Overall theme of the course is the relationship between the individual and the community.<br><br>Examine three prominent political theorists who have conceptualized that relationship.<br><br>These are important building blocks of political theory.<br><br>Makes sense to cover authors in chronological or historical order.<br><br>Three authors talking about similar issues.<br><br>Contrast theoretical perspectives that the authors offer. | **SP RIT Post-Class Interview**<br><br>466: Here I'm talking about the connection between Mill's utilitarianism and his advocacy of the harm principal and it's standardly thought that there's a tension between being utilitarian and being a sort of lib- , between being a liberal who favors the harm principle..<br><br>602: SP: Ah... it didn't seem to, didn't seem to - it just didn't have the sort of logical progression that I... in, intended when I was planning it.<br><br>**SP RIT Pre-Class Interview**<br><br>19: SP: Um... well, the uh... the... overall theme of the course I guess was to look at the relationship between individual and the community and uh... ways in which three prominent political theorists have conceptualized that, that relationship... um... and um... chosen Mill as one... you know representative of perhaps one of the most interesting and accessible uh... liberal theorists of the individual and community and uh... we're looking at a text he's written called On Liberty... um... which is probably his most important statement of those, of those issues and the harm principle is the central principle that Mill defends and in On Liberty and freedom of expression is one of the most important applications of his, of his view. So it's really very central to his... ideas. It fits in with the themes of the course and uh... it's, there are important building blocks I guess of political theory.<br><br>21: I: As I recall you do Plato, Rousseau and Mill primarily.<br>23: SP: Yup.<br>25: I: And and why in that particular sequence.<br>27: SP: That's the chronological, uh... sequence and... without too much stretching... um... you can see... Mi... uh... Rousseau and Mill as responding to the theoretical inheritances that are left by among other people you know Plato and Rousseau, so - uh... for for instance in, in one of the chapters that we're going to be doing today on freedom of expression I think uh... uh... Rousseau um... sorry Mill specifically uses a text by Rousseau that we read as an example, so it makes sense to sort of do it in historical, historical order.<br><br>31: SP: Yeah, and there's thematic similarities. For for instance, all three of the authors discuss in different contexts freedom of expression. Uh... both Plato and Rousseau are not opposed to censorship or as um... Mill has very strong anti-censorship arguments, so<br>32: I think... it would probably be an exaggeration to, to say that the three are not talking to each, each other in any really direct way, but to some extent they're talking about a similar issue, so we can contrast the theoretical perspectives that they, that they offer.<br><br>36: SP: Yeah! I think that uh... in in Plato um... in particular there's very, the- there's almost no |

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| | Plato's view would seem odd today.<br><br>Mill's view is much more compatible with what courts would say today.<br><br>Lectures on Rousseau are a little more complicated.<br><br>Arguments in Mill's work are not very complicated past a certain point.<br><br>One essay question is on the subjection of women.<br><br>Use theoretical arguments, examples, counterexamples and thought experiments.<br><br>Different mode of reasoning. | statement whatsoever of the positive value of free speech either for uh... an individual, for the individual or for the society whereas, uh... by the time you get to Mill I think you get a, an account of the benefits of freedom of speech which are... uh... to a considerable extent much closer to the way we would think about it today, the way that courts would think about it today. Uh... although his view of course is, would still be a controversial view, but I think we could at least locate ourselves in that controversy whereas Plato's um... view I guess would seem much more kind of bizarre to us today, or if you're talking about using different sorts of concepts that uh... that uh... we're less familiar with.<br><br>81: SP: This, this is fairly, it's fairly straight forward... material, unlike uh... for instance the lectures on Rousseau cause some of the material is a little bit more complicated and so I think each year I'm always thinking of, okay is there a better way of... engaging them or presen- presenting it to them. But with Mill it's... to my mind anyways, and I think students would agree that uh... the actual ideas and arguments are not very uh... complicated at least once we're gotten... this far.<br><br>144: Off the top of my head I can't remember what the other question is, I think it's probably not on On Liberty, but on one of the other texts that we're, we're looking at. We're looking at his uh... essay on the subjection of women, uh... next, and I think the other essay was related to that.<br><br>**SP RIT Pre-Course Interview**<br><br>264: Theoretical arguments work in different ways. You use examples and counterexamples and um... They sometimes set up though experiments, and so forth. So, there's a different mode of reasoning. |
| **Knowledge base for teaching**<br>**Knowledge for teaching**<br>**Pedagogical content knowledge**<br><br>This category of knowledge refers to the knowledge the professor has of specific teaching strategies for teaching specific content in specific contexts.<br><br>Unlike knowledge of content or knowledge of teaching, the knowledge here is multidimensional and integrated, which makes it impossible to break it down into subcomponents without inferring what those would be. | Sequence of authors.<br><br>Contextualization of authors in relation to one another.<br><br>Contextualization of topics in relation to controversies of today. | **SP RIT Post-Class Interview**<br><br>585: SP: This is something I should have mentioned earlier. I, I had intended to go... you know, first contextualize it in Plato and Rousseau, then contextualize it in Mill's own time, and then contextualize it in... controversies of today. |

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| Knowledge of domain-specific instructional strategies<br>Refers to a teacher's knowledge of instructional aspects of general pedagogical knowledge that are specific to the subject matter being taught.<br><br>Knowledge of domain-specific curricular issues<br>Refers to a teacher's knowledge of educational programs and the objectives of such programs for students, in a particular subject area.<br><br>Knowledge of domain-specific assessment<br>Refers to knowledge associated with the evaluation of learning in a particular domain.<br><br>Knowledge of domain-specific student understanding<br>Refers to a teacher's knowledge of the learners and/or learning in a particular subject area. | | |
| **Knowledge base for teaching**<br>**Knowledge for teaching**<br>**Knowledge of teaching and teachers**<br><br>This category of knowledge refers to the knowledge the professor has of teaching and teachers in general. The professor may discuss various aspects of his/her experience of teaching or dealing with teachers in the university context. This may include a discussion of years of experience, size of classes taught or number of students in class. It may also include specific examples of how one Approaches instruction or how one actually implements instruction, including a discussion/description of strategies or methods used. | I'm able to organize the material and to select materials in such a way that it will be maximally possible for students to learn that.<br><br>Use tricks, PowerPoint presentation.<br><br>I have learned the utility of certain tools and methods. | **SP Long Interview**<br><br>73: SP: Uh... That's a good question. How do I learn new things as far as teaching and learning. Um... I'd still say that the main, the main way which I feel I'm learning about that is by better learning my discipline.<br>75: DB:OK.<br>77: SP: Um... So, to me I'd, I'd say it's, it's almost still an extension of what I started learning as a graduate student. Uh... I'm surprised how long that, that continues on but I think the better one masters the substance of one's discipline at least the better, I find, I'm able to organize the material and to sel- select materials in such a way that it will be maximally possible for students to, to learn that. I guess I learn about what to do in the main by uh... uh... continuing to learn my own discipline. Um... and then a second factor for me has always been comparing work with other colleagues, the practice of other colleagues.<br>79: DB:Do you... and how do you do that-compare work with other colleagues?<br>81: SP: Um... either informally asking them how they, how they Approach certain teaching challenges. I've done a few visiting lectures and so that's usually an opportunity to talk to people in a more sustained way about how they, how they do that. So, I picked up tricks, PowerPoint presentation, and that kind of thing.<br>83: DB:When you say picked up, what do you mean...? |

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| | | 85: SP: Well, I've sort of learned the utility of certain tools and methods. |
| | Teaching comprises:<br>- organize the materiel in my mind before class,<br>- presenting the materiel to the students, and<br>- interacting with the students.<br><br>Emphasize clarity and simplicity of organization without sacrificing the complexity of the ideas.<br><br>Importance of knowing the materiel to make judgments about simplifying the exposition.<br><br>Use overheads/PowerPoint as a visual counterpart.<br><br>Engaging students with questions, interesting details, examples, anecdotes. | 196: SP: Um… well I would have to divide that into different elements. One would be how I organize the material in my mind and on paper, and Power Point presentation and so forth, before the class. And then the second would be how I um… actually present the material and interact with the, with the students. So, in the first I guess I really try to emphasize clarity and simplicity of organization without trying to sacrifice the complexity of the ideas. I'm trying to strive to organize the material in ways that will make it easy for me to fluently present it, and also easy for them to see the logic of the narrative…<br>198: DB: So, you're balancing this simplicity and clarity with the complexity of the material?<br>200: SP: That's right. Yes, yes. So, there again I'm really emphasising the importance of knowing the material as it allows you to make those judgements about, about what you leave in or what you take out to simplify the exposition. So, for a big class I might then spend a fair amount of time trying to work this out in overheads or now I use PowerPoint, so that there is a visual counterpart to the way I kind of map it out in my head. Um… and then the classroom, I guess the strategy is to try to tweak people's interest and enthusiasm by, even in the large class setting, engaging with the students a fair amount by um… questions, by asking them, questions by, um… trying to weave into the material more interesting details or examples or anecdotes. |
| | Connecting to other materiel in the course to give it some coherence. | 288: SP: Um… it's hard to say without seeing what I did before or particularly what I did after, which I don't remember well enough. But, seeing it again uh… my reaction is that what I did maybe works in terms of um… motivating the students about the importance of uh… the subject I would like to talk about and also uh… in terms of connecting it with other material we covered in the course, and therefore, in giving the courses, helping to give the course as a whole some coherence and ((unity)). And so perhaps, you know I was able then subsequently to get on to discussing what uh… controversies about censorship that were in Mills' own day. I think it still could have worked. So maybe this sounds a little, like I was a little harsh on myself. |
| | Not upsetting the logic of presentation. | 290: DB: So, you're saying that basically, if you were looking at this video today, you would say it's not that big an issue, or -<br>292: SP: Uh… that's right. This issue about forgetting to contextualize it in Mills' own time, but I imagine, I hope I did not completely forget it, uh…because I think without upsetting the logic of the presentation I could have then gone on, I could then go on to, to discuss that um… afterwards. |
| | Give the students a point of departure for the discussion. | 296: SP: Um… Well, at this point, just to remind you in the course, we are only studying those three authors. And, so at this point we'd already completed Plato and Rousseau so now we're looking at Mill. Um… and so the point of mentioning them at the outset was in part to um… to um… give them a um… sort of point of departure for the discussion that I could assume that they shared. |

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| | Remind students of materiel covered previously. | 296: I was kind of reminding them about what the other authors we are already studied thought about particular topics that we already discussed in the class. So, that was sort of the motivation for starting with that |
| | Contemporary examples:<br>- to get students interested in discussion itself<br>- to give students a resource for critically evaluating author/work. | 296: the motivation for mentioning the contemporary examples was perhaps two-fold. One was again to get them interested in the discussion itself. Because actually when you read Mill, it's rather dry. The style with which he develops his argument is sort of crisp logical distinctions that he makes. So I want them to see that it is an interesting and important topic and it is connected with issues that they've thought about probably and perhaps even gotten excited about in the past. |
| | | 296: the second motivation for starting, for proceeding with the actual exposition of what Mill thought with these contemporary examples is… uh… the contemporary examples might give students a uh… a kind of resource that they can draw on in critically evaluating what Mill |
| | Presenting materiel with simplification means trying to emphasize positions and contrasts. | 316: SP: The order in which I mention the three theorists? Um… well I guess the other thing to emphasize is I think part of presenting material clearly sometimes is also where the over-simplification comes in, or simplification comes in, is um… trying to point to all positions and contrasts. |
| | | 316: it's helpful I think to lay out those authors because they starkly contrast these ((views)). |
| | Use different authors to emphasize contrast. | 318: if you made abstraction of the content or subject matter, any teaching and learning principle that's affected your thinking there? |
| | Teaching and learning principles:<br>- giving students a point of departure,<br>- generating interest by showing relevance,<br>- prod them to think critically about materiel. | 320: SP: Um… Certainly two that I referred to. One would be… um…<br>322: DB: The point of departure?<br>324: SP: The point of departure, and the other is perhaps three then: generating their interest by showing the relevance of the argument. The third would be trying to prod them into thinking critically about the material that we're about to see by mentioning examples about which um… |
| | Selection and ordering of materiel for class depends on state of knowledge about that subject matter. | 336: SP: Um… so would I normally… If I ordered material for class, I would normally start by thinking about the subject matter itself, about what the, the state of knowledge about what that subject matter is, and I would draw on that for making certainly my selection of what kinds of materials would be included or excluded um… and what to accentuate, what distinctions to bring out in class.<br>338: DB: So, would you say that this example, I mean this illustration of your thinking, is representative of how you do things in general more so-with regards to that particular instance of ordering material?<br>340: SP: Um… in general, my teaching decisions are they based on… do I first ask myself…<br>342: DB: Well, either in terms of order or really you just sort of gave me a list of things you |

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| | | would consider when making those decisions about ordering. Would you say that this is what you normally look or normally examine when you make decisions?<br>344: SP: Yes. |
| | Not knowing the materiel may lead to organization problems:<br>- incompleteness,<br>- inconsistency,<br>- lack of flow. | 346: how did you learn to combine these factors in making teaching decisions or developing ideas like that? How would you say you learned how to do this?<br>348: SP: Uh... well... probably in different ways depending which of those factors we are talking about.<br>348: or, if you don't know the material very well, then you may find, halfway through the class, that you sort of realize that the way it's organized doesn't really quite work. It's incomplete, or there's an inconsistency or not bringing out a point that I want to bring out or, in order to bring out the point that I want to bring out, I have to kind of introduce it in an ad hoc way because it does not really flow with the rest. |
| | Clarity of presentation not the whole story about teaching; must also take into consideration:<br>- point of departure,<br>- stimulating interest,<br>- motivating the students. | 376: I think just striving for that clarity of presentation is not again the whole story about how to teach. You also have to take other ((?)) in terms of point of departure, stimulating interest, motivating the students. I sort of have, over time as a teacher, come to attach more importance to those factors. |
| | Try to model skills to be acquired by the students. | **SP RIT Post-Class Interview**<br>52: SP: Well but they, we work on that goal by... actually doing essays and then getting feedback on the essay.<br>54: CW: In a sense do you model that for them?<br>56: SP: Um... a little bit, yeah. I mean I hope that the way that I structure the, the cla-, the lectures and um... you know maybe take apart a particular argument or look closely at a particular passage would be a model for... their own work. |
| | Use overhead but pass over if doesn't show well. | 125: SP: Ah, I see. Right. Oh yeah yeah yeah. Actually it's not a very good overhead anyway, and they all have it in their books. *pause 3 sec* Uh... and in fact... um... there was something about the way the overhead was set up that I didn't have time to fix, which, on that particular transparency led me to decide not to uh... rely on it as much as I, as I could. It seemed like not the whole transparency was showing up on the, on the, on the overhead, and so I had... intended to use that overhead more, uh... extensively, but... at the start I decided to pass over it more, more quickly.<br>127: CW: So what, you mean the edges of it were not-<br>129: SP: Yeah, the edges were not showing. Exactly.<br>218: SP: It was a question about, uh... example of a heroine... uh... user... and whether or not, um... laws against... that that criminalized drugs like heroine were always um... uh... for the good of the drug user or whether they would bring harm to the rest of society. Uh... which is sort of a standard |

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| | Getting the question allowed me:<br>- to make a point that I wanted to make,<br>- could refer back to that question. | question about Mill, so it was good to get that question first because it sort of allowed me to make, uh... a point that I wanted to make then I think that I could refer back to that question on several- |
| | Should ask students questions in response to their questions rather than just answering. | 236: SP: I should have asked him to define it. Oh, well... he was just asking because paternalism is, is, is a term that's mentioned in one of the essay questions, so he just wanted to- I'm sure he just wanted to *laughs* It would have been much better for me to ask him, well, what do you think... what do you think it means? Um ...<br>238: CW: Did you think about that right at the time when you were defining it, did you-<br>240: SP: Yeah, I was sort of halfway through defining it, and I, I probably shouldn't have done it this way. |
| | Write down important points in own notes. | 311: SP: I mean the points that are really important I will have in my notes and therefore I'll reinforce... independently of the question period. But they may only have been fleshed out during, during the question part. |
| | Unsure about how to handle "incorrect" answers from students during class time.<br><br>May say that the answer is not the best or redirect to class. | 397: SP: The hard part I find is knowing, it's, you know, if you ask a, if you throw out a question and somebody puts up their hand, it doesn't really quite... give the the right answer or maybe... quite express it exactly as you would, to what extent to kind of get into an engagement with them, or take other points or just to say, okay, well that's basically it. This is how I would, uh-<br>399: CW: Mm. How do you do that?<br>401: SP: Well you sort of judge it by the context I guess.<br>403: CW: And what if they're totally off.<br>405: SP: If they're totally off, then I might say, well, that's not quite, not quite right or are there any other ideas. |
| | Pacing can be right (important factor?). | 470: as I was doing it and reviewing the tape, it seemed like the pace was about right for the first part, so maybe I just planned to do a little bit too much, uh... in the lecture. |
| | Decision about topic of discussion made in relation to what would be useful for their understanding. | 489: DB: How did you make your decision to say this is what I'm going to talk about for the rest of the section or -<br>491: SP: Um... I guess on the basis of what I thought would be uh... useful for their understanding, uh... I think, I mean one thing is that spelling out the structure of the argument to come. I might be able to still do that after I've presented the... argument. |
| | Examples sometimes chosen in advance and | 571: CW: How do you choose your examples? Do you think of them in advance, or... do you think of them on the spot?<br>573: SP: Um... sometimes I think of them in advance and sometimes I think of them on the spot.<br>575: CW: And you choose your examples based on - |

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| | sometimes on the spot.<br><br>Examples are things he hopes students will be able to identify with.<br><br>Modelling an example by stripping it down to the bare essentials.<br><br>Sometimes seems nice to have interaction but may interfere with flow of lecture.<br><br>Good pace:<br>- not rushing over anything important<br>- repeating points to accentuate<br>- giving illustrations of points made<br><br>Invite students to criticize or object to class materiel.<br><br>Examples not chosen ahead of time may not be best or most Appropriate.<br><br>Maybe go back to a topic if feels that was not covered Appropriately/sufficiently. | 577: SP: Things I hoped they'd be able to kind of identify with maybe<br>---<br>608: SP: This is a good example of how you know you can, of modelling taking, taking apart<br>609: an argument. This is why I am hope, hopeful that when they do their work they'll take this kind of analytic approach to that.<br>611: CW: So you're intentionally... proceeding in a particular way -<br>613: SP: Yeah, that's right. I'm really sort of trying to strip it down to the bare, bare essentials.<br>---<br>620: one thing that would have been, in this last sort of say ten minutes of the lecture would have been nice to have... some kind of interaction with students. I think that there was a lot in the first half and not so much in the, in the second half... um... but um... at, where, yeh-, just given where I was in the lecture it would have sort of interrupted the flow a little bit<br>---<br>622: CW: When you said a better pace, and you'd mentioned pacing before. When you say it's a good pace, what does that mean for you?<br>624: SP: That I'm not kind of rushing over anything that's... uh... important, that I'm *pause 3 sec* repeating to an appropriate degree the points that I, that I want to kind of accen- uh... accentuate, that um... *pause 4 sec* giving illustrations of the points I want to make and, and so forth.<br>---<br>630: It's useful to get all of the material sort of... done, because then at the beginning next time I will... um... invite them to raise criticism, to make objections and so forth,<br>---<br>668: SP: No. *pause 5 sec* This is, this is a definite situation where I hadn't thought<br>669: through the examples beforehand. Um... *pause 4 sec* and I probably didn't choose the best example at this point as a result.<br>---<br>675: CW: Now how do you think it went?<br>677: SP: It was okay. I think that if maybe I'd thought about it beforehand I might have... chosen a crisper example. *watching video*<br>679: CW: So normally you were writing down the examples for each point -<br>681: SP: Or, not writing them out but just uh... if I'd thought about it beforehand I might... just write down a word in my, in, in my notes. Or just having, just having thought about it in advance I probably would have covered my head here.<br>715: it was a fairly difficult question, a good, good question, sort of not something naturally we would have covered anyways, but... having said what I said during the question I can now maybe go back to it and uh... uh... have another, have another go at it if there, if there's time on Wednesday.<br>---<br>**SP RIT Post-Course Interview** |

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| | Possibility of tactical changes in instructional strategies (as I review notes from previous years). | 43: SP: I don't think so. I don't think there would be overall changes in the strategy.<br>43: I'm sure there would be, um... uh... I would hope there would continue to be and I think there has been every year, um... changes in the, in the strategy for presenting particular pieces of, of materials<br>43: I find that if I just try to pull something out of my filing cabinet that I did last year, then it's not very fresh in my memory, so you know I try to spend a few hours before each lecture sort of re-approaching the material and that usually means that there are changes in... uh... not only the content, but also um... you know how I would mix up different aspects of the lecture, in terms of getting them to res- respond at certain points or throwing out questions to them at certain points. So those sort of, sort of tactical changes in strategy would certainly uh... continue to evolve I'm sure in the future<br>43: you know what, the way I might do that would be to look at my notes from last time this time say and then would hopefully trigger my memory of whether something I you know I thought worked well or didn't didn't work well, took more time than I thought or didn't take as long as I thought, etc. |
| | Choose what worked well over what did not work well. | 51: if I have a sense that some... uh... theme that I was trying to convey wasn't effectively conveyed in the previous... two lectures, and it... arises again in let's say today's lecture, then I might spend more time trying to re-articulate that so that, so that it's clear.<br>51: I also would um... I like, I like to try to have something that is a little bit different, it maybe is halfway through the lecture, so if I talk for a while then maybe throw out a question, say twenty minutes into the lecture- |
| | If sense that things to go well over time, might spend more time and re-articulate it. | 60: Also, I mean sometimes I just change my mi- change my mind about... what I, what I'm saying. If I read Mill again for the sixtieth time I might see something that um... *pause 3 sec* that wasn't part of the presentation say last year, and then I would work, work that in. |
| | Like to have something different maybe halfway through the lecture. | 80: I mean the... texts that I work with are a kind of an endless resource for for reaching, re-thinking the content.<br>88: I think some... uh... lecturers would use that third hour to sort of lead a discussion themselves? But I'm not sure how much good that would do in... in, in a class of 300 students.<br>90: CW: Mm, mm-hm. |
| | Work in changes in his mind about materiel. | 92: SP: I think probably it'd have limited, limited value. Uh... it wouldn't really... you'd have all... dealing with, you know, forcing them to re-articulate in their own... voices the, the themes that they're learning, which is a way of consolidating the material, so-<br>**SP RIT Pre-Class Interview** |

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| | Not sure how effective a discussion would be in a class of 300... | 15: so it wouldn't shock me nor would it be a serious problem if there was a lot of questions and so forth which I didn't quite cover as much as I hoped. |
| | | 15: I think we're maybe half a lecture behind my schedule but I built in a whole day of ca..., a whole lecture of catch ups, so it wouldn't be a problem if we go, fell a little bit far behind in the lecture. |
| | Questions are not a problem | 40: the first part, the harm principle, um... let's see, well at the end last time we started introducing the harm principle and I actually had a significant um... quote from Mill up on the overhead and they have it, they have it in their uh... books as well, and so we kind of worked to extract the principle from the te- the text where Mill actually announces it, and uh... so I'll probably start off the lecture by, at that point sort of a little bit of, little bit of recap, um... and um... then using the, using the text which everyone will have sort of in front of them so to speak um... just make a few comments about that, |
| | Room to fall behind in course as built a whole day for catching up. | 40: at the end last time, um... not had time to take questions uh... and I think, I suspect probably challenges, uh... so I I wouldn't be surprised if they, if they came fairly early on in the, in the lecture, and I'd be happy to sort of entertain those, so I think that uh... the first part of the lecture will be, uh... will be well mainly me talking around uh... uh... around an overhead uh... and then uh... they'll probably be some class discussion. |
| | Start lecturing with a recap and use text everyone has to make comments. | 40: It's hard to predict, but- it's, you can't predict for sure, but- uh... that would be my guess. Um... and I don't think, I, I don't think I would need to sort of artificially stimulate that *laughs* that discussion I suspect it'll just uh... it'll, it'll just happen. Or I might say something like are there any questions about the harm principle. |
| | Happy to entertain questions, challenges, and/or discussion. | 48: SP: For the freedom of expression, um... I, I'm, I will probably... this is the part that I haven't thought through as much, I will pro- um... and I've given the lecture before. I will probably introduce it just by mentioning some... contemporary controversies just because I like to remind people, or remind students that these questions are never... obvious, but there's normally two, two, at least two sides, maybe uh... remind the students of um... Plato's views and perhaps Rousseau's views to sort of set it in context with what we've done before in uh... in the course. |
| | | 48: and then um... give a brief sort of lecture-focused exposition of what Mill's views are. Now I suspect that would take us to the end of the, the class |
| | Introduce contemporary controversies to remind people that such issues are not obvious—normally two sides. | 48: my normal practice would then be, once I've given a basic exposition of the author's views on whatever subject it is that we're looking at, to invite members of the class to offer challenges to the, to that view |

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| | Lecture-focused exposition of Mill's views. | 48: and then I usually use the points that they make and weave them into um... you know some of the standard criticisms that I'm, that I'm familiar with and uh... we, we proceed from there. |
| | Then invite class to offer challenges. | 48: But I, I suspect that in this particular lecture we, we won't get that far.<br>50: I: But you... that would be where you would next go-<br>52: SP: That's right.<br>54: I: -would be taking questions... from the class.<br>56: SP: Or chal- or or you know I might say, what kind of criticisms would you raise<br>57: of this uh... view about freedom of expression that I've just presented to you on behalf of... Mills, something like that. |
| | Use points they make to get to standard criticisms. | 61: ob- obviously a lot of the class will just be me kind of lecturing on what, what's in the harm principle and what in those views on freedom of expression are. Um... and so I guess that would fit into the, the knowledge and understanding goals of the, of the course. |
| | | 61: I also will, as I said I think earlier um... start them off by, by looking at a particular text which is actually a very important paragraph in, in in Mill and uh... so I I'm hoping that maybe some of the questions will uh... bounce off of that uh... text |
| | | 124: in the previous, previous year I could use the board, no one ever, no one ever said they couldn't read it, um... and with the overhead on, um...it's almost as if there's a physical barrier between me and about a third of the, uh... a third of the students, and you can't really walk around it or anything, because the, the layout doesn't uh- . |
| | A lot of the class just me lecturing: knowledge and understanding goals. | 146: DB: Do you make the relationship between the paper and uh... class discussion obvious? Uh... meaning do you make reference to the paper, saying this is going to be very-<br>148: SP: This is gonna be helpful. Yeah, uh... occasionally, yeah, yeah. I don't, I mean I want to avoid as much as possible getting a lot of papers which just... you know more or less reprint their their lecture notes from a particular day. Uh... on the other hand sometimes, for example when when we looked at Rousseau uh... there was, one, one of the two questions made a distinction that Rousseau makes between what Rousseau calls the general will and the will of all. And that's actually quite a difficult distinction, uh... to understand in Rousseau, so I did spend, um... maybe more time than I otherwise would have trying to... take them through that distinction so that they'd be um... in a good place to an- to answer the essay question. So there's definitely some, some *phone* relationship between the two, but I try not to overdo it. |
| | Start off by looking at text. | |
| | In the past, could use the board; not this year, because of layout. | |
| | Relationship between assignments (essays) and class explanations. | |
| | | 158: I will uh... be, look at my notes for an hour and a half or so before the, before the class, or at some point before the class and um... you know usually try to... uh... I do that in order to you know remind myself of what I'm gonna say, but also to sort of highlight or underline the things that um... I |

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| | | think will... be uh... you know, unlocking doors into their, into their understanding of, of the materials. So, sometimes it involves trying to think of good examples, or um... good ways of expressing or formulating... um... a a point that uh... I'm hoping to, to convey to them. Um... so... so really I just sort of will, will, will sit down and try to think of a way of making the material as engaging or accessible as possible in the hour or two before the exam, before the uh... before the lecture. |
| | Spend over one hour prior to class to remind myself what to say. | **SP RIT Pre-Course Interview**<br>3: This is my seventh year teaching full time in the university context and my... entering my seventh year uh...entering my fourth year at McGill... |
| | Look for ways to unlock the doors to their understanding (e.g., through examples). | 3: The course that we will be looking at is one that I taught each of the three years at McGill. It's an undergraduate course... |
| | | 3: The previous three years prior to when I arrived at McGill I taught in the British university system at the University of Exeter where I taught a mix of undergraduate and graduate courses but um... none that were quite the same as the one I'm teaching... the ones I'm teaching at McGill. |
| | Seven years of teaching experience in 2001. | 114: CW: And how many times have you taught the course you said? Three times...before? And generally how many students?<br>116: SP: The... um... generally between two and three hundred. So, I think the first year was about two hundred and then the other two years it was between two-seventy-five and three hundred. |
| | Undergraduate course taught for at least three times. | 122: CW: Had you... In Exeter, had you taught courses, classes ever that big.<br>124: SP: No, I've never taught any more than 60. |
| | Taught at University of Exeter prior to coming to McGill. | 136: SP: I'd, I'd never taught a group between a hundred and a hundred-fifty-<br>138: CW: Yeah!<br>140: SP: - I taught several classes of around sixty. |
| | | 215: an ideal would be having one, at the most two presentations each time, and then, have some other kind of activity during that hour which gets all the students participating. |
| | Generally between 200 to 300 students. | 276: least several times throughout the semester, I try to reinforce you know what we're trying to do in, in the course and making it a little more concrete, by connecting it with more specific outcomes and goals that we're looking for. |
| | | 280: The two hours of the week are... uh... consist of my lecturing to them um... and I guess the main idea of that strategy is to um...trying to... impart... first aim is to impart some knowledge and |

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| | | maybe also to try to impart some enthusiasm or excitement for the material so it can encourage them to go off and do more on their own and not just think of the courses or the lectures. |
| | Ideal scenario would be one or two presentations each time and other participatory activity.<br><br>Reinforce what trying to do by connecting strategies to outcomes. | 280: I actually also... during those two hours do as much as possible in such a large group encourage them to um... ask questions or even sometimes ask questions of them. So I might present an argument and then get them to uh... criticise the argument, or first identify what the different assumptions of the argument are and think critically about that. So, it is sort of... um... there's an interactive element which I guess is maybe emphasising some of the goals other than knowledge like critical thinking or interpretation of, interpretation of texts. |
| | Lecture to students to impart knowledge and enthusiasm/excitement about materiel. | 280: The second teaching activity is the conferences, and that's much more oriented around um... getting them to effectively communicate um...their ideas in oral, an oral way. Um...It's also meant to consolidate some of the knowledge they've got from the reading and from the...um... and from the lectures. |
| | Encourage interaction with learners. | 280: And, um... to make time for those [the conferences], we do certain exercises and so forth that are part of those conferences, which can... maybe they'll look at a small piece of text and come up to their interpretation or a criticism in the small group and then compare that with what other small groups. So, that works on some of the textual interpretation and critical... um... critical skills. |
| | Conferences to help students communicate effectively ideas in oral.<br><br>Small group work with texts during conferences. | 280: I suppose what's hopefully the biggest part of the course for them is the...all the work they're going to do on their, on their own, and a lot of that ends up geared around the three essays that they write. Now, there's three authors in the course that we look at and they have to write an essay on each one of the authors on a pre-assigned... two pre-assigned questions that they can choose, they can choose from. Um... so, I expect that a lot of the learning that actually takes place when they sit down and have to synthesise all the material and-<br>284: SP: -think through how they're going t:o: condense it all down into a 1,000 to 1,500 word-essay. |
| | Biggest part of course is work done by students on their own. | 288: SP: Well, I guess the... start from the teaching goals, what sorts of goals do you have, what kinds of outcomes do you want to achieve? And, then, what are the most appropriate strategies for realising those outcomes? Um... Subject to the huge constraint of resources, and class size, and um... of course... the size of conferences and all those sorts of things. |
| | | 384: So, last year I particularly sat down and rethought the lectures and tried to streamline or to simplify them in uh... various ways, um... identify for the students what sorts of questions they need to be um.. thinking about with respect to that, that text. |
| | | 390: CW: You can see that. And when do you tend to make changes to a course? Do you make |

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| | Start from teaching goals/outcomes.<br><br>Streamlined questions.<br><br>Most technical changes made before course start.<br><br>Most content changes made during course.<br><br>Changes based on students' comments from previous years. | it before the course, like during the planning, during the course, after all of the... When does that normally happen?<br>392: SP: Um... For the more... sort of... technical changes that I, that I mentioned um... before the course starts and plan, in the planning of the course.<br>---<br>392: In terms of changing the, you know the material, how I present, I present during the lectures, um... That kind of thing, that's... that I do as I'm teaching the course.<br>396: SP: As I prepare.... *5 secs.* Particular lectures or particular weeks, yeah.<br>398: CW: So, during you're, you m... might be making adjustments to content or presentation.<br>---<br>400: SP: Based either on comments from last, comments... you know perceptions from last year or the last years, or perhaps um... it has certainly happened a few times that um... enough students who said "we're really not understanding such and such" or maybe the TAs are saying they're really not getting such and such that I've used in the lecture time to try to represent material in hopefully a more, clearer way, a more accessible way. So, it makes a small adjustments as I go and...<br>402: CW: And so for this course you said... we look at the improvements or changes that you've made, that you changed the middle part of the course, or at least some part of it, and now the technical changes that you were talking about, was that for this course? |
| **Knowledge base for teaching**<br>**Knowledge for teaching**<br>**Knowledge of learning and learners**<br><br>This category of knowledge refers to the knowledge the professor has of learning and learners. Comments can be related to learner characteristics, comprising a description of the demographics (i.e., age, entry knowledge, etc.) or of specific behaviors of students or sub-groups of students.<br><br>Comments can also be related to what constitutes | Who the students are:<br>- background<br>- points of reference<br>- what examples are meaningful<br>- what will gear up their enthusiasm | **SP Long Interview**<br><br>204: and you've got to have some sense of who your students are and, I'm going back to what I was saying before, what their background is, what their points of reference are, what uh... examples are likely for them to be meaningful. Um... and uh... you also have to have a sense of what is working in terms of gearing up their enthusiasm about the course.<br>---<br>296: This is going back to what I was saying earlier about, about trying to think about what the students have at the start. So, in this case, I could assume or at least hope that they had the material we'd already covered in the, in the course.<br>---<br>296: the second motivation for starting, for proceeding with the actual exposition of what Mill |

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| evidence of learning on the part of students or merely expectations with regards to the students' learning. | | thought with these contemporary examples is... uh... the contemporary examples might give students a uh... a kind of resource that they can draw on in critically evaluating what Mill ... so they can say, "Well I like Mill's argument. But when I think of what it would imply for hate speech legislation, then I find that there is actually a problem with what Mill was saying." Or maybe they'll think, "Hm... Mill has a point". And they'll start rethinking their positions about hate speech or whatever the example is. |
| | Students already have opinions on which they can draw. | 324: it's reasonable to expect that they already have opinions which they can then draw on to um... to sort poke their way at the argument that's been given. |
| | Sort-term evidence of learning:<br>- questions asked during class<br>- questions from after the lecture | **SP RIT Post-Class Interview**<br>19: the scant evidence I have would be based on the kinds of questions they ask during the, the class and a handful of questions I got after the, after the lecture, and uh... uh... that seemed to indicate a fairly... a success but, uh... in terms of their learning. But it's hard, hard to say without further, further sort of longer, longer term evidence. |
| | Longer-term evidence of learning:<br>- essays<br>- people coming during office hours<br>- reports from TAs | 21: CW: And I think you said the longer term evidence was going to be the essays.<br>23: SP: Essays, you know, people coming during the office hours, people... uh... I guess next week the conference relates uh... to some of the stuff that was covered in the first half or two-thirds of the lecture, so you know... TA's come to me and say, Oh they're not really understanding this or that then, um... or if they come to me and say oh, the students all were wondering about something, we're wondering what that suggests, uh... did they really understand the, the lecture. We get that kind of thing sometimes. So the, then I'd have a a clearer sense I think by the end of next week for that class. |
| | Students accumulate gradually, over the course of degree; difference between start and graduation. | 77: SP: Yeah, I think they... accumulate gradually. Hope, hopefully over the course of the degree. Right, so that you notice a difference between them when they graduate and when they started. |
| | | 154: The students always complain in the course evaluations about me... uh... reviewing too much from the previous lecture anyways. |
| | Students sometimes turn off during their colleagues' questions. | 303: I think you know some students find a little bit hard to get used to because their tendency is sometimes to turn off during the questions, uh... but I have warned them several times not, not to do that because sometimes -<br>305: CW: It's not just separate, an answer to a question, but you're also tailoring it to move.<br>307: SP: That's right. We may be moving forward during the question and answer. |
| | A lot of students are not good at extracting points | 323: seminar courses. Where you know most of the... the material is presented through the medium of discussions between... between students and a lot of students aren't very good at it. You look at their notebooks, and they, they're just blank after a three-hour, uh... a three-hour seminar. Cause |

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| | from a conversation (seminar). | they're so used to everything coming in a, in the form of a pre-prepared lecture.<br>325: CW: Mm. They don't know how, like you say, how to listen for what-<br>327: SP: A conversation and then and then extract points from the conversation. |
| | Some notions/concepts, students would have picked prior to course or class. | 383: DB: Do they normally have the knowledge to answer that question? Do other courses, logic courses?<br>385: SP: Other courses... yeah, if they did a philosophy course or well, even other... I remember first using that... learning that terminology in an, in an economics course okay, so... you know it's the kind of thing they could have picked up in a number of different places. I may have even used it earlier in the, uh... term in some, in some connection or other. Uh... I probably did. I may have even explained it at that point. |
| | Easier to appreciate an author after seeing what he's done rather than in anticipation. | 491: In fact, if they seem, it may be easier for them to appreciate, okay, this is what Mill was doing, uh... after we've sort of looked at what he was doing rather than as an anticipation before, you know, before we hit the substance of his... of his argument. |
| | When students are not engaged, there tends to be:<br>- less eye contact,<br>- less note taking,<br>- more rustling,<br>- less engagement,<br>- less concentration. | 557: You know they may not have been, there may not have been as much eye contact, as much note, note-taking, maybe a little bit more rustling, etc. etc. That normally happens I find in the last fifteen... ten to fifteen minutes.<br>559: CW: You start to see and hear those-<br>561: SP: That's right, yeah.<br>563: CW: And they tell you that-<br>565: SP: There's been a... they're, they're not as engaged, they're not concentrating as well. |
| | Students come to next class with questions or quick criticisms. | 630: so having done it once, and we've done it really quickly, summarize for the next time we'll be ready with some... typically they'll be ready with some questions or some quick criticisms. |
| | Sometimes questions express anxiety as much as desire for information. | 736: you know, in the first part of the term for instance we got an inordinate number of questions about how they should do their bibliography and that, that sort of thing. Which I think was covered in the conferences, but they, they all seem to be... it seemed to be a kind of expression of their anxiety as much as... uh... a desire for information. |
| | Students tend to have fairly strong opinions. | **SP RIT Pre-Class Interview**<br>15: students tend to...uh... they often have opinions... uh... that are fairly strong about these issues<br>48: and normally um... you know normally they come up with... some good ones, some kind of off, off-beat ones, |

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| | Evidence of learning: questions in class and after. | 61: you know sometimes they catch things that I haven't mentioned and you know whe- whe- when we're discussing a particular... text. |
| | | 61: I guess other students probably just sort of say, oh, this is time for a five minute break *laughs*. Um... but at least then they're getting the first benefit which is... hopefully when we come back to the lecture they'll be, they'll be concentrating better. |
| | | 132: judgment on the basis of... um... the kinds of questions and comments you get during the lecture. Uh... perhaps the kinds of questions and comments I get at the very end of the lecture. |
| | | 132: comments and questions that I and TA's get you know in office hours or in conferences. |
| | Comments and questions that I and TA's get you know in office hours or in conferences. | 132: understanding, the understanding and engagement with the material that they show in their um... third essay which is a, which is an essay on Mill. |
| | Evidence of learning: understanding and engagement with the material shown in essay and final exam. | 132: finally the understanding and engagement they show in the final exam. |
| | Range of kinds of evidence from instantaneous through to final exam. | 132: And so there's all those sort of different, different, different I mean ob, ob, obviously there's course evaluations as, as well, but... I suppose it's unlikely that they'd mention a particular, you know a particular class or particular topic that I, that I taught. So I mean there's a range of different... kinds of evidence from the instantaneous through to the, you know, marking of the final, final exam that uh... that's helpful. |
| | | **SP RIT Pre-Course Interview** |
| | Good students listen to fellow students. | 39: And good students often do, good students are good at listening to fellow students and then situating what they think vis-à-vis what others, others have said. |
| | Students learn best when told about expectations and link those expectations assessment of the course. | 43: SP: Um… I tend to think that, I tend to find that students learn best when you s… um… tell them as specifically as you can what your expectations are and link those expectations with um… the assessment of… the assessment of the course so they know that um… |
| | Students quite goal-oriented. | 43: I find that the students tend to be quite goal, goal-oriented |
| | Students learn from the lecture, able to learn from each other. | 43: a lot of students do tell me they learn from the lecture. |
| | | 43: I do think that some students are able to learn from each other |
| | | 47: Many students have told me over the past how that helps them to consolidate what they've got |

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| | | from the readings |
| | Get better sense of students' understanding during conferences. | 231: SP: I enjoy giving conferences. I love the…<br>233: CW: We get a little closer connection I guess.<br>235: SP: Yeah! You get a better sense of what the students are understanding and… |
| | Variety of backgrounds amongst students. | 252: they [the students] tend to come from a variety of backgrounds, not, not surprisingly, but perhaps of those students or let's say all the students in the course maybe a quarter of them would have had some kind of course at CEGEP or in their previous academic experience, which would be in the neighbourhood of what we're doing in this, in this course. They would may be have read some philosophical um… texts or some theoretical uh… texts. |
| | Some students find difficult because modes of reasoning different for theory course; cannot:<br>- memorise bunch of facts,<br>- reproduce facts in multiple choice exam. | 252: I would say the other three quarters [of students] probably don't have that, that background. They're coming at it as a new thing and some of them find it quite difficult because the modes of, of reasoning are a little bit different for a theory course than they would be um… for other social sciences courses that they might be doing at the same time, or as they might have done in the past. |
| | Students have to read the text over and over again to figure out what the arguments are. | 252: they [students] find they can't just memorise a bunch of facts and then reproduce those in a multiple choice exams or … |
| | | 256: they [students] also point to you that they're surprised that there's not more reading, but that the reading they have to do they find they have to read the text over and over again to figure out what the… what the arguments are. So, it's a sort of different kind of approach I think that um… that students find, especially when they're doing this sort of thing for the first time. |
| | Expect that second year students be able to write an essay. | 302: CW: Cause I wonder if you'd find essays in other large classes…<br>304: SP: Probably not, no. Because…um… And I think it's… I think it's a shame because by the time they get to the second year of classes which are a bit smaller uh… you want to be able to expect that the students know how to write an essay. Unless they've been forced to do that in their first year, you're really relying on whatever they learned in high school or in CEGEP. Um… But the reason that is, is normally resources. |
| | Evidence of learning: qualitative assessment of how students do in the various activities that they are being assessed. | 368: I guess I regard as evidence um…a qualitative assessment of how students do in the various activities that they are being…that are being assessed. |
| | Can get a sense from the final exam to what extent | 368: I require to read a few of the essays, and getting feedback from the markers, and we always discuss the, you know, strengths and weaknesses of the students. We normally discuss that, and then I will spend maybe a couple minutes in the lecture to tell the class in general what was good, what area maybe needs to be worked on. And, the same goes for the final exam. I can get a sense from the |

**Appendix H (Example of aggregated information per professor – SP**



| Code | Theme(s) | Excerpt(s) |
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| | the students are meeting the objectives. | final exam um… to what extent the students are meeting the objectives that you've, that you've set. So, that I guess, is one um…kind. |
| | Written comments of the student evaluation: when starts to be interesting when sees patterns. | 368: Some other kind I get is from the written comments of the student evaluation. The written comments from the student evaluation, some of them are not worth much… Um…<br>370: CW: You may begin to see patterns.<br>372: SP: Yeah! When you see patterns, that, that's when it starts to be interesting. In a group of that size, you sort of see the same comments you know… five times or more then…, then you sort of sit up and take, you take note. |
| | Get a sense that students struggling through conversation with them. | 372: I suppose a third thing which is hard, harder to think as reliable, but you can't discount it altogether, is um… talking to students. I get an enormous number of students coming to see me during office hours, and you get a sense from them um… what they're struggling with. Some of them [students] come in [to office hours] and they're completely on top of the material, and they're asking me questions that I have trouble… um… trouble answering. So, you get a real range. But then I'm not confident that it's a representative sample because I know a lot of students are just terrified by the um… idea of going to talk to professors during their office hours. It always amazes me because I don't feel-<br>374: CW: I know!<br>376: SP: -I'm a very terrifying person but… |
| **Knowledge base for teaching**<br>**Knowledge for teaching**<br>**Knowledge of assessment of learning**<br><br>The professor discusses how s/he goes about assessing the learning to be achieved by the students.<br><br>The reference to principles of assessment can be either explicit or implicit. It can also refer to either an Approach or an actual strategy/technique. | Procedures for reliability in grading. | **SP Long Interview**<br><br>376: SP: Um… As a faculty member I found that students valued and liked that, that would be generally probably the way students, um… for example would evaluate classes that I taught. It seems to work in terms of getting, getting the material conveyed to the students and then verified on the exams.<br><br>**SP RIT Post-Course Interview**<br><br>128: SP: Uh... actually it's not completely true. I also we- for the Rousseau and, and Mill I also double-graded a selection of each person's and we grad-, we all graded three of them.<br>130: CW: For each essay. So you'd all sit down and grade the same three?<br>132: SP: Yeah, and then we had an e-mail sort of discussion where we each posted our, our... what our grade would be and what our comments would be.<br>134: CW: So, all six of you.<br>136: SP: All six, yeah. All seven, including me.<br><br>138: CW: Oh, yeah right. You look for a kind of reliability in there, and how, how does that go, how |

**Appendix H (Example of aggregated information per professor – SP**



| Code | Theme(s) | Excerpt(s) |
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| | | did it go?<br>140: SP: Um... pretty, pretty well in terms of uh... the, there was quite good convergence in terms of the, the marks. I was lucky I think. All six of the t- the graders and TA's had, had good judgement about... the uh... what mark to assign? One or two of them were a little less good on the comments. Well actually one of them was not very good on the comments, which tended to frustrate students because there just weren't very many - |
| | Deep reservations about multiple choice, in particular in political theory as would try to get them to learn facts. | 228: SP: To some extent. It's um... I think some courses would have multiple choice... aspects, but um... that... I have deep... reservations about that, and even in those other courses, but in political theory I just think it would be a waste of time. You're not really testing the things you want them to learn. You're trying to get them to learn a bunch of facts, really. |
| | Resources lead to second best option (i.e., poorly designed multiple choice exams). | 236: SP: Well, that's that's an example of how I think um... they wouldn't always admit this but I think it's an example of how resources are forcing people to adopt second best... um... you know, evaluation... systems. Some people claim that they can do very sophisticated um... multiple choice exams and it would probably take me as long to design it - |
| | Grade essays with TAs.<br>Discuss general patterns or weaknesses. | **SP RIT Pre-Class Interview**<br><br>185: the uh... essay did come in um... on I think it was October 6th. And they were all graded and... handed back, and I had a ve-, I read a very limited number of them myself, but uh... had a meeting with the... four TA's and two graders, uh... to discuss... I guess in late October, uh... or about two weeks after I guess uh... the, the, the due date once they had done all the grading. And, uh... we discussed sort of general patterns that uh... that they had observed, general weaknesses they'd observed in the, in the, in the papers. |
| | Reliability: making sure everyone is judging with similar standards. | 185: then um... I went over a few of them in the class, and they also went, the TA's went over some of the general points in the, in the conferences. And it was also designed just to make sure that people were all making the same kinds of comments and judg- judging according to similar, similar standards. |
| | Usual weaknesses:<br>- inadequate use of primary texts<br>- tendency not to support statements with references/citations | 185: I would say that uh... you know there were, there were there usual weaknesses in, in the essays um... which include in-, inadequate use of the primary text, so a tendency not to um... support statements they make about an author's views with uh... references or citations to what the author actually says, that's a, that's a major weakness normally in the, in the essays in this class, especially at the, at the beginning. Doesn- didn't surprise me at all... that that was there. |
| | Feedback is both oral (in class) and written (on the standardized feedback sheet) | 191: DB: When you talk about feedback, um... there's your own feedback which is mostly verbal in the class, and they're getting written feedback which comes from the TA? |

**Appendix H (Example of aggregated information per professor – SP**



| Code | Theme(s) | Excerpt(s) |
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| | Approach to assessing essays takes a bit longer than normally… | 193: SP: That's right, the uh... when, when they get their, their essay back, there will be kind of comments in the margin in the normal way, but there's also a standardized, uh... feedback form that they get which has six or seven... questions like uh... uh... is the essay clearly structured, does it use primary sources appropriately? Is… does it show evidence of critical thinking, does it show understanding of the issues, etc., etc., there's about six or seven questions like that... uh... and so the grader will fill out some or all of those... um... spaces as, as appropriate.<br>195: I: So that becomes a great template for them for thinking about structuring their second essay.<br>197: SP: That's right. Well, in fact, they were given that template before their first-, the first<br>198: essay.<br>---<br>232: I: We had this one, the guide to essay writing.<br>234: SP: You're right. There's three handouts. So there's that, there's that one, then there's one that had the actual assignments on it -<br>236: I: Oh that one we don't have.<br>238: SP: And, um... also I think maybe warned them what the grid was going to be, and then there's the thing that's actually used for um... feedback. So I'll try to remember to bring those, on Friday.<br>---<br>244: I: That would be very helpful. But also it sounds like you've got a really terrific Approach to marking the essays. You must have spent some time coming up with that.<br>246: SP: Um... yeah, I think it works fairly well, I mean, one drawback is that it takes a little bit longer to mark each essay, and uh... the resources are already pretty... pretty strained. Uh... and I, I, I think some graders find it more useful than others. Um... I think sometimes the graders don't fully think through the, the criteria so you look at a lot of their sheets and maybe huge comment is just fit into one category for almost all the essays that they're uh... that they're marking, so maybe they're not making all these different dis- distinctions as much as they should when they're, when they're doing the grading. So I think it sort of depends on um... on who's, who's grading. I've, I've talked to the TA's in the past before and they they find it fairly useful, although they do sometimes grumble a little bit about the extra, extra time, and understandably. |
| | Feedback sheet has six or seven criteria of a good essay. | **SP RIT Pre-Course Interview**<br><br>276: one of the elements of the course is the… they write three short essays and um.. the... When they receive their essays back, the essays uh… have… there's a sort of feedback sheet or commentary sheet which has six or seven different criteria of um… of a good essay. |
| | Connect expectations of final exam back to aims of | 276: there's a sort of feedback sheet or commentary sheet which has six or seven different criteria of um… of a good essay. In fact, I tell them about this before they start the, the first one. And there's another hand out that is not included with the initial course syllabus. I try to connect those criteria back to the aims of the course. |

**Appendix H (Example of aggregated information per professor – SP**



| Code | Theme(s) | Excerpt(s) |
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| | course. | 276: also, on the very final day of the course, when I'm talking about the final exam, I try to connect what we'll be looking for in the final exams back to the aims of the course. |
| | Evaluation part of the planning process. | 294: CW: Um…At what point in your planning of a course do you normally think about the evaluation of learning, how you are going to go about evaluating learning?<br>296: SP: Um…*3 secs* I guess it's part of the… part of the planning process, right… right from the start. Um… So I think about *3 secs* what mix of different forms of assessment would get the students to do what I hope…hope they're… doing. |
| | Having three essays puts a lot of strain on me and TAs. | 296: So for the particular course we've been talking about.. um… having the three short essays was… despite the fact that it's, it actually puts a lot of strain on the teaching assistants and on me to get… it's a lot of…a lot of grading. |
| | Assessing them and how well they're achieving the goals of the course (as opposed to reproducing stuff). | 296: I really think that in terms of planning the course and getting the students to do some of the things you want them to do, it's a… it's a very good exercise and a very good way of evaluating, of assessing them and also for us to assess how well they're achieving the goals we… that they've understood each of the authors, to what extent are they just reproducing stuff from the lecture or are they synthesising themselves, thinking independently etc… etc… |
| | Essays are not normally used in large classes. | 302: CW: Cause I wonder if you'd find essays in other large classes…<br>304: SP: Probably not, no. |
| | | 342: DB: And short essays are how long?<br>344: SP: Four to six pages double-spaced.<br>346: DB: Double-spaced, OK.<br>348: SP: Yeah! So, they're not, they're not terribly long. On the other hand, there's not a lot of point in grading them at this stage unless you put comments.<br>350: CW: Um um!<br>352: DB: Um um!<br>354: CW: Absolutely!<br>356: SP: So, I had this feedback sheet which can slow, slow things down a little. |
| | Assesses conference participation. | 364: SP: There's a final exam…and there's uh… a grade for their conference participation. |
| | In the past, issues of reliability amongst the graders. | 408: In the first couple years I taught it , the students um… I thought the best way to assess the essays would be to have a different grader, a different teaching assistant or different grader, or me mark each of the students' three essays. The idea being that if the graders were marking at different standards it would kind of even out. Um… The problem with that Approach, uh… I discovered based |

| Code | Theme(s) | Excerpt(s) |
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| | Settled this with having same TA grade all of a student's essays. | on many, many comments, was that grader A would say that "you're not doing enough of this in your essay", and so when it got to the second essay, they would do more than grader A and in the worst case grader B would say that "you're doing too much of this in your..."<br>---<br>408: So, I mean... no...no matter how, what you say to the graders, what instructions you give them, it's inevitable that they will have slightly different um... ideas in mind when they mark, when they rate totally different understanding of the material themselves. And this was immensely frustrating to say, to um... even students doing reasonably well would get really frustrated by... So, I changed that last year and had...you always have the same person marking your essays throughout the year, and also got no complaints whatsoever. So, I think I'll probably stick, stick with that to... |
| **Knowledge base for teaching**<br>**Knowledge for teaching**<br>**Knowledge of curricular issues**<br><br>The professor discusses how a given topic or course fits in the larger educational program. Comments may include a discussion of educational programs in general or of a specific program. They may also include a discussion of the relationship between one specific course and others. | Choice of course materiel in relation to broader curricular materiel.<br><br>Collective nature of design and delivery. | **SP Long Interview**<br><br>212: SP: Um... in terms of organizing the material I'm going to teach, there is working out with colleagues um... how material you teach in a particular course fits into broader curricular material - when you are ((collectively designing and delivering.)) |
| **Knowledge base for teaching**<br>**Knowledge for teaching**<br>**Knowledge of human behaviour**<br><br>The professor discusses human relations as they affect teaching and/or learning. This may include a discussion of group dynamics such as how the group size and/or composition affect teaching and learning at the university level. It may also include a discussion of interpersonal relations such as the verbal and non-verbal attitudes and/or actions on the part of the teacher or the learner. | Eye contact important for visual cues (i.e., other person looking perplexed or not).<br><br>Students spread out in class: SP felt less connected with students as a result.<br><br>Size of class affects sense of what's going on in the class:<br>- how students react to what you say | **SP RIT Post-Class Interview**<br><br>206: Well it's like when you're having a conversation with someone. It's so important to make uh... eye contact, see whether you get those visual cues that they're... looking perplexed or-<br>---<br>**SP RIT Post-Course Interview**<br><br>287: CW: They kind of, they can spread out.<br>289: SP: Sprawl, yeah.<br>291: CW: *laughs* Sprawl.<br>293: SP: It's, it's terrible, uh... and um... so I felt like I had less uh... I was less connected with, with the students as a result.<br>---<br>**SP RIT Pre-Course Interview**<br><br>140: I taught several classes of around sixty.<br>142: CW: Yeah! Which is a whole difference-<br>144: SP: And that seems very different from teaching two or three hundred um... You don't |

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| Code | Theme(s) | Excerpt(s) |
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| | - whether you're loosing them<br>- much more sort of doodling<br>- much more chatting | really have as much a sense of what's going on in class, or how the students are reacting to what you're saying, whether they're… whether you're loosing them because the group is so massive, the lights are such that you can't, you know, clearly see all the faces, and um… I'm sure there is much more sort of doodling and-<br>146: CW: *laugh*<br>148: SP: -and chatting and so forth in a large group than there would be in a small group. |
| | Large groups are problematic for SP because he has students do presentations.<br><br>Presentations do not foster genuine discussion.<br><br>People not presenting tend to tune out. | 211: SP: Part of the reason why large groups is a problem for my classes particularly is that I haven't.. I have the students do presentations.<br>213: CW: Um…<br>215: SP: And, even though the presentations are very short, under ten minutes each, if you have more than two then the whole hour basically has taken up listening to two or three students talking in succession and there isn't any real, genuine discussion. The ones who aren't presenting that week tend to tune out. |
| | Big lectures do not enable you to be impressed by how smart students are. | 239: SP: You're… It's nice sometime to be impressed by how smart some of these students are.<br>241: CW: Yeah!<br>243: SP: You don't get that as much in a big lecture. |

**Appendix H (Example of aggregated information per professor – SP**



| Code | Theme(s) | Excerpt(s) |
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| **Knowledge base for teaching**<br>**Knowledge for teaching**<br>**Knowledge of the physical environment**<br><br>The professor discusses the physical arrangement of the class or location of the class.<br><br>The professor's comments can be either positive or negative, or even a mix of both. | Hallway produces noise and cannot ensure that door remains shut.<br><br>Wide auditorium makes it difficult to establish eye contact with people on left and right.<br><br>Do not like the classroom because it is too big and too wide .<br><br>Frustrated by this classroom; find it harder.<br><br>Harder to sustain students' attention because they are spread out all over the place.<br><br>Getting the class to order is more a challenge.<br><br>Classroom feels more formal.<br><br>Feels constrained into:<br>- using the overhead<br>- not using the board because people cannot see. | **SP RIT Post-Class Interview**<br><br>186: SP: The hallway is very noisy, and... sometimes I've asked them to shut the door, but... somebody just comes in two seconds later and then leaves it open again. There's nothing you can do.<br><br>196: because it's such a wide auditorium... I'm trying to make eye contact not only with people in front of me, but the people on the left and on the right, but it looks li- , it looks sort of funny, doesn't it?<br><br>**SP RIT Post-Course Interview**<br><br>281: SP: No I, I didn't like the classroom I was teaching in, um... I think that was... yeah, and which maybe partly is a function of the size of the class, although we would have fit into the, several other cla- classrooms on campus.<br>283: DB: Is it the first time you used that classroom?<br>285: SP: Yes, yeah. It's it's too big and wide uh... for the number of people.<br>287: CW: They kind of, they can spread out.<br>289: SP: Sprawl, yeah.<br>291: CW: *laughs* Sprawl.<br><br>**SP RIT Pre-Class Interview**<br><br>89: I find it frustrating teaching in this, in this classroom.<br>91: I: I was gonna say, how is, how are you finding that-<br>93: SP: It's just harder, I just find it harder to- feel like I'm sustaining their attention because people are just kind of spread out all over the place, um... and uh... there's probably a little bit more kind of chattering at the beginning in particular so just sort of getting the... getting the class to order is uh... more of a challenge in, in this uh... in this room.<br><br>123: Here it feels more formal. Also the size of the room means that<br>124: I... uh... pretty much always have to use the overhead. I nev-, I never use the board because you can't see it. |
| **Knowledge base for teaching**<br>**Beliefs for teaching**<br>**Beliefs about the purposes of instruction**<br><br>The professor discusses the long-term purposes of | Purpose may not be to remember content.<br><br>Hopefully students have acquired certain tools. | **SP RIT Pre-Course Interview**<br><br>27: I think twenty years after they've been to university they may not remember a thing in terms of the, the content of the knowledge we were imparting to them but hopefully… uh… in a university education they at least sharpen those tools they may have already started to acquire in earlier stages, |

| Code | Theme(s) | Excerpt(s) |
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| university instruction. This may include a discussion of the finalities of educational systems. It may also include a discussion of what should be the expectations directed at graduates many years after they have finished studying. | | or um… maybe start to acquire and develop them further. |
| **Knowledge base for teaching**<br>**Beliefs for teaching**<br>**Beliefs about the conditions for instruction**<br><br>The professor discusses what s/he believes to be basic requirements or conditions for good university teaching and/or learning to take place.<br><br>These requirements or conditions seem to be external to either the teacher or the learner and, thus, beyond the control of either. | Size of class important.<br><br>Ideal size for seminar is about 12 or 15. | **SP RIT Pre-Course Interview**<br><br>198: SP: Um…Well, to me the ideal size for a seminar is probably about twelve or fifteen. |
| **Knowledge base for teaching**<br>**Beliefs for teaching**<br>**Beliefs about teaching and teachers**<br><br>The professor discusses the role of the university teacher in general (i.e., responsibilities). This can take the form of a generic discussion (i.e., 'the university professor...') or be specific to him/herself (i.e., 'as a professor, I...').<br><br>The professor may also discuss what "good" university teaching is, or university teaching that is regarded positively, would entail. This can refer to a generic discussion of what university professors ought to do, or refer to what the professor has chosen to do because s/he feels it is the 'right' way of doing things. | Role of university teacher:<br>- to motivate and excite students<br><br>General view of university teacher may be complemented by one different perspectives.<br><br>Students might get irritated when lecture is too slow. | **SP Long Interview**<br><br>111: SP: So, it is a question about the role of the university teacher in general?<br>113: DB: Yes, yes. Um…does this still represent your thinking? Do you feel it…<br>115: SP: Yah! I think I would add a third factor which I maybe even originally mentioned.<br>117: DB: OK.<br>119: SP: Um… or we might have discussed it. And that is um… to motivate and excite<br>120: students.<br>122: DB: OK.<br>124: SP: It's not just the matter of getting them tools or giving them knowledge, but it is also a matter of motivating them to think that having this knowledge is important and also motivating them to think that it is, is useful to use these tools and perhaps also to keep on learning about the tools once the formal class is over.<br><br>166: DB: Um… I guess you've covered this. But the idea that… is this description somehow representative of all of university teachers. You're saying it's just a different ordering and it may be, may be that that's common to all, across the university professors, you're saying?<br>168: SP: Um… That would be my view but I would expect that other university professors might add other elements into the picture of what they think of… as the goal of good teaching.<br><br>254: SP: Mmhh… watching that, watching that it strikes me that I speak slowly. Um…<br>256: DB: Is that good or bad? |

| Code | Theme(s) | Excerpt(s) |
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| | Simplicity and economy in teaching very important; however, they are not opposed too strongly.<br><br>Striving for clarity of presentation no whole story, also:<br>- the point of departure,<br>- stimulating interest,<br>- motivating the students.<br><br>Helpful to students to lay out clearly basic elements of theory examined.<br><br>Imparting knowledge not most important part of teaching; giving certain lifelong tools more important.<br><br>Good university teaching:<br>- excites the students<br>- encourages them to acquire lifelong skills<br>- turns goals into specific expectations<br>- links expectations to assessment | 258: SP: Uh... ((it's hard to know.)) Perhaps if you were sitting there for, for 50 minutes uh... it could be easier to sort of extract the main points ((when someone's)) not speaking too quickly. Um... but just listening, if you were having a conversation with someone like that with who was talking that slowly, it would be irritating. It might be irritating to some students.<br><br>364: SP: Um... now, I definitely think that achieving a degree of simplicity and economy in teaching is very, very important in terms of communicating the material to the students. Um... but I would not necessarily oppose that quite so strongly as you just did to um...<br><br>376: but I think just striving for that clarity of presentation is not again the whole story about how to teach. You also have to take other ((?)) in terms of point of departure, stimulating interest, motivating the students<br><br>**SP RIT Pre-Class Interview**<br><br>61: I think it's helpful to students just to have a lecturer kind of layout hopefully clearly what the, you know, the basic elements of the, the theory is that we're, that we're looking at.<br><br>**SP RIT Pre-Course Interview**<br><br>27: although one of the tasks, I suppose, is to impart knowledge to the students, it is not necessarily uh... from the standpoint of the humanities teacher the most important task.<br><br>27: the most important task is probably... uh...to give uh... students certain tools that they can then hopefully use throughout their lives,<br><br>31: one is that it um...excites students about uh... about what they are doing and about thinking in a certain way so that they um... don't just regard it as a dreary hurdle they have to cross on the way to something else in the future, but they come to see I think a certain way of thinking about the world as interesting, fun, and important.<br><br>31: another is that it encourages them to start to acquire some of these different skills that I was talking about. So... good university teaching, you know, gets them to be critical, lets them um... see how difficult texts are interpreted, sharpens their writing skills, gives them a chance to uh... give presentations in which uh.. they have to uh... present ideas about subjects that are difficult.<br><br>43: if the goal is to teach them critical reasoning, which is sort of a fairly abstract sounding goal, if you can, try to make that fairly specific in terms of what you expect of them as far as that dimension of the course is concerned and how that will be tied to um... their assessment. |

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| Code | Theme(s) | Excerpt(s) |
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| | Because students are goal-oriented, making goals concrete encourages/helps learning. | 43: And I find that the students tend to be quite goal, goal-oriented and so if you can um… make the goals fairly concrete than that um… *3 secs* that encourages the learning or that helps, helps the learning… right? |
| **Knowledge base for teaching**<br>**Beliefs for teaching**<br>**Beliefs about learning and learners**<br><br>The professor discusses the roles and responsibilities of the learner in a university context.<br>The professor may also discuss the processes by which students acquire or construct new knowledge in the university setting.<br><br>The professor's comments have to be directed at the university learner. Comments that are directed at learners or learning in general (i.e., no specific mention of university learners or students) should be coded with 'Beliefs about knowledge construction'. | Not important learners remember facts.<br><br>Good for learners to be involved in grading; encourages them more objectively about written work; hopefully reflected back onto their own work.<br><br>If ask students what they think, their brain works in different way.<br><br>Learners must do aspects of course in a conscientious way:<br>- doing the readings<br>- attending seminars<br>- attitude to fellow students<br>- participate/contribute to community of learning.<br><br>When engaged in small group discussions:<br>- some students will sort of turn off;<br>- other learn from their peers' comments<br>- other obtain clarification of own understanding<br><br>Having informal discussion of materiel with peers helps some students. | **SP Long Interview**<br><br>164: SP: Personally, I don't care as much whether the students remember facts about the subject matter that I'm teaching.<br><br>**SP RIT Post-Course Interview**<br><br>181: SP: Yeah, I, I definitely see it that way. I think it's really good for the the- it's really good for the students to be involved in grading because it leads them to see uh... uh... encourages them to think of written work in a more objective way which hopefully then will reflect back onto their own written, written work.<br><br>**SP RIT Pre-Class Interview**<br><br>61: I don't know whether it works for everybody, but I think for some students if you say okay, what do you think of this, then their brains start to work in different ways.<br><br>**SP RIT Pre-Course Interview**<br><br>39: doing the various aspects of the course in a, in a conscientious way um… you know… obvious things like doing the readings, attending the seminars , etc, etc.<br><br>39: I think the learner has a responsibility to have a certain uh... attitude to the fellow, fellow students.<br><br>39: I suppose one of the tasks of the learner is to participate in and contribute to a kind of community of learning.<br><br>43: if you can get students to engage in discussion for instance in smaller group setting then, although some students will sort of turn off, others will I think um… learn from either the positives of what their fellow students are saying or sometimes… clarified by hearing versions of the material that are not the hottest.<br><br>45: CW: Like you say, listening to others and using that as part of the learning experience is |

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| Code | Theme(s) | Excerpt(s) |
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| | | really…<br>47: SP: Yeah! I think that does help for, for some students to have that kind of informal discussion of the material. |
| **Personal epistemology**<br>**Beliefs about knowledge and knowing**<br>**Beliefs about the act of knowing**<br><br>The professor discusses what people do when they know or how they know.<br><br>This code departs from 'Knowing in the discipline' in that the professor refers to his/her own personal view and does not refer to the discipline at all. | Social factors affect how people understand:<br>- what one needs to succeed in life.<br><br>In Canada, fairly individualistic outlook, which puts emphasis on having tools of critical reasoning.<br><br>Also certain expectations about sorts of things individuals value.<br><br>We're supposed to value informed critical people.<br><br>Personal autonomy very central in our society.<br><br>Mastery of discipline:<br>- ability to make distinctions<br>- ability to cut through complexity<br>- grasp issue by its roots<br>- not be dazzled by details/superficial components | **SP Long Interview**<br><br>170: DB: Actually, along those lines. Do you think this description is influenced by who you are, your own personal beliefs? And, and if so, what kind of influence is there?<br>172: SP: Um… Prob- probably yes. It probably reflects um… it certainly reflects a… um… not so much a biographical fact but you know a maybe a social fact about um… the way people understand um… what an individual needs to succeed in life ((in a broader sense)) or, or um… in various social contexts ((in a certain narrower sense)) In our society, here in Canada, in 2004, and it is true in many other countries and it has been true for a very long time, we have a fairly sort of individualistic outlook which puts a lot of emphasis on individuals having tools of critical reasoning and um… sort of navigating their way through needing these tools, and also um… there are certain expectations about the sorts of things that individuals ((value, right?)) And we're supposed to value, I mean, um… informed critical people. Both those are elements that go with the value of autonomy. Personal autonomy is very central in our society. So, insofar as I, I guess, am part of that society, and am ((attracted) to that value…<br>---<br>364: how I would Approach knowledge, this knowledge dimension of my discipline, because I also think that… that… a tool for a way of making progress in terms of better mastering a discipline is through an ability to make distinctions and to some extent at least cut through some of the complexity and learn to grab an issue kind of by its roots and not be - to make a metaphor - to be dazzled by all the kind of detail and all those sort of superficial components.<br>366: DB: So, instead of opposing them it's really sort of combining them, combining those two dimensions.<br>368: SP: That's right. |
| **Personal epistemology**<br>**Beliefs about knowledge construction**<br>**Beliefs about how people learn in general**<br><br>The participation discusses issues of learning and knowledge construction that remain general (not about him/her).<br><br>This differs from 'Learning in the discipline' in that there is no relationship to the specific discipline. It also differs from 'Beliefs - learning and learners' in | Less useful/interesting to be told plan beforehand.<br><br>Better to see what's there, then go back and see what structure was.<br><br>Examine differences in arguments after having looked at actual argument. | **SP RIT Post-Class Interview**<br><br>524: Sometimes it's less useful and interesting to... sort of be told the overall plan beforehand, sometimes it's better just to... see what's there and then maybe at the end go back and see, okay, well this is what, this is what the structure was. Or this argument differs from that other kind of argument in these ways, once you've actually looked at the, the argument. |

**Appendix H (Example of aggregated information per professor – SP**



| Code | Theme(s) | Excerpt(s) |
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| that the professors does not specifically address the university setting. | | |
| **Personal epistemology**<br>**Beliefs about knowledge construction**<br>**Beliefs about how one learns specifically**<br><br>The participation discusses issues of learning and knowledge construction that are specific to him/her.<br><br>This differs from 'Learning in the discipline' in that there is no relationship to the specific discipline. It also differs from 'Beliefs - learning and learners' in that the professors does not specifically address the university setting. | Because of academic mindset, has a reading Approach to learning.<br><br>Example: first reaction in trying to learn golf is to read book.<br><br>However, does not feel is best way because need to train body. | **SP Long Interview**<br><br>91: DB:OK. Now, a trickier question: how do you feel you learn new things in general in life? It could be, you know, learning how to drive, learning about parental issues, learning about the arts, whatever.<br>93: SP: Right. I suppose that uh..., being someone with an academic mindset, I probably do learn, I do have something of a reading Approach to learning. Uh... so, even to... an extreme example, and I don't really know if that is a successful example, but for the last few years I've been trying to learn golf.<br>95: DB: OK.<br>97: SP: And... uh... my instinct is sort of to get books-<br>99: DB: Get a book on golf?<br>101: SP: Which doesn't work, of course. But I would say that probably is my... my... my... uh...<br>103: DB: When you say it doesn't work, why do you think it does not work?<br>105: SP: Uh... In that case because uh... you're trying to, you're trying to train your body in certain critical habits and uh... that obviously is something in which learning, learning by doing... perhaps in a sort of controlled way is probably the best way. |
| **Personal epistemology**<br>**Beliefs about the value of knowledge**<br>**Beliefs about the relative value of knowledge**<br><br>The professor discusses the ordering or relative importance of certain types or sources of knowledge.<br><br>This includes a discussion of willingness or not of sharing such knowledge (which provides an idea of the level of confidence one has in his/her knowledge, thus the relative value). | Value experiential knowledge quite highly.<br><br>Hard to compare experiential knowledge and knowledge acquired through course (formal).<br><br>Experiential knowledge, acquired through trial and error and through absorption of other's models cannot be achieved simply through reading.<br><br>Yet still biased towards learning by reading because it's a more effective way of learning. | **SP Long Interview**<br><br>378: DB: So, now if you think of the learning that, over time, you've achieved about all these great ideas, and so the knowledge you've developed, um... how much do you value the general knowledge you developed from experience like this? Personally, what kind of value do you give to that?<br>380: SP: I would say I value it quite highly.<br><br>392: DB: Yes, how much you value this form of knowledge and all... If you were to compare it to other forms of knowledge-knowledge you acquire through a course or through reading and all that-what's the comparative value of this form of knowledge that you acquired through experience?<br>394: SP: Um... *pause 7 sec* Hard, hard to compare. I think it would be - this knowledge through experience, through trial and error, and through absorption of others' models ((of the student)) uh...produces a knowledge that can't be achieved simply through reading about. I believe I wouldn't achieve it by reading and um...<br>396: DB: As in the case of golf...<br>398: SP: Yes. And yet... my views are a little bit contradictory because I am still biased towards learning by reading. For example, it's a more efficient way of learning. |

**Appendix H (Example of aggregated information per professor – SP**



| Code | Theme(s) | Excerpt(s) |
|---|---|---|
| | Attracted to more academic way of learning because seems more efficient/faster way to learn material.<br><br>With regards to teaching political theory, value experiential knowledge probably more than would obtain from reading a book on topic.<br><br>Because one's Approach to teaching has to be indexed to one's personality and capabilities.<br><br>Not discounting what could learn from book or workshop on teaching political theory. | 404: DB: OK. Yet, you value still this form of experiential learning, but if you were given the choice hypothetically of learning about something either way, would you go for a more academic or a more experiential?<br>406: SP: Um… I guess I'm attracted to more academic because it seems more efficient. Um… it seems a faster way to learn material.<br><br>412: SP: Uhh… I'd say both that I value the knowledge I achieve a great deal probably more than I would value knowledge that I could obtain by reading a…<br>414: DB: A book on teaching political theory?<br>416: SP: A book on teaching political theory, that's right. Yes. Um…<br>418: DB: Why is that?<br>420: SP: Well, in part because I think teaching… teaching is a very personal act in which you're opening yourself up to strangers and, therefore, one's teaching… um… one's Approach to teaching has to be indexed, to some extent, to one's own personality and capabilities. Um… but I wouldn't want to say that, I'm not saying that I want to discount what I could learn in a book on teaching political theory or by attending a workshop on teaching political theory. It's the kind of thing actually I would like to attend at some point. |
| **Disciplinary culture and structure**<br>**Socio-cultural characteristics**<br>**Teaching in the discipline**<br><br>The professor discusses how teaching is generally organized in a given domain of knowledge (discipline or area) (e.g., skills targeted by the university teacher for acquisition/development by the learner). This could include any kind of discussion of the training that s/he has received in order to teach in a given discipline: training in teaching per se (i.e., participation in faculty development activities) or training within a given discipline (i.e., doctoral education) if the focus is on how this helps him/her to teach.<br><br>This differs from 'Knowledge - teaching or teachers' in that the professor talks about some form of norm, convention, or rule about teaching that seems to prevail among his/her colleagues teaching that | Has been teaching in political theory/philosophy since 1994 (over ten years).<br><br>Have taught occasional courses that overlap into other areas of political or social sciences.<br><br>Training in teaching political theory include:<br>- exposure to materials other people think are important and are part of the curriculum of teaching in this area<br>- take up positive and negative examples of teaching practice | **SP Long Interview**<br><br>19: DB:Doesn't matter? OK. Um… how long have you been teaching in political theory/political philosophy?<br>21: SP: Uh… since 1994. So, ten years.<br><br>23: DB:Ten years. And, have you ever been teaching in other areas apart from that? Or was it almost within…<br>25: SP: M…mostly within that area. I have taught the occasional course which overlaps into other areas of political science.<br>27: DB:OK.<br>29: SP: Or social sciences.<br><br>39: DB:And, what kind of training have you received that has contributed to your sense of competence uh… in that disciplinary area?<br>41: SP: Training as a teacher?<br>43: DB:To teach political theory.<br>45: SP: OK. Most obviously training in the discipline itself by getting a masters and PhD.<br>47: DB:OK.<br>49: SP: Um… and that exposes you to certainly the materials that other people think are important |

**Appendix H (Example of aggregated information per professor – SP**



| Code | Theme(s) | Excerpt(s) |
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| discipline. | Studied something different as undergraduate so cannot draw from that. | and are um… part of the curriculum I guess for some of the teaching in this area. Um… you of course also take up positive and negative examples of teaching practice by being a student yourself ((?)). In my case a graduate student. As an undergraduate I studied something quite different so I didn't have that to draw on. |
| | Attended certificate program in university teaching when in the UK.<br><br>Attended a series of workshop on pedagogy offered at McGill's CUTL. | 53: SP: And then, I also when I started off teaching, this was still in Britain, at the University of Exeter, I attended for I think it was one year, it might have been two years, a series of workshops, kind of a course I guess-<br>55: DB:Kind of a certification program they had-<br>57: SP: -we do a, um…a certificate which was relevant for renewal at the end of the three-year process uh… period.<br>59: DB:OK.<br>61: SP: Um… That was actually quite a good course, in retrospect. It wasn't the sort of thing that I enjoyed so much at the time, although I quite liked the person who was the instructor, but actually I think I learned a fair amount from that. And I also attended a handful of workshops that are pedagogy-centred offered by the Centre for University Teaching and Learning. |
| | Informally ask colleagues.<br><br>Talked to people in a more sustained way about how they do certain things. | 73: SP: Uh…That's a good question. How do I learn new things as far as teaching and learning. Um… I'd still say that the main, the main way which I feel I'm learning about that is by better learning my discipline.<br>75: DB:OK.<br>77: SP: Um… So, to me I'd, I'd say it's, it's almost still an extension of what I started learning as a graduate student. Uh… I'm surprised how long that, that continues on but I think the better one masters the substance of one's discipline at least the better, I find, I'm able to organize the material and to sel- select materials in such a way that it will be maximally possible for students to, to learn that. I guess I learn about what to do in the main by uh… uh… continuing to learn my own discipline. Um… and then a second factor for me has always been comparing work with other colleagues, the practice of other colleagues.<br>79: DB:Do you… and how do you do that-compare work with other colleagues?<br>81: SP: Um… either informally asking them how they, how they Approach certain teaching challenges. I've done a few visiting lectures and so that's usually an opportunity to talk to people in a more sustained way about how they, how they do that. So, I picked up tricks, PowerPoint presentation, and that kind of thing.<br>83: DB:When you say picked up, what do you mean…?<br>85: SP: Well, I've sort of learned the utility of certain tools and methods. |
| | Teaching in my discipline more on tools and less on | 140: SP: Um… I think in some disciplines, professors place more weight on imparting knowledge and less on the, the tools. Um… so the fact that mine is more on the tools and less on the knowledge here… |

**Appendix H (Example of aggregated information per professor – SP**



| Code | Theme(s) | Excerpt(s) |
|---|---|---|
| | imparting knowledge.<br><br>Three elements I would regards as elements of good teaching in general (across the university):<br>- the knowledge,<br>- the tools,<br>- the motivation<br><br>I would expect that different disciplines would put more or less weight on those.<br><br>In my field, giving them tools and exciting them about he subject more important than the knowledge.<br><br>In the humanities, age-old debate between knowledge and wisdom, and eloquence (i.e., what you know and the presentation of what you know).<br><br>The better you will be able to intelligently select and organize the material that you want to present to the students.<br><br>Knowledge of your discipline is a necessary not a sufficient condition to be able to teach the discipline well.<br><br>Teaching itself requires you to think about a whole set of issues related to the students' experience of what you're doing. | 142: DB: Your reference, reference to the humanities there [in the comment from Fall 2000].<br>144: SP: That's right. Yeah. Uh… I think that in fact does, or at least towards humanities and social sciences as opposed to perhaps certain hard sciences-<br>146: DB: Natural-<br>148: SP: Natural sciences, that's right. Um… I don't, I don't know, it's speculation. Um… in terms of exciting students about the discipline I don't think that's something that should be regarded as specific to the discipline.<br>150: DB: So, the tools yes. But not so much the, the uh… motivation and excitement.<br>152: SP: Well, I think all three elements-the knowledge, the tools and the motivation-I would regard as elements of good teaching in general-<br>154: DB: Across the university-<br>156: SP: Across the university. Um… but I would expect that in different disciplines, more or less weight would be put on those.<br>158: DB: OK. And in the case of your discipline, if I hear you correctly, you're saying that the "tools" is probably more important than imparting knowledge or exciting/motivating students.<br>160: SP: I would say giving them the "tools" and "exciting them about the subject" are more important than the knowledge.<br><br>---<br><br>180: SP: Um… That's interesting. Uh… uhh… that uh… question is actually connected with something which is itself part of the content of my, my discipline because there is an age old debate, I guess in the humanities, about the relationship between what sometimes gets called knowledge and wisdom and eloquence. So, one is substance, and what you know, and the other is the presentation of what you know in an accessible and persuasive way. And, I think that over, over time, I have become more, more convinced that there is an important difference between those two. You can know your subject inside out but really be quite bad at um… teaching it. And not particularly ((um reflect a)) person that that's the best way of teaching it. So, I think there is a distinction.<br>182: DB: So, there is a distinction, a difference. And if you were to try to identify one or two similarities or differences, what would those be?<br>184: SP: Um… I think the similarity would be, something I mentioned earlier, the better you know your own discipline, um… the better you will be able to intelligently select and organize the material that you want to present to the students. So, that… knowledge of your discipline is a necessary not a sufficient condition to be able to teach the discipline well. Um… but a difference would be that teaching itself requires you to think about a whole set of issues related to the students' experience of what you're doing. Things like what is their likely backgrounds, um… even trivial sounding things like how are they experiencing your ((authority)) in the classroom. Are you maintaining their um… attention? Are you getting them to actually think in an active way or is it very passive? So there is a whole, to me there is a whole sort of set of issues that are distinct from knowing the discipline.<br>186: DB: So, if I understand you correctly, in one case it's, it's the discipline itself and in the |

**Appendix H (Example of aggregated information per professor – SP**



| Code | Theme(s) | Excerpt(s) |
|---|---|---|
| | Learn from experience by seeing what works in the classroom and what doesn't.<br><br>Mill is probably generally taught as a distinct view and that's accomplished probably by contrasting his view with other well known theorists, not necessarily Plato's work or Rousseau's.<br><br>My graduate experience in political theory:<br>- most professors' Approach was to to treat a class as giving a paper at an academic conference,<br>- mode of teaching that really emphasized passing on knowledge without a lot of thinking about how best to communicate that knowledge<br>- I have probably drawn on that since it probably is the heavy bias in my discipline in terms of how people think about teaching.<br><br>If I do not know the materiel inside out, things do not go well.<br><br>Knowing the materiel well has led to less negative teaching experiences.<br><br>Learned a lot from experience. | other case it's the discipline but in relation to these issues. Is that what you're saying?<br>188: SP: It's communicating some of the content from the discipline to people who have different backgrounds, um… who have perhaps um… suspicions about who you are in telling them this stuff, and who have other things on their mind, right? And who are into other interests. Easily distractible.<br><br>204: I guess those are things that you partly judge by some experience, by seeing what works in the classroom and what doesn't.<br><br>328: Um… I would not say it's always taught this way. In fact, although Mill is always thought as having a fairly extreme view on freedom of expression or particularly distinctive views-I don't want to use the word extreme. Um… and so, I assume that it's generally taught as having such a distinct view and that's accomplished probably by contrasting his view with other well known theorists, not necessarily Plato's work or Rousseau's.<br><br>348: Um… so, for example, um… on the emphasis of really knowing the subject matter, knowledge of the subject matter, um… certainly as a graduate student-I don't know if this is your experience as a graduate student-but as a graduate student in political theory that was really what almost all of my teachers did. Right, so their Approach to teaching was just to get up and um… treat a class as if it was giving a paper at an academic conference. Um… and so, that, that was, to some extent, a mode of teaching that really emphasized um… passing on knowledge without a lot of thinking about how that knowledge would be best um… best communicated to the students. Um… and um… so, I have probably drawn upon that since it is probably the heavy bias in my discipline in terms of how people think about teaching.<br><br>348: but also at sort of, kind of the other end, my experiences of teaching things where I didn't know the material inside out is that the classes don't tend to go well. Students ask you things and, since you don't really know the, the material as well as you should perhaps, you can't answer the questions as clearly.<br><br>348: So, I find that really knowing the material um… over time has led to less um… perceived negative teaching experiences.<br><br>354: DB: "My experience as a professor." Um… would you be confident saying that you're learning to combine these things through experience, in various capacities or …?<br>356: SP: Yes. I think that is, that is largely true especially um… this knowledge component that we've been talking about.<br><br>356: I think some of the other elements which weren't emphasized in my experience as a graduate |

**Appendix H (Example of aggregated information per professor – SP**



| Code | Theme(s) | Excerpt(s) |
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| | Elements that were not emphasized in experience as graduate student, did learn in more pedagogical settings (learning seminars and workshops). | student, I did learn in a more um… pedagogical setting, going to these teaching and learning seminars and workshops, and um… being made to think about, a little bit more about the non-knowledge components of teaching, or even to uh… to think about the learning and teaching. |
| | One thing my teachers were particularly good at that I came to value a lot: striving for clarity of expression, clarity of exposition research and teaching. | 370: DB: And, did you come to this realization suddenly one day?<br>372: SP: That I got from my experience as a graduate student. That's one thing my teachers were particularly good at that I came to value a lot, that is um… a striving for clarity of expression, clarity of exposition as a… both a norm of doing the discipline itself, doing research in the discipline, um… and then also as a norm of what to strive for in teaching. |
| | Colleagues are fairly receptive to discussions about teaching. | 422: DB: Um… how much do you feel your colleagues would value this type of knowledge coming from you first? How receptive would they be to hear you talk about your experience?<br>424: SP: Um… reasonably receptive-these are the kinds of things we talk about in informal environment. |
| | Standard point about and reactions to Mill's ideas. | **SP RIT Post-Class Interview**<br><br>218: SP: It was a question about, uh... example of a heroine... uh... user... and whether or not, um... laws against... that that criminalized drugs like heroine were always um... uh... for the good of the drug user or whether they would bring harm to the rest of society. Uh... which is sort of a standard question about Mill, so it was good to get that question first because it sort of allowed me to make, uh... a point that I wanted to make then I think that I could refer back to that question on several-<br>220: CW: Was that her example, or is that one from your readings, the heroine use.<br>222: SP: Uh... it's not from the readings, but I used the example of de- , decriminalizing drugs... a few minutes... before.<br>226: SP: Yeah, it's sort of a standard persp- , standard reaction I guess when people... read the text. |
| | Typical questions and criticisms. | 295: the uh... question about, the, the first question about uh... the example of drug usage is a, is a sort of standard reaction. Which I'm going to return to I think in, in another lecture.<br><br>630: so having done it once, and we've done it really quickly, summarize for the next time we'll be ready with some... typically they'll be ready with some questions or some quick criticisms. |
| | A lecture is normally about 45 minutes. | 687: Normally I mean a lecture I guess is about 45 minutes with all the… a classroom of this size with all the coming and going<br><br>**SP RIT Post-Course Interview**<br><br>3: I think the goals are goals that are pretty widely accepted in the profession or in the discipline as |

| Code | Theme(s) | Excerpt(s) |
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| | Goals of course are pretty accepted in the profession or in the discipline. | things that you just have to get the students to start doing right from their first year, um... particularly you know if they're going to pursue further courses in the area that I teach in, political theory, but for other arts subjects or other aspects of political science as, as well.<br>---<br>**SP RIT Pre-Course Interview**<br><br>27: To me the most important task is probably... uh...to give uh... students certain tools that they can then hopefully use throughout their lives, tools of being able to uh... read and interpret texts uh... tools about making arguments, tools about...uh... tools relating to critical... uh... critical reasoning, and tools relating to communications. So, obviously, written communication but also being able to make presentations or respond to presentations made by, made by other people. |
| | Teach in the discipline is to give students certain tools that they can hopefully use throughout their lives:<br>- critical reasoning<br>- communications (oral and written) | |
| **Disciplinary culture and structure**<br>**Socio-cultural characteristics**<br>**Learning in the discipline**<br><br>The professor discusses what learning in a given domain of knowledge (discipline or area) generally entails (e.g., skills development by the learner). This may include a discussion of how the professor goes about learning new materiel related to her/his discipline or field of knowledge.<br><br>This code differs from 'Knowledge - learning and learners', 'Beliefs - learning and learners', 'Beliefs about how people learn', and 'Beliefs about how one learns' in that the professor talks about some form of | Learn mainly by reading, and to a lesser extent by hearing people talk or through discussion. | **SP Long Interview**<br><br>87: DB:OK. Now, you've covered this a little bit but how do you feel you learn new things in your discipline as opposed to teaching your discipline?<br>89: SP: Um... mainly, mainly by reading and uh... to a lesser extent by hearing people talk, either formally at a conference or informally by having substantial discussions with someone.<br>---<br>356: being made to think about, a little bit more about the non-knowledge components of teaching, or even to uh... to think about the learning and teaching. Which I don't think is the first instinct of people who've just been graduating... in my discipline anyways.<br>---<br>398: my views are a little bit contradictory because I am still biased towards learning by reading. For example, it's a more efficient way of learning.<br>400: DB: Is that um... because people learn that way in your field or...? Or is that because you personally prefer that-remember you talked about it earlier, you said that, "my first reaction is to go |
| | Does not know if learning through reading specific to field. | |

| Code | Theme(s) | Excerpt(s) |
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| norm, convention, or rule about learning that seems to prevail among his/her colleagues teaching that discipline and/or students learning that discipline. | | with a more academic type of learning."<br>402: SP: Yes. Um… I don't know whether it's very specific to my field - I wouldn't guess that it is very specific to my field. |
| | Certain questions essential for learners in this field. | **SP RIT Pre-Class Interview**<br>19: These are important questions that um... that undergraduates sort of starting out in a subject uh... would benefit from being exposed to. |
| | Learning in field requires somewhat simplified version to start from. | **SP RIT Pre-Course Interview**<br>43: I teach fairly… I teach political philosophy which can be fairly abstract and the… at times could be fairly difficult so I think that for many students important part of the learning process is to have a perhaps a somewhat simplified version of what they're expected to learn set before them that they can at least uh… start from. |
| | Important to learn foundation concepts first. | 264: I want them to have some knowledge of these basics sorts of issues, the concepts, the content of what these different theorists thought um… because I guess it's a foundation of a lot of political science and thinking about pol… thinking about politics even in Western, Western societies you need to have some basic conceptual tools in your tool kit. |
| | Basic conceptual tools acquired through reading. | 264: I think they acquire some of those tools, at least in the knowledge sense, from reading some of these texts. |
| **Disciplinary culture and structure**<br>**Socio-cultural characteristics**<br>**Knowing in the discipline**<br><br>The professor discusses how knowledge or thinking is generally seen within his/her discipline or how certain forms of knowledge or thinking are valued more than others within his/her discipline.<br><br>This code differs from 'Beliefs about the nature of knowledge', 'Beliefs about the act of knowing', 'Beliefs about the relative value of knowledge', and 'Beliefs about how to evaluate' in that here the professor refers specifically to his/her discipline of instruction whereas in the other categories s/he is | Modes of reasoning different in theory course | **SP RIT Pre-Course Interview**<br>252: the modes of, of reasoning are a little bit different for a theory course than they would be um… for other social sciences courses |
| | Different modes of reasoning in political theory | 264: understanding what an argument is like in political theory because you don't necessarily present facts in order to prove a point or in order to refute a point. Theoretical arguments work in different ways. You use examples and counterexamples and um…They sometimes set up though experiments, and so forth. So, there's a different mode of reasoning. |

**Appendix H (Example of aggregated information per professor – SP**



| Code | Theme(s) | Excerpt(s) |
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| concerned with knowledge and knowing outside of any particular discipline. | | |
| **Disciplinary culture and structure**<br>**Epistemological characteristics**<br>**Description of the discipline**<br><br>The professor describe his/her discipline with regards to knowing, teaching, learning, or researching. This could have to do with the complexity, difficulty or mere nature of the discipline or profession. | Political philosophy can be:<br><br>- dry (Mill)<br><br><br><br><br>- abstract<br>- at times fairly difficult | **SP Long Interview**<br><br>296: Because actually when you read Mill, it's rather dry. The style with which he develops his argument is sort of crisp logical distinctions that he makes.<br><br>**SP RIT Pre-Course Interview**<br><br>43: I teach fairly… I teach political philosophy which can be fairly abstract and the… at times could be fairly difficult. |
| **Disciplinary culture and structure**<br>**Epistemological characteristics**<br>**Organization of the discipline**<br><br>The professor discusses how the discipline is organized, that is, what the main branches and/or sub-branches of the discipline are, and how those may have evolved over time. | Political theory vs. political philosophy<br><br>- location of employment<br><br>- methodological differences | **SP Long Interview**<br><br>9: SP: Yep! You can call… I think of myself either as a political philosopher or a political theorist.<br>11: DB: OK. Do you see any difference between the two?<br>13: SP: Uh… It's complicated. Roughly speaking, political philosophers tend to um… be employed in philosophy departments and political theorists in political science departments. And there are some methodological, minor methodological differences that go, go with that but there isn't a huge difference. I don't think I would say there are differences as far as teaching is concerned. |

## Knowledge base for teaching/Goals related to teaching

Course-level goals:

SP seems to have two sets of goals. On the one hand, he has goals that are closely related to the content. Those would include:

- to introduce students to political theory by looking at classic texts; and
- to help students learn to interpret texts, which involves getting them to pay attention to the detail of texts, and comparing texts.

On the other hand, SP entertains goals that are not necessarily specific to the content per se. These would include:

- wanting learners to engage with ideas;
- helping learners set ideas out in analytical way;
- helping learners think critically about ideas; and
- helping learners develop effective written and oral communication skills.

Because all those goals are linked to core aspects of discipline, SP believes they are not likely to change easily. Nonetheless, availability of resources such as the number of teaching assistants are likely to affect goals.

What is evident in the goals SP discusses is the fact that he wants learners to think actively, he does not want them to be passive.

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SP is interested in going over the content he has set out to cover. In the case of this particular class, he wishes to go over Mill's harm principle and his views on freedom of expression.

With regards to this specific goal, SP wishes to emphasize to the students how interesting and important the topic is. More specifically, he wishes to do that by connecting it with issues of interest to the students.

Simultaneously, SP continues to reinforce some of the course-level goals he entertains, such as:

- helping the students to think critically about aspects of arguments;
- helping students make distinctions between different elements in the argument; and
- engaging students a little bit.

Ordering of goals:

SP finds it particularly difficult to rank them as each is important in its own ways. However, three goals appear to be particularly important to him:

- to be able to communicate effectively, both orally and in writing;
- to have basic knowledge of different ideas and issues; and
- to be able to think critically.

Accomplishment of goals:

SP feels that students understood well the materiel covered in the particular class and that he did what he was set out to do. However, he finds it hard to accomplish his goals in one lecture or even series of lectures. He also finds it hard to assess achievement in such a short period of time (i.e., after a class). SP feels that achievement of goals can only be measured at the end of a course.

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SP described the overall theme of the course as the relationship between the individual and the community. The purpose of the course is thus to examine three prominent political theorists who have conceptualized that relationship as these are important building blocks of political theory.

The focus of the course is thus on the relationship amongst three authors talking about similar issues, namely Plato, Rousseau, Mill. The standpoint of each of those authors is quite different though. For instance, Plato and Rousseau adopt a pro-censorship position in the name of public interest whereas Mill challenges that way of thinking about expression.

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SP feels that the nature of this content calls for certain specific strategies for teaching. For instance, he emphasized a form of sequence in which the authors were approached (i.e., Plato, Rousseau, Mill). This enabled him to contextualize the authors in relation to one another. Furthermore, it enabled SP to contextualize the topics in relation to controversies of today.

Knowledge of teaching and teachers:

SP has over 10 years of teaching experience — seven at the time of the first interview in 2001. he has taught at McGill University and, prior to that, at the University of Exeter, in the United Kingdom. he has taught this particular undergraduate course for at least three times. his classes normally attract between 200 to 300 students.

For SP, teaching comprises three distinct elements: the organization of the materiel in his mind before class; the presentation of materiel to the students; and the interaction with the students. In addition, SP finds that clarity of presentation is not the whole story about teaching; one must also take into consideration the students' point of departure, stimulate their interest by showing the relevance of concepts, motivate them, and prod them to think critically about the materiel.

When designing instruction, SP tries to organize the material and to select materials in such a way that it will be maximally possible for students to learn that. In doing so, he emphasizes clarity and simplicity of organization although he makes sure not to be sacrificing the complexity of the ideas. SP feels it is important for him to know the materiel well in order to make judgments about simplifying the exposition. Not knowing the materiel could potentially lead to organization problems, such as incompleteness, inconsistency, or lack of flow.
As he intends to give the students a point of departure for the discussion, SP feels that the selection and ordering of materiel for class depends on the state of their knowledge about the subject matter. Any decision about topics for discussion need to be made in relation to what would be useful for the students' understanding.

SP also talks about how examples are sometimes chosen in advance and sometimes decided on the spot. The problem he sees with the latter is that they may not be best or most appropriate. However, this is what happens when one allows for interaction. And SP is quite happy to entertain questions, challenges, and/or discussion. However, he feels that it sometimes seems nice to have interaction but it may interfere with the flow of the lecture.

What SP finds particularly important is to begin with the teaching goals or learning outcomes. Then, he looks for ways to unlock the doors to the students' understanding (e.g., through examples). As such, he reinforces what he is trying to do by connecting strategies to outcomes. Thus, SP tries to make clear the relationship between assignments (e.g., essays) and the explanations he provides in class. Simultaneously, SP likes to have something different maybe halfway through the lecture.

SP is open to tactical changes in his instructional strategies. For instance, he reviews notes from previous years and chooses what worked well over what did not work well. Most technical changes are made before the course actually starts. However, most content changes are made during the actual course. Very often, changes are based on students' comments from previous years. And to accommodate for such changes, SP leaves room to fall behind in the course (i.e., he has built a whole day for catching up).

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Lecturing is an important strategy for SP. This is because some of his goals/outcomes are concerned with knowledge and understanding of the materiel. So, he would normally start off by looking at text and provide an exposition of some author's views. During such exercises, SP tries to model skills to be acquired by the students. One such skills is the ability to identify positions and contrasting amongst authors. To model this, SP often introduces contemporary controversies to remind students that such issues are not obvious (i.e., that there are normally two sides to the issue).

When lecturing, SP feels that pacing as very important factor. he feels that a good pace is when he is not rushing over anything important, he can repeat points to accentuate certain aspects, and he can give illustrations of the points he makes. SP feels that the right pacing enables him to go back to a topic if he feels that it was not covered appropriately/sufficiently. On the other hand, if he senses that things go well over time, he might spend more time and re-articulate it.

After the lecturing portion of the class, SP normally invite students to criticize or object to/challenge the class materiel. he uses this mode of questioning/interaction because he is not sure how effective a discussion would be in a class of 300. Therefore, he lets students ask questions and tries to answer them. SP feels that getting those questions allows him to make a point that he wanted to make. he also feels he can refer back to that question if needed. However, SP feels a little unsure about how to handle "incorrect" answers from students during class time. he may say that the answer is not the best or he may redirect it to class. The latter is something he feels he should be doing more often.

SP also tries to use contemporary examples in his teaching. Such examples are things he hopes students will be able to identify with. As such, the purpose of examples is to get students interested in the discussion itself and to give students a resource for critically evaluating an author or his work.

<u>Knowledge of learning and learners:</u>

SP feels that knowing who the students are involves knowing what their background is, what their points of reference are, what examples are meaningful to them, and what will gear up their enthusiasm. This is a particularly difficult task as there is a variety of backgrounds amongst students. However, he is pretty confident about certain dimensions. For instance, he can expect that second year students will be able to write an essay. This is because students would have picked some notions or concepts prior to coming to his course or class. In addition, students already have opinions on which they can draw. And on that matter, SP feels that students tend to have fairly strong opinions. Maybe this is because students tend to be quite goal-oriented.

On the other hand, SP finds that a lot of students are not good at extracting points from a conversation or a seminar. Whereas some students listen to fellow students and come to the next

class with questions or quick criticisms, other students sometimes turn off during their colleagues' questions. And SP finds it easy to see when students are not engaged. In those instances, there tends to be less eye contact, less note taking, more rustling, and less concentration.

SP feels that students accumulate knowledge gradually, over the course of degree. There is therefore a noticeable difference between their knowledge at the start of their degree and upon graduation.

For SP, students learn from the lecture and they are able to learn from each other. In fact, he feels that students learn best when they are told about the course expectations and that assessment of the course is linked to those expectations.

However, SP feels that learning is not necessarily easy. Some students find it particularly difficult because the modes of reasoning are different in a theory course. As such, students cannot memorize a bunch of facts nor reproduce those facts in a multiple choice exam. Rather, students have to read the text over and over again to figure out what the arguments are. This is because, SP believes, it is easier to appreciate an author after seeing what he's done rather than in anticipation.

SP feels he has access to a range of kinds of evidence of learning, from some that is more instantaneous (i.e., questions) through to some that is more long-term (e.g., final exam).

SP considers sort-term evidence of learning to comprise questions asked during class and questions from after the lecture. he feels he can get a sense that students are struggling through a conversation with them in either of those settings.

SP considers longer-term evidence of learning to correspond to a qualitative assessment of how students do in the various activities in which they are being assessed. This might comprise their level of understanding and engagement with the material shown in their essays; to what extent the students are meeting the objectives of the final exam; reports from TAs about students' understanding during the conferences; and written comments of the student evaluation. With regards to the latter, SP finds it starts to be interesting when sees patterns.

<u>Knowledge of assessment of learning:</u>

SP's approach to assessing learning is to examine how well students are achieving the goals of the course as opposed to merely getting them to reproduce the material of the course. As such, SP has deep reservations about the use of multiple choice, in particular as in political theory that would encourage the students only to learn facts. Rather, SP uses essays. However, essays are not normally used in large classes. This is because, in a large class, having students write three essays puts a lot of strain on SP and his TAs. SP feels that, too often, lack of resources leads university professors to a second best option (i.e., poorly designed multiple choice exams).

SP's approach to assessing takes a bit longer than normally. This is because he is quite concerned with reliability of assessment (i.e., making sure everyone is judging with similar

standards). In the past, he has encountered issues of reliability amongst the graders. he has settled this in two ways. On the one hand, he now has the same TA grade all of a student's essays. On the other hand, he has established procedures for reliability in grading. For instance, he uses a feedback sheet that has six or seven criteria of a good essay. In addition, he grades essays with TAs and discusses general patterns or weaknesses.

To SP, assessment has to be part of the planning process. For instance, it is important for SP to connect his expectations at the final exam back to the aims of the course. He also communicates such expectations throughout the course, mainly through feedback to the students, both oral (i.e., in class) and written (i.e., on the standardized feedback sheet). In addition, SP assesses conference participation.

Through those various assessment methods, SP has been able to identify two usual weaknesses of students in his class:
- the inadequate use of primary texts; and
- a tendency not to support statements with references/citations.

Knowledge of curricular issues:

SP finds that the acts of designing and delivering a course have a collective nature. This is because the choice of course materiel has to be done in relation to the broader curricular materiel (i.e., what colleagues would end up teaching in their courses).

Knowledge of human behaviour:

SP feels that the size of the class affects his sense of what is going on in the class. This has to do with how students react to what he says and whether he is loosing them or not. In large classes, he feels that there is much more doodling and chatting. Furthermore, as students tend to spread out in class, SP feels less connected with them as a result. And this constitutes a problem for him because, for instance, eye contact is important in terms of visual cues (i.e., the other person looking perplexed or not). In a large class, SP feels he is loosing some of that eye contact.

Large groups are problematic for SP because he has students do presentations. This is because, he feels, presentations do not foster genuine discussion as people not presenting tend to tune out. Overall, SP feels that big lectures do not enable him to be impressed by how smart the students actually are.

Knowledge of the physical environment:

With regards to the classroom in which he teaches, SP feels quite frustrated. He finds it too big and too wide. In addition, the hallway produces noise and he cannot ensure that doors remain shut.

Overall, SP finds it difficult to teach in that classroom mainly because:
- it is harder to sustain students' attention as they are spread out all over the place;

- the width of the auditorium makes it difficult to establish eye contact with people on both left and right;
- getting the class to order is also much more of a challenge;
- he feels constrained to use the overhead rather than the board as people cannot see the latter

**Knowledge base for teaching/Beliefs related teaching**

Beliefs about the purpose of instruction:

SP emphasized that the main purpose may not be to remember content but rather for students to acquire certain tools. One of such tools is curiosity as a habit of mind.

Beliefs about the conditions for instruction:

SP finds that the size of a class plays an important role in instruction. Hs ideal size for a seminar is about 12 or 15 students.

Beliefs about teaching and teachers:

SP sees the role of the university teacher as being predominantly about motivating and exciting students. In that sense, imparting knowledge is not the most important part of university teaching; it is more important to give students certain lifelong tools or skills. But to do that, it is essential to clearly identify the point of departure of students, where they are at when coming into your classroom.

In addition to exciting students and encouraging them to acquire lifelong skills, good university teaching would include turning one's goals into specific expectations and linking those expectations to assessment. So, mere clarity or simplicity of presentation is not the whole story of teaching. Whereas it may be helpful for students to have basic elements of a theory clearly laid out to them, students might get irritated when, for instance, a lecture is too slow. Simultaneously, because students are goal-oriented, making goals concrete would encourage/help learning. Therefore, university teaching is much more complex than many envisage.

Beliefs about learning and learners:

SP believes that it is not so important that learners remember facts. Rather, he tries to get students to think about the materiel. he does that by asking them what they think, so that their brain works in a different way (i.e., less passive). Another way to help learners think is to get them involved in grading as this encourages them to be more objective about written work which, hopefully, can be reflected back onto their own work.

However, SP feels that for learning to happen, university learners must do certain aspects of the course in a conscientious way. This would include:

- doing the readings,

- attending the seminars, and
- adopting a positive attitude to fellow students.

SP puts a lot of emphasis on the discussion of course materiel amongst learners, either formally or informally, as he feels this helps some students. More specifically, this helps students in that they learn from their peers' comments, in particular in that they may obtain clarification of their own understanding.

However, when engaged in small group discussions, some students will sort of turn off. It thus comes down to their responsibility in participating/contributing to the community of learning.

**Personal epistemology/Beliefs about knowledge and knowing**

Beliefs about the act of knowing:

For SP, knowing means mastery of a subject or discipline. This involves the ability:
- to make distinctions;
- to cut through complexity;
- to grasp an issue by its roots;
- not to be dazzled by details or superficial components.

**Personal epistemology/Beliefs about knowledge construction**

Beliefs about how people learn in general:

SP believes that it is less useful or interesting for a learner to be told about the structure before the learning takes place. Rather, he believes that it would be better to see what's there, and then go back and see what the structure was. For instance, SP believes that it is better examine the differences in arguments after having looked at the actual arguments.

However, in the member-checking interview, SP specified that those beliefs were actually about teaching, but that, in his mind, they were related to learning.

Beliefs about how one learn specifically:

Because of what he described as an ''academic mindset'', SP believes he has a reading and responding approach to learning. As an example, he explained that his first reaction in trying to learn golf was to read book about golfing. However, SP does not feel this is the best way to learn golf because he would need to train his body in the actual motions involved in golfing.

**Personal epistemology/Beliefs about the evaluation of knowledge**

Beliefs about the relative value of knowledge:

SP appears to value experiential knowledge quite highly. However, he finds it hard to compare experiential knowledge with more formal knowledge (i.e., acquired through a course).

SP recognizes that experiential knowledge, being acquired through trial and error, as well as through absorption of other's models, cannot be achieved simply through reading. Yet, he is still biased towards learning by reading because he finds it to be a more effective (i.e., efficient and faster) way of learning.

In that sense, with regards to teaching political theory, SP values experiential knowledge probably more than the knowledge he would obtain from reading a book on the topic. However, he is not discounting what he could learn from a book or workshop on teaching political theory.

**Disciplinary specificity/Socio-cultural characteristics**

Teaching in the discipline:

SP has been teaching in political theory/philosophy since 1994 (over ten years). He has taught occasional courses that overlap into other areas of political or the social sciences. His training in teaching political theory includes:

- exposure to materials other people think are important and are part of the curriculum of teaching in this area;
- positive and negative examples of teaching practice in this area;
- attending a certificate program in university teaching when he was teaching in the United Kingdom; and
- attending a series of workshops on pedagogy offered at McGill's CUTL.

SP's experience as a graduate student in political theory was one source of information about the teaching of his discipline. There, he saw that most professors' approach was to treat a class as giving a paper at an academic conference; and the main mode of teaching was one that really emphasized passing on knowledge without a lot of thinking about how best to communicate that knowledge. SP feels that he has probably drawn on that since it probably is the heavy bias in his discipline in terms of how people think about teaching.

In addition to learning about teaching political theory through more formal channels, SP has learned from experience by seeing what works in his classroom and what does not. He also talks to colleagues in a more sustained way about how they do certain things. With regards to that, he feels it is acceptable in his field to ask how one's course is going but it would not be accepted to criticize one another. Over the years, SP found that people like to talk about their students (i.e., what they think of them) which tends to reveal some of their thinking about teaching.

With regards to teaching in his discipline, SP feels the emphasis is more on tools and less on imparting knowledge. According to him, three elements would constitute good teaching in general (across the university): the knowledge, the tools, and the motivation. SP would expect that different disciplines would put more or less weight on each of those. In political theory, SP

feels that giving them tools and exciting them about the subject is more important than the knowledge. Such tools comprise critical reasoning and communications (oral and written).

This is particularly in line with the age-old debate, in the humanities, between knowledge and wisdom, and eloquence (i.e., what you know and the presentation of what you know). This means that knowledge of your discipline is a necessary but not a sufficient condition to be able to teach the discipline well. For instance, one has to be able to intelligently select and organize the material to be presented to the students. This is actually one thing SP feels his teachers were particularly good at, which he came to value a lot: the idea of striving for clarity of expression, clarity of exposition in both research and teaching. Therefore, teaching itself requires one to think about a whole set of issues related to the students' experience of what one is doing.

With regards to content, SP feels that knowing the materiel well has led to less negative teaching experiences. On the other hand, if he does not know the materiel inside out, things do not go well. More specifically about the content of the course, SP feels that there are typical questions and criticisms, or standard points about and reactions to the works examined. For instance, Mill is probably generally taught as a distinct view and that is accomplished probably by contrasting his view with other well known theorists, but not necessarily Plato's work or Rousseau's.

Learning in the discipline:

SP emphasized the preponderant role of reading in learning in political theory. he argues that most people in his field would tend to learn about the subject matter through readings and, to a much lesser extent, through hearing people discuss various topics. This would explain why people in political theory are somewhat dismissive of the value of conferences.

SP added that he does not know if learning through reading is specific to his field. However, most people teaching in his field do try to get the students to read more in order to learn. This is because, he emphasized, certain questions or foundation concepts are essential for learners in this field. Those pieces of fundamental knowledge — conceptual tools — should thus be learned first, mainly through reading.

SP explained that the nature of political theory meant that the teaching and learning of was quite different. he compared it to economics, as field he has taught at the early undergraduate level. SP argued that economics is more about building blocks (i.e., learning takes place in a cumulative fashion) whereas political theory does not work quite like that. Rather, political theory is learned through a series of fundamental concepts that run parallel to one another.

Knowing in the discipline:

SP emphasized the fact that reasoning in political theory is different than in many other fields or even in other sub-fields of political science. This is because in many of those instances the model is to formulate hypotheses and then proceed with empirical testing of those hypotheses. Thus, knowing takes the form of empirical confirmation or verification.

In a theory-inclined field, such as political theory, people are most often dealing with questions that are basic concepts or tools that will go into hypothesis or propositions for empirical tests. So, the modes of knowing are rather detached from anything empirical. One example in political theory is the notion thought experiment as a form of reasoning or knowing.

## Disciplinary specificity/Epistemological structure

Description of the discipline:

During the various interviews, SP emphasized the fact that political theory can be dry — in particular Mill, and abstract. he added that materiel in the field could at times be fairly difficult.

In a member-checking interview, SP added that students of political theory often think that they have a good understanding of issues at first glance. However, those issues are not necessarily as easy as students may believe.

In the same interview, SP added that the notion of difficulty is not specific to political theory. Other parts of political science (e.g., modelling) can be dry and abstract but not in the same way.

Organization of the discipline:

With regards to the organization of his discipline, SP explained that political theory is a subfield of political science and that it is very close to political philosophy, a subfield of philosophy. However, he added, the two fields differ along two lines:

- physically (i.e., their location within departments of political science vs. philosophy);
- methodologically (i.e., political theorists tend to work on empirical questions whereas political philosophers tend to work on theoretical or analytical questions.

## Knowledge base for teaching/Goals related to teaching

Course-level goals:

SP seems to have two sets of goals. On the one hand, he has goals that are closely related to the content. Those would include:

- to introduce students to political theory by looking at classic texts; and
- to help students learn to interpret texts, which involves getting them to pay attention to the detail of texts, and comparing texts.

Denis Berthiaume 18 05 20 51
**Commentaire:** 1

On the other hand, SP entertains goals that are not necessarily specific to the content per se. These would include:

- wanting learners to engage with ideas;
- helping learners set ideas out in analytical way;
- helping learners think critically about ideas; and
- helping learners develop effective written and oral communication skills.

Denis Berthiaume 18 05 20 51
**Commentaire:** 2

Because all those goals are linked to core aspects of discipline, SP believes they are not likely to change easily. Nonetheless, availability of resources such as the number of teaching assistants are likely to affect goals.

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Denis Berthiaume 18 05 20 51
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Denis Berthiaume 18 05 20 52
**Commentaire:** 6

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Denis Berthiaume 13.05 20:53
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Denis Berthiaume 13.05 20:53
**Commentaire:** 10

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Denis Berthiaume 18 05 20 55
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Denis Berthiaume 18 05 20 54
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Denis Berthiaume 18.05.20 54
**Commentaire:** 14

Lecturing is an important strategy for SP. This is because some of his goals/outcomes are concerned with knowledge and understanding of the materiel. So, he would normally start off by looking at text and provide an exposition of some author's views. During such exercises, SP tries to model skills to be acquired by the students. One such skills is the ability to identify positions and contrasting amongst authors. To model this, SP often introduces contemporary controversies to remind students that such issues are not obvious (i.e., that there are normally two sides to the issue).

When lecturing, SP feels that pacing as very important factor. he feels that a good pace is when he is not rushing over anything important, he can repeat points to accentuate certain aspects, and he can give illustrations of the points he makes. SP feels that the right pacing enables him to go back to a topic if he feels that it was not covered appropriately/sufficiently. On the other hand, if he senses that things go well over time, he might spend more time and re-articulate it.

Denis Berthiaume 18.05.20 55
**Commentaire:** 15

After the lecturing portion of the class, SP normally invite students to criticize or object to/challenge the class materiel. he uses this mode of questioning/interaction because he is not sure how effective a discussion would be in a class of 300. Therefore, he lets students ask questions and tries to answer them. SP feels that getting those questions allows him to make a point that he wanted to make. he also feels he can refer back to that question if needed. However, SP feels a little unsure about how to handle "incorrect" answers from students during class time. he may say that the answer is not the best or he may redirect it to class. The latter is something he feels he should be doing more often.

SP also tries to use contemporary examples in his teaching. Such examples are things he hopes students will be able to identify with. As such, the purpose of examples is to get students interested in the discussion itself and to give students a resource for critically evaluating an author or his work.

Denis Berthiaume 18.05.20 55
**Commentaire:** 16

<u>Knowledge of learning and learners:</u>

SP feels that knowing who the students are involves knowing what their background is, what their points of reference are, what examples are meaningful to them, and what will gear up their enthusiasm. This is a particularly difficult task as there is a variety of backgrounds amongst students. However, he is pretty confident about certain dimensions. For instance, he can expect that second year students will be able to write an essay. This is because students would have picked some notions or concepts prior to coming to his course or class. In addition, students already have opinions on which they can draw. And on that matter, SP feels that students tend to have fairly strong opinions. Maybe this is because students tend to be quite goal-oriented.

Denis Berthiaume 18.05.20 56
**Commentaire:** 17

On the other hand, SP finds that a lot of students are not good at extracting points from a conversation or a seminar. Whereas some students listen to fellow students and come to the next

class with questions or quick criticisms, other students sometimes turn off during their colleagues' questions. And SP finds it easy to see when students are not engaged. In those instances, there tends to be less eye contact, less note taking, more rustling, and less concentration.

SP feels that students accumulate knowledge gradually, over the course of degree. There is therefore a noticeable difference between their knowledge at the start of their degree and upon graduation.

Denis Berthiaume 18.05.20 56
**Commentaire:** 18

For SP, students learn from the lecture and they are able to learn from each other. In fact, he feels that students learn best when they are told about the course expectations and that assessment of the course is linked to those expectations.

Denis Berthiaume 18.05.20 56
**Commentaire:** 19

However, SP feels that learning is not necessarily easy. Some students find it particularly difficult because the modes of reasoning are different in a theory course. As such, students cannot memorize a bunch of facts nor reproduce those facts in a multiple choice exam. Rather, students have to read the text over and over again to figure out what the arguments are. This is because, SP believes, it is easier to appreciate an author after seeing what he's done rather than in anticipation.

Denis Berthiaume 18.05.20 56
**Commentaire:** 40

SP feels he has access to a range of kinds of evidence of learning, from some that is more instantaneous (i.e., questions) through to some that is more long-term (e.g., final exam).

SP considers sort-term evidence of learning to comprise questions asked during class and questions from after the lecture. he feels he can get a sense that students are struggling through a conversation with them in either of those settings.

SP considers longer-term evidence of learning to correspond to a qualitative assessment of how students do in the various activities in which they are being assessed. This might comprise their level of understanding and engagement with the material shown in their essays; to what extent the students are meeting the objectives of the final exam; reports from TAs about students' understanding during the conferences; and written comments of the student evaluation. With regards to the latter, SP finds it starts to be interesting when sees patterns.

Knowledge of assessment of learning:

SP's approach to assessing learning is to examine how well students are achieving the goals of the course as opposed to merely getting them to reproduce the material of the course. As such, SP has deep reservations about the use of multiple choice, in particular as in political theory that would encourage the students only to learn facts. Rather, SP uses essays. However, essays are not normally used in large classes. This is because, in a large class, having students write three essays puts a lot of strain on SP and his TAs. SP feels that, too often, lack of resources leads university professors to a second best option (i.e., poorly designed multiple choice exams).

Denis Berthiaume 18.05.20 57
**Commentaire:** 34

SP's approach to assessing takes a bit longer than normally. This is because he is quite concerned with reliability of assessment (i.e., making sure everyone is judging with similar

standards). In the past, he has encountered issues of reliability amongst the graders. he has settled this in two ways. On the one hand, he now has the same TA grade all of a student's essays. On the other hand, he has established procedures for reliability in grading. For instance, he uses a feedback sheet that has six or seven criteria of a good essay. In addition, he grades essays with TAs and discusses general patterns or weaknesses.

To SP, assessment has to be part of the planning process. For instance, it is important for SP to connect his expectations at the final exam back to the aims of the course. he also communicates such expectations throughout the course, mainly through feedback to the students, both oral (i.e., in class) and written (i.e., on the standardized feedback sheet). In addition, SP assesses conference participation.

Through those various assessment methods, SP has been able to identify two usual weaknesses of students in his class:

- the inadequate use of primary texts; and
- a tendency not to support statements with references/citations.

Denis Berthiaume 18 05 20 57
**Commentaire:** 35

Knowledge of curricular issues:

SP finds that the acts of designing and delivering a course have a collective nature. This is because the choice of course materiel has to be done in relation to the broader curricular materiel (i.e., what colleagues would end up teaching in their courses).

Denis Berthiaume 18 05 20 57
**Commentaire:** 33

Knowledge of human behaviour:

SP feels that the size of the class affects his sense of what is going on in the class. This has to do with how students react to what he says and whether he is loosing them or not. In large classes, he feels that there is much more doodling and chatting. Furthermore, as students tend to spread out in class, SP feels less connected with them as a result. And this constitutes a problem for him because, for instance, eye contact is important in terms of visual cues (i.e., the other person looking perplexed or not). In a large class, SP feels he is loosing some of that eye contact.

Large groups are problematic for SP because he has students do presentations. This is because, he feels, presentations do not foster genuine discussion as people not presenting tend to tune out. Overall, SP feels that big lectures do not enable him to be impressed by how smart the students actually are.

Denis Berthiaume 18 05 20 56
**Commentaire:** 32

Knowledge of the physical environment:

With regards to the classroom in which he teaches, SP feels quite frustrated. he finds it too big and too wide. In addition, the hallway produces noise and he cannot ensure that doors remain shut.

Overall, SP finds it difficult to teach in that classroom mainly because:

- it is harder to sustain students' attention as they are spread out all over the place;

- the width of the auditorium makes it difficult to establish eye contact with people on both left and right;
- getting the class to order is also much more of a challenge;
- he feels constrained to use the overhead rather than the board as people cannot see the latter

Denis Berthiaume 18.05.20.58
**Commentaire:** 31

**Knowledge base for teaching/Beliefs related to teaching**

Beliefs about the purpose of instruction:

SP emphasized that the main purpose may not be to remember content but rather for students to acquire certain tools. One of such tools is curiosity as a habit of mind.

Denis Berthiaume 18.05.20.59
**Commentaire:** 25

Beliefs about the conditions for instruction:

SP finds that the size of a class plays an important role in instruction. his ideal size for a seminar is about 12 or 15 students.

Beliefs about teaching and teachers:

SP sees the role of the university teacher as being predominantly about motivating and exciting students. In that sense, imparting knowledge is not the most important part of university teaching; it is more important to give students certain lifelong tools or skills. But to do that, it is essential to clearly identify the point of departure of students, where they are at when coming into your classroom.

Denis Berthiaume 18.05.20.59
**Commentaire:** 26

In addition to exciting students and encouraging them to acquire lifelong skills, good university teaching would include turning one's goals into specific expectations and linking those expectations to assessment. So, mere clarity or simplicity of presentation is not the whole story of teaching. Whereas it may be helpful for students to have basic elements of a theory clearly laid out to them, students might get irritated when, for instance, a lecture is too slow. Simultaneously, because students are goal-oriented, making goals concrete would encourage/help learning. Therefore, university teaching is much more complex than many envisage.

Denis Berthiaume 18.05.20.59
**Commentaire:** 27

Beliefs about learning and learners:

SP believes that it is not so important that learners remember facts. Rather, he tries to get students to think about the materiel. he does that by asking them what they think, so that their brain works in a different way (i.e., less passive). Another way to help learners think is to get them involved in grading as this encourages them to be more objective about written work which, hopefully, can be reflected back onto their own work.

Denis Berthiaume 18.05.20.59
**Commentaire:** 28

However, SP feels that for learning to happen, university learners must do certain aspects of the course in a conscientious way. This would include:

- doing the readings,

- attending the seminars, and
- adopting a positive attitude to fellow students.

Denis Berthiaume 18.05 21:00
**Commentaire:** 29

SP puts a lot of emphasis on the discussion of course materiel amongst learners, either formally or informally, as he feels this helps some students. More specifically, this helps students in that they learn from their peers' comments, in particular in that they may obtain clarification of their own understanding.

However, when engaged in small group discussions, some students will sort of turn off. It thus comes down to their responsibility in participating/contributing to the community of learning.

Denis Berthiaume 18.05 21:00
**Commentaire:** 30

**Personal epistemology/Beliefs about knowledge and knowing**

Beliefs about the act of knowing:

For SP, knowing means mastery of a subject or discipline. This involves the ability:
- to make distinctions;
- to cut through complexity;
- to grasp an issue by its roots;
- not to be dazzled by details or superficial components.

Denis Berthiaume 18.05 21:01
**Commentaire:** 20, 2A, 5A, 8A, 13A, 15A, 16A, 28A, 34A, 40A

**Personal epistemology/Beliefs about knowledge construction**

Beliefs about how people learn in general:

SP believes that it is less useful or interesting for a learner to be told about the structure before the learning takes place. Rather, he believes that it would be better to see what's there, and then go back and see what the structure was. For instance, SP believes that it is better examine the differences in arguments after having looked at the actual arguments.

Denis Berthiaume 18.05 21:02
**Commentaire:** 21, 4A, 7A, 13B, 19A, 28B, 40B

However, in the member-checking interview, SP specified that those beliefs were actually about teaching, but that, in his mind, they were related to learning.

Beliefs about how one learn specifically:

Because of what he described as an ''academic mindset'', SP believes he has a reading and responding approach to learning. As an example, he explained that his first reaction in trying to learn golf was to read book about golfing. However, SP does not feel this is the best way to learn golf because he would need to train his body in the actual motions involved in golfing.

Denis Berthiaume 18.05 21:02
**Commentaire:** 22, 1A

**Personal epistemology/Beliefs about the evaluation of knowledge**

Beliefs about the relative value of knowledge:

SP appears to value experiential knowledge quite highly. However, he finds it hard to compare experiential knowledge with more formal knowledge (i.e., acquired through a course).

Denis Berthiaume 1.8.05 21:02
**Commentaire:** 23

SP recognizes that experiential knowledge, being acquired through trial and error, as well as through absorption of other's models, cannot be achieved simply through reading. Yet, he is still biased towards learning by reading because he finds it to be a more effective (i.e., efficient and faster) way of learning.

In that sense, with regards to teaching political theory, SP values experiential knowledge probably more than the knowledge he would obtain from reading a book on the topic. However, he is not discounting what he could learn from a book or workshop on teaching political theory.

Denis Berthiaume 1.8.05 21:03
**Commentaire:** 24; 1B, 29A

**Disciplinary specificity/Socio-cultural characteristics**

Teaching in the discipline:

SP has been teaching in political theory/philosophy since 1994 (over ten years). he has taught occasional courses that overlap into other areas of political or the social sciences. his training in teaching political theory includes:

- exposure to materials other people think are important and are part of the curriculum of teaching in this area;
- positive and negative examples of teaching practice in this area;
- attending a certificate program in university teaching when he was teaching in the United Kingdom; and
- attending a series of workshops on pedagogy offered at McGill's CUTL.

Denis Berthiaume 1.8.05 21:03
**Commentaire:** 14A, 23A

SP's experience as a graduate student in political theory was one source of information about the teaching of his discipline. There, he saw that most professors' approach was to treat a class as giving a paper at an academic conference; and the main mode of teaching was one that really emphasized passing on knowledge without a lot of thinking about how best to communicate that knowledge. SP feels that he has probably drawn on that since it probably is the heavy bias in his discipline in terms of how people think about teaching.

Denis Berthiaume 1.8.05 21:04
**Commentaire:** 3A, 12A, 14B, 15B, 21A

In addition to learning about teaching political theory through more formal channels, SP has learned from experience by seeing what works in his classroom and what does not. he also talks to colleagues in a more sustained way about how they do certain things. With regards to that, he feels it is acceptable in his field to ask how one's course is going but it would not be accepted to criticize one another. Over the years, SP found that people like to talk about their students (i.e., what they think of them) which tends to reveal some of their thinking about teaching.

Denis Berthiaume 1.8.05 21:04
**Commentaire:** 14C, 23B

With regards to teaching in his discipline, SP feels the emphasis is more on tools and less on imparting knowledge. According to him, three elements would constitute good teaching in general (across the university): the knowledge, the tools, and the motivation. SP would expect that different disciplines would put more or less weight on each of those. In political theory, SP

feels that giving them tools and exciting them about the subject is more important than the knowledge. Such tools comprise critical reasoning and communications (oral and written).

Denis Berthiaume 7.8.05 17:15
**Commentaire:** 2B, 3B, 5B, 6A, 13C, 15C, 16B, 17A, 20A, 25A, 26A, 28A,, 34A, 40C

This is particularly in line with the age-old debate, in the humanities, between knowledge and wisdom, and eloquence (i.e., what you know and the presentation of what you know). This means that knowledge of your discipline is a necessary but not a sufficient condition to be able to teach the discipline well. For instance, one has to be able to intelligently select and organize the material to be presented to the students. This is actually one thing SP feels his teachers were particularly good at, which he came to value a lot: the idea of striving for clarity of expression, clarity of exposition in both research and teaching. Therefore, teaching itself requires one to think about a whole set of issues related to the students' experience of what one is doing.

Denis Berthiaume 1.8.05 21:06
**Commentaire:** 6B, 10A, 11A, 14D, 15D, 19B, 25B, 26B, 27A

With regards to content, SP feels that knowing the materiel well has led to less negative teaching experiences. On the other hand, if he does not know the materiel inside out, things do not go well. More specifically about the content of the course, SP feels that there are typical questions and criticisms, or standard points about and reactions to the works examined. For instance, Mill is probably generally taught as a distinct view and that is accomplished probably by contrasting his view with other well known theorists, but not necessarily Plato's work or Rousseau's.

Denis Berthiaume 1.8.05 21:06
**Commentaire:** 3C, 7B, 8B, 10B, 11B, 14E, 15E, 16C

Learning in the discipline:

SP emphasized the preponderant role of reading in learning in political theory. he argues that most people in his field would tend to learn about the subject matter through readings and, to a much lesser extent, through hearing people discuss various topics. This would explain why people in political theory are somewhat dismissive of the value of conferences.

Denis Berthiaume 1.8.05 21:08
**Commentaire:** 24A

SP added that he does not know if learning through reading is specific to his field. However, most people teaching in his field do try to get the students to read more in order to learn. This is because, he emphasized, certain questions or foundation concepts are essential for learners in this field. Those pieces of fundamental knowledge—conceptual tools—should thus be learned first, mainly through reading.

Denis Berthiaume 1.8.05 21:09
**Commentaire:** 6C, 13D, 15F, 22B, 24B, 35A, 40D

SP explained that the nature of political theory meant that the teaching and learning of was quite different. he compared it to economics, as field he has taught at the early undergraduate level. SP argued that economics is more about building blocks (i.e., learning takes place in a cumulative fashion) whereas political theory does not work quite like that. Rather, political theory is learned through a series of fundamental concepts that run parallel to one another.

Denis Berthiaume 1.8.05 21:10
**Commentaire:** 1C, 7C, 20B, 21A, 21B, 22A, 29B

Denis Berthiaume 1.8.05 21:10
**Commentaire:** 10C, 18A, 20C, 21C, 29C

Knowing in the discipline:

SP emphasized the fact that reasoning in political theory is different than in many other fields or even in other sub-fields of political science. This is because in many of those instances the model is to formulate hypotheses and then proceed with empirical testing of those hypotheses. Thus, knowing takes the form of empirical confirmation or verification.

In a theory-inclined field, such as political theory, people are most often dealing with questions that are basic concepts or tools that will go into hypothesis or propositions for empirical tests. So, the modes of knowing are rather detached from anything empirical. One example in political theory is the notion thought experiment as a form of reasoning or knowing.

Denis Berthiaume 1 8 05 21 12
**Commentaire:** 2C, 5C, 28B

**Disciplinary specificity/Epistemological structure**

Description of the discipline:

During the various interviews, SP emphasized the fact that political theory can be dry—in particular Mill, and abstract. he added that materiel in the field could at times be fairly difficult.

Denis Berthiaume 2 8 05 17 16
**Commentaire:** 3D, 9A

In a member-checking interview, SP added that students of political theory often think that they have a good understanding of issues at first glance. However, those issues are not necessarily as easy as students may believe.

In the same interview, SP added that the notion of difficulty is not specific to political theory. Other parts of political science (e.g., modelling) can be dry and abstract but not in the same way.

Denis Berthiaume 2 8 05 17 16
**Commentaire:** 9B

Organization of the discipline:

With regards to the organization of his discipline, SP explained that political theory is a subfield of political science and that it is very close to political philosophy, a subfield of philosophy. However, he added, the two fields differ along two lines:

- physically (i.e., their location within departments of political science vs. philosophy);
- methodologically (i.e., political theorists tend to work on empirical questions whereas political philosophers tend to work on theoretical or analytical questions.

**Between the Knowledge base for teaching and the Personal epistemology**

| Source | Knowledge base for teaching | Personal epistemology |
|---|---|---|
| Component | Goals related to teaching | Beliefs about knowledge and knowing |
| Emerging dimensions | Course-level goals (2)<br>Class-level goals (5) | Beliefs about the act of knowing (2A)<br>Beliefs about the act of knowing (5A) |
| Component | Knowledge structures related to teaching | Beliefs about knowledge and knowing |
| Emerging dimensions | Knowledge of content (8)<br>Knowledge of assessment (34)<br>Knowledge of teaching and teachers (13, 15, 16, 40) | Beliefs about the act of knowing (8A)<br>Beliefs about the act of knowing (34A)<br>Beliefs about the act of knowing (13A, 15A, 16A, 40A) |
| Component | Beliefs related to teaching | Beliefs about knowledge and knowing |
| Emerging dimensions | Beliefs about learning and learners (28) | Beliefs about the act of knowing (28A) |
| Component | Goals related teaching | Beliefs about knowledge construction |
| Emerging dimensions | Course-level goals (1)<br>Class-level goals (4) | Beliefs about how one learns specifically (1A)<br>Beliefs about how people learn in general (4A) |
| Component | Knowledge structures related to teaching | Beliefs about knowledge construction |
| Emerging dimensions | Knowledge of content (7)<br>Knowledge of teaching (13, 19, 40) | Beliefs about how people learn in general (7A)<br>Beliefs about how people learn in general (13B, 19A, 40B) |
| Component | Beliefs related to teaching | Beliefs about knowledge construction |
| Emerging dimensions | Beliefs about learning and learners (28) | Beliefs about how people learn in general (28B) |
| Component | Goals related to teaching | Beliefs about the evaluation of knowledge |
| Emerging dimensions | Course-level goals (1) | Beliefs about the relative value of knowledge (1B) |
| Component | Beliefs related to teaching | Beliefs about the evaluation of knowledge |
| Emerging dimensions | Beliefs about learning and learners (29) | Beliefs about the relative value of knowledge (29A) |

**Between the Knowledge base for teaching and Disciplinary specificity**

| Source | Knowledge base for teaching | Disciplinary specificity |
|---|---|---|
| Component | Goals related to teaching | Socio-cultural characteristics |
| Emerging dimensions | Course-level goals (1, 2)<br>Class-level goals (3, 5)<br>Ordering of goals (6) | Teaching in the discipline (2B, 3A, 3B, 3C, 5B, 6A, 6B)<br>Learning in the discipline (1C, 6C)<br>Knowing in the discipline (2C, 5C) |
| Component | Knowledge structures related to teaching | Socio-cultural characteristics |
| Emerging dimensions | Knowledge of content (7, 8)<br>Pedagogical content knowledge (10)<br>Knowledge of teaching (11, 12, 13, 14, 15, 16)<br>Knowledge of learning (17, 18, 19, 40)<br>Knowledge of assessment (34, 35) | Teaching in the discipline (7B, 8B, 10A, 10B, 11A, 11B, 12A, 13C, 14A, 14B, 14C, 14D, 15B, 15C, 15D, 15E, 16B, 16C, 17A, 19B, 34B, 40C)<br>Learning in the discipline (7C, 8C, 10C, 13D, 15F, 18A, 35A, 40D) |
| Component | Beliefs related to teaching | Socio-cultural characteristics |
| Emerging dimensions | Beliefs about the purpose of instruction (25)<br>Beliefs about teaching and teachers (26, 27)<br>Beliefs about learning and learners (29) | Teaching in the discipline (25A, 25B, 26A, 26B, 27A)<br>Learning in the discipline (29A, 29B) |
| Component | Goals related to teaching | Epistemological structure |
| Emerging dimensions | Class-level goals (3) | Description of the discipline (3D) |
| Component | Knowledge related to teaching | Epistemological structure |
| Emerging dimensions | Knowledge of content (9) | Description of the discipline (9A, 9B) |

**Between the Personal epistemology and Disciplinary specificity**

| Source | Personal epistemology | Disciplinary specificity |
|---|---|---|
| Component | Beliefs about knowledge and knowing | Socio-cultural characteristics |
| Emerging dimensions | Beliefs about the act of knowing (20) | Teaching in the discipline (20A)<br>Learning in the discipline (20B, 20C) |
| Component | Beliefs about knowledge construction | Socio-cultural characteristics |
| Emerging dimensions | Beliefs about how people learn in general (21)<br>Beliefs about how one learns specifically (22) | Learning in the discipline (21A, 21B, 21C, 22A, 22B) |
| Component | Beliefs about the evaluation of knowledge | Socio-cultural characteristics |
| Emerging dimensions | Beliefs about the relative value of knowledge (23, 24) | Teaching in the discipline (23A, 23B)<br>Learning in the discipline (24A, 24B) |

| | | Source: Knowledge Base for Teaching | | |
|---|---|---|---|---|
| | | Goals Related to Teaching | Knowledge Structures Related to Teaching | Beliefs Related to Teaching |
| Source: Personal Epistemology | Beliefs About Knowledge and Knowing | Course-level goals & Beliefs about the act of knowing<br><br>Class-level goals & Beliefs about the act of knowing | Knowledge of content & Beliefs about the act of knowing<br><br>Knowledge of assessment of learning & Beliefs about the act of knowing<br><br>Knowledge of teaching and teachers & Beliefs about the act of knowing | Beliefs about learning and learners & Beliefs about the act of knowing |
| | Beliefs About Knowledge Construction | Course-level goals & Beliefs about how one learns specifically<br><br>Course-level goals & Beliefs about how people learn in general | Knowledge of content & Beliefs about how people learn in general<br><br>Knowledge of teaching and teachers & Beliefs about how people learn in general<br><br>Knowledge of learning and learners & Beliefs about how people learn in general | Beliefs about learning and learners & Beliefs about how people learn in general |
| | Beliefs About Knowledge Evaluation | Course-level goals & Beliefs about the relative value of knowledge | | Beliefs about learning and learners & Beliefs about the relative value of knowledge |

| | | Source: Knowledge Base for Teaching | | |
|---|---|---|---|---|
| | | Goals Related to Teaching | Knowledge Structures Related to Teaching | Beliefs Related to Teaching |
| Source: Disciplinary Specificity | Epistemological Structure | Class-level goals & Description of the discipline | Knowledge of content & Description of the discipline | |
| | Socio-Cultural Characteristics | Course-level goals & Learning in the discipline<br><br>Course-level goals & Teaching in the discipline<br><br>Course-level goals & Knowing in the discipline<br><br>Class-level goals & Teaching in the discipline<br><br>Class-level goals & Knowing in the discipline<br><br>Ordering of goals & Teaching in the discipline<br><br>Ordering of goals & Learning in the discipline | Knowledge of content & Learning in the discipline<br><br>Pedagogical Content Knowledge & Teaching in the discipline<br><br>Pedagogical Content Knowledge & Learning in the discipline<br><br>Knowledge of teaching & Teaching in the discipline<br><br>Knowledge of teaching & Learning in the discipline<br><br>Knowledge of learning & Teaching in the discipline<br><br>Knowledge of learning & Learning in the discipline<br><br>Knowledge of assessment & Teaching in the discipline<br><br>Knowledge of assessment & Learning in the discipline | Beliefs about the purpose of instruction & Teaching in the discipline<br><br>Beliefs about teaching and teachers & Teaching in the discipline<br><br>Beliefs about learning and learners & Learning in the discipline |

| | | Source: Personal Epistemology | | |
|---|---|---|---|---|
| | | Beliefs About Knowledge and Knowing | Beliefs About Knowledge Construction | Beliefs About Knowledge Evaluation |
| Source: Disciplinary Specificity | Epistemological Structure | | | |
| | Socio-Cultural Characteristics | Beliefs about the act of knowing & Teaching in the discipline<br><br>Beliefs about the act of knowing & Learning in the discipline | Beliefs about how people learn in general & Learning in the discipline<br><br>Beliefs about how one learns specifically & Learning in the discipline | Beliefs about the relative value of knowledge & Teaching in the discipline<br><br>Beliefs about the relative value of knowledge & Learning in the discipline |

## Knowledge base for teaching/Goals for teaching

Course level-goals

With regards to content, HP hopes the students will take away two things: to see linear algebra being applied; and to take away a feel for scientific applications of linear algebra. More specifically in terms of skills, HP would like students to become able to think like mathematicians and to learn to verify their own work.

This translates into goals that HP sets for herself, including to take students out of their comfort zone and making them active learners during instruction. In that sense, HP wants students to be able to write down theorems during instruction.

Simultaneously, HP wants to convey to students that it is normal that codes do not work the first time around. She also wants to break them out of the mode of thinking that mathematics and computing shall not meet, and to help them overcome resistance to thinking about computing as a serious endeavour. Overall, HP wants to convey a sense of joy linked to learning; she would like students to learn how beautiful mathematics is.

Class-level goals:

In terms of this particular class, HP has promised herself to lay down what conditioning was and to talk more about stability in the following class. So, she wants to give students a heuristic feel for those concepts. But she wants the students to understand by triggering primordial memory, that is for them to remember both the accurate definition and the intuitive explanation.

To achieve that, HP intends to start to set up precise definitions for conditioning. This is because she feels that one cannot do a good job on an ill-conditioned problem. So, she wants the students to think about using algorithms. She wants them to remember that a problem might be ill-conditioned and no algorithm is going to do a good job. However, HP will not be shattered if she does not get to a precise definition on stability in this particular class.

Ordering of goals:

Understanding of finite arithmetic (algorithmic level, consequences of doing something with computers), and matrix computations (interplay between theorems and linear algebra, and applications and issues of stability, conditioning, error control) is most important goal for learners (course-level).

Accomplishment of goals:

HP has identified two main goals of this course: to expose students to mathematical and computational aspects of matrix computations and, more specifically, to convey to them the importance of conditioning and stability. Overall, she feels that both goals were achieved.

## Knowledge base for teaching/Knowledge for teaching

Knowledge of content:

HP says that this class is mainly about conditioning and stability, that is, definitions and theorems related to conditioning and stability. Tied to both concepts is the notion of accuracy. She adds that the class is likely to cover coding, as well as other themes in numerical analysis such as error, convergence, optimality of algorithms.

HP says that conditioning is crucial to the successful implementation of a problem. It relates to how sensitive the output of a problem is to changes in the input (e.g., a well-conditioned problem is one in which small changes in input require small changes in output). Stability relates to how conditioning is implemented on a computer. Conditioning is the abstract notion. Both the way we compute and what we use to compute for what application is influenced by these factors. Conditioning and stability can be applied to various settings.

HP feels that Applied mathematics is what she does, but specifically matrix computation is something that she knows. HP also feels that her undergraduate background in physics helps her as that field provides problems for applied mathematics (along with engineering).

Pedagogical content knowledge:

With regards to specific ways of teaching mathematics, HP wants to be able to write a theorem on one single line as that facilitates comprehension on the part of the students. Also, she uses coloured chalk to emphasize certain elements on the blackboard, for instance to differentiate conditioning from stability.

However, HP reports facing a dilemma over showing the intuitive method and pointing out the difficulty, or just giving the accurate definition to the students. HP tends not to use a precise mathematical definition because she thinks it makes it easier for students to understand.

Knowledge of self

HP says that she considers herself a mathematician because she is from a math department and because mathematics has affected who she is as a person (her attitudes are influenced by it). HP really enjoys mathematics and wants to convey it to other people. She also claims not to be sloppy as a mathematician, which is why she doesn't believe in the argument that good researchers can't talk to students; if one understands research, one should communicate effectively. HP also teaches students from other disciplines but could not teach in those disciplines. Nonetheless, she enjoys having students from other fields than mathematics.

Overall, HP enjoys people, talking to people. Yet, she does not feel the need to be popular. HP reports to be very conscious of her strengths and weaknesses, at every point. In particular, she reports having a fairly strong self-esteem, which makes her willing to take risks in terms of engaging with her students. Such strong self-esteem gives her/him intellectual confidence. Yet, HP reports that the influence of personality on teaching is mind-boggling to her.

Knowledge of teaching and teachers

HP reports to feel a trade-off between the expediency of teaching well and delivering the perfect lecture. She claims that the negative part of her teaching is that she tries/wants to get everybody along. However, HP is not prepared to say that the way she does it is more successful than the way others do it. She does not want to become arrogant. She asks: "How do I know this is the best way of teaching?"

Simultaneously, HP feels very emotionally involved with her students' welfare. Actually, she gets irritated and feels very protective if she senses her students are being distracted by something external (e.g., noise). And it hurts a little bit when students drop her class.

HP partly derives her knowledge of teaching and teachers from experience. She has taught math for four years as a graduate student, then for a year as post-doc. She has been teaching at McGill since 2001. Her knowledge about teaching and teachers also comes from formal training in teaching math as a graduate student, in the form of an apprenticeship. In addition, HP credits numerous discussions she has had with her friends who are math educators and some workshops she has taken at McGill's CUTL. Overall, HP feels that one cannot learn about teaching passively; one has to learn by doing. She adds that there is a rigorous way to think about teaching but it is hard because of the subjectivity level.

HP is guided by some very general thoughts about teaching and teachers. For instance, she feels that teaching is not reproducible: every classroom is different and every teacher is different. She also does not like teaching to the top or bottom group (third) of students. But, as she says, it is particularly challenging when you have a mix of students. Those instances mean that one has to use the same lectures for two different groups. And, although there is no sacrifice in rigour for the major students, HP expects more rigour from the honours students (e.g., prove harder theorems or code more significant projects).

HP's overall approach to teaching is one in which she is trying to help students be able to use math as a tool. She also communicates her way of doing math, that is, with proof and rigour. For students who are not from math, HP emphasizes the applicability of what they learn in math. In any case, students cannot be passive. For instance, HP feels that students have to calculate. She feels that, sometimes, she has to go through painful intermediate steps to foster student understanding. And she uses assignments to push student thinking beyond what is seen in class.

As regards more practical aspects of teaching, HP relies heavily on the blackboard in a way that makes the learners active. As she writes a lot in her classes, she tries to add in the logical steps in terms of exposition that go behind the mathematical definitions. She also uses chalk sparingly to convey the idea of importance of certain concepts or notions, using colours to differentiate between concepts and examples of the concepts. HP's chalk strategy is derived from feedback from students about using more colours. Yet, she uses only two colours where she circles examples in one particular colour.

HP feels that she cannot convey more than one concept per lecture, therefore she identifies one central idea when planning a lecture, and reinforces that idea through various means. Maybe this is why, as she says, she spends a lot of time to prepare for class. And during her planning, HP allocates time for questions in each lecture, as well as using a combination of familiar/simple and/or dramatic to illustrate notions/concepts.

In class, HP likes to give students time to absorb important concepts. This is why she uses markers to emphasize important notions and brings examples from all kinds of different applications. HP also uses transparencies and the blackboard, the former being used mainly if students do not need to write. She also tends to follow the book quite closely but the treatment in class differs a little, as she has less time to elaborate.

In her course, HP uses two types of assignments: theoretical assignments, in which students analyze algorithms, and computing assignments, in which students implement algorithms and apply them to specific situations (applications). She also uses open-ended problems, throughout the semester, that permit a lot of different answers. Overall, HP reports that she does not enjoy the grading but finds that assignments are necessary for learning. HP's approach to teaching is also affected by the presence of computers or not in the classroom. This is because the availability of computers enables her to directly link theoretical materiel with computer implications.

One dimension that appears particularly important for HP is to use student feedback and evaluations. For instance, she gives time to students to respond in class. She also uses body language to assess their ability to follow. On a larger scale, she uses student feedback to revise decisions on assignments. HP actually goes as far as saying that she would not like to teach online because she takes her cues from students. However, she feels the need to develop her skill of judging when to take the feedback seriously or not.

Knowledge of learning and learners:

HP believes that she has to deal with a very diverse group. According to her, some students plan to become mathematicians whereas students from other disciplines need math for problem solving as opposed to theorem proving. In addition, she has students who are honours and others who are major. In mathematics, honours students split off the mainstream very early on. However, major students like opportunities to take courses alongside honours students.

Overall, HP trusts her students to be mathematically sophisticated. There are certain things students should have known for some time, certain elements they should be able to do without her help. However, many students have never taken an Applied Math course. Therefore, some students have not seen numerical analysis before. Most students have taken the pre-requisite very early in their program, but they may have forgotten about the content. Therefore, students needed to be reminded of the content of the pre-requisites. HP adds that most students have already been theorem proving in other courses and that many of them think that theorem proving is the most important thing to do. Overall, HP feels that because the background of the students is slightly different, the things that they get tend to be slightly different. And this would be why the class tends to settle early into three layers, with a broad bunch in the middle.

HP feels that students must act in an autonomous fashion. For instance, students get from HP's use of capital letters that certain notions are important. However, they have the responsibility of not taking anything the teacher is saying on faith. This is why HP has the students work in groups. However, HP doesn't feel that the students in this class would work well in large groups. She thinks Engineers know how to work with each other, as they have done it before, but Mathematicians do not work as well in groups. As for individual work, HP reports that students are not always disciplined about starting assignments when they are supposed to start them. In addition, some students do not seem to focus on self-verification enough.

With regards to the content of the course, HP feels that students may have a feel for some new concepts but would not have precise definitions. In relation to that, she feels that she knows when it becomes a good time to think about some more concrete terms, to give them a precise language. However, students are unlikely to remember both the accurate and the intuitive definitions. Rather, students might take away the message, but they need to practice to learn it. HP feels that if students remember definitions vaguely, they can discover them more easily. However, she feels that they may also retain the inaccurate definition. This maybe because students have never had to really visualize how it works when you don't have infinite precision; they're used to seeing a function and just plug in a number.

As evidence of learning, HP uses a variety of types and sources of information. For instance, she may use performance on assignments and the final examination, as well as students questions, body language and functioning in class. Students also tend to come see her with questions during office hours. In the specific case of assignments, students were sometimes building upon codes that were not working, and some students went quite far in the cumulative assignment before correcting the faulty code. Also, open-ended problems were very revealing of their learning: students that had learned the material seemed much more comfortable trying to explore something open-ended; students who hadn't learned well were very uncomfortable with the open-ended problems.

HP also uses informal student feedback (through anonymous informal evaluations twice per semester: understanding of materiel, pacing, other concerns) as evidence of learning. Yet, she reckons that long-term effectiveness would mean that they remember the materiel 30 years for now. Nonetheless, this enabled her to see that students got very excited about the materiel. In fact, most students got enthusiastic about the subject matter and threw themselves into the coding. One student from outside math even switched from major to honours to do interdisciplinary work with math.

During the classroom, HP is very attentive to non-verbal cues that are provided by the students. For instance, when they're not sure about what she is writing, they fidget. Their fidgeting means that they are paying attention. When students are writing and occasionally looking up, they are part of the way there. Students experiencing difficulties tend to feed her cues: they tend to slouch or stare off in space; if they're learning well, they seem more engaged. Students nod their heads if they are getting the point. Overall, HP reports that she likes students to become impatient since it tells her that they're gaining a lot more confidence.

Knowledge of assessment of learning:

With regards to her approach to assessment, HP says that, ideally she likes to have a very clear guideline in her own head about what she wants to evaluate, how many points she's going to give it and what the students are expected to do. For instance, she is uncomfortable only giving take home exams or having students in this kind of course only taking an in-class exam. This is why she gave them both.

Furthermore, HP finds that it's a very difficult thing to test if a student has a skill to be very critical about their own work. Therefore, instead of having them work in groups, she feels it's going to be much more reflective of the time they're putting in if she grades their homework and their computer projects sort of in a weighty fashion.

HP has also decided not to use a grader, because she has a small class, and she is being a control freak (she guesses). She feels that it is a small enough number that she can actually do this on her own.

Therefore, assessment is going to be based on assignments, the group project (which got dropped after discussion with students—not enough of them), a midterm (about 15% of the total course evaluation), and a final (with take home component—same for midterm). Odds are that she'll make the final worth anywhere between 25 and 35%, but not more. And honours and major students have different assignments and exams.

Knowledge of curricular issues:

With regards to the curriculum, HP feels that, as this course is both a follow-up and logical extension of a previous one, she needs to figure out how much to assume with regards to what learners know (from other classes).

Knowledge of human behaviour:

HP used a discussion board for students to exchange files. However, she believes that some people found it more convenient to meet in person than through the electronic discussion board. Nonetheless, most students were courteous for the most part except for one group that stopped communicating.

Knowledge of the physical environment:

HP argues that she has a specific way to write on the board. However, she argues that the class layout prevents her from writing the way she would do it (i.e., what she calls "proper boardmanship").

Knowledge of logistical issues:

HP feels that administrative issues related to teaching a course can make it difficult to be an enthusiastic teacher. For instance, she feels that large classes (i.e., 600 students) become

'administrative things' rather than actual teaching. This is because, among other things, the system brings in students who have difficulty, particularly through service courses. In such instances, HP feels that the presence of TAs can make a difference.

As regards this particular course, HP feels that 19 is too large a number; 13 is much better. This is partly because she feels like she is teaching two courses because of two sections in class (honours and major math).

HP adds that the availability of computers can also make a difference. However, she was prevented to do computer-based demonstration because her NSERC grant does not allow her to get a license through McGill.

## Knowledge base for teaching/Beliefs about teaching

Beliefs about teaching and teachers:

HP believes that the role of the teacher is to convey the content of the course as well as a way of thinking rigorously in mathematics (i.e., that students have to be very careful). She adds that the teacher must show the students problems that involve application, and that it is important to relate mathematics to the students' long-term academic and professional goals.

HP then discusses what she categorizes as "outside of mandate". By that, she means that the teacher must have a sustained level of enthusiasm and must be present for students to come talk about their experience. Being a teacher also involves an incredible amount of honesty. HP believes that the teacher must respect the students and be respected by them.

Beliefs about learning and learners:

HP believes that the task of the learner is two-fold: to assimilate as much of the materiel as possible; and to seek clarification on content and thinking.

## Personal epistemology/Beliefs about knowledge and knowing

Beliefs about the act of knowing:

HP argues that, within an axiomatic framework, knowledge is constructed by people. However, she also says that that does not mean that it cannot be justified.

Along those lines, HP feels that thinking about teaching can be rigorous. However, rigorous thinking about teaching constitutes a hard task because of the subjectivity of the topic.

HP finds that this is one big difference between thinking about Mathematics and thinking about teaching: she argues that thinking about Mathematics is not subjective, whereas thinking about teaching is subjective.

**Personal epistemology/Beliefs about knowledge construction**

Beliefs about how people learn in general:

HP believes that people only learn through doing things. Therefore, one learns a lot if she does a lot. Simultaneously, she believes that people learn by having their interest/curiosity peaked.

Beliefs about how one learns specifically:

In general, HP gets her information mostly through talking to people, or reading books and newspapers. However, when it comes to learning about mathematics, HP feels that she learns by reading papers, through discussion, and by doing the proofs.

The way she assimilates mathematics is by going through arguments or proofs very carefully, often trying to do them differently. HP finds it very hard to read mathematics on its own. She has to actually do it. And then the last step in her learning process is always coming back to the material maybe a couple of weeks, three weeks later, just to make sure that she really understands it. This would explain why HP finds it very difficult to learn mathematics by merely looking at a slide; she feels that she has to be taking notes.

As a student, HP learned in three different ways: by listening to what the instructor or professor had to say; then, she would come back and look over the material that was covered; then, she would try and relate it to what she had heard it was and saw if it made sense, and it was in this phase that doing problems actually helped—having to sit with the material, trying to prove it in a couple of different ways. HP tries to prove everything that she is going to be doing in at least a couple of different ways. She finds that it forces you to actually invest the time in learning the subject. The process where she went over her notes (triangulate it to what the teacher said, working on problems) was often a time that she spent discussing issues with other students.

Overall, HP wants to be able to wake up at three in the morning and be able to prove anything in her area. And that only happens when she teaches it. Designing problems in mathematics takes quite a lot of intellectual investment and HP feels that a lot of her learning comes from there.

**Personal epistemology/Beliefs about the evaluation of knowledge**

Beliefs about the relative value of knowledge:

HP would not feel confident about sharing her ideas on teaching and learning with somebody else who's trying to teach and learn the subject. She says that she is not prepared to say that her way is more successful than other people's way. This is because she is thinking about certain dimensions of teaching. As such, she would want to have more experience. HP adds that she would have confidence if she had taken courses with people who had credibility as mathematicians and good teachers.

Beliefs about how to evaluate knowledge:

HP believes that the level of formality of the learning/knowledge is one useful criterion. In addition, to be evaluable, learning/knowledge has to be as little subjective as possible.

**Disciplinary culture and structure/Socio-cultural characteristics**

Teaching in the discipline:

HP has a degree in mathematics, so she feels that she was taught as a mathematician. Informally, she feels that she has learned to teach math mainly through observation of teachers she admired and through discussion with buddies from the education department.
Overall, HP feels that if she learnt it, and she was taught in a particular fashion, then that fashion must have been reasonably effective.

From a more formal point of view, HP undertook a year-long teaching training in the mathematics department as a graduate student in which she learned how to stand in front of a classroom, a little bit about blackboardmanship, how to use technology in the classroom, and how to use mathematical software for education and try to integrate it. Then, she was put into teaching assistantship situations, in very structured courses (a form of apprenticeship). Then, she was given more and more responsibilities. For instance, during her first summer as a graduate student, she was given a five-week course to teach in college algebra. That meant that she had to show her assignments to the person in charge, but also received constant feedback from that person.

HP reports that, at her current math department, professors get together to talk about how classes are going and share their experiences. Such discussions may involve people from Computer Science but in a very informal way. In addition, colleagues go to each other's class to observe their teaching. In the larger community of mathematicians, HP reports that there are sessions on mathematics education at conferences, but that they run parallel to the research sessions. Therefore, most professors go to the latter.

HP believes that there are some excellent teachers of mathematics but they have really come through the non-traditional routes. They have all been straight mathematicians with a gift. Simultaneously, she reports that research mathematicians, who have encountered a lot of the teaching reform movements, in particular in the US, are mistrustful. With that in mind, HP does think that educators have a lot to teach university teachers. However, she feels that mathematicians need to be challenged and treated like competent adults.

With regards to teaching mathematics, HP reports that it involves a lot of writing. In addition, the use of markers (notes to draw the attention of students) seems to be standard practice in high level mathematics.

At a more abstract level, HP argues that, when teaching, it does not matter who the professor is; things are right or wrong. This is why she says that, in mathematics, you make a mistake on the board and very soon it catches up with you. And you can either try and paper it over or admit it.

The important point is to convey that one has to be careful. As far as she is concerned, HP tries to avoid situations in which she does not know what is going to happen. ''It would be death in a math course'', she says.

HP also feels that it is very hard to convey the content of mathematical instruction without students working along. She also feels that it is very hard to discuss mathematics online. Finally, she feels that mathematics is one such field in which one needs to build upon a strong structure.

Learning in the discipline:

For HP, mathematics is not a subject that you can cram into the last week before the finals. Rather, mathematical learning seems to build on itself. You learn something and then it's not as if there is a discreet jump to a new topic. Everything is building on prior knowledge. So you do get asked to look over things you just learned a few weeks ago. So that third step is often very illuminating.

This is why, for HP, it would appear difficult for anyone to learn mathematics by looking at a slide. Rather, one would have to take notes. And note taking would require that one goes back to them, dissect them, see if she can make sense of them or find mistakes. HP adds that mathematics is very hard as a spectator sport. Rather, most of mathematical learning is done by the individual digesting it by herself. And until one actually sits down and tries and use those definitions, it's not clear that it would be learnt effectively. Therefore, to reach deeper levels of understanding, students not only have to write theorems, but they also have to implement algorithms. A student may feel like she understood something, but if she does not go back and try it on her own, she cannot possibly internalize it. Yet, HP is conscious that articulating or explaining one's thoughts does not work for everybody in learning mathematics.

One dimension of learning mathematics, according to HP, is that if one learns something new, one must be able to relate it to what she already knows. For HP, students must be uncomfortable when they see something coming out of nowhere. Thinking rigorously means that every fact that one learns has to be justified. Otherwise, one must reject it. Learning mathematics is about answering both the why and how, not only one of those questions. Therefore, students have the responsibility not to take anything the teacher is saying on faith.

With regards to the content of this course (i.e., scientific computing), HP adds that a very frustrating but important part of the learning process is writing a code. Therefore, students implement algorithms. And a lot of time is eaten up in de-bugging a computer code.

Knowing in the discipline:

HP says that Mathematics requires rational scepticism: one should be able to prove her assertions as everything a person says can be checked. Therefore, mathematical knowledge requires that one be able to independently verify the accuracy of her own work (which is possible in Mathematics).

Simultaneously, HP argues that there is room for both intuition and accuracy in Mathematics. This is because Mathematics is an exact and cumulative field so there is very little room for interpretation or subjectivity. It is also because knowledge of mathematics is not context-dependent, which means that it does not depend upon where one is. Thus, to HP, knowing mathematics and knowing teaching are not necessarily connected.

Credibility is important in mathematics; somebody talking about teaching mathematics should have a degree in math and a degree in education.
Important to be able to talk to research mathematicians in their own terms as opposed to others' terms. Mathematics appropriate certain words from English for its very specific purposes, which can be confusing.

In Applied mathematics, computing or doing stuff with computers, is deeper than many people would think.

Practicing in the discipline:

HP explains that practising Mathematics means writing codes, which includes having to spend time debugging them. As such, mathematicians proceed in small blocks and then put them together. This is why, HP feels, mathematicians cannot be sloppy.

Simultaneously, HP feels that a large number of mathematicians are opiniated, solitary, and arrogant. As such, HP says that mathematicians do not function well in groups, in particular theorem provers.

**Disciplinary culture and structure/Epistemological characteristics**

Description of the discipline:

HP believes that Mathematics requires rigorous thinking or, she calls it "strength". This is because in Mathematics, she feels, things are right or wrong.

HP also believes that Mathematics is a cumulative discipline. This means that learning in Mathematics builds on prior knowledge; there cannot be a discreet jump to a new topic. However, HP believes that Mathematics is not a perfect discipline in that it grows by trial and adjustment.

For HP, the more specialised field of Applied Mathematics constitutes the creative side of Mathematics, the one that focuses on using Mathematics or developing Mathematical tools.

Relation to other disciplines:

HP feels that, when observing phenomena from other disciplines, mathematicians should ask themselves how it relates to something they have learned. HP likes to interact with students from

other disciplines, in particular Physics as this is the field in which she obtained her undergraduate degree. However, those interactions are not at the working level but rather at the comfort level.

HP feels that Computer science is a subpart of Applied Mathematics because: people who do theoretical computer science are mathematicians; and mathematicians use scientific computing as a tool. And, if Computer Science is a separate school at McGill University, members of that school publish in Mathematics journals. As such, HP feels that they are mathematicians.

**Appendix P (Web of relationships between components of DPK – HP)**



| | | Source: Knowledge Base for Teaching | | |
|---|---|---|---|---|
| | | Goals Related to Teaching | Knowledge Structures Related to Teaching | Beliefs Related to Teaching |
| Source: Personal Epistemology | Beliefs About Knowledge and Knowing | | Knowledge of self &<br>Beliefs about the act of knowing<br><br>Knowledge of teaching and teachers &<br>Beliefs about the act of knowing | Beliefs about learning and learners &<br>Beliefs about the act of knowing |
| | Beliefs About Knowledge Construction | Course-level goals &<br>Beliefs about how people learn in general<br><br>Course-level goals &<br>Beliefs about how one learns specifically | Knowledge of teaching and teachers &<br>Beliefs about how people learn in general<br><br>Knowledge of teaching and teachers &<br>Beliefs about how one learns specifically<br><br>Knowledge of learning and learners &<br>Beliefs about how people learn in general<br><br>Knowledge of learning and learners &<br>Beliefs about how one learns specifically | Beliefs about learning and learners &<br>Beliefs about how people learn in general<br><br>Beliefs about learning and learners &<br>Beliefs about how one learns specifically |
| | Beliefs About Knowledge Evaluation | | Knowledge of teaching and teachers &<br>Beliefs about the relative value of knowledge<br><br>Knowledge of teaching and teachers &<br>Beliefs about how to evaluate knowledge | |

| | | Source: Knowledge Base for Teaching | | |
|---|---|---|---|---|
| | | Goals Related to Teaching | Knowledge Structures Related to Teaching | Beliefs Related to Teaching |
| Source: Disciplinary Specificity | Epistemological Structure | Course-level goals & Description of the discipline<br><br>Class-level goals & Description of the discipline | Knowledge of the content & Relation to other disciplines<br><br>Knowledge of self & Relation to other disciplines<br><br>Knowledge of teaching and teachers & Description of the discipline<br><br>Knowledge of curricular issues & Description of the discipline | Beliefs about teaching and teachers & Description of the discipline |
| | Socio-Cultural Characteristics | Course-level goals & Teaching in the discipline<br><br>Course-level goals & Learning in the discipline<br><br>Course-level goals & Knowing in the discipline<br><br>Class-level goals & Learning in the discipline | Pedagogical content knowledge & Teaching in the discipline<br>Pedagogical content knowledge & Knowing in the discipline<br>Pedagogical content knowledge & Practising in the discipline<br>Knowledge of teaching and teachers & Teaching in the discipline<br>Knowledge of teaching and teachers & Learning in the discipline<br>Knowledge of teaching and teachers & Practising in the discipline<br>Knowledge of learning and learners & Teaching in the discipline<br>Knowledge of learning and learners & Learning in the discipline<br>Knowledge of learning and learners & Knowing in the discipline<br>Knowledge of learning and learners & Practising in the discipline<br>Knowledge of assessment of learning & Knowing in the discipline<br>Knowledge of curricular issues & Learning in the discipline<br>Knowledge of the physical environment & Teaching in the discipline<br>Knowledge of logistical issues & Learning in the discipline | Beliefs about teaching and teachers & Teaching in the discipline<br><br>Beliefs about teaching and teachers & Learning in the discipline<br><br>Beliefs about learning and learners & Learning in the discipline |

| | | Source: Personal Epistemology | | |
|---|---|---|---|---|
| | | Beliefs About Knowledge and Knowing | Beliefs About Knowledge Construction | Beliefs About Knowledge Evaluation |
| Source: Disciplinary Specificity | Epistemological Structure | Beliefs about the act of knowing & Description of the discipline | | Beliefs about the relative value of knowledge & Description of the discipline |
| | Socio-Cultural Characteristics | Beliefs about the act of knowing & Learning in the discipline<br><br>Beliefs about the act of knowing & Knowing in the discipline | Beliefs about how people learn in general & Teaching in the discipline<br><br>Beliefs about how people learn in general & Learning in the discipline<br><br>Beliefs about how one learns specifically & Teaching in the discipline<br><br>Beliefs about how one learns specifically & Learning in the discipline<br><br>Beliefs about how one learns specifically & Knowing in the discipline | Beliefs about the relative value of knowledge & Teaching in the discipline<br><br>Beliefs about the relative value of knowledge & Knowing in the discipline |

## Knowledge base for teaching/Goals related to teaching

Knowledge base for teaching/Goals related to teaching/Course-level goals

SA feels that she has meta-objectives or guiding goals for her teaching. She feels that she is preparing the next generation. This would be why her teaching is guided by the notion of sending a message about the important role students will be playing in the near future.

Yet, SA also has more immediate objectives for the course. One of them is for the students not just to know but to be able to demonstrate that knowledge. In that sense, SA feels that she has the responsibility to provide something to them that will be useful when they go out into practice. An example she provides is for the students to be able to use knowledge from the course as an internal dialogue to direct their questions when they work with patients.

For SA, students should have an understanding of various aspects of social work in a health care setting. This is why she feels obligated to give students something in several specific areas (e.g., social work with the elderly).

Another objective for SA is to make social workers (i.e., the students) believe that they can be scholarly and academically inclined. So, for them to be able to write a scholarly paper.

Knowledge base for teaching/Goals related to teaching/Class-level goals

At the class level, SA talks about covering some material. For instance, she discusses covering notions like beliefs about health and illness, the individual's response to illness, the family's response to illness, Lazarus' stress and coping theory, as well as a number of theoretical frameworks.

SA entertains the goals of delivering content (i.e., key concepts) as well as inviting students to provide examples of those concepts (i.e., to operationalize them). So, she wants students to think about how they would apply these concepts. For instance, SA wants to get the students to think about the use of the term coping and what it means.

Simultaneously, SA is trying to get the students to see the broader picture of social work, to see beyond administrative duties. She wants students to see the needs of the people and to make connection with their role. She would like them to recognize that asking questions is not an easy task. SA tries to communicate how to use theory so that students can use these to structure their questions when interviewing.

Knowledge base for teaching/Goals related to teaching/Accomplishment of goals

SA feels that she has accomplished the piece on domains of beliefs that can be elicited in an interview. However, she feels that she may have too much (i.e., content or goals) which means that she may not get through all of those. That leads her to say that she is not sure she does a great job at covering/fostering understanding on some aspects of the materiel. For instance, she

says that, at times, students may not understand something, so she may not have done a good job explaining it. At other times, she feels they get it.

SA talks about one specific aspect of accomplishment; she is not sure that she manages to get them to integrate theory and practice, but students tell her that they appreciate the linkages between practice and theory. However, SA feels that what she achieves is to get them to understand that there is a link between the theory and what comes out of their mouth when questioning patients.

Knowledge base for teaching/Goals related to teaching/Goals – New/future

For the future, SA hopes the students will challenge the way in which their role is prescribed. And eventually, she would like to get into more practical stuff, based on feedback she gets from the students.

**Knowledge base for teaching/Knowledge related to teaching**

Knowledge base for teaching/Knowledge for teaching/Knowledge of content

SA's area of knowledge is social work with a specialization in children and families, children with chronic health conditions and disabilities, direct practice, as well as research methods. She says that she is not really familiar with areas such as the elderly with depression, or adults with mental health conditions. In the course, SA draws upon various theoretical models that address individual and family response to illness, for instance, family systems theory, chronic illness in the family cycle.

SA considers herself to operate in both the more theoretical and the more applied dimensions of social work. She says that, as a social worker, you have to use the theoretical framework to structure your thinking about impact—impact is kind of the general phenomenon. She also says that a given theoretical framework can work independently of who the clients are and that there are specific procedures for examining a specific case. Nonetheless, SA argues that most knowledge in social work is based on evidence, so they're best practices.

SA also says that social work is about knowledge, skills and values. For instance, psychosocial assessment involves speaking to the coping response of individuals. Using the notion of denial is not sufficient, one has to go underneath to find out more about the perceptions. The notion of denial is a dismissive term, it may be a minimization of what's going on. In social work, SA feels that one has to remain open and not judge, or not presume to know, but to inquire and ask about where people want to go from.

Knowledge base for teaching/Knowledge for teaching/Pedagogical content knowledge

SA talks about specific strategies to teach specific topics. For instance, with regards to coping, she feels that eliciting would emphasize the multiplicity of views instead of lecturing, which would emphasize a unicity of view.

She also discusses the progression of types questions when students are learning how to question: start with problem-, pathology-oriented questions to get it out of their system; then juxtapose that with questions that have assumptions, more facilitative assumptions embedded in them.

With regards to writing a paper about stress and coping, SA says that certain key concepts should be used such as: subheadings, operationalisation of key concepts in population studied, meaning for assessment and intervention, concept by concept.

Finally, when addressing the variety of beliefs, SA wants students to develop questions that they would ask in order to get at those beliefs, using the case study.

Knowledge base for teaching/Knowledge for teaching/Knowledge of self

SA takes her responsibility in preparing students for practice, in preparing professionals, very seriously. She has a sense that she is modelling something for the students. In addition, she has an advisory role with regards to field placements. However, she tends to get involve only to put out fires. As such, she feels that she does not have the time to fulfil her advisory role to the extent that she would like. And she is becoming concerned with what the expectations of the social worker's responsibilities are.

Most specifically as regards teaching, SA feels that she cannot lecture for hours because of who she is. She feels that she is not good at that. Rather, she is good at eliciting, asking questions, mainly because, as a person, she has learned the importance of asking good questions. SA says that she needs contact with the students, she needs to be able to interact with them. She depends on a lot of interaction, which influences the teaching activities that she chooses. However, she adds that it is not like her to be controlling during class discussion. But what is like her is the feeling that she has a responsibility to have a presence, to be helpful; so that takes quite a bit out of her. And, SA adds, when she is not into it, she tends to teach slower.

As regards her confidence, SA thinks that what she is doing is OK, which has increased her confidence. SA comes from a hospital culture in which one would have to constantly rethink what she was doing, which is very consistent with her values. For instance, in the past SA reports to have been more anxious about the content she was delivering than what the students were doing with it. Now, SA reports to have shifted towards what they do with the content and how she can evaluate that.

One thing that is important to SA is her commitment to her family, which makes her work here all day, go home to make supper and put the kids to bed, and come back to the university.

Knowledge base for teaching/Knowledge for teaching/Knowledge of teaching and teachers

SA has been teaching at McGill for four years. She did some sessional lecturing at the University of Toronto during her doctoral studies and enjoyed numerous teaching opportunities in hospital settings where she worked for 17 years. So, she did not take any formal course on

teaching during that time but ended up speaking a lot to people who did. SA feels that she has learned a lot about teaching through feedback from students because it helps her determine what works and what does not. She also feels that she has learned to teach through practice with families.

SA's teaching is informed by theories of social work (socio-ecological model and social-constructionism). That means that she tries to model values of integrity of the person, which are central to social work practice. She also uses interaction principles from Social Work in her teaching. SA actually sees teaching as facilitating, just as social work practice can be (i.e., they're isomorphic).

When planning teaching, SA tends to have an idea of how she will proceed: shifting, engaging, interacting, giving them something. She feels that small group work is useful in that students experience a-ha moments during those exercises. And she does not like to just do the didactic because she doesn't know if the students are asleep and listening, or if they're really thinking and integrating it in some way. So, she wants to deliver some content first and then see what they do with it. She wants them to struggle with it. Sometimes, SA feels that she is imposing too much of 'her' content. This is because she wants the students to bring their own experiences. And she worries about the linkages between what takes place in class and in the field.

SA finds that there are parallel processes between knowledge of practising social work and knowledge of teaching: the relationship with someone in need, about inspiring someone, the relational dimension. However, she feels that teaching is more directive than social work. For SA, knowledge about teaching really has to do with sitting down and thinking through, "What is it that students need to know and be able to do?" So, teaching is about the knowledge students need to have. To her, knowledge of social work is very similar to knowledge of teaching; it is about understanding where they're at, providing them with something that will bring them along, and working with them.

To conceptualize a course, SA works her way backwards, starting with the needs of graduating professionals. Her lectures comprise a didactic portion, use of PowerPoint, use of case examples, small-group work, and a link between theory and practice. She interacts with the students to get their feedback. She gets the students engaged with the content; she invites questions. She also links new materiel with materiel covered in prior lecture.

SA sometimes uses her own body to add to what she says (by nodding her head, etc...). She uses reframing as a way to put students on the right path. She also tells stories to reach the affective side of students but is not always sure how they react to it. When she does not know the answer, SA uses the class to respond to each other, to create a debate, a dialogue. So her teaching strategies combine didactic, interactive delivery of content with role playing and small-group work.

SA reports that, sometimes, she needs to structure activities very much to avoid students doing something else. Sometimes, she gives students more structure with regards to how to get where they need to get. And the structure can be accompanied by some modelling. For instance, she encourages them to use the theoretical framework to structure their paper.

SA also uses small-group/case studies to apply constructs that have just been presented. During small-group work, she walks around and tries to get the students focused by asking them questions. During classroom conversations, SA tries to direct students to applications of the theory. So, she emphasizes the usefulness of a new concept.

SA sends slides to students ahead of time so that they can take notes. She also reports that she teaches in a very interactive way in that she asks a lot of questions. She may use some of the students' experience as example (should they let her do that). She doesn't use a textbook but use a reader instead (journal articles). She also sometimes use videotapes, just as in social work practice.

When planning her teaching, SA tends to record what works about the lectures and uses that in the preparation of the following course. She finds that identifying what worked and what did not is a very difficult process to do alone. So, she will make notes about the course structure to return to when planning later iterations of a course/class: content covered, link with readings, were students confused, were students interested. For instance, as regard this particular course, she feels the need to work on her objectives as those are more what she wants to give to the students as opposed to what they can get out of it. And SA says that she would like to be more structured and explicit in the course outline.

SA also reports to be very careful of what students do with their learning (e.g., generalizing beyond the example). She finds that it is sometimes useful to slow the pacing down to enable students to have more practice time with a concept. Sometimes, she finds it more important to have students do some skill-building rather than knowledge acquisition. To SA, students need to experience something, which is why she fosters such experiences. She also feels that it is sometimes better to play a less active role to let students come up with the knowledge. However, SA is struggling with how much work she should make the students do (i.e., who should come up with the examples?) She feels the need to think more about eliciting stories from students to connect with materiel, to ask them more questions and relate it to their experience.

Feedback from students is a very important dimension for SA. For instance, she checks if their heads are nodding as signs of their understanding (use non-verbal cues). To her, that provides useful information about the students' engagement, their confusion, their certainty. Also, SA feels that the depth of comments sometimes indicate that things have to be taken a little bit further. For instance, if students are asking similar questions, she takes some time and addresses the topic of their question.

<u>Knowledge base for teaching/Knowledge for teaching/Knowledge of learning and learners</u>

With regards to learning in general, SA feels that students must experience or struggle to learn something. Therefore, students need to be successfully engaged: paying attention, struggling with materiel, enjoy the tasks. Simultaneously, she feels that not every student learns the same way; some are more open, talkative than others, and some do better than others. What is clear to her though is that students cannot possibly sit through 3 hours even with a break; they need to be changing activities.

SA explains that her students vary greatly in age (i.e., anywhere from 21 to 60). Some students have been out in the field as social work technicians, whereas others come from other disciplines and they are every strong. In addition, students work with a variety of clienteles: children, elderly, mentally ill, and disabled. One thing they have in common, according to SA, is that they come into the profession because they want to help.

SA further explains that students often connect personally with the materiel. For instance, many of the students in this class have experienced losses in their lives so they could apply what she is teaching. Also, some students in this class are outstanding. They catch on, engage and become passionate about the materiel. Not all students do that, but some take the initiative to say what they arrive at. Some students ask for more feedback while others come back to say that they are using that materiel.

SA reports less positive aspects about the students. For instance, students in that class can be quite judgemental. And they at times get ideological around certain issues that are discussed. SA feels that this is because beliefs affect how some students hear or how they learn. One other dimension about the students is that, after break, because it is midday, they are tired and need to eat.

SA discusses what she needs to do to foster learning. She says that she wants students to be engaged with the materiel to avoid being passive learners. So, she tries to keep them alert, on their toes, engaged. Sometimes, the students' understanding needs to be pushed a little bit further. At other times, they need to be refocused. And SA says that students can use WebCT-based resources to catch up if they miss a session or if they want to review things. Also, students need help to make sense of what they see or experience in the field. Most often, students make the link between the field and the class by themselves. However, in the field, students hear SA's voice or structure their work according to what they have learned.

SA uses a variety of sources and types of evidence of learning from the students. It ranges from feedback from students, kinds of questions asked, her own observations to students receiving ideas well, students connecting with ideas, students operationalizing ideas. Evidence could also take the form of students modelling back the same questions as what SA wanted them to learn. SA also gauges learning with the level of energy in the room, engagement in small groups, and engagement with one another. She also examines the language students use, the passion expressed by students, or what they write in papers.

One way for SA to know if the learning is not deep is if their content is thin, superficial, or if there is no struggle. It is also when they do not draw on multiple sources of knowledge, or when there is no integration of theory with their experience.

<u>Knowledge base for teaching/Knowledge for teaching/Knowledge of assessment of learning</u>

SA talks about specific methods of assessing student learning. She says that grading based on participation would not be fair as she would not have remembered students names. She also feels that grading participation is too subjective. This is why, instead of looking at participation, she

gives a midterm exam worth 40% and a paper worth 60%. SA feels that the mid-term exam is more objective in the sense that there are specific things that she is looking for in responses. For instance, the exam is structured with short answer questions, case study, and two essay questions. And SA feels that exams are part of the life of social workers—for licensing, you have an oral and written exam.

SA thought that she would do something different at midterm (i.e., use mid-term exam) because of the paper crunch students experience at that time. She was debating having more ways of evaluating them because that would provide her with more info on the students, but she was unsure about her capacity to handle it. SA adds that she is aware of other mechanisms for peer grading and feedback, but she would need help with those. Nonetheless, informal evaluation does take place when she walks around small groups, when they're working on their case studies.

Knowledge base for teaching/Knowledge for teaching/Knowledge of curricular issues

With regards to the curriculum, SA feels that the BSW program prepares generalists whereas the MSW program prepares specialists. The idea behind the BSW is that one acquires general skills and knowledge that get transferred to whichever context of practice. There is also a special BSW program for students who already have an undergraduate degree (12 months duration).

SA also discusses the fact that she knows very little of the teaching in her colleagues' classes. She did a curriculum review, which helped her in knowing what is taught; but she doesn't have any idea of what is covered by whom. So, she knows about the program because of the research that she conducted about the content of courses in the BSW and MSW. And SA feels that having some knowledge of what is covered in the rest of the program helps when designing her own course. For instance, she explains that the course on ageing was eliminated and it was agreed that she would cover some of that.

However, SA feels that there exists a disconnect between the field, the curriculum, and the teaching; she feels that there needs to be a closer link. Students are going back and forth between the field and the university, but they are not supported very well in tying the two together. SA adds that meetings with field educators have not proven to be very effective in the past as there was no depth. Small group consultation, peer consultation, could be a nice change but she argues that the program would need to be restructured.

Knowledge base for teaching/Knowledge for teaching/Knowledge of human behaviour

For SA, teaching is like having a conversation; one can't have a unidirectional conversation, that's not a conversation. She needs the students to engage and give her feedback for teaching to be like a conversation. SA feels that the synergy generated by a discussion is incredible. She also feels that we don't do enough of that in our teaching. This is why she wants to be there, more physically, to bring them together, to facilitate an interaction amongst the students.

Knowledge base for teaching/Knowledge for teaching/Knowledge of logistical issues

SA argues that her choice of instructional strategies and/or format is limited by what the school requirements enable her to do. For instance, she has a limited number of TA hours (i.e., 90 hours). Also, the school has traditionally employed a lot of sessional lecturers but that money is soon going to disappear. So, she feels that teaching staff at the school will need to re-configure what they are teaching and how they are teaching it (i.e., how broad and deep they are going).

Another consideration that SA raises has to do with students, namely the fact that classes sometimes run through the lunch hour and some students go through a whole day of classes.

**Knowledge base for teaching/Beliefs related to teaching**

Knowledge base for teaching/Beliefs for teaching/Beliefs about the purposes of instruction

For SA, a university education has to prepare students to carve out a place for themselves in the working world.

Knowledge base for teaching/Beliefs for teaching/Beliefs about the conditions for instruction

SA feels that smaller programs enable you to get to know students, their style, who they are, how they are, their academic strengths. In addition, SA feels that it would be great to have time, opportunity, and environment to discuss our respective teaching with colleagues. For her, bringing people together, in the form of partnering, would be great; this would provide her with more feedback about her teaching.

Knowledge base for teaching/Beliefs for teaching/Beliefs about teaching and teachers

SA believes that good teachers have an appreciation of the value of both scholarship and practice. Therefore, their role is to help students bridge work done in academia and in the field, to help them be able to speak to the academic base of the profession, and have respect for it.

At the undergraduate level, this would mean to bring forward the knowledge based related to the profession and to link it to the code of ethics. Thus, the role of the teacher at the undergraduate level is to link practice to theory and theory to practice (research plays a smaller component). At the graduate level, SA feels that the role of the teacher is to inspire students to raise questions and to pursue that.

So, for SA, good teaching involves balancing theory and opportunity for the classroom application of it. This is why she says that she provides them with the knowledge base and uses their experiences in the field to link the two. SA adds that she has a responsibility to prepare them. She has to link what is taught in university with what students learn in the field.
On a more practical level, SA believes that good teaching means being connected with the students by making eye contact and having a presence in the students' space.

Knowledge base for teaching/Beliefs for teaching/Beliefs about learning and learners

SA believes that students learn better when they enact or experience an ah-ha moment of their own. Therefore, the role of learner is to engage and struggle with the material, to embrace it, and to be challenged by it. Thus, students have a responsibility to read, to think, and to engage critically with the content.

Simultaneously, SA believes that some students are better at writing exams whereas others are better at writing papers.

**Personal epistemology/Beliefs about knowledge and knowing**

Personal epistemology/Beliefs about knowledge and knowing/Beliefs nature of knowledge

SA does not see Social Work as a science. To her, a profession (like Social Work) has a body of knowledge and a code of ethics. As such, she feels that people in Social Work think of knowledge, skills, and values. And, she adds, one cannot assume that if you have knowledge, you'll know what to do (i.e., have the skills). SA also feels that theories are not discipline-specific.

Personal epistemology/Beliefs about knowledge and knowing/Beliefs - act of knowing

SA feels that there is a major difference between knowing and understanding, and implementing and enacting. To her, there exists a huge leap between getting and understanding the theory and actually using it. As SA summarises it, it's one thing to understand, and it's another to know what to do.

In addition, SA feels that people hear or understand differently depending on their beliefs. This would be why, in certain fields (such as Social Work), SA feels that knowledge is not technical but professional in that the people operate from a code of ethics.

**Personal epistemology/Beliefs about knowledge construction**

Personal epistemology/Beliefs about knowledge construction/Beliefs people learn in general

SA feels that students learn by struggling with something, by going through the experience of doing something. Therefore, to her, learning includes engaging with the content, struggling with it to try to make sense of it. As such, students learn better when they enact or experience an Ah-ha moment of their own (i.e., discovery learning). Learning happens through the process of struggling and figuring things out by themselves. Therefore, learners need to engage with the content, they cannot be passive.

More specifically, SA feels that learning is done by doing, by writing and applying, by experiencing things at an affective level. Therefore, learning happens through struggling to close

the gap between knowing and doing. SA feels that people are not learning well when their knowledge is thin and superficial, when there is no struggle, when they do not integrate theory with their experience. Rather, she feels that learning takes place when people bring and reorganize their experiences given the theoretical lenses acquired in the course. Students learn by using the theoretical lens to position their experiences. SA adds that learning well means beginning to internalize and reflect back to her in some of the language used in the course.

That being said, SA discusses the fact that different people learn in different ways, that not everybody learns in the same way. Therefore, to learn, students need to shift modalities.

Personal epistemology/Beliefs about knowledge construction/Beliefs one learns specifically

For SA, learning has to be tactile and contextualized. She feels that she learns through feedback. Feedback provides her with an indication of what's working and what's not (very much a Social Work principle). SA feels that learning requires applying life or social skills principles because you think it's right; the positive feedback then tells you if it works, if it's good.

But SA also learns through discussion with colleagues, mainly because she feels she would be challenged. SA says that she depends on a lot of interaction for learning.

**Personal epistemology/Beliefs about knowledge evaluation**

Personal epistemology/Beliefs about the value of knowledge/Beliefs… value of knowledge

SA has a lot of trust and confidence in knowledge acquired through experience. She would also be willing to share ideas about teaching with colleagues. At some point, she even thought about publishing some of her thinking about teaching social work (i.e., analysis of the curriculum). Yet, at conferences, she prefers to present/attend what she calls "substantive content or research".

**Disciplinary culture and structure/Socio-cultural characteristics**

Disciplinary culture and structure/Socio-cultural characteristics/Teaching in the discipline

For SA, teaching in a profession like social work means teaching with the code of ethics in mind. Therefore, teaching social work requires grounding the curriculum in the code of ethics.

But teaching social work, for SA, is about helping students understand that social work is not just about doing tasks. So, she has to teach them to see past what the job description says, to see the knowledge base, and to link the theoretical knowledge base and the field experiences. For SA, teaching social work as an endeavour that is scholarly, that has a knowledge base and research to support it, means educating students to do more than administrative duties; they have

a therapeutic role. So, students are taught to carve out a place for themselves in the working world.

But SA feels that the current structure does not value spending time in the field linking theory with practice. For instance, she is supposed to have meetings with field educators and students, but she is not given the time to do that properly. This is why she perceives a lack of congruence between what is taught and what goes on out there.

With regards to her own particular knowledge of teaching social work, SA feels that she has learned about teaching social work through talking with colleagues who took the specialized course on teaching during her doctoral studies. She adds that she has learned through her practice with families—social work being isomorphic to teaching (i.e., doing things that are relevant to ''them'').

Yet, SA reports that she knows very little about what happens in other professors' classrooms. She explains that, in her school, they have a hard time getting people to staff meetings. So, they do not get together to talk about teaching. What is left are journals and conferences as venues to talk about teaching and learning in social work.

Disciplinary culture and structure/Socio-cultural characteristics/Learning in the discipline

SA feels that learning in social work means acquiring a structure that stays with you and that guides your thinking in a variety of actions: interviewing, social work assessment, conducting professional work. However, she reckons that people tend to connect with the materiel in a very personal way.

SA also reports that, in social work, students go back and forth between the field and the classroom for their learning. The theoretical/classroom component is there to help them make sense of what they are seeing in the field, thus directing what they are to do (skills). However, SA feels that there is a need to link the field component back to the theory, which is not always happening in social work. Students are left having to connect their classroom, academic learning with the learning they achieve in the field on their own. To help foster that sort of learning, placements are supervised by social workers (so students learn from practicing social workers) and examinations help students learn the skills of real life social workers. However, SA reports that some students have a hard time seeing how exams are related to learning social work.

As regards learning across the curriculum, SA feels that undergraduate students learn general skills and knowledge, which they then transfer to wherever they end up. Graduate students learn more about critical perspectives and theories so that they have a deeper understanding of what they are doing; this is not the case at the undergraduate level. The difference in learning at the graduate and undergraduate levels therefore revolves around the role of research and the emphasis on critical perspectives.

Disciplinary culture and structure/Socio-cultural characteristics/Knowing in the discipline

SA says that knowing in social work involves trying things in a way and the feedback you get, sort of the bouncing, the reflection of that, is what makes you determine if it's working or not. In that sense, she feels that knowing in social work requires dancing on your feet, just like in an exam. But knowledge in Social Work is also a scaffold, a template that people can carry with them and draw on, using the theoretical framework to structure one's thinking about impact.

To SA, social work includes scholarly and academic thinking. It includes knowledge, skills, and values. In that sense, SA feels that knowing does not automatically mean knowing what to do. And there are principles embedded in social work theories; those principles correspond to the values and beliefs associated with the code of ethics.

SA reports that there also exist various epistemologies in Social Work. So, when teaching, she ensures that all views are represented.

Disciplinary culture and structure/Socio-cultural characteristics/Practicing in the discipline

SA feels that in social work practice, one is constantly thinking on her feet, drawing on various pieces of theory to direct questions or interactions. Yet, the mandate of social workers in hospital tends to revolve around discharging patients. Thus, social workers tend to be limited to paper pushing and filling forms and they operate within a fairly hierarchical system of institutions. As such, the culture in which social workers sometimes practice is sometimes driven by cutbacks and constantly re-thinking how things are done.

However, SA also feels that when social workers are not responsible for discharge planning, they can do the front-line, clinical, supportive stuff. Then, the role of the social worker is to act as intermediary between the medical knowledge and awareness of where the family is at. However, SA feels that what students are learning may not be the most congruent with what expectations of what a social worker is supposed to be doing.

SA explains that social workers are moving to a position in which they can justify our actions based on research evidence. There's a whole new generation of social workers out there who sound different from the preceding generations. Social work practice may be in trouble in this age of evidence-based practice. This is because there is a need for social work practice to be documented by research. This is why social workers, like SA, go to conferences and present on substantive content, on research.

Yet, one thing that is particularly important to SA is the fact that everything social workers do is grounded in the Code of Ethics. She says that social workers are professionals because they operate from a Code of Ethics. And some provinces are moving towards licensing exams (oral and written), thus enforcing that Code of Ethics even more.

SA draws a parallel between the Code of Ethics and what one should do as a teacher. For SA, social work practice has a lot in common with teaching through the notion of 'facilitation of learning'. For instance, working with families—learning from them, moving them along—is

similar to what SA is doing with her students. Social work practice is similar to teaching in that you have to think through, to understand, to provide the clients with things, to work with them.

**Disciplinary culture and structure/Epistemological characteristics**

Disciplinary culture and structure/Epistemological characteristics/Description of the discipline

To SA, Social Work positions itself in the space between the person and the environment. Therefore, there exists a very important relational dimension in Social Work as it is about building rapport in a relationship with somebody who needs something. As such, argues that the beliefs and values of social work are humanistic—they're based on a universal moral code.

Yet, SA feels that some things in social work appear deceptively simple. For instance, SA argues that Social Work is more than practice with individuals; the field is also about institutional and policy work. And a form of tension exists in Social Work between deductive models and inductive social constructionism.

Overall, SA would say that Social Work is an art, a profession. She would not use the word science to describe Social Work. And when comparing Social Work with teaching, SA feels that teaching is more directive or authoritative than Social Work practice.

Disciplinary culture and structure/Epistemological characteristics/Relation to other disciplines

SA argues that Social Work draws on philosophy, sociology, psychology, psychiatry, etc... and that there exists some tension with some of the source disciplines (e.g., psychiatry). To her, this may be because of differences in the epistemological basis for thinking about practice.

SA adds that other professions also have a code of ethics and a value base from which they operate. However, she feels that certain disciplines may not necessarily have a set of values or beliefs belonging to those discipline; she feels that they may have a moral code?

With regards to health sciences, Social Work theories are shared by other disciplines (e.g., nursing). SA believes that this may be why her field struggles to differentiate itself from nursing or OT (i.e., the allied health professions). She adds this reflects the current debate over protected professional acts.

## Appendix R (Web of relationships between components of DPK – SA)



| | | Source: Knowledge Base for Teaching | | |
|---|---|---|---|---|
| | | Goals Related to Teaching | Knowledge Structures Related to Teaching | Beliefs Related to Teaching |
| Source: Personal Epistemology | Beliefs About Knowledge and Knowing | Course-level goals & Beliefs about the nature of knowledge<br><br>Course-level goals & Beliefs about the act of knowing<br><br>Class-level goals & Beliefs about the act of knowing<br><br>Accomplishment of goals & Beliefs about the act of knowing | Knowledge of the content & Beliefs about the nature of knowledge<br>Knowledge of the content & Beliefs about the act of knowing<br>Knowledge of self & Beliefs about the act of knowing<br>Knowledge of teaching and teachers & Beliefs about the nature of knowledge<br>Knowledge of teaching and teachers & Beliefs about the act of knowing<br>Knowledge of learning and learners & Beliefs about the act of knowing<br>Knowledge of curricular issues & Beliefs about the act of knowing | Beliefs about teaching and teachers & Beliefs about the nature of knowledge<br><br>Beliefs about teaching and teachers & Beliefs about the act of knowing<br><br>Beliefs about learning and learners & Beliefs about the act of knowing |
| | Beliefs About Knowledge Construction | Course-level goals & Beliefs about how people learn in general<br><br>Class-level goals & Beliefs about how people learn in general | Knowledge of the content & Beliefs about how people learn in general<br>Knowledge of self & Beliefs about how people learn in general<br>Knowledge of self & Beliefs about how one learns specifically<br>Knowledge of teaching and teachers & Beliefs about how people learn in general<br>Knowledge of teaching and teachers & Beliefs about how one learns specifically<br>Knowledge of learning and learners & Beliefs about how people learn in general<br>Knowledge of learning and learners & Beliefs about how one learns specifically<br>Knowledge of curricular issues & Beliefs about how people learn in general<br>Knowledge of human behaviour & Beliefs about how one learns specifically | Beliefs about teaching and teachers & Beliefs about how people learn in general<br><br>Beliefs about learning and learners & Beliefs about how people learn in general |
| | Beliefs About Knowledge Evaluation | | Knowledge of teaching and teachers & Beliefs about the relative value of knowledge | Beliefs about the conditions of instruction & Beliefs about the relative value of knowledge |

## Appendix R (Web of relationships between components of DPK – SA)



| | | Source: Knowledge Base for Teaching | | |
|---|---|---|---|---|
| | | Goals Related to Teaching | Knowledge Structures Related to Teaching | Beliefs Related to Teaching |
| Source: Disciplinary Specificity | Epistemological Structure | Course-level goals & Description of the discipline<br><br>Class-level goals & Relation to other disciplines | Knowledge of the content & Description of the discipline<br><br>Knowledge of teaching and teachers & Description of the discipline<br><br>Knowledge of learning and learners & Description of the discipline | |
| | Socio-Cultural Characteristics | Course-level goals & Teaching in the discipline<br>Course-level goals & Learning in the discipline<br>Course-level goals & Knowing in the discipline<br>Course-level goals & Practising in the discipline<br>Class-level goals & Teaching in the discipline<br>Class-level goals & Learning in the discipline<br>Class-level goals & Knowing in the discipline<br>Class-level goals & Practising in the discipline<br>Accomplishment of goals & Teaching in the discipline<br>Accomplishment of goals & Learning in the discipline<br>Accomplishment of goals & Practising in the discipline<br>New/future goals & Teaching in the discipline<br>New/future goals & Practising in the discipline | Knowledge of the content & Teaching in the discipline<br>Knowledge of the content & Learning in the discipline<br>Knowledge of the content & Knowing in the discipline<br>Knowledge of the content & Practising in the discipline<br>Knowledge of self & Teaching in the discipline<br>Knowledge of self & Learning in the discipline<br>Knowledge of self & Knowing in the discipline<br>Knowledge of self & Practising in the discipline<br>Knowledge of teaching and teachers & Teaching in the discipline<br>Knowledge of teaching and teachers & Learning in the discipline<br>Knowledge of teaching and teachers & Knowing in the discipline<br>Knowledge of teaching and teachers & Practising in the discipline<br>Knowledge of learning and learners & Teaching in the discipline<br>Knowledge of learning and learners & Learning in the discipline<br>Knowledge of learning and learners & Knowing in the discipline<br>Knowledge of learning and learners & Practising in the discipline<br>Knowledge of assessment of learning & Learning in the discipline | Beliefs about the purpose of instruction & Teaching in the discipline<br><br>Beliefs about the purpose of instruction & Practising in the discipline<br><br>Beliefs about the conditions of instruction & Teaching in the discipline<br><br>Beliefs about teaching and teachers & Teaching in the discipline<br><br>Beliefs about teaching and teachers & Learning in the discipline<br><br>Beliefs about teaching and teachers & Knowing in the discipline<br><br>Beliefs about teaching and teachers & Practising in the discipline<br><br>Beliefs about learning and learners & Learning in the discipline |

## Appendix R (Web of relationships between components of DPK – SA)



| | | Source: Personal Epistemology | | |
|---|---|---|---|---|
| | | Beliefs About Knowledge and Knowing | Beliefs About Knowledge Construction | Beliefs About Knowledge Evaluation |
| Source: Disciplinary Specificity | Epistemological Structure | Beliefs about the nature of knowledge & Description of the discipline<br><br>Beliefs about the nature of knowledge & Relation to other disciplines<br><br>Beliefs about the act of knowing & Description of the discipline<br><br>Beliefs about the act of knowing & Relation to other disciplines | | |
| | Socio-Cultural Characteristics | About the nature of knowledge & Teaching in the discipline<br><br>About the nature of knowledge & Learning in the discipline<br><br>About the nature of knowledge & Knowing in the discipline<br><br>About the nature of knowledge & Practising in the discipline<br><br>About the act of knowing & Teaching in the discipline<br><br>About the act of knowing & Learning in the discipline<br><br>About the act of knowing & Knowing in the discipline<br><br>About the act of knowing & Practising in the discipline | How people learn in general & Teaching in the discipline<br><br>How people learn in general & Learning in the discipline<br><br>How people learn in general & Knowing in the discipline<br><br>How people learn in general & Practising in the discipline<br><br>How one learns specifically & Teaching in the discipline | About the relative value of knowledge & Teaching in the discipline |

## Knowledge base for teaching/Goals for teaching

Knowledge base for teaching/Goals related to teaching/Course-level goals

HA has a series of goals for this course. First, he wants the students to develop an intuitive feel for what a system does. That means that he wants them to walk away with the concept of design being very large. In that sense, the students should be able to reduce design problems into a series of problems that are easy to solve; allocate the problems to various members of the group; bring that information together; and synthesise it to the solution to the first problem, then the larger problems. Embedded in the first goal is the notion of being able to problem solve, that is, how to attack problems, how to find information needed to solve the problem, and how to solve the problem. Also embedded in this goal is for the students to be able to work with a team approach.

A second objective is for the students to be able to go to a book if they need to write an equation. A third objective is for the students to be able to produce the report (that would actually be of some use).

A fourth and final objective is for the students to learn to listen to the public: what are the issues being expressed, what are questions people have; and what are big concerns and distrusts. In that sense, HA wishes to relate the materiel to community issues and the responsibility the students have so as to make them understand that the issue they're working on is quite important. Embedded in this is HA's intent to show students that they're having a definite impact out there with the type of work that they're doing. So, he wants them to feel their responsibility rather than be able to state it. He also wants them to see that responsibility and try to deal with it.

Knowledge base for teaching/Goals related to teaching/Class-level goals

In relation to the class, HA wants to make students aware of the sheer number of choices and the fact that they're going to have to do a lot of detailed work. He wants students to know how to put all of these components together, that they understand the complexity of the whole process and all the various issues that there are. HA also wants to show to students the importance of identifying the structure and being able to make sure that one can put out the fire... if it does occur.

HA also would like for the students to understand what the phenomenon are that are involved with certain types of materials, and how they can then protect them from things that may happen (things like corrosion). So, he wants students to have an understanding of the broader issues of the materials selection for water distribution systems. He also wants to show students the thought process behind the selection of the material itself, so that they can go off and raise issues for their own particular jobs.

In addition, HA is trying to connect the students with the broader issues of the larger community. For instance, he tries to make them understand that they have to deal with the public reaction out there.

Knowledge base for teaching/Goals related to teaching/Accomplishment of goals

One of HA's goals is to make the students understand the level of responsibility they have. And HA does not think that they have that yet. He does not think that people have a good feel until they are out in the field. HA feels that, while in the programme, students may understand what the responsibility is about, but they may not necessarily feel that. And HA is disappointed that the students do not necessarily get that insight into the materiel.

Knowledge base for teaching/Goals related to teaching/New or future goals

There are a few aspects of the course which HA wishes to develop in the future. One of those would include to make the students familiar with softer aspects of Civil engineering rather than the hard technical details—what he calls the "insight". Another would be to give the students an opportunity to submit something written to him in an acceptable format, that is, to have them reference information, present information, have a thesis or some sort of point that they're trying to make. Finally, HA would like students to learn to work as a group.

**Knowledge base for teaching/Knowledge related to teaching**

Knowledge base for teaching/Knowledge related to teaching/Knowledge of content

HA explains that he teaches thermodynamics, which is considered a chemical or mechanical engineering course. He also explains that he has adapted the subject matter to changing needs.

HA also says that he is a chemical engineer teaching environmental topics in civil engineering. He says that his multi-disciplinary background has fully prepared him to speak the language of a chemical engineer, that he understands the concepts, and that they both need to be taught. And HA says that he is more comfortable teaching in a Civil engineering department because he is able to bring very different perspectives. However, that tends to limit courses he can teach: for instance, HA says that he cannot teach a structural engineering course.

HA explains that thermodynamics is not a subject that is out there in popular discussions. The implications of a lot of things that he teaches are not only understood through the subject matter, but through other influences. So, he says that it is a dry type of topic on certain particular points.

HA explains that the course covers the inter-relationship between three different systems involved with the design of the water distribution system. So, the course covers details of the materials that are used in the transportation of water throughout the community, as well as degradation of materials in the environment depending on the acidity of the soil, abrasion, effects like that. For those, mathematical equations can be used to describe what is going on. So, one has to know how to write equations and relate them to the real situation.

HA explains that parts of the subject are softer, as opposed to hard technical details. For instance, future engineers will need to make choices using supporting information that is at times somewhat exaggerated. There is no precise formula that says this is the material of choice for that kind of application, because the context changes from community to community. So, this course makes

students aware of the materials out there so that they are exposed to broader issues. The course introduces students to selection procedures to decide what kinds of materials will be appropriate in certain situations. HA further explains that the choice of best material depends on the local situation, the local availability of materials, of people, and of the particular circumstances.

HA explains that the course is about designing water distribution systems. That includes taking water from its original supply, identifying local populations, determining how populations can grow over the course of the next thirty years, and trying to predict what their needs are going to be for water over the course of an entire year. HA adds that that depends on weather patterns as well, how hot or cold it is going to get, and then right down to the design, pipe by pipe, that is how one builds up a system that supplies water to, say, a community of 1,000 people. HA adds that design is not the hard technical side, it is rather the softer side.

HA says that his views in the environmental area have changed in a big way over the past twelve years, because of his research and teaching.

Knowledge base for teaching/ Knowledge related to teaching /Pedagogical content knowledge

HA explains that presenting some material, even if it is not to be used in practice, reinforces the concept at a very basic level. For instance, he says that some equations will never be used as they are not applicable; the equations help reinforce the concept presented to the students. The key is to get the equation right; plugging in numbers is the easy part.

HA also says that equations can be used in combination with a diagram to help students understand what is in the diagram. For instance, at times, a diagram is overly complex and it does not represent a complex problem. In those instances, it should be replaced by separate figures to show the same problem.

HA explains that the organization of content needs to be changed around, with more technical stuff at the front and then softer issues. This would get students to understand the mechanics of it, and then understand the community context for their application.

And whereas HA uses history as a way to interest students in the hard technical subjects, he uses real-life examples as reminders of students' responsibilities—what he calls the softer side of civil engineering. HA explains that students have to make their own ethical and moral decision with regards to the use of certain materials, which is what he wants them to learn when using examples such as the asbestos pipe. Also, HA feels that bringing real people who had to deal with the ethical or moral issues (as in the Walkerton crisis) would help students learn about that.

Knowledge base for teaching/Knowledge related to teaching/Knowledge of self

HA explains that he was scared of teaching at McGill in his early days because he felt that he was not qualified to teach. HA explains that, during his first week of teaching, he remembers feeling completely unprepared. And HA says that he still has some moments of panic, particularly with a hundred students behind his back, as he is writing something on the board. He is not more confident than he was, but HA hopes that this nervousness will never go away as he thinks that it is healthy. HA says that he certainly does not want to project arrogance.

HA says that his biggest fear is that he loses touch with the difficulties the students are having when introduced to certain concepts. And he finds his responsibility as a teacher quite frightening in that some students look to him as an expert, and they take every word down as Gospel truth. HA feels overwhelmed that the students take everything that he says in the classroom as Gospel truth.

HA also gets frustrated when he sees that students have gone through the mechanics of a project without really learning from it. That is because, as he explains, HA is uncomfortable about the fact that some students are not getting it.

HA says that, over the years, he has developed an outward-looking approach to life. Simultaneously, HA has come to feel that, when he is teaching, he is just being himself. So, he has not had to create a teaching persona in any way. And HA claims to be very comfortable about his teaching style and his use of these things. However, he would be very nervous about being questioned on the technical details by his colleagues. HA says that, deep down in his heart, he knows that he is not a real professor, that he is a fraud, and that he is just getting by.

HA also explains that he is comfortable teaching in a civil engineering department because he is bringing a very different, novel viewpoint. Also, HA says that he needs to have that constant stimulation from outside fields to keep him interested in his own field. And he really gets a kick out of being in another person's faculty and actually - not only understanding what's going on, but having something to contribute.

One thing that makes HA feel pretty positive about the way that he teaches is that he is not relying entirely on a script that is on the page. Rather, he feels that he can adjust as he goes on. And to keep himself interested in what he is teaching, HA will emphasize different things in different years, and also it depends on what is being done out there.

HA also feels that he feeds off a bigger audience much better. For some reason, he must be a show person in some ways. And his biggest frustration is finding the time to make all the changes that he always wants to make. But HA explains that how content he is with the course is the biggest motivator. He also explains that he was trying to get away from chalk and talk as much as he could, but he kept getting dragged back into it, because it seems to work naturally for him.

<u>Knowledge base for teaching/Knowledge related to teaching/Knowledge of teaching and teachers</u>

HA has been at McGill for over 12 years. Prior to that, he has taught at the University of Windsor. Prior to teaching in higher education, he has taught survival techniques in the wilderness. At McGill, HA has been teaching all courses in the department of Civil engineering, but finds himself always teaching courses is his areas of expertise or interest. In the case of this particular course, it is the 8$^{th}$ time that he is teaching it.

HA has experience of lecturing to 400 students, although his usual range is from 22 to 97 students. As he uses smaller-group projects in his classes, HA says that the highest number of groups he has had is 18. HA also says that he has taught at all levels and that he received teaching awards on several occasions.

HA explains that he has no formal instructional training. Everything has been learned purely through experience. After he finished his Master's degree, he was awarded a position as a lecturer in a department of Chemical Engineering where he replaced someone who was away on leave for two years. HA ended up teaching 8 courses in two years. At his first lecture, HA says that he was 21, that some of the students in the class were older than him, and that he had never taught anybody before. HA says that he was lucky to have the experience and the forgiveness of the class that was willing to keep going with him.

As regard sources of information for teaching, HA says that, when preparing for class, he uses the Internet to review recent development in terms of materials. He also presents certain concepts and talks about situations that he has had to deal with in the past. For instance, he brings in some new developments of when he was on sabbatical [as a consultant]. He would go through some of his brochures from pipe manufacturers to show students some of the material.

HA says that, when he sees that students only go through the mechanics of projects without actually learning, that shapes how he teaches. However, he adds that one of the things that informs his teaching more than anything else is the background readings that have nothing to do with the course (e.g., history of science, philosophy of science, evolutionary biology, evolutionary psychology). He adds that outside readings trigger his thinking about teaching and that he ends up trying things out.

HA explains that, from an engineering standpoint, professors use regular assignments, problems, and things like that. Generally, 3 hours of lecturing per week are devoted to delivery of basic concepts. Then, tutorials supplement lectures. What normally happens is that concepts are introduced in lectures and tutorials are for putting them into practice in some ways. HA explains that there exists, therefore, a very strong link between lectures and tutorials. Normally, theory is covered in class, then an example of its application is covered in the tutorial, and then students take that theory and apply it to their individual projects, in groups.

HA explains that the project serves to seal the whole thing, that is, they send students off to do their own project, which is a different application of the things that they have been learning in class. The big project implies that students produce a report for the entire course of the semester in which they analyze and design a water distribution system for an existing community.

HA describes himself as a "chalk-and-talk" type of lecturer in that he has a lot of material to cover, so there tends not to be a lot of time for discussion in the classroom itself. Rather, he delivers theoretical information. For instance, his course outline does not list learning outcomes. Specifically, it talks about the subjects that he is going to teach. And some lectures are very oriented toward the blackboard, because they have supporting figures and overheads, such as graphs, diagrams and structures and that sort of thing, because the material is more conceptual and visual. And in the case of the tutorial, HA explains that he tries to verbalize the whole thought process that he is going through in approaching a particular design, and emphasizing here and there that these are his decisions.

Yet, HA emphasises that a "chalk-and-talk" approach only works when students have a certain energy level. He wishes that he could get in more discussion. However, HA finds it hard because they are talking about technical subjects that constitutes "information". HA argues that there are

theories that are being transmitted. Yet, he tries to bring people into the discussion as much as possible. He does that by trying to grab their interest, by trying to get them to respond to questions. HA says that he asks a series of questions for students to answer; if they come to him with the same questions, he answers them again with a question.

HA says that one cannot deliver everything. So, one has to deliver some very important points that illustrate the concepts. He adds that he feels a trade-off between more group-dynamic type of environments (which may enhance the learning of certain people) and the pace in the delivery of material. He adds that there is a trade off between quantity and quality in terms of learning and the number of concepts.

HA says that it is worthwhile to emphasize and re-emphasize certain issues over and over and over so that the students are aware of them, and they do not take these things for granted. This is why he asks, at the beginning of every tutorial, if the students have any questions or any problems with their projects. Also, he always starts by re-connecting and identifying where they were. HA feels that there needs to be a flow. He adds that he has to be very conscious of the differences of the various levels because it is too easy to accelerate and leave certain people behind.

HA says that he needs to review his notes for ½ hour prior to every lecture. He comes up with anecdotes as he reviews his notes (as opposed to having them written down). HA says that it is dry material. So the idea is to liven it up a little bit with anecdotal stuff. He adds that preparing his anecdotes ahead of time prevents him from heading off in strange directions on the fly. However, HA says that he changes direction in class if he needs to. He also says that he varies his anecdotes by widening his array of them.

HA says that he brings in materiel in which he is excited as the students themselves pick up on that and they themselves become more interested in the material. He brings in materiel that he hears/reads about [current affairs] into the classroom. That way, HA says that he connects the materiel he is teaching with what is going on in the world. He also relates class material to what students may see or experience on a daily basis. And, to create awareness of the ethical dimension of their work, HA says he needs to bring in somebody who is involved in those kinds of issues.

HA says that he has a collection of about 150 problems arranged in various subject areas and he chooses combinations of these problems to illustrate certain ideas. He also posts the solution to problems onto WebCT. Meanwhile, HA encourages students to read beyond the textbook. He says that his teaching supplements the textbook, and therefore acts as a reminder of some of the concepts.

HA does answer some questions through e-mail. However, he will answer some individual questions as if it were asked in class to avoid having to answer the same questions three times in three different groups.

HA says that he has to make sure that the students are learning the material. This is why he gives them assignments that are shorter applications of the concepts. He also has them present their results over the course of the semester, to report on progress to him and to the class. HA says that when students make oral presentations, they get feedback and adjust their design accordingly. HA feels that that might keep people in line, and it might provide some sort of stimulus. However, he

says that this can only be done in a small class, it would take too much time in a large one. HA says that he likes to keep students under control, to make sure they achieve their goals by the end without actually cramming it into the last week of classes.

HA feels that the level of preparation on the part of students limits what can be covered in his course. For instance, if he injects something, something else needs to be ejected. He also feels that his is a hard course to have discussion because it is just design.

HA says that, over the years, explanations of certain portions of material were lengthened, better explained, or reinforced. The interconnectedness was also reinforced. Yet, he says that he may need to get more involved into their groups to review their progress in the future.

HA points out that he is still working with the series of notes that evolved out of the first time he taught the course so all the concepts that he taught originally are there. And at the end of each course, he writes notes in his class notes to omit or replace for the next iteration of the course. HA says that he loves to spend a month re-hashing or re-doing his course before he teaches it. However, he says it is hard to find the time to make the changes he wants to make to the course (i.e., updating it, and bringing in new numbers, new figures, new technical references). HA says that, as he does not have time to review his notes significantly, he instead just readjusts them based on recent experiences.

Knowledge base for teaching/Knowledge related to teaching/Knowledge of learning and learners

HA explains that almost half of the class is composed of exchange students, which is very unusual. He adds that the exchanges students they get into the programme are excellent students in that they think globally. This is particularly true of the students from France. And HA adds that good foreign students challenge their students.

HA explains that he knows immediately halfway through the course the people who are really into this and the other people who are just trying to get through it. HA adds that they have had a group of people who have established almost a political dominance among the student body for a number of years. And that group has almost a philosophy that comes out regularly of doing the minimum in any given course. HA adds that this is not true of all students, but that there are some people who really need to be lead by the hand. HA adds that they have a pattern of learning and it is very hard for them to break free of that pattern.

HA says that he is used to the students being comfortable with him the moment he walks into class, because they know him through his advising or whatever else.

HA says that there are things that are going on in the background of the students that have a direct impact on their learning. For instance, this is the last year of studies and last term for many students. Therefore, they would have completed the entire core curriculum. As such, a lot of these students have the background for this course; they should know that material already. HA adds that they have received the technical training already; they have proven that by getting to that level of the program. One example of things students should have done in other courses is writing.

Yet, HA says that students haven't got the same depth of experiences as he does, so they do not know all the right questions to ask. In addition, he thinks that the students come from a background of very large classes and, as such, are not used to interaction, so they do not feel comfortable with it. HA says that students at this level are so used to the lecture style that they feel uncomfortable to speak up.

HA explains that there is great variation in the learning approaches of students. For instance, some students are looking at him as an expert and they take his word as Gospel truth whereas other students are so technically-oriented that they do not want to hear about other anecdotes. Also, sometimes students gloss over what is the most important part (i.e., the thought process involved) or even loose sight of the fact the goal is not the grade but the learning.

With regards to the project, HA says that two groups are made of very enthusiastic students who want to do this materiel but that the third group seems to be made of people who have common apathy for this materiel. He adds that there is always a group of students like that.

HA explains that students do not seem to take advantage of the freedom to explore other realms of knowledge in a non-threatening environment. As such, some students complete the project but still have no real understanding of the interconnectedness of these systems. HA argues that this is because some students are not likely to be practicing engineers, and they just seem to want to do the minimum amount of work. He adds that, as usual, students delay everything until the very end.

HA also says that, sometimes, students generalize from his opinions. He says that they pull something out and use is as a complete sweeping generalization on a lot of other issues.

HA explains that students are sometimes afraid of this course because it entails a different way of thinking, and that they can also be saturated by the number of presentations done in class [by fellow students].

HA says that some students complain that they come out of engineering, and they say, "I don't know anything. I'm not ready to go out and practice." In addition, he argues that they do not have a fundamental appreciation for what they contribute, that they do not see it until they are out there.

HA also explains that some foreign students do not have the same background as local ones. For instance, there was a complete lack of awareness of the crisis that occurred in Walkerton. Therefore, it was very hard for them to discuss an issue with which they had no connection whatsoever.

As regard student learning, HA says that some students go through the mechanics of preparing the project with no understanding of it. HA feels that they do not really understand how everything comes together. HA says that instead of them actually learning the thought process involved in making a judgment, they are just taking his judgment as a good one. So, when it comes to the notion of responsibilities, everybody understands, they will know all the right words to say. However, none of them will understand that decision-making process until they really apply it themselves. But HA says that, at least, they now have the vocabulary and they have a few experiences to show how these things are put together.

As regard evidence of learning, HA says that he does not actually know how the students are doing until the very end of the whole course. This is because the major project is his real basis for evaluating what they understand. In the meantime, progress on the project and tests results, along with perceptive questions are, he thinks, the biggest signal that he can possibly get.

As regard student results, HA says that the projects were acceptable quality overall. The final exam was very, very good from the point of view of a bimodal distribution: the exchange students had an exceptional performance whereas the full-time students here did not do so great, but okay.

HA also derives cues from the students. For instance, when people write something down, it signals that they are attentive and that they picked up on that concept. However, HA adds that if students are spending all their time writing, that means that they are just grabbing the information and that they're not really mulling through it, challenging the ideas.

Other cues that HA uses include the lack of discussion. HA says that he really feels that that indicates that students did not understand the whole point. Also, he can see when students are confused by the way they frown, or, their foreheads are compressed down a little bit. Finally, he says that students are not into it when they sit stone-faced.

Knowledge base for teaching/Knowledge related to teaching/Knowledge of assessment of learning

HA says that he is still not clear on how to evaluate good learning. In some ways he does not think there is any way to test the students, if they are really understanding the depth of the thought process.

HA explains that students are designing a project based on eight weeks of material, and there is a limit to how much they can write in these projects. The advantage of an individual project is that they have to do everything, but it is unrealistic for the size of these projects. This is why HA uses group projects.

However, HA says that in any given project, the scenario when you have a group project is that it is very hard to evaluate the individual's progress. It is hard to decide when two people work together on a technical problem because they could end up with exactly the same answer.
So, HA has a grade for group projects but that requires that he arbitrates among the group members. He adds that he does not intend to use this as a way to penalize people, but to emphasize right at the very start that they are working as a team. This is why HA establishes a contract to break down the amount of work done per person.

HA also explains that the students have assignments, which they are marked on individually, a midterm and a final. The breakdown is final 40%, midterm 20-25%, and the project and assignments 15% each. HA explains that some people did very poorly on the midterm, and he agreed that he would transfer some of the weight to the final exam—not eliminate it completely. HA also explains that he breaks his exams down differently as well: he asks a lot of short answer questions to really test the students' ability to understand the concepts, and then a few to work out the problems and do the calculations, as well as design.

Knowledge base for teaching/Knowledge related to teaching/Knowledge of curricular issues

HA explains that the structure of the program is imposed from outside and that professors try to adapt to it. Because engineering programs are professional programs, they go through an accreditation process about every five years. One requirement for accreditation is that the program provides exposure to different ways of thinking. And the last faculty accreditation board was not satisfied that the weakest path was avoiding design.

HA explains that the faculty really wants to emphasize design a lot more. The program has fifteen credits of technical complementaries that one must choose from. So, the faculty is restricting the students' choices and saying that at least two of those courses of the five must be selected from a reserve list of core courses, and HA's course has been identified as one of them. It is a key design course. This is considered to be what they call a capstone course, where it brings elements from all the various branches within engineering, and tries to separate them.

HA says that, because of the structured nature, he has to deliver a certain minimum number of concepts in the 39 hours of class that he is giving. Because of the accredited programme, they have very specific goals that have to be met, particularly early in the process where his course is a pre-requisite for another course. So, HA says that he must get through that content. He also says that he cannot fail because then somebody else has to pick up the slack. That creates a restriction.

HA explains that the breadth of areas of expertise in civil engineering has widened over time. Thermodynamics would normally not appear in a Civil engineering curriculum. It is really because the field of engineering has grown in leaps and bounds—what used to be a 90-credit program is now usually a 108- or 112-credit program. So what they try to do is to give the students a core curriculum and then give them the ability, through complementary courses, to specialize in a particular area of interest.

As per accreditation requirements, students have to submit a technical report which has to meet all the necessary standards of technical reporting. There used to be a second technical report, so that they could learn from the first experience and put it together. That was eliminated a few years ago, and HA thinks that that is starting to show up in their courses. And an engineering program, much like you would have in law or you would have in medicine, has a certain period of internship of four years with professional engineers.

Knowledge base for teaching/Knowledge related to teaching/Knowledge of human behaviour

HA explains that, in group situations, one can often end up with a couple of people who are dead weight to the group and are coasting, and they just want to grab the group mark and walk away from the course. He adds that he always has a few problem people who are dead weights to the whole group. So, HA often lets those dead weight people associate with each other. However, he feels that in his class students are held up to it by having to submit a form detailing the work of everyone and granting a mark based upon that.

HA also talks about how he usually relies on a class size of fifty students to find that one really good catalyst of a student who challenges you. And this is the smallest class he has ever taught,

and what was missing was the catalyst he often can rely on. And HA feels that it is the same with groups; there is always a group, the dynamic group that is way ahead of everybody else that, again, is a catalyst.

HA explains that different people have different ways of tackling problems, and some people work better under pressure. Also, some people do have physical stamina. And some people do not. The way those two groups interact with each other is very, very important to the learning process. And sometimes it is very difficult to work with certain people.

HA also says that smaller classes may provide an opportunity for more interaction. And the level of interaction tells you certain things about the class—for instance, a lack of interaction tells you that they are not getting it, or just not hearing at all. But classes should not be too small. In a small group, people may feel a little bit more self-conscious or that they are drawing too much attention to themselves.

With reference to this particular small group, HA feels that if half of them are exchange students, the exchange students tend to cluster together with the others and not mix a lot. He feels that it is like he is almost trying to speak to two audiences.

Finally, HA says that he has not taught them well enough how to work together as a group. So, each of them have fragmented off pieces of these projects, and they may understand their individual pieces, but they do not know how to bring them together.

Knowledge base for teaching/Knowledge related to teaching/Knowledge of logistical issues

HA feels that administration takes his time away from his primary purpose of being here (teaching). Certain dimensions of the "logistics of teaching" appeared particularly important to HA. One is that a paperless approach to coursework will not work; HA feels that people will not read online. He has open book exams, so people print everything and bring it over. It is therefore important to facilitate access to old exams and solutions for the students, mainly for them to understand his expectations. Another one is that a higher number of small assignments did not work as opposed to some bigger ones because of the required time for preparation. Finally, his course is at 8:30 a.m. which makes it difficult for students to come to class.

One dimension that was important to HA was the fact that [at the time of the interviews] he is Associate dean of student affairs for the Faculty of Engineering.

## Knowledge base for teaching/Beliefs related to teaching

Knowledge base for teaching/Beliefs related to teaching/Beliefs about teaching and teachers

For HA, the role of the teacher is to create excitement. In addition, it is not to transmit facts but solution techniques. HA also says that it is about transmitting concepts and the big picture rather than facts and detail. HA feels that his role is to teach basic concepts and how to put them in practice. In addition, he feels that his role involves connecting the materiel to what is going on in the world. This is why HA says that he has to act as both a professor and an engineer.

For HA, an important role for himself includes making students understand that one is a human being.

HA feels that good teachers need humility, to admit their mistakes, and integrity. To him, being respectful of students is essential.

For HA, understanding the material and being able to get it across to the students is more important than being an absolute expert in a field. HA adds that not being a full expert at what one teaches is good in that it keeps that person humble. HA feels that some professors think everybody has the same interest as they do in the material they are covering.

HA also feels that the university teacher is a member of a community. Simultaneously, he feels that every teacher develops his own style.

For HA, a good teacher is a natural teacher in a lot of ways. For him, teaching is instinctive. And good teaching would include giving the essentials to the students, not cramming more and more facts. Good teaching is when students feel proficient when they leave the classroom, feel confident that they can do something, and think they can do other things. Good teaching is also about being respectful of the students and be willing to answer questions over and over. Good teaching is about creating environments in which students can learn. In that sense, teaching goes beyond the classroom.

For HA, teaching requires understanding how students handle the materiel in a parallel fashion to your teaching. Teaching involves transmitting information but also helping students integrate that information with the rest of the world. HA also feels that teaching involves transmitting his own ideas to students for them to experiment, without being brainwashed. And takes place through distributing workloads across semesters and clarifying roles and expectations.

Knowledge base for teaching/Beliefs related to teaching/Beliefs about learning and learners

For HA, the task of the learner is to absorb the information and to put it into practice. Students thus apply tools they have just learned in totally different situations. And for HA, that requires a certain level of dedication on the part of the students.

HA also feels that certain aspects of learning can be very valuable for the students and that, in a sense, the students end up surpassing their teacher in certain areas. Yet, HA feels that students have to be very careful with the concepts they are learning not to overdo it.

One specific observation about the learners is that, for HA, if he makes the effort to draw a diagram for something, he thinks that the students realize that there is something there.

**Personal epistemology/Beliefs about knowledge and knowing**

Personal epistemology/Beliefs about knowledge and knowing/Beliefs … nature of knowledge

One the one hand, HA feels that people have certain beliefs and their arguments (i.e., knowledge) may be affected by those beliefs.

On the other hand, HA feels that we are captive of the image of what a professor is (i.e., what the professor says is true, unquestionable). And he does not agree with the fact that some of the students take everything that he says in class as Gospel truth.

Personal epistemology/Beliefs about knowledge and knowing/Beliefs about the act of knowing

To HA, a person who knows has the generic insight. To him, knowledge of the facts is not enough.

HA also says that, based upon a judgment that he makes in certain situations, some students use that as a complete generalization on several other issues. And HA feels that that is very dangerous.

## Personal epistemology/Beliefs about knowledge construction

Personal epistemology/Beliefs about knowledge construction/Beliefs … learn in general

HA feels that students learn by doing, more than anything else. For him, experiential learning is the way to go. Large-scale experiences, that is, in their full complexity. HA feels that people do not get the insight until they struggle, in particular with situations in which there is no clear answers. And in the case of students, HA feels that copying down is an important part of the learning process as it registers the information, it imprints it on their brains.

However, HA also feels that learning is conditional upon the experience one has. He adds that students do not have the same depth of experiences than he has had, so they do not know all the right questions to ask.

Personal epistemology/Beliefs about knowledge construction/Beliefs … one learns specifically

HA says that he purely learns by doing, either with his experiences at home or in academia. HA says that he cannot stand reading textbooks or the research literature. HA says that he cannot learn from a textbook. It just does not work. Somebody has to lead him through the information and show him some of the hidden aspects about that information that are really important, the nitty gritty, fundamental things that are important, that he never thought of, and then lead him into some applications. HA says that he learns through reinforcement, reinforcement through application.

However, HA adds that this is specifically in situations in which he is the learner. In situations in which he is the instructor, HA says that he can learn by reading and preparing lectures. Actually, he says that he learns a lot about the materiel from having to teach it, preparing for it.

For HA, learning is a very active process. And for him, learning by doing sometimes in academia is purely by interpreting for yourself what is in textbooks, and notes that you may have come across, internet pages, and just through the process of synthesis (i.e., not just reading it, but actually putting it down on paper to make it into a more presentable, accessible form).

## Personal epistemology/Beliefs about knowledge evaluation

Personal epistemology/Beliefs about the value of knowledge/Beliefs ... value of knowledge

HA entertains mixed views of knowledge in that he has no problem sharing teaching experiences with colleagues. However, he says that he would be nervous if his colleagues were attending his classes as they may want to challenge him. In particular, HA says that he would find it very hard to stand up in front of a group of professors to say that reading the biography of John Adams changes the way he teaches. He adds that he does not think many people want to hear about that anyway.

HA says that he does not trust intuitive or experiential knowledge too much. For him, knowledge has to be informed. Intuition can be used, but the basic information is essential.

## Disciplinary culture and structure/Socio-cultural characteristics

Disciplinary culture and structure/Socio-cultural characteristics/Teaching in the discipline

For HA, teaching in engineering involves combining a theoretical and a practical viewpoint. He feels that his role as an engineering professor is not to transmit facts, it is to transmit solution approaches. To him, that involves stepping out of his professors shoes and putting on his engineer shoes.

HA says that engineering teachers try to teach their students to have an intuitive feel for what is happening in the system and, based on a limited amount of information that one can get in a reasonable amount of time, to interpret and come up with a solution or an answer to the problem. HA adds that the one global concept that they try to teach in any engineering design, is that one cannot possibly have the best choice. There is not one best choice.

HA says that, in engineering, they teach students: to attack problems and to solve them, to go about finding the information they need to solve a particular problem, to know the limitations and to look for additional resources, to work with teams to approach a problem, to come up with a solution even when they feel they do not have all the information or resources, and to use intuition or codes of practice.

HA also feels that engineering teachers try to bring in the realities. They keep reminding the students over and over of their responsibility for the community. As such, he feels that they are teaching students to solve problems in a very flexible way.

According to HA, tutorials are very important. They include running through a series of problems which take the theories presented in class, linking the theories to specific issues, and completing term projects to seal the whole thing, although the last point may be less prevalent. HA says that engineering professors tend to follow the old model of "chalk and talk" to get through the material (which has been translated now into PowerPoint). He adds that they also rely heavily on a lot of outside work and interactions with the students. More specifically with regards to himself, HA

says that everything becomes a series of reinforcements for one concept. That is his personal approach.

HA says that he needs that half-hour before any hour lecture which, in the mind of some of his colleagues, is just way too much time. They do not necessarily say it, but HA feels that they would not spend the time. Furthermore, HA says that he has no problem disclosing his techniques of teaching, but he does not think many people want to hear about that anyway. In particular, HA feels that his approach may clash with the culture of teaching engineering in that he is showing how some theories are open to misapplication if they are not understood.

Disciplinary culture and structure/Socio-cultural characteristics/Learning in the discipline

For HA, the notion of engineers as problem-solvers has implications for the education of future engineers. For instance, engineering training comprises learning certain habits of mind; those are acquired from day one.

HA argues that engineers often understand the implications of certain types of theories and ideas only through practice, through doing the work. And as such, most engineers learn by applications, by applying theories to concepts. For instance, HA says that by sketching down, students learn in engineering.

HA explains that students get fundamental tools for how to deal with very specific problems in the workplace. They are acquiring the foundation on which they will build later on. As such, HA feels that students should learn the thought process behind the selection of specific materials, so that they can go off and raise issues for their own particular jobs. This would be why essays are not necessarily part of the learning process in engineering. Technical reports are.

HA adds that like other professional programs, engineering comprises a certain period of internship (4 years) to gain experience (continuous learning experience and training). This enables future engineers to learn that there is an immense responsibility that goes along with the job, which is often taken for granted.

HA also finds that engineering students end up working around the world, but they are learning about the Western context.

Disciplinary culture and structure/Socio-cultural characteristics/Knowing in the discipline

For HA, there is an engineering way of thinking, an approach shared by engineers. According to him, knowing in engineering is pretty much being able to solve a variety of problems, through the application of practical and theoretical knowledge. To do so, problems need to be broken down into smaller, manageable problems; then information is brought back together and synthesized into a solution to the first, larger problem.

HA also says that, as problem solvers, engineers encounter new problems every time and situations are quite different. Therefore, engineers are used to consuming technical content. And for engineers, equations are tools to describe certain things. HA says that some people can interpret equations better than they can a diagram.

But HA feels that the approach of breaking things down may not be the right one in that it does not make you take other parts into consideration. For instance, he says that doing that may provide you with a team experience, but one does not necessarily reflect on what that experience means.

Rather, HA feels that the students' viewpoint of the world needs to be widened. He sometimes thinks that if the students are too oriented just on that specific problem, they are not terribly aware of everything else that is going on out there, the bigger picture. And a successful engineer needs to have the bigger picture, in particular since the breadth of expertise of civil engineers has widened over time (leading to sub-specialties).

One dimension that is quite important to HA is the code of practice. The latter includes recipes for success, legal documents about norms of practice, detailed, technical norms. HA feels that the code is sometimes constraining but at times helpful. For instance, an engineer will sometimes rely on a code of practice as a source of knowledge to undertake a project. And HA says that codes of ethics have been in place for a long time, alongside the code of practice. To him those codes influence teaching in that codes are part of the profession; codes need to be taught.

Disciplinary culture and structure/Socio-cultural characteristics/Practicing in the discipline

HA feels that engineers are problem-solvers in that they take theoretical and practical knowledge and try to create a solution to a problem that is posed. In some cases, this means figuring out, within the context of a given community, what materials are appropriate.

Civil engineers, particularly people working in this kind of work, work for the public and are accountable for whatever kind of decisions they make. This is because, HA argues, civil engineers are responsible for providing the basic services to a community, which is an awesome responsibility, a responsibility that is not well know by the public. HA argues further that, as a civil engineer, if you fail in your role, and other people fail around you, it has major repercussions on the community.

HA explains that this is why, to become members of the professional order, engineers-in-training have to write an exam in ethics and an exam in law. In addition, the evaluation process comprises the submission of a résumé of projects they have done and a recommendation letter.

Normally, an engineer will work as an apprentice under a professional engineer for four years, before they become professionally licensed. However, engineers can also work within a company without having their own professional accreditation, as long as the company has professional engineering staff who are willing to take responsibility for the products.

HA argues that civil engineering is one of the lowest paid group of engineers—they get hired by municipalities at a much lower salary than other kinds of engineers. As a result, civil engineers feel their work is not valued.

HA argues that it is important for engineering students to get a chance to stand up and speak in front of the group, because that is what they will be doing for their careers. HA insists that some students choose this field to do technical stuff whereas many civil engineers do more. For instance,

HA argues that only ten percent of engineers are actually working formally in technical areas about ten years after graduating.

HA says that practicing engineers may have to work with people who do not have the same knowledge as they do. And in an engineering office, one is forced to work with certain people. But practical realities are sometimes make it sometimes very difficult to work with some people.

## Disciplinary culture and structure/Epistemological characteristics

### Disciplinary culture and structure/Epistemological characteristics/Description of the discipline

As regard the structure of civil engineering, HA says that it is dry material, at least certain aspects of it. But overall, civil engineering tends to be interesting because of its consequences on people. HA adds, regarding the nature of the content, that the design side is a little on the softer side, but it is at the heart of what is engineering.

HA also says that growth in sub-areas of civil engineering has been a problem in that the high number of specializations make the requirements of the job more difficult to meet. With regards to that, he feels that breadth may not be the way to go. Yet, he feels that faculties of engineering do not give their students the tools that would enable them to walk into the working world, pick up a pen and paper and go for it. HA adds that students do not have the whole kit, all the skills to put everything they have learned together. This is what they acquire through the apprenticeship.

HA also explains that civil engineering is not terribly prominent in North America right now, but it is very prominent in other areas of the world.

### Disciplinary culture and structure/Epistemological characteristics/Organization of the discipline

When discussing his sub-specialty within civil engineering, HA says that the structural area for engineers has started to grow again, people are shifting back to that. That has a big impact.

### Disciplinary culture and structure/Epistemological characteristics/Relation to other disciplines

When discussing his area of expertise, HA describes it as a sub-specialty within civil engineering. And, like other disciplines, it has shifted in recent years. And HA feels that civil engineering has grown relatively to other disciplines in recent years.

**Appendix T (Web of relationships between components of DPK – HA)**



| | | Source: Knowledge Base for Teaching | | |
|---|---|---|---|---|
| | | Goals Related to Teaching | Knowledge Structures Related to Teaching | Beliefs Related to Teaching |
| Source: Personal Epistemology | Beliefs About Knowledge and Knowing | Class-level goals & Beliefs about the act of knowing<br><br>Accomplishment of goals & Beliefs about the act of knowing<br><br>New/future goals & Beliefs about the act of knowing | Knowledge of self & Beliefs about the nature of knowledge<br><br>Knowledge of self & Beliefs about the act of knowing<br><br>Knowledge of teaching and teachers & Beliefs about the act of knowing<br><br>Knowledge of learning and learners & Beliefs about the nature of knowledge<br><br>Knowledge of learning and learners & Beliefs about the act of knowing | Beliefs about teaching and teachers & Beliefs about the nature of knowledge<br><br>Beliefs about teaching and teachers & Beliefs about the act of knowing<br><br>Beliefs about learning and learners & Beliefs about the act of knowing |
| | Beliefs About Knowledge Construction | Course-level goals & Beliefs about how people learn in general<br><br>Course-level goals & Beliefs about how one learns specifically<br><br>Class-level goals & Beliefs about how people learn in general<br><br>New/future goals & Beliefs about how one learns specifically | Knowledge of content & Beliefs about how one learns specifically<br><br>Pedagogical content knowledge & Beliefs about how people learn in general<br><br>Knowledge of self & Beliefs about how people learn in general<br><br>Knowledge of teaching and teachers & Beliefs about how people learn in general<br><br>Knowledge of teaching and teachers & Beliefs about one learns specifically<br><br>Knowledge of learning and learners & Beliefs about how people learn in general | Beliefs about teaching and teachers & Beliefs about how people learn in general<br><br>Beliefs about learning and learners & Beliefs about how people learn in general |
| | Beliefs About Knowledge Evaluation | | Knowledge of self & Beliefs about the relative value of knowledge<br><br>Knowledge of Teaching and teachers & Beliefs about the relative value of knowledge | |

| | | Source: Knowledge Base for Teaching | | |
|---|---|---|---|---|
| | | Goals Related to Teaching | Knowledge Structures Related to Teaching | Beliefs Related to Teaching |
| Source: Disciplinary Specificity | Epistemological Structure | Course-level goals & Description of the discipline | Knowledge of the content & Description of the discipline<br><br>Knowledge of the content & Relation to other disciplines<br><br>Knowledge of teaching and teachers & Description of the discipline<br><br>Knowledge of learning and learners & Description of the discipline<br><br>Knowledge of curricular issues & Description of the discipline | |
| | Socio-Cultural Characteristics | Course-level goals & Teaching in the discipline<br>Course-level goals & Learning in the discipline<br>Course-level goals & Knowing in the discipline<br>Course-level goals & Practising in the discipline<br>Class-level goals & Teaching in the discipline<br>Class-level goals & Learning in the discipline<br>Class-level goals & Practising in the discipline<br>Accomplishment of goals & Teaching in the discipline<br>Accomplishment of goals & Learning in the discipline<br>Accomplishment of goals & Practising in the discipline<br>New/future goals & Teaching in the discipline<br>New/future goals & Learning in the discipline<br>New/future goals & Knowing in the discipline<br>New/future goals & Practising in the discipline | Knowledge of the content & Teaching in the discipline<br>Knowledge of the content & Learning in the discipline<br>Pedagogical content knowledge & Teaching in the discipline<br>Pedagogical content knowledge & Learning in the discipline<br>Knowledge of teaching and teachers & Teaching in the discipline<br>Knowledge of teaching and teachers & Learning in the discipline<br>Knowledge of teaching and teachers & Knowing in the discipline<br>Knowledge of teaching and teachers & Practising in the discipline<br>Knowledge of learning and learners & Teaching in the discipline<br>Knowledge of learning and learners & Learning in the discipline<br>Knowledge of learning and learners & Knowing in the discipline<br>Knowledge of learning and learners & Practising in the discipline<br>Knowledge of assessment of learning & Teaching in the discipline<br>Knowledge of assessment of learning & Learning in the discipline<br>Knowledge of assessment of learning & Knowing in the discipline<br>Knowledge of curricular issues & Teaching in the discipline<br>Knowledge of curricular issues & Learning in the discipline<br>Knowledge of curricular issues & Practising in the discipline<br>Knowledge of human behaviour & Knowing in the discipline | Beliefs about teaching and teachers & Teaching in the discipline<br><br>Beliefs about teaching and teachers & Learning in the discipline<br><br>Beliefs about learning and learners & Teaching in the discipline<br><br>Beliefs about learning and learners & Learning in the discipline |

| | | Source: Personal Epistemology | | |
|---|---|---|---|---|
| | | Beliefs About Knowledge and Knowing | Beliefs About Knowledge Construction | Beliefs About Knowledge Evaluation |
| Source: Disciplinary Specificity | Epistemological Structure | | | |
| | Socio-Cultural Characteristics | Beliefs about the act of knowing & Teaching in the discipline<br><br>Beliefs about the act of knowing & Learning in the discipline<br><br>Beliefs about the act of knowing & Knowing in the discipline | Beliefs about how people learn in general & Teaching in the discipline | Beliefs about the relative value of knowledge & Teaching in the discipline |