The Construct of Cognition in Language Teacher Education and Development

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aus Philadelphia, USA

2006

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Tag der Disputation: 19.01.2007

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Chapter 1: Introduction

As long as institutionalized second language teacher education has existed, there have been debates about what L2 teachers need to know and what second language teacher education (SLTE) can do to help them acquire such knowledge. Central issues in such debates rest on conceptions of human cognition: what knowledge is, how it is acquired, and how it is used. However, human cognition is not a focus of the academic disciplines which usually are in charge of SLTE programs. Therefore, general research and theory on the nature of human cognition is usually not included in debates on SLTE. The purpose of this dissertation is to use a wide range of work on human cognition to address and evaluate fundamental issues in SLTE. This first chapter outlines the structure of this volume and how each chapter contributes to our understanding of the relationship between human cognition and issues central to the field and practice of Second Language Teacher Education.

1.1 Cognition and Second Language Teacher Education

Conceptions of what language teachers should know are almost as old as institutionalized language teaching itself (Howatt & Widdowson, 2004). However, within the last 15 years there has been a considerable increase in interest and scholarship on L2 teacher cognition and second language teacher education (SLTE) (Borg, 2003c; Freeman, 2002). (By "SLTE" I am referring to both preservice and inservice SLTE programs). Unfortunately, much of the work in this area (although by no means all) has not been empirical in nature, relying on folk theories of human cognition: "most conventional practices in language teacher education have operated like hand-me-down stories, folk wisdom shared as 'truths' of the profession with little other than habit and convention on which to base them" (Freeman, 1996: 351). However, even the empirical work in SLTE has tended to ignore deeper issues of human cognition.

Cognition is a central issue in SLTE because models and understandings of SLTE are based on assumptions and folk theories about what knowledge is, how teachers acquire knowledge, and how teachers can and should use knowledge. In general, many approaches to SLTE view knowledge, knowledge acquisition and knowledge as unproblematic and simple. The basic view is that if you tell someone something, then they know it, they can use this knowledge, and there is nothing more to be worried about. Furthermore, to a great extent work in SLTE has ignored the large body of research on human cognition which has been done in other disciplines. Therefore, it is important to evaluate the extent to which SLTE conceptions of cognition match what is actually known about related cognitive issues such as what kinds of knowledge there are, how they are used and how they are acquired.

The purpose of this volume is to review conceptions and hypotheses about L2 teacher cognition in the field of SLTE and evaluate these in light of the extensive research on what is known about human cognition. Although the focus of this volume is on institutionalized teacher education, the basic questions of what knowledge is useful to teachers and how they might acquire such knowledge are also central to teacher development outside institutionalized SLTE programs. In order to evaluate hypotheses about cognition in SLTE it is necessary to begin by reviewing the historical development of conceptions of SLTE in order to get a deeper understanding of the assumptions about cognition that underlie these conceptions. The vast majority of such work published in international journals and academic books are from the Anglo-American perspective; however, a substantial body of research on teacher education has been produced in

Germany. German research which plays a significant role in this volume addresses experiential knowledge (e.g., Appel, 2000; Caspari, 2003), processes of SLTE (e.g., Christ, 1990; Gabel, 1997; Schocker-von Ditfurth, 2001; Zydatiß, 1996), and professionality research (e.g., Bromme, 1989, 1992, 1995, 1999).

After detailing the assumptions made about cognition in work on SLTE, these hypotheses will be investigated and evaluated in light of relevant research from a wide variety of disciplines and research directions. At the end of the volume, the research presented here will be summarized and a new model of teacher cognition (focusing on knowledge use and acquisition) will be presented which reflects the latest research insights.

1.2 The scope of research on human cognition

Hypotheses about SLTE are fundamentally questions about cognition: What is knowledge? How are particular types of knowledge used? How is knowledge acquired? These are not questions that focus specifically on language, literature or culture, so to answer these questions, we must review research which focuses on those questions. Therefore, the studies reviewed in this volume will be those that focus on the nature of cognition, especially knowledge and knowledge use. While some relevant research has been done in SLTE, by the very nature of the issues involved, most of the relevant research for these questions has been done outside of the field of Language Studies or Philology.

This means that many of the data collection and data analysis methods, research contexts, research populations, and research questions will be quite unfamiliar to readers who are involved in SLTE. This raises the question of whether such studies are relevant to SLTE. After all, what do Brazilian market vendors, and New Jersey housewives have to do with language teaching? What do puzzle stories, such as how to get a bunch of missionaries and cannibals across a river, or memorizing strings of random letters have to do with learning to teach? The answer is that, on their own, each study does not say much about SLTE. However, when studies find that Nepalese shopkeepers, Dutch medical students, and US college students all exhibit the same qualities and problems in cognition, this indicates there are general properties of human cognition; and the focus of this book is general properties of human cognition (which are relevant for SLTE). Such findings can help deepen our understanding of L2 teacher learning and cognition and further support findings from STLE research. Furthermore, generalities about a group are not always true for every member of the group. It is possible that even if studies find, for example, that implicit knowledge is central to medical practice, playing basketball and midwifery, there may very well be special circumstances inherent in the practice of language teaching which makes implicit knowledge less important for that activity.

Therefore, it is important to discern between levels of evidence. The best situation, of course, is if a hypothesis about L2 teacher cognition is supported by data on the performance of L2 teachers doing naturalistic teaching tasks, as well as data on the cognition of teachers of other subjects and of people from the general population. However, a specific hypothesis about L2 teacher cognition which has solid evidence from studies of other teachers and non-teachers, but similar studies on L2 teachers have not yet been conducted, is still important for the field of SLTE. Of course, such a hypothesis would need to be further investigated to test to what extent it describes L2

teachers' cognition. Nevertheless, the practice of L2 teachers is very similar to the practice of teachers of other subjects, so data on the cognition of non-L2 teachers strongly suggests that L2 teachers' cognitions are similar. Even if a hypothesis is supported by solid data which is exclusively from performance on abstract tasks by non-teachers (and is not contradicted by data on L2 teachers), then it can serve as working hypothesis which needs to be tested, refined, or rejected by research on L2 teachers' cognition. Decisions to reject a hypothesis need to be made on the basis of empirical data that shows that it is faulty, not because the best possible evidence has not yet been gathered.

1.3 Terminology

In discussing issues of teacher cognition and SLTE, it will be necessary to talk about L2 teachers at different stages of their development and in different roles (i.e., as L2 teachers and as SLTE students). To make this easier to follow, the meanings of the terms I will use for teachers are explained below:

- o *Novice teachers*: People who are learning to be teachers but (generally) do not possess extensive experience in teaching
- o *Beginning teachers*: Teachers with 0-2 years of experience
- o *Experienced teachers*: Teachers with more than 2 years of experience
- o *Student teaching*: The part of a teacher education program where novice teachers spend an extended time engaged in classroom teaching.
- o *Student teachers*: Novice teachers who are doing their student teaching.
- o *Teacher students*: People who are learning to be teachers. They might have little experience or extended experience as teachers.
- o *SLTE students*: Teacher students enrolled in an SLTE program.
- o *STLE teachers*: People who teach in SLTE programs. They are often referred to as "teacher educators".
- o *L2 teachers*: Teachers of a second or foreign language.
- o *Language teachers*: L2 teachers.

1.4 Cognition

1.4.1 Definition

Before reviewing research on cognition and its relationship to concepts of SLTE, it is important to make clear what is meant by "cognition". Commonly cognition is thought of as thinking or mentally processing information. However, technically it refers to a much broader concept.

> [T]he term "cognition" refers to all processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used. It is concerned with these processes even when they operate in the absence of relevant stimulation, as in images and hallucinations (Niesser, 1967: 4)

In other words, how information from the senses is used to make and store knowledge, what knowledge is, and how knowledge is used. Furthermore, cognitive entities which are normally not considered part of cognitive processes play an important role in this view of cognition. For example, emotion is commonly considered as separate from cognition despite the growing amount of research showing that emotions are a central

factor in cognitive processes (Cobb & Mayer, 2000; Griffiths, 1997; Lane & Nadel, 2002; LeDoux, 1996; Mayer, Caruso, & Salovey, 2000; Mayer & Salovey, 1993, 1997; Mayer & Stevens, 1994; Salovey, 1990; Salovey & Mayer, 1990). In addition, people's values (i.e., how they want to see themselves, what they would like to accomplish, what they regard as "good" or "bad") has also been recognized as a crucial part of cognition, especially for teachers (Johnston, 2003; Shohamy, 2001). Therefore, both emotion and values are part in this concept of cognition.

1.4.2   Knowledge vs. "beliefs"

One issue which is important for understanding cognition is the debate about the difference between knowledge and "beliefs". In the field of western philosophy, the distinction between belief and knowledge has been a key issue since Plato. Philosophers see knowledge as a kind of belief: a "justified true belief", a belief which (a) you have good reason to believe and (b) is also true (Fenstermacher, 1994). In the field of education, however, beliefs are seen to be similar to conceptual knowledge and, furthermore, to guide intelligent action. "This view is based on the assumption that beliefs are the best indicators of the decisions individuals make throughout their lives…an assumption that can be traced to human beings' earliest philosophical contemplations" (Parajes, 1992: 307).

However, the distinction between knowledge and "beliefs" is mainly based on introspection rather than empirical evidence. The roots of this distinction lie in the field of philosophy and the work most often cited for differences between knowledge and belief (Abelson, 1979) came from the field of artificial intelligence and was the result of work on computer programming, not on observation of human cognition. In fact, research has consistently failed to find a clear distinction between knowledge and beliefs in studies of human cognition and teaching (Caspari, 2003; Kagan, 1990; Verloop, van Driel, &. Meijer, 2001). "[U]ntangling closely related notions such as belief and knowledge is problematic. Researchers attempting this task have concluded as much" (Borg, 2003c: 86). In their large-scale study of knowledge growth in teaching, Grossman, Wilson and Shulman report that "while we are trying to separate teachers' knowledge and belief about subject matter for the purposes of clarity, we recognize that the distinction is blurry at best" (Grossman, Wilson, & Shulman, 1989: 31). Woods (1996) also found that in his intensive longitudinal studies of eight ESL teachers' cognition there were no real separation entities which could be easily labeled knowledge and beliefs in the teachers' cognitions.

> There is a sense in which the terms 'knowledge', 'assumptions' and 'beliefs' do not refer
> to distinct concepts, but rather to points on a spectrum of meaning, even though they have
> been treated for the most part as separate entities in the literature…This is an important
> point surfacing from the data: it was difficult in the data to distinguish between teachers
> referring to beliefs and knowledge as they discussed their decisions in the interviews."
> (Woods, 1996: 195)

Woods concluded that there was a general cognitive construct that teachers relied on during cognition, instead of using separate knowledge, beliefs, etc. "The hypothetical construct I am proposing, then, is of BAK [beliefs, attitudes, knowledge], a construct analogous to the notion of schema, but emphasizing the notion that beliefs, assumptions and knowledge are included" (Woods, 1996: 197). As a result, many researchers treat knowledge and beliefs as referring to much the same thing. For example, in her

introduction to a special issue of the journal *System* on learner beliefs, Wenden states that "[l]earner beliefs is a term that appears to be used interchangeably with metacognitive knowledge" (Wenden, 1999: 436).

Part of the problem is that those factors which, it is claimed, distinguish belief from knowledge in fact do no such thing. In the following, I present the main distinctions made between belief and knowledge in the literature and show how each factor fails to clearly distinguish knowledge from beliefs.

1) *Knowledge is true; belief is not* (Richardson, 2002; Feiman-Nemser & Floden, 1986; Abelson, 1979)

Many feel that it is important to separate those kinds of knowledge we know to be true ("knowledge") from those mental entities which function like knowledge but are not true ("beliefs"). "If one accepts all experienced understanding as knowledge, standards for veracity are difficult to employ. Knowledge, by definition, may include deception, illusion, and falsehood" (Richardson, 2002: 88). The argument is that if this distinction is not made, then the very concept of knowledge becomes meaningless. "[Not] everything a teacher believes or is willing to act on merits the label knowledge, although that view has some support. Such a position makes the concept of knowledge as justified belief meaningless" (Feiman-Nemser & Floden, 1986: 515).

However, many concepts that have been considered knowledge have turned out to be untrue (the sun rotating around the earth, languages are learned through imitation, etc.). "Fallibilism, the view that we can be wrong about what we claim to know, is a fairly well accepted doctrine among contemporary epistemologists" (Fenstermacher, 1994: 23). Furthermore, this distinction does not help us at all when something can be said to be partially true or true but misleading. After all, knowledge can be faulty, vague, non-trustworthy or unhelpful. Thus, this distinction does not show any clear difference between belief and knowledge.

> If an assertion involves matters of which little is known, we may be entitled to say that we know p, with only modest justification. In other words, 'it's the best we've got' at this time and so we are entitled to claim to know it. In areas in which more is known, our obligation to address this evidence and consider it in relation to our own grounds for believing the proposition is correspondingly increased (Fenstermacher, 1994: 24).

Thus, the key question is the quality of knowledge, not whether it is knowledge or not.

2) *Beliefs do not require consensus with others in the field and are not open to change* (Abelson, 1979; Wenden, 1999)

"Beliefs… are static and represent eternal truths that remain unchanged in a teacher's mind regardless of the situation. Knowledge, however, is fluid and evolves as new experiences are interpreted and integrated into existing schemata. Beliefs also foster schools of thought, whereas knowledge is unique to the individual" (Parajes, 1992: 312). The problem with this argument is that people can be very resistant in altering or updating their knowledge (Chinn & Brewer, 1998; Clement, 1982; Haller & Krauss, 2002; Halloun & Hestenes, 1985b; Reif & Allen, 1992). Similarly, consensus cannot be a requirement for knowledge as it is possible for one person to know something that no one else knows. Therefore, the willingness of people to alter their conceptions or (non-)existence of group cannot be used as evidence of a difference between belief and knowledge.

3) *Beliefs are highly open with no clear boundaries* (Abelson, 1979)

"[I]t is unclear where to draw a boundary around the belief system, excluding as irrelevant concepts lying outside" (Abelson, 1979: 359). However, as Abelson himself admits, the same problem exists with "knowledge systems", and thus cannot be used to distinguish the two. "Now of course the same problem is encountered with knowledge systems. Openess is often a matter of degree. An expert on, say, moon rocks, might well need to know a lot about cosmology, geology, physical chemistry, and mathematics, and the appropriate boundaries in each of these disciplines might not be well-defined because each bit of knowledge would drag new bits into the system" (Abelson, 1979: 359-360).

4) *Beliefs often assume the existence or focus on the existence of certain conceptual entities* (Abelson, 1979; Nespor, 1987)

"Belief systems frequently contain propositions or assumptions about the existence or nonexistence of entities. Beliefs in God, ESP, or assassination conspiracies are vivid examples, but existential presumption also occurs in less obvious ways at much more mundane levels of thought. Both of the mathematics teachers involved in the research, for example, held strong beliefs about student 'ability', 'maturity', and 'laziness'. These were not simply descriptive terms, they were labels for entities thought to be embodied by the students" (Nespor, 1987: 318). Unfortunately, academic knowledge also contains examples where the existence of some entity is assumed, such as Chompsky's black box or Krashen's "i + 1", so this as well cannot cleanly distinguish knowledge from belief.

5) *Beliefs contain a lot of episodic material* (Abelson, 1979; Nespor, 1987)

"[B]eliefs often derive their subjective power, authority, and legitimacy from particular episodes or events…The experiences of Mr. Ralston…led him to believe that students would be more willing to study mathematics if they could see that it had some 'practical' value – and he tried to organize his instructional activities according to this assumption. More generally, a number of teachers suggested that critical episodes or experiences gained earlier in their teaching careers were important to their present practices" (Nespor, 1987: 320). This distinction is clearly outdated. In the 20 years since it was formulated there has been a great deal of research showing that narrative knowledge is an important and legitimate type of knowledge (Bullough & Pinneagar, 2001; Clandinin & Connelly, 1986; 1996; 1998; 2000; Craig, 2001; Johnson & Golombek, 2002; Kelchtermans & Vanderberghe, 1994; Nairn, 2004; Polkinghorne, 1988). In cognitive psychology this is referred to as "episodic knowledge" (Shank & Abelson, 1977; Tulving, 1972, 1983).

The last category which supposedly can distinguish belief from knowledge is as follows:

6) *Beliefs focus on evaluation and values; beliefs often focus on what should be, rather than what is* (Abelson, 1979; Borg, M., 2001; Nespor, 1987; Wenden, 1999)

"[B]eliefs are distinct from metacognitive knowledge in that they are value-related" (Wenden, 1999: 436). For many, the key distinction is the process which produces the knowledge (or belief): "beliefs are seldom clearly defined in studies …but the chosen and perhaps artificial distinction between belief and knowledge is common to most definitions: Belief is based on evaluation and judgment; knowledge is based on objective fact" (Parajes, 1992: 313). Nespor, in particular, argues that belief is separated from knowledge by its focus on "alternativity", the focus on *what could be* instead of *what is*.

He gives the example of one teacher: "Mrs. Skylark drew her ideal of teaching from a model of what she had wanted classes to be like when she was a child…she had never achieved it; nor had she experienced it as a child. Rather, this was a sort of utopian alternative to the sorts of classrooms she was familiar with" (Nespor, 1987: 318-19).

One problem here is that things which are quite different are being lumped into one category. In the example from Nespor, Mrs. Skylark has a set of goals or hypotheses that she is working toward achieving. She hopes and expects that she will find out that she is right and it is possible for her to develop a way of teaching which will achieve the teaching atmosphere she desires, much like researchers have a certain hypotheses about language or language learning and expect that their hypotheses are true. Yet apparently it is only the hypotheses of teachers which are labeled as "beliefs".

Moreover, claiming that beliefs include values is not very helpful because the types of things that are studied under "beliefs" usually are not value related or focus on utopian views of teaching. For example, the BALLI questionnaire items (Horwitz, 1985) is one of the most commonly used instruments for investigating language teachers' beliefs (e.g., Bernat, 2006; Fox, 1993; Horwitz, 1985, 1988; Mantle-Bromley, 1995; Peacock, 2001). However, none of the items in the questionnaire are value or utopia oriented. Instead, they address typical academic questions about language learning like: "Is it easier for children than adults to learn a foreign language", "Some languages are easier to learn than others", or "Learning a foreign language is a matter of learning a lot of grammar rules" (Horwitz, 1985: 339-340). The statements developed by Lightbown and Spada (1999) and used as questionnaire (e.g., Kerekes, 2001; MacDonald, Badger, & White, 2001) is equally devoid of value related items, consisting of statements such as: "People with high IQs are good learners", "Students learn what they are taught", etc., so the claim that beliefs focus on values does not explain why teachers' knowledge is labeled beliefs in studies like these.

Therefore, because (a) research has been unable to find a clear distinction between the concepts of knowledge and belief and (b) purported descriptions of belief either can also describe knowledge or do not describe belief, it seems sensible to agree with the researchers who have come to the conclusion that "beliefs" should be considered as another term for conceptual knowledge.

> For researchers in the field of cognition…it goes nearly without saying that knowledge refers to an individual's personal stock of information, skills, experiences, beliefs, and memories. …[K]nowledge encompasses all that a person knows or believes to be true, whether or not it is verified as true in some sort of objective or external way (Alexander, Schallert, & Hare, 1991: 317).

Finally, the terms "knowledge" and "beliefs" have political or ideological uses (Gee, 1990). One could argue that these terms are primarily used to mark some types of knowledge as legitimate and others as lacking in legitimacy, to give the knowledge of one group status and withhold it from the knowledge of other groups. "Many philosophers regard the term knowledge a 'purr' word; it feels so good to use and hear that we almost purr when doing so. It is also a concept with legitimating qualities; everyone has beliefs and opinions, but knowledge is something special, something that elevates one's thoughts and expressions beyond 'mere' belief or opinion" (Fenstermacher, 1994: 33-34). Given that the "prevailing view and organization of the educational enterprise gives little credit to [teachers'] knowledge" (Clandinin, 1986: 8)

and the trend that language teachers are often seen as knowing less about the learning going on in their classrooms than researchers (Clarke, 1994), it is hardly surprising that what academics think about questions like "Is it easier for children than adults to learn a foreign language" or "Learning a foreign language is a matter of learning a lot of grammar rules" is labeled as "knowledge" while what teachers know about the same questions is considered "beliefs" (MacDonald, Badger, & White, 2001).

The distinction between knowledge and "beliefs" appears to have originated in philosophy and folk psychology rather than from empirical study of human cognition, which has not provided any evidence for such a distinction. Instead, it appears that what is often labeled as "beliefs" refers to conceptual knowledge (however accurate). There are two dangers with confusing "beliefs" and conceptual knowledge. First, it delegitimizes what teachers know and makes it easier to ignore this kind of knowledge in LTE programs. Second, it distracts SLTE teachers from the real problems with the conceptual knowledge their teacher students are acquiring, for example: lack of complexity and depth.

1.4.3   Summary

Teacher cognition, as defined here, refers to the processes of knowledge acquisition and use that teachers engage in with regards to their practice. The issue of teacher cognition is central to understanding and investigating assumption and hypotheses about SLTE because these focus on what knowledge teachers use, how they acquire such knowledge and how they use it. Factors that have a significant effect on these processes include emotional processing and individual values, so they must be included into any construct of teacher cognition. The purpose of this volume is (a) to make clear the assumptions about human cognition which underlie current conceptions of SLTE, (b) to investigate empirical support for or against these assumptions, and (c) create a new construct of cognition for SLTE which incorporates the most important research insights relating to L2 teacher cognition.

1.5 Organization of this volume

The second chapter examines the professional conceptions of SLTE that have been proposed throughout the years in order to understand the conceptions of cognition that they assume. There were four main issues found: (1) the assumption that explicit knowledge guides teachers' practice, (2) that general knowledge (i.e., knowledge which academics produce) is more useful than specific, context-bound information, (3) that teachers' practice is guided by general principles and if these principles are changed, teachers' practice will change, and (4) if teachers recognize problems in their practice, they will be able to solve them.

The construct of cognition underlying most hypotheses about SLTE assumes that using knowledge gained in such programs can be easily used in the practice of teaching; in other words, the knowledge which is learned in one context (SLTE programs) can be transferred and used in a different context (L2 teaching) without problems. The third chapter reviews an extensive amount of research on this issue from a wide range of sources. Studies show that knowledge transfer from SLTE programs to L2 teaching is very difficult and problematic. Language teachers find it very difficult to use academic information or theoretical principles in their practice. Research shows that teachers of

other subjects have the same problems with knowledge transfer; however, knowledge transfer is not just a problem for teachers. Humans in general are not very good at taking knowledge gained from one activity and using it in another and will even resist knowledge which contradicts knowledge they already possess. Transfer seems only to occur when the learning activities (SLTE activities) are similar to target activities (L2 teaching activities) at both surface and structural levels, what is known as near transfer. Far transfer, transfer when the activities are different, seems to occur only very rarely. Traditional conceptions of cognition within the SLTE literature do not account for the extensive data presented in this chapter; therefore, a new construct of cognition is needed which will account for what kinds of knowledge people use, how they acquire it, and how it is used.

The fourth chapter discusses constraints on thinking and ways in which we deal with these. Human cognition is not unlimited; there are some important constraints on the kinds of cognitive operations we can engage in. A central constraint is the limited amount of information that can be explicitly processed at any one time in working memory; what Bruer (1993) refers to as the "Cognitive Bottleneck". Because of this bottleneck, knowledge which needs to be explicitly processed, such as declarative knowledge, is very inefficient. On the other hand, implicit knowledge, which is largely processed outside of working memory, is cognitively efficient. Studies of experts have shown that they are able to perform better than others because they use their implicit knowledge recognize important cues as well as actions which have good chances of achieving their objectives in that specific situation. A possible reason for the lack of transfer of knowledge from SLTE programs to language teaching is that teachers do not acquire enough implicit knowledge about teaching in SLTE programs. Therefore, it is suggested that SLTE programs need to focus on helping teachers acquire implicit knowledge for teaching. Implicit knowledge is acquired by participating in activities you want to gain facility in. However, such knowledge is specific to the activity: practicing diagramming sentences results in implicit knowledge about diagramming sentences, not in providing understandable grammatical explanations to L2 students. This reinforces the finding from transfer research of the importance of similarity between SLTE activities and activities that L2 teachers engage in.

The importance and structure of knowledge organization is investigated in Chapter Five. SLTE programs typically focus on general knowledge about language, language learning and language teaching (Brown, 2000; Bardovi-Harlig & Hartford, 1997; Lightbown & Spada, 1999; Shrum & Glisan, 2004). However, teachers need and use knowledge specific to the practice of teaching. For example, teachers' knowledge is different from knowledge of academic fields. On the one hand, only a portion of academic knowledge is useful for teaching; on the other hand, teachers draw on significant kinds of knowledge not included in academic fields of study. Teachers and academics also engage in practices which are different, and different knowledge is required for different practices. For example, while *talking about* language and language learning is a central practice of academics, *doing* things with such knowledge to help learners acquire language is central to teachers' practice. Furthermore, evidence suggests not only that other kinds of practitioners rely on knowledge specific to their practice, but also that such practice-specific knowledge is central to competence and expertise in any kind of human activity because such knowledge is cognitively efficient. Two other factors point to the practice-specific nature of teachers' knowledge. First, one needs such practice-specific knowledge to truly understand any concept for practice. Second, teachers' decisions are based to a

large extent on factors specific to their particular contexts and students, not on general principles or issues. Practice-specific implicit knowledge is acquired when participating in activities in which detailed, context- and teaching-specific information is available as well as necessary for participating in the activity.

The sixth Chapter explores how teachers' knowledge is specific to their practice. Nevertheless, how their knowledge is organized is just as important as the amount of knowledge a teacher possesses. A well organized knowledge base helps teachers match student cues or their instructional agenda with options for action automatically without demanding much of their scarce explicit processing capacity. However, teachers' knowledge organization is different from the organization of explicit, academic knowledge. Instead of general conceptions which account for all relevant factors, teachers rely on a dynamic network of practice-specific knowledge, which allows teachers to continually construct interpretations of student behavior, instructional goals and other classroom issues as activities unfold in the classroom. As efficient users of their cognitive capacities, teachers do not construct full models of the situation, but rather they use only as much knowledge as necessary to create temporary, on-the-spot understandings of key issues and options at hand. The better a teachers' knowledge is organized into such a practice-specific network, the easier it is to create these on-the-spot conceptions of classroom issues. This answers the dilemma posed by Larsen-Freeman (1983) that SLTE programs cannot provide teachers with the specific knowledge for teaching in all situations. If teachers have a well organized network of knowledge based on a wide variety of context and practice-specific knowledge, this will allow them to create such on-the-spot understandings of practice for teaching contexts they have not been prepared for. Such a network is acquired by participating in teaching-similar activities which focus on comparing, contrasting and linking knowledge. Teachers also acquire such knowledge by engaging in deliberate practice activities, meaning activities which they design for the purpose of adding to and enriching their knowledge for practice. Although explicit, academic knowledge is not *the goal* of these processes, it can be helpful. Academic knowledge can (a) help scaffold acquisition and link practice-related knowledge and (b) help teachers generate feedback about their performance in the practice task. Academic knowledge, therefore, can be an important tool for helping acquire the kind of implicit, practice-specific, dynamically organized knowledge that teachers need.

In Chapter Seven, ways in which SLTE programs can help teachers learn by managing their cognitive load are investigated. Research indicates that for teachers to acquire the kind of practice-specific dynamically organized implicit knowledge in SLTE programs they need to have explicit cognitive processing capacity available for learning during SLTE activities. If teachers need to pay attention to too many factors, they will suffer from cognitive overload and will not be able to learn much. Therefore, one of the central responsibilities of SLTE teachers is to manage the cognitive load of their students. For instance, they can scaffold teacher learning by directing teachers' attention to the most salient factors, supporting performance, and using assessment of teachers' knowledge to design activities which do not overload working memory. Another way to reduce cognitive load is by designing SLTE activities which are superficially and structurally similar to the activities that make up the practice of teaching. If SLTE tasks are truly similar to teaching, teachers will be able to simply recognize the connections to teaching, which greatly reduces the need to mentally work out this connection. Finally, the extent to which an activity is easy, challenging or results in cognitive overload depends on the

teacher's knowledge base, their learning styles, and their values for teaching. In other words, SLTE programs should not be "one-size-fits-all". Instead, activities need to be designed and scaffolded according to the knowledge, styles and interests of the teachers involved.

Chapter Eight presents three studies which investigate whether teachers acquire dynamically organized, practice-specific, implicit knowledge through engaging in long-term teaching practice. Studies of teacher learning have shown that teachers generally are not able to use academic knowledge to enrich or guide their practice in the short term. However, given the ability of explicit, general knowledge to focus attention and guide deliberate practice, one could argue that teachers use explicit, academic knowledge to generate implicit, specific knowledge organized around L2 teaching. Unfortunately, there have only been a few minor studies which address this topic in some way. Therefore, these three empirical studies were undertaken to test this hypothesis by investigating to what extent very experienced teachers exhibited the kind of practice-specific networks of knowledge that the hypothesis predicts they will have developed. This was done by using three separate tasks selected because they are the prototypical tasks used to investigate expertise and knowledge organization and have shown consistent differences between experts and non-experts in a wide range of fields. The studies focused specifically on the teachers' knowledge of learners' interlanguage because previous research has indicated that this is a significant focus of language teachers and, thus, a logical target for deliberate practice. The first study used a memory task.

The ninth chapter begins by evaluating the hypotheses underlying traditional conceptions of SLTE from the second chapter. The conclusion is that the evidence does not support these hypotheses, but does support the position of Freeman and Johnson (1998), Tsui (2003) and others who have argued that (a) SLTE needs to focus on the activity of teaching and the contexts of teaching and (b) that developing expertise requires reinvestment of cognitive resources into deliberate practice. However, neither of these approaches provides a full model of teachers' knowledge use and acquisition or explains why teacher cognition is this way, so a new construct of cognition is needed which better fits the data we have on knowledge and knowledge use. Such a model, focusing principally on teacher knowledge use and acquisition, is presented and discussed. This chapter ends with a series of recommendations or working hypotheses for SLTE programs.

Chapter 2: Conceptions of Second Language Teacher Education

Much of the theory on Second Language Teacher Education (SLTE) relies on folk theories of cognition which see the issues of knowledge, knowledge use and knowledge acquisition as simple and unproblematic. You tell someone something, then they know it and can use this knowledge, end of story. This volume investigates the extent to which the findings of empirical research on cognition resemble these folk conceptions of issues such as knowledge, knowledge use, and knowledge acquisition. This chapter examines the professional conceptions of SLTE that have been proposed throughout the years in order to understand the conceptions of cognition that they assume. There were four main issues found: (1) the assumption that explicit knowledge guides teachers' practice, (2) that general knowledge (i.e., knowledge which academics produce) is more useful than specific, context-bound information, (3) that teachers' practice is guided by general principles and if these principles are changed, teachers' practice will change, and (4) if teachers recognize problems in their practice, they will be able to solve them.

2.1 Introduction

The purpose of this volume is to investigate and evaluate conceptions of human cognition underlying conceptions and theories of Second Language Teacher Education (SLTE). The first step in this process is to make clear what hypotheses or assumption about L2 teacher cognition have been made, which is the task of this chapter.

2.2 Conceptions of SLTE

Given that university academics are in charge of most SLTE programs, it is not surprising that most of the assumptions and hypotheses about SLTE see academic knowledge and practices as central to the process of learning to teach. This has ranged from claims that models of L2 teaching practices constructed using academic knowledge and theory are superior to traditional ways of language instruction (for example, the audiolingual method), to assertion that teachers need academic knowledge to understand what they are actually teaching, from suggestions that teachers use general principles to guide practice, to proposals that teachers need to become skillful in academic practices such as reading research, reporting studies and explicitly thinking through explanations of their practice. Common among all these approaches is the underlying assumption that what academics know and the activities which are typical of academics are also central to the practice of language teaching.

2.2.1 Linguistics as source of teaching knowledge

2.2.1.1 The Craft Model
While language teachers have always used insights from work done on language analysis (Mackey, 1966; Kelly, 1969; Handschin, 1929), the relationship between those engaged in such scholarship and those engaged in language teaching changed during the decades after the Second World War. Arguing that their research based theories of language were superior to folk theories of language teachers, linguists succeeded in establishing themselves as the primary source of legitimate knowledge concerning language teaching. Spolsky claimed that "if there is one thing that the applied linguist has been successful at, it has been in his publicity campaign. No publisher today would risk a book in the field of language teaching without linguistics or a linguist on the title page" (Spolsky, 1970: 144). This influence was used, with the best of intentions, to gain control of the

levers of power in language teaching such as the production of teaching materials, training of language teachers, etc. Again, Spolsky: "In under thirty years, then the 'applied linguists' have won their public debate with the 'traditionalists', and even more importantly have captured the sources of power" (Spolsky, 1970: 144).

One thing that linguists and applied linguists were able to do with their newly acquired power was to recommend activities, materials, and methods for teachers to use which fit in with current theories of language and language learning. A plethora of handbooks appeared for teachers which explained how they should teach various aspects of language (e.g. Cornfield, 1966; Fries, 1945; Politzer, 1965; Rivers, 1964; Stack, 1960). A prime example of this was the Audio-Lingual method of language teaching which was directly developed from insights in linguistics and psychology (Lado, 1964; Rivers, 1968).

This is what Wallace (1991) refers to as a "craft model" (figure 2.1) of teacher education where teachers do not use knowledge of linguistics directly, but instead teachers are taught what to do, practice these ways of teaching, and then perform these actions in their classrooms. This model fell out of favor when research failed to show that such research and theory based methods of L2 teaching were superior to traditional ways of teaching (Larsen-Freeman & Long, 1991; Lightbown & Spada, 1999).
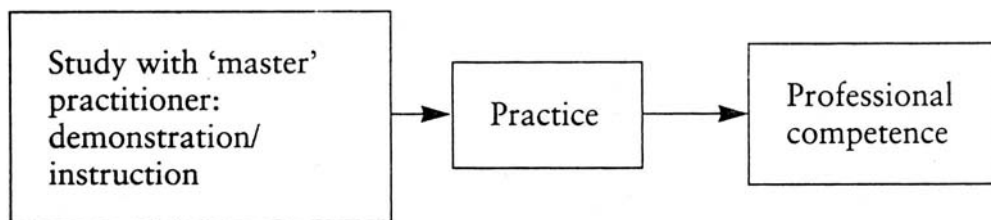
Figure 2.1: Wallace's (1991) depiction of the 'craft model' of LTE

2.2.1.2 Technical Rationality
The following approaches fall under the general "technical rationality" model (Schön, 1983) which assumes that practitioners can use academic knowledge to determine their course of action (figure 2.2). In this approach, any problems practitioners have in using academic knowledge are thought to be the fault of the practitioners, not the approach:

> It is up to the trainees to put the conclusions from these scientific findings into practice. If the trainees fail, it is perhaps because they haven't understood the findings properly, or because they have not properly applied the findings (Wallace, 1990: 9).

2.2.1.2.1   Applied Linguistics as the knowledge base for L2 teachers
One technical-rational hypothesis states that linguistic theory and research helped frame and answer specific methodological questions in L2 teaching practice. Corder argued that the field of linguistics was central to the development of L2 teaching: "There can be no systematic improvement in language teaching without reference to the knowledge about language which linguistics gives us" (Corder, 1973: 15). He also criticized attempts to answer questions about L2 teaching without relying on linguistic theory:

How can we account, then, for those total language-teaching operations in which no applied linguist has been involved? The answer must be that what are essentially linguistic questions have been answered without the benefit of scientific linguistic knowledge…the formulation of the questions, the identification of the problems and the specification of their nature presupposes linguistic theory (Corder, 1973: 138).
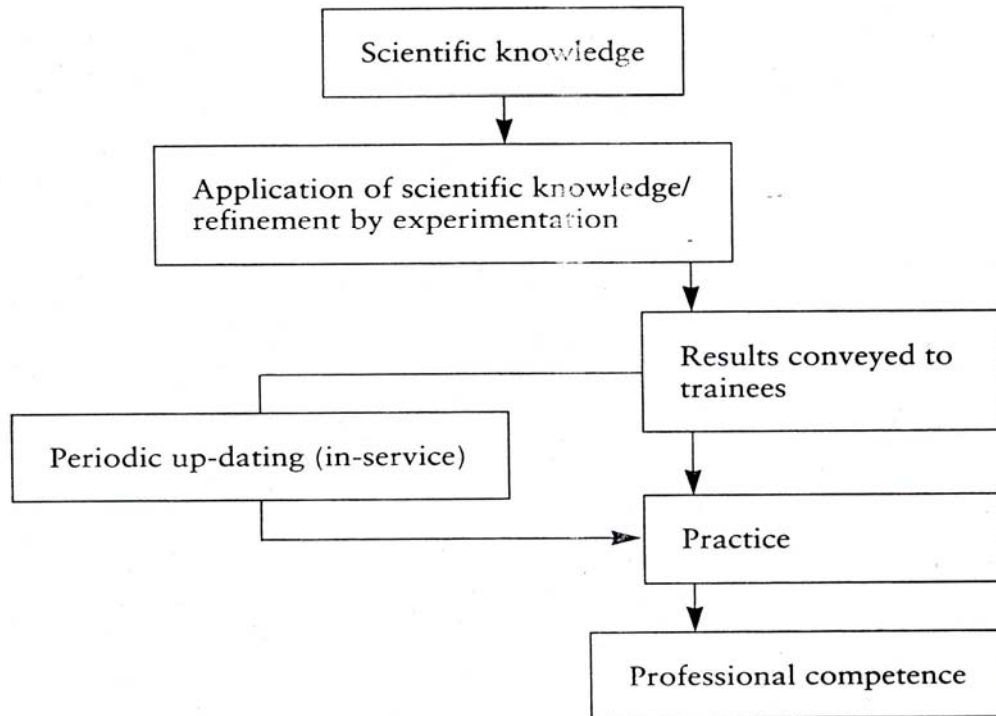
Figure 2.2: Wallace's (1991) depiction of technical rationality

Furthermore, in SLTE novice teachers were provided with facts, models and perspectives about the target language from the academic field of linguistics. The assumption was that these represented what needed to be 'taught' and that language teachers needed to know these facts, models and perspectives in order to teach them to their students (Huebener, 1959; Lado, 1964). It was reasoned that providing teachers with 'accurate' information about language (a) would be much better than letting teachers to base their practice on folk theories of language and language learning and (b) would help teachers evaluate and reject methodological fads which had no scientific basis (e.g. Rivers, 1964; Politzer, 1965). It has also been argued that academic disciplines such as linguistics are the best kind of knowledge for teachers. "In order to teach effectively, one must have an adequate theory of the language to be taught, and the best developed theories have been those developed by linguists" (Flynn, 1991: 528).

It is still commonly believed that knowledge of academic fields such as linguistics can and should form a central part of L2 teachers' knowledge base and is used directly in creating L2 teaching (Bardovi-Harlig & Hartford, 1997; Baur, 2003; Bou-Franch & Garcés-Conejos, 2003; Spillner, 2003; Yates & Muchisky, 2003; Zimmermann, 2003). For example, Pica claims that: "The research base provided by educational linguistics offers no prescriptions, but rather a source of information that teachers can apply to choices they must make about classroom strategies and materials" (Pica, 1994: 280) and

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Yates and Muchisky argue that: "the ability of the teacher to provide attention to all levels of language rests on knowledge based in linguistics and SLA." (Yates & Muchisky, 2003: 144). There are two important factors to notice in such arguments. First of all, claims about what teachers "can" do are not accompanied by any empirical evidence that teachers actually are able to do what is claimed (Bartels, 2004). Second, the relationship between the academic knowledge and teaching knowledge is seen as neither complex nor problematic. In fact, the ability to use academic knowledge about language (KAL) is often seen as purely a question of how well novice teachers learn the content knowledge of applied linguistics. "The degree to which teaching practice is guided by linguistic theories, however, depends on how well teachers are trained linguistically" (Wu, 1995: 480). Furthermore, there is also an implicit assumption that any time new discoveries are made about language, teachers need to know about these developments (Bald, 1988; Crusan, 2005; Hawkins, 2004), resulting in an ever expanding catalog of what teachers "need to know" (Fillmore & Snow, 2002; Hudson, 2004).

In fact, it has even been proposed that one function of SLTE should be to train novice L2 teachers to be linguists (Leow, 1995). In this view, language teaching is merely one subcategory of academic fields of inquiry. As Flynn put it: "language pedagogues need to be concerned with linguistics and research and *integrate their own work within these larger paradigms*" (Flynn, 1990: 114) [emphasis added]. Another, more humorous, example of how self-evident the importance of linguistics for teachers was seen to be is Sinclair's argument that SLTE without linguistics would be like medical education with courses on "Diagnosis without Evidence, Natural Amputation and Badminton" (Sinclair, 1982: 21).

Another fundamental assumption of many SLTE programs is that language teachers need to become skillful in activities typical of academic work. For example, it has been claimed that teachers need research skills in order to properly judge the quality of research methodology in academic studies (Abel, 2003; Gass, 1995). Widdowson claims that "it is not the findings, the *products* of inquiry, that we should apply [to L2 teaching] but the *process* of enquiry, the conceptual analysis, observation and experimentation which research exemplifies" (Widdowson, 1990: 26). That academic knowledge might be difficult for practitioners to use in their own practice or different from the knowledge L2 teachers need is not explicitly considered. The theory is that if someone has knowledge and skills from these academic fields, they will be able to use this knowledge in dealing with related teaching problems in the context they work in without much difficulty.

2.2.1.2.2   Including other academic fields into the knowledge base for L2 teachers
When linguistics research expanded from description of language to description of language acquisition, it was argued that teachers also needed knowledge of this new area of inquiry. For example, Krashen claimed that theory of second language acquisition, not a theory of language, is what L2 teachers need to know: "the most practical, most valuable information we can provide is a coherent view of how language is acquired, a theory of language acquisition" (Krashen, 1983: 261). According to Krashen, not only could such a theory serve as guidelines for what L2 teachers do in the classroom, this model is depicted in fig. 1.2, but there could be no useful guidelines for L2 teaching practice without such a theory.

When we provide theory, we provide them with the underlying rationale for methodology in general. This permits adaptation for different situations, evaluations of new techniques and evaluation of materials. Without theory, there is no way to distinguish effective teaching procedures from ritual, no way to determine which aspects of a method are helpful and which are not helpful (Krashen, 1983: 261).
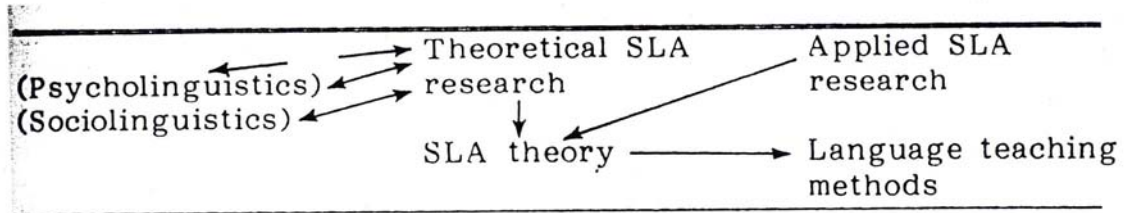
Figure 2.3: Krashen's (1983) model of the relationship of academic knowledge to teaching

Later other academic fields were added to the knowledge base that language teachers were presumed to need in order to teach. Stern (1983), for example, listed the academic fields of Linguistics, History of Language Teaching, Sociology, Anthropology, Psychology, and Educational Theory as providing the foundations for teachers' understandings of their language teaching. (See figure 2.4 for full list.) The construct of L2 teachers' knowledge and kind of academic knowledge they supposedly need is strongly influenced by the professional interests of those running SLTE programs. For example, in SLTE programs which are run by professors of literature and culture, such as many foreign language teacher education programs, the argument is often that academic work in literature and cultural studies provide the central knowledge base for L2 teachers (Christ, 2002; Lafayette, 1993; Meißner, 1997). In fact, in many in many such
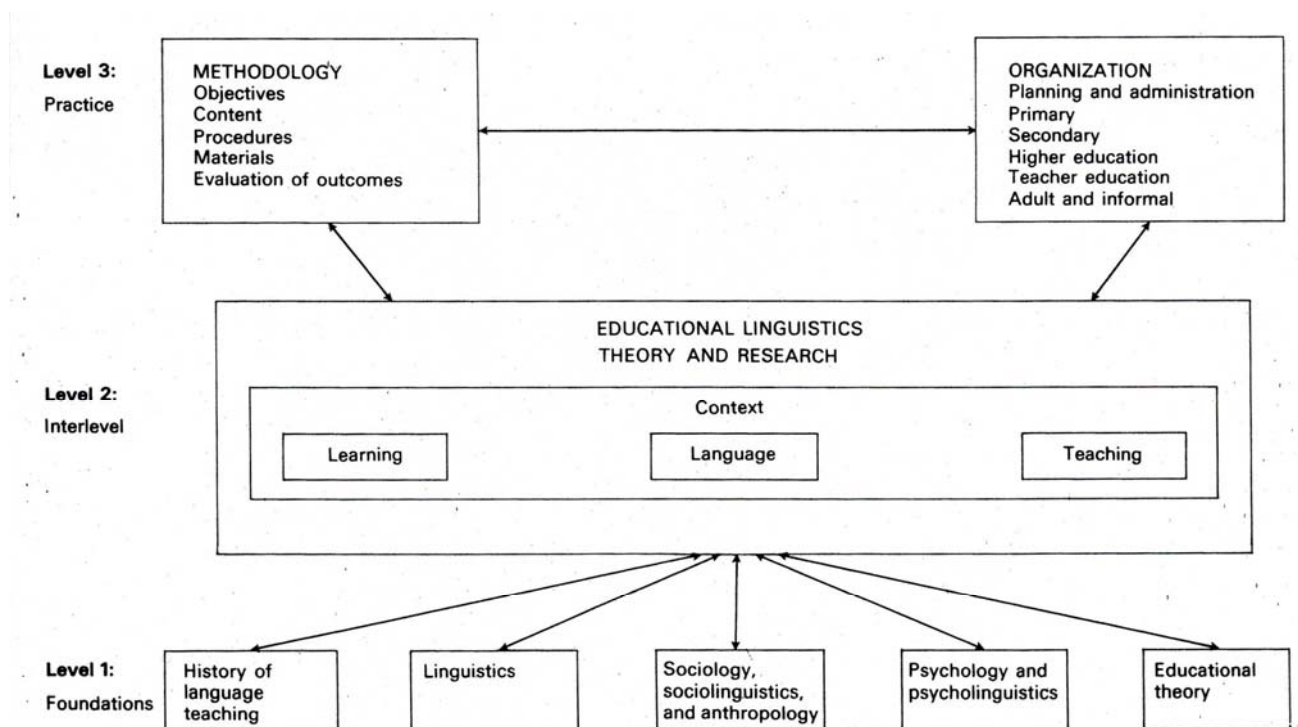
Figure 2.4 Stern's (1983) model of SLTE

departments novice teachers receive little, if any, instruction in language analysis and second language learning, disciplines which are seen as central to cognition (Crookes, 1997; VanPatten, 1999).

The view that the composition of SLTE programs is significantly influenced by the personal research interests of the faculty is supported by Ramanthan, Davies and Schleppegrell (2001) who investigated the SLTE curriculums in two universities. They found that the MA TESOL requirements reflected the research interests of the faculty rather than a discipline-wide vision of teacher knowledge or LTE. The curriculum of the MA TESOL program based in the Linguistics department focused on general linguistics while the program based in the English program (which also provided composition courses for the university) focused more on rhetoric, composition, and sociolinguistics (Ramanthan, Davies & Schleppegrell, 2001). Many programs coordinate little with colleges of education so that novice teachers receive basically the same education as those who have a (non-teaching) major or minor in that foreign language (Meißner, 2003; Tedick & Walker, 1994). In many of these SLTE program those designing and administrating the programs know little about language teaching in elementary and secondary schools and language teacher education in general (Bartels, 2002; Christ, 2003; Gnutzmann, 2003; Zöfgen, 2002). Although this is rarely seen as problematic, allowing specialists in magical realism or generative linguistics to design and administer SLTE programs makes as much sense as allowing chemists whose specialty is some sort of rare carbon bonding to determine the curriculum of medical programs or experts in particle physics to design architecture programs.

Furthermore, it has been argued that Applied Linguistics is a field that teachers of all subjects, not just language teachers, needed to know because all teachers work with and through language and most work with minority or dialect minority children. For example, Fillmore and Snow (2002) proposed a long list of facts about language which they claim mainstream teachers need to know such as the answers to questions like: "What are the basic units of language?", "How is the lexicon acquired and structured?", "What is academic English?", "Why is English spelling so complicated?", etc. According to Reagan (1997):

> Knowledge of the nature of language, as well as a general familiarity with applied linguistics, is a timely and necessary component of the knowledge base for the contemporary educator… Both preservice and inservice teachers must be familiar with eight broad areas: (1) the nature of human language; (2) the components of language; (3) the process of language acquisition; (4) language and culture; (5) linguistics and literacy; (6) TESOL methodologies; (7) language pathology; and (8) language policy and planning in education (Reagan, 1997: 187).

2.2.1.2.3 Mediation

Widdowson argues against the idea that knowledge, skills and conceptions of academic fields such as linguistics will be directly used by L2 teachers in the class room, an idea he labels *linguistics applied*: "in the case of linguistics applied the assumption is that the problem can be reformulated by the direct and unilateral application of concepts and terms deriving from linguistic enquiry itself. That is to say, language problems are amenable to linguistic solutions" (Widdowson, 2000: 5). He contrasts this with his notion of applied linguistics which is not necessarily similar to the academic fields on which it draws:

> In the case of applied linguistics, intervention is crucially a matter of mediation. Here there is the recognition that linguistic insights are not self-evident but a matter of interpretation; that ideas and findings from linguistics can only be made relevant in reference to other perceptions and perspectives that define the context of the problem. Applied linguistics is in this respect a multilateral process which, of its nature, has to relate and reconcile different representations of reality, including that of linguistics without excluding others (Widdowson, 2000: 5).

According to Widdowson, the process of mediation consists of two stages.

> The first of these we might prefer as *appraisal*. This focuses on theory and consists of the *interpretation* of ideas within their own terms of reference, within the context of their own theoretical provenance. , and the *evaluation* of their relevance or validity in principle with reference to the domain of enquiry which constitutes the context of application. Evaluation, then, is the process of specifying what might be called the transfer value of ideas…Appraisal, then, is a conceptual evaluation based on a proper understanding of the ideas proposed, and it is directed at establishing a set of valid principles of general relevance (Widdowson, 1990: 31).

In other words, academic fields of knowledge are searched for information, models, and processes which could be useful in addressing general practice-related problems such as the importance of L2 input or explicit correction. Academic knowledge is not seen as being the same as the knowledge that teachers need. Instead, those aspects which are seen as most relevant to language teaching are selected to be communicated to L2 teachers. This phase is seen as the responsibility of applied linguists: "Appraisal is seen to be principally the activity of applied linguistics (or that branch of it that concerns itself with language teaching)" (Widdowson, 1990: 32). "The second pragmatic process might be called *application*... First, ideas are actually put into *operation* in the practical domain and then the consequences are monitored in a second process of *evaluation*, this time directed at establishing the practical effect of the ideas as operationally realized" (Widdowson, 1990: 31).

In this second phase, L2 teachers use these insights from academic fields to change or develop their practice. However, according to this view, they are expected to evaluate the changes and developments in their practice rather than just assuming that these are automatically better than older practices. It is important to note here that the responsibility of this second stage of the process is seen to lie with L2 teachers, not applied linguists. "But the concerns of pedagogy are the business of teachers. It is surely they who have to determine relevance in this case, they who have to be convinced that what research has to say has a bearing on what they do...it is they who have to act as mediators between theory and practice, between the domains of disciplinary research and pedagogy" (Widdowson, 1990: 29).

Thus, it is L2 teachers, not academic researchers, who are responsible for deciding pedagogical questions in specific contexts, such as what kind of curriculum to choose (Ellis, 1993; Long & Crookes, 1992; Robinson, 1994) or the importance of L2 input (Krashen, 1988). However, in this model there is nothing similar to the process of *evaluation* for applied linguists. They should just chose what seems to be important to teaching, communicate this to teachers and wish them good luck. Communicating such knowledge to teachers and teachers using what is communicated is seen as simple and non-problematic.

2.2.1.2.4   Summary

The scholarship reviewed in this section has argued that teachers need and will use the kind of explicit, research-based knowledge that academics produce to guide their teaching. While there is not always agreement as to which disciplines teachers need to know about, generally academics propose that the knowledge from their own discipline is vital for teachers, there is general agreement that disciplinary knowledge, theories and frameworks can and should guide L2 teaching. Furthermore, continued acquisition of disciplinary knowledge is seen as central to teacher development even after initial, preservice SLTE program. For example, it has been argued that teachers need become accomplished in academic discourses and practices in order to further their knowledge once they leave SLTE programs. In general, the processes whereby teachers acquire and use such knowledge are portrayed as simple and non-problematic.

2.2.1.3 General principles, conceptions or "beliefs"

Other approaches suggest that it is not academic knowledge itself which helps teachers, but how academic knowledge helps refine teachers' general conceptions (or "beliefs") about language, SLA and L2 teaching. For example, some applied linguists have argued that academic theories and research knowledge about language did not provide an adequate knowledge base for language teaching directly. "A description of the language is not in itself a set of directions as to how to learn or teach the language…It specifies the material to be taught, but not the way to present it" (Spolsky, 1970: 145). Instead of applied linguistics serving as a direct knowledge base for teachers, it was purposed that teachers use the knowledge and theories of applied linguistics to develop their own principles or theories of language teaching (Spolsky, 1970) and to develop hypotheses about the causes of and solutions for problems in their classrooms (Politzer, 1972), and these would in turn direct how L2 teachers taught (figure 2.5).
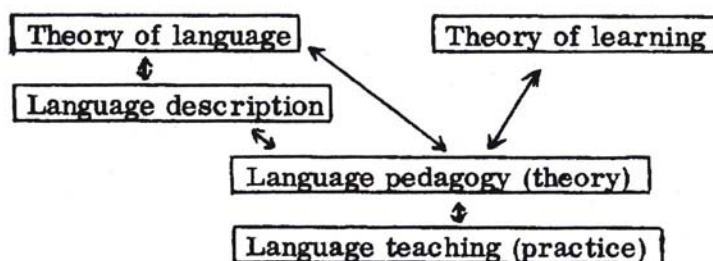
Figure 2.5: Spolsky's (1970) model of the relation of academic knowledge to teaching

Thus through the use of academic practices and models it is thought that L2 teachers can (a) understand their practice better than they would without training in applied linguistics and (b) actively test the validity of their personal theories about language and language learning. For example, Widdowson argues:

> the value of research is that it can help teachers to define more clearly the problems that they themselves must solve... It can also provide them with a conceptual context within which to work, in the form of hypotheses to test out in the conditions of their particular classrooms..., theory can help practitioners to adopt a theoretical orientation to their task, whereby they seek to refer the particular techniques they use to more general principles, and, reciprocally, test out the validity of such principles against the observed actualities of classroom practice (Widdowson, 1990: 25).

This is similar to Politzer's (1972) model of SLTE where applied linguistics provides information, but L2 teachers are expected to test and evaluate the implications themselves (figure 2.6).
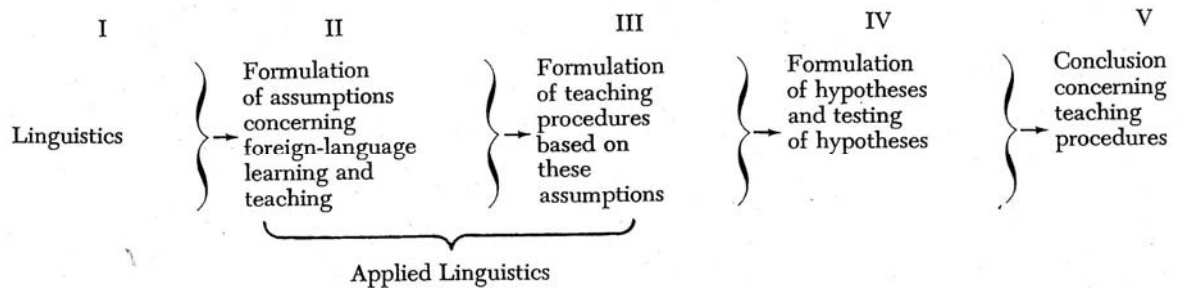
Figure 2.6: Politzer's (1972) model of the relation of academic knowledge to teaching

Larsen-Freeman made a distinction between L2 teacher 'education' and L2 teacher 'training' (which were usually used synonymously at the time and still are today sometimes) in order to further the argument that teacher preparation needed to focus on the development of general, abstract conceptions which are not bound to a specific context. The argument is a follows:

> Since situations in which languages are taught are so varied, it seems unrealistic to expect a university teacher preparation program to train teachers for every eventuality…Given this outlook, it is my contention that it is neither desirable nor practical to provide trainees with a different kind of training, depending upon those with whom they expect to be working. Instead, we must educate an individual to be an effective teacher in any situation…the process of educating is indispensable since teacher trainers cannot prepare their trainees for every situation with which the later will have to deal (Larsen-Freeman, 1983: 264-5).

Larsen-Freeman argues that the purpose behind teacher education should be to enable language teachers to make informed choices in their work: "the process of educating is a process of preparing people to make choices. Since there are few facile answers for pedagogic success, making informed choices is what teaching is all about" (Larsen-Freeman, 1983: 266). According to Larsen-Freeman, to enable L2 teachers to make informed choices SLTE must help them improve their own ideas about language and language learning. This involved helping teachers become aware of their ideas and exposing them to alternative conceptions, usually from academic sources. The centrality of general conceptions or principles does not mean that specific skills or knowledge are entirely unimportant in this process.

> Teachers do not have a legitimate choice to make if they can put only one of the possible options into practice…Just as with knowledge, the language teacher needs to develop skills in the areas of language (e.g. conducting error analyses), language teaching (e.g. classroom management), culture (e.g. entering a new culture sensitively), and interpersonal communication (e.g. listening to others) (Larsen-Freeman, 1983: 269).

The importance of changing teachers' conceptions or beliefs about language and language teaching has gained popularity since the beginning of the 1990s when several studies indicated that the practices of L2 teachers were very similar to their general conceptions ("beliefs") (e.g. Burns, 1992; Johnson, 1992, Woods, 1996). This has led

many teacher educators to conclude that "beliefs are reliable predictors of teacher practices" (Savova, 2003: 27). SLTE, is was argued, needs to provide academic knowledge to help teachers to change or gain "better" conceptions which can then be used for teaching (Johnson, 1999; MacDonald, Badger, & White, 2001; Peacock, 2001; Richards & Lockhart, 1994). According to Williams' (1999) model (Fig. 1.8), both public (i.e. academic) and private (i.e. personal) theories can be directly realized in practice without any mediation. Therefore, studies finding that SLTE programs were successful in changing novice teachers' conceptions concluded that this would result in changes in teachers' practices (MacDonald, Badger & White, 2001; Peacock, 2001).
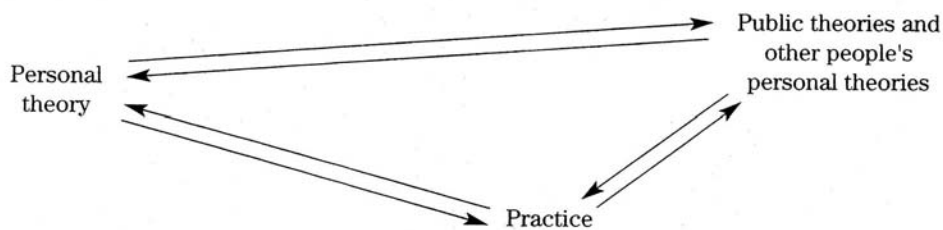
Figure 2.7: Williams' (1999) model of the relation between theory and practice

However, Kennedy (1996) and Kennedy and Kennedy (1996), drawing on the work of Ajzen (1988) contended that this was too simplistic. While conceptions have an effect on intentions, Kennedy and Kennedy argued that the social norms of the teaching situation and teachers' perception of their control of situational factors are also very important in determining eventual classroom practice (figure 2.8). In other words, even if a teacher believes that instruction should be largely in the target language, if she feels that doing this would violate the norms of acceptable behavior in her school or if she feels that such a choice is not hers to make (because of objections from students, parents, administrators, etc.), she might still hold class mainly in the L1. Therefore, they argue that SLTE programs must help teachers explore the subjective norms of schooling, the extent to their control as teachers, and ways that they can work with or around such factors. Tudor (1998) has also argued the subjunctive norms of actors within a teaching situation in that, in his view, what happens in the classroom is the outcome of the dynamic interaction between the conceptions of teachers and those of others involved in that teaching context (other teachers, administration, students, parents, etc.). However, Larsen-Freeman's (1983) emphasis on skill building as part of teacher education is not the focus in this model. It is assumed that if teachers understand the general idea, they will find a way to put it into practice.
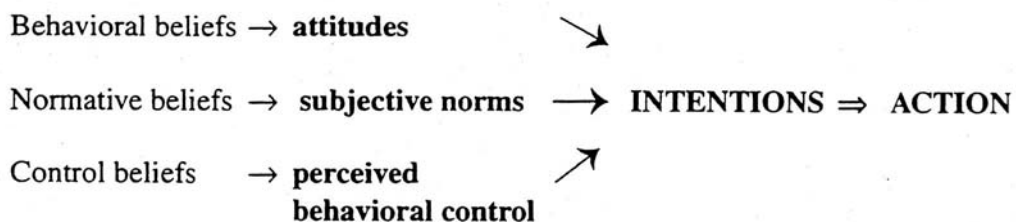
Figure 2.8: Kennedy's (1996) model of the relationship between beliefs (conceptions) and action

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As shown in this section, teachers are seen to use general principles ("beliefs") to guide their practice, to decide the focus of a unit, to decide what activities to use in a series of lessons, to decide how to respond to student work, etc. Contextual factors may influence the extent to which teachers follow these general principles, but the actual implementation of general ideas is seen as unproblematic: if an idea is understood, then a teacher should know what this idea means in practice. A central role of SLTE programs, according to the view presented in this section, is to provide teachers with academic knowledge which teachers will use to make their principles more accurate. In this view, the practice of teaching is seen as very similar to academic work: public knowledge is used to make hypotheses, and these are then tested in practice. The result of testing hypotheses is thought to produce better, more solidly grounded principles for practice.

2.2.1.4 Reflection
Many applied linguists, however, noticed that teachers did not seem to use academic KAL in their practice, even in cases where it would seem to be important. "[W]hat is learned in our teacher education programs becomes what Whitehead (1929) defines as inert knowledge – that is, knowledge that can be recalled when explicitly asked to do so, but is not used spontaneously in problem-solving even though it is relevant" (Johnson, 1996b: 24). It was argued that L2 teaching is much too complex and demanding for teachers to seamlessly apply academic knowledge while teaching. "[T]he number and complexity of professional decisions made every working day by teachers…is such that they cannot be explained only in terms of the conscious application of specific, taught 'skills'. Nor can professional action be entirely random or ad hoc: if it were, it would obviously be incompetent" (Wallace, 1991: 50).

Inspired to a large extent by the work of Schön (1983, 1987), it was proposed that in order to avoid making knowledge inert, teachers need to think about (or 'reflect on') academic knowledge and how it can be used to understand and develop teaching knowledge. This view of teacher learning also assumes that general, academic knowledge can and does directly guide practice, but that teachers will be able to use such general knowledge much better if they first think about it and compare it to their own experiential knowledge. Central to the reflective approach is the hypothesis that experiences, either with L2 teaching or academic knowledge, should be *explicitly* examined rather than simply stored in memory (figure 2.9). "It is possible to leave these [experiences] either unexplored or unconsciously stored, or it is possible to reflect on
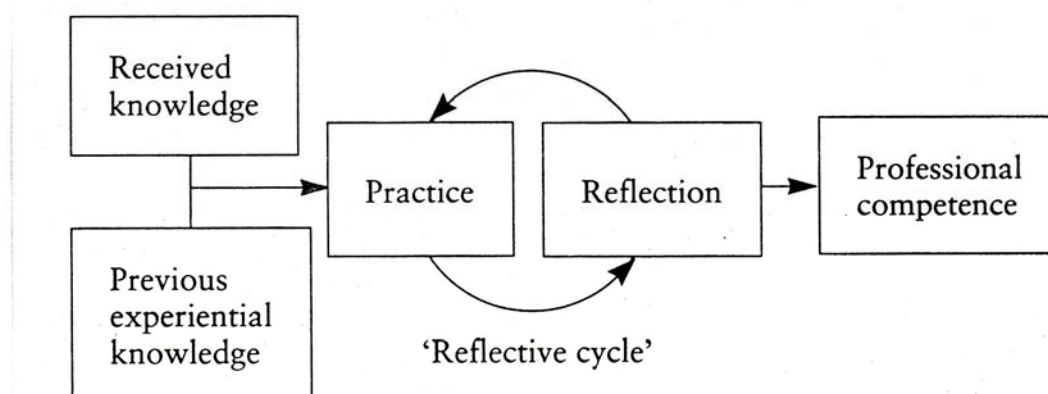
Figure 2.9: Wallace's (1991) model of reflection in teacher learning

them, leading to the conscious development of insights into knowing-in-action" (Wallace, 1991: 13).

The aim is to integrate reflection into the regular practice of teaching, even at a very basic level.

> [A] teacher may go to a talk on reading comprehension and come across the technique of asking pre-questions before reading a passage for comprehension. The teacher may relate this to the sort of mental constructs which she has about reading, and may decide that it is a technique worth trying. After the talk she may try it out in her class and, if she is pleased with the way that part of her lesson has gone, she may incorporate this technique into her repertoire of techniques for teaching reading comprehension…This is a very common way in which professional competence is developed, and in it the process of 'reflective teaching' is clearly taking place (Wallace, 1991: 53).

However, the focus of this approach is on using these experiences to gain general, explicit understanding of language teaching and language learning. Specific activities for language teaching are not seen as important to this process. "This means we have to move away from the 'how to' questions, which have a limited utilitarian value, and the 'what' and 'why' questions, which regard instructional and managerial techniques not as ends in themselves but as part of broader educational purposes" (Bartlett, 1990: 205). The common sense assumption behind reflective teaching is that if teachers think about what they are doing, then they will do it better. The theory is that if teachers make their personal theories explicit, they can use public knowledge and their own experiential knowledge to critically evaluate, change and improve their theories, leading to "robust reasoning" (Johnson, 1999) about their practice. In this approach as well, explicit and abstract ideas and principles are seen to guide teachers' actions and decisions. It is assumed that each person is equally able and willing to engage in such reflection and that using insights gained from reflection is relatively simple and easy. This approach is similar to the practice of academics in that researchers and theorists are also expected to reflect by explicitly examining their theories and conceptions for possible problems, discontinuities or unconsidered factors.

Wallace (1991) contrasts his version of the reflective approach to teaching with the technical rational model. Here, I have included his reflective model of teacher cognition as one example of technical rationality because his model relies on the same central argument as technical rationality: that practitioners rely on explicit, generalized knowledge to guide situated practice. In contrast, the hypotheses that follow suggest that specific, contextualized knowledge forms the basis of teachers' knowledge.

2.2.2   Focus of SLTE should be 'the activity of teaching itself'

A different approach is to make 'the activity of teaching itself' (Freeman & Johnson, 1998, p. 397) the focus of SLTE programs. The centrality of academic disciplines in SLTE has been criticized for several reasons. First, it has been argued that the problem "of applied linguistics in language teaching is due to the fact that some linguists have been more interested in finding application for their science than in solving the problems of language teaching" (Mackey, 1966: 200). It has also been argued that many academics are only interested in apprenticing teacher students to their particular discipline and not in helping them learn to teach (Gnutzsmann, 1995; Grucza, 1993; Meißner, 2003). Others have pointed out that applied linguistics lacks a coherent and well-rounded

research program on the practical aspects of language teaching, so it cannot provide answers central to teachers' practices (Brumfit, 1995; Larsen-Freeman, 1990; Grucza, 1993). According to Hatch (1979), applied linguists make assumptions about the significance of their research results for language teachers without any empirical evidence for such a relationship, something she refers to as "leaps of logic" (Hatch, 1979: 124).

Furthermore, it has been argued that the KAL that L2 teachers need is fundamentally different from the knowledge of the academic field of linguistics (Mackey, 1966; Larsen-Freeman, 1990). For example, while arguing for the importance of KAL for teachers Halliday argues:

> I would like to reject categorically the assertion that a course of general linguistics is of no particular use to teachers. I think it's fundamental. But I don't think it should be a sort of watered down academic linguistics course. *It should be something new*, designed and worked out by linguists and teachers and teacher trainers working together (Halliday, 1982: 13) [emphasis added].

This was stated more forcefully by Brumfit:

> Whatever else applied linguistics may do for teacher preparation, it cannot provide the basis on its own without seriously distorting either its own aims or those of teaching. Learning to perform competently is not the same as learning to understand the process of performance and to explain it…It cannot legitimately be a demand that teachers should become applied linguists unless we hold that applied linguistics is identical with pedagogy (Brumfit, 1983: 61).

The problem with seeing academic theory as providing conceptions which can form the basis of L2 teachers' practice is that "linguistic theory has proven an inadequate theoretical base for the SLT [second language teaching] field" (Larsen-Freeman, 1990: 261). Therefore, Larsen-Freeman sees the need to develop and investigate a theory of SLT separate from the fields of applied linguistics and SLA. She argues that this is necessary because "SLA and SLT theorists have different goals. The former are intent on identifying what is minimally necessary for SLA to occur; the latter should be intent on understanding the teaching/learning process so that learning may most effectively be managed" (Larsen-Freeman, 1990: 263).Thus, it is becoming increasingly common to argue that the practice of L2 teaching, not academic disciplines, needs to be the focus of SLTE programs.

At the heart of this debate is the question of what kinds of learning experiences to provide novice teachers with. While some approaches offer mainly academic experiences – reading academic works, discussion, presentations, literature reviews, etc. – other approaches claim that it is necessary to engage novice teachers in tasks similar to problems they will face in teaching. "In addition to providing accurate and up-to-date language descriptions, every session of such a course, as well as the course-related assignments, should provide language teacher trainees with a variety of problem-solving exercises. For example: (1) A student asks you what a 'tag question' is. What will you do?" (Celce-Murcia, 1983: 100).

It has also been suggested that new conceptions of language teaching require new forms of activities for LTE:

> Task-based approaches will require a total rethink of teacher training. What the teacher using a task-based approach isn't going to need is any linguistic 'knowledge' of a conscious, deliberate sort. But teachers will need to be trained in task development and task selection, and to recognize when a particular task is appropriate for a particular group. What they won't need is grammatical theory (Corder, 1986: 198).

Edge (1988) points out that novice teachers need to develop skills in three different roles: that of a language user, language analyst, and language teacher. That is, teachers need to know more than how to use the target language and analyze it; they also need to know how to use this information for teaching. Wright and Bolitho (1993), drawing on the tradition of language awareness (LA), argue that SLTE must go beyond helping L2 teachers develop their analytical skills and include tasks which develop skills in language teaching such as evaluating and creating L2 learning activities.

> On initial training courses, for example, there are often compulsory classes in the language systems: grammar, phonology and (sometimes) lexis…We believe that this knowledge is essential. On too many courses, however, this is where the language work stops. The processes of LA work can (and should) add extra dimensions to these knowledge-based approaches (Wright & Bolitho, 1993: 300).
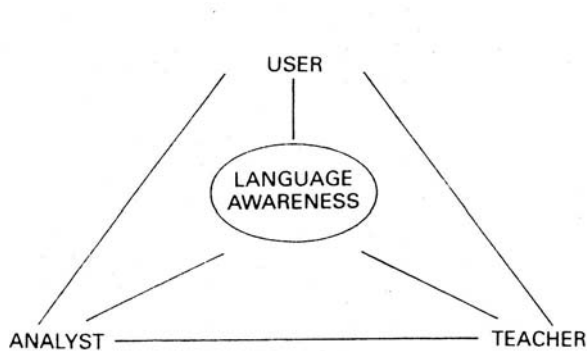
Figure 2.10: Wright and Bolitho' (1993) model of the 3 roles for language teachers

Van Lier (1992; 1994) argues for task-based teacher education. Instead of a range of activities beginning with awareness raising focusing on a specific aspect of language, he proposes starting with issues in teaching and only focusing on aspects of academic information which enable novice teachers to be knowledgeable about these issues.

> Instead of the usual linguistic sub-topics such as phonetics, syntax, discourse analysis, and so on, I propose that we identify language-related themes from the teachers' own sphere of activity…Themes that are most certain to come up include the following: (1) Correctness…(2) Bilingualism…(3) The language of specific professions…(4) Classroom talk…Within each theme, it is inevitable that straightforward linguistic phenomena of phonology, syntax, discourse, etc. will need to be explored at some point. This exploration will necessitate a certain amount of linguistic study in the traditional sense, but it is very important that such study is now motivated by a real-life question that requires an answer. Interestingly, in this scheme of LA development, we treat 'the teaching of linguistics' in a way that is similar to the way in which we treat 'the teaching of grammar' in a task-based communicative approach. We do not teach linguistics 'because it is there', but because it helps us to solve language problems in real-life tasks (van Lier, 1992: 96).

Thus, a central part of this approach is that the focus of SLTE should be on the activity of teaching rather than on academic disciplines, which are seen more as resources for

expanding understanding of teacher problems rather than in areas to be mastered. In the words of Edge: "it seems preferable to orient one's mode of operation toward 'reference out' to theory, rather than 'application in' to practice." (Edge, 1988: 11)

These developments in thought on SLTE helped bring about what Johnson calls the "quiet revolution" (Johnson, 2000: 1). In this view SLTE had to provide experiences that focused on doing teacher-like activities and used teacher-like thinking because "for teachers to make sense of theory [or any learning], it must be situated in the familiar context of their own teaching." (Johnson, 1996a: 767). Central to this concept of SLTE is Freeman and Johnson's argument that "language teacher education is primarily concerned with teachers as learners of language teaching rather than with students as learners of language" (Freeman & Johnson, 1998: 407). This was driven by a growing realization that "the cumulative effect of studying what language is and how it is learned, especially when language is defined structurally, does not necessarily translate cogently into knowing how to teach" (Freeman & Johnson, 2004: 122) and that "what novice teachers learn in our teacher education programs tends to be absent from and alien to the authentic activity of real teaching." (Johnson, 1996b: 24). Therefore they suggest that "professional learning…needs to rely less on the transmission of codified knowledge about language, language learning, and language teaching and more on the experiences that teachers engage in as learners of L2s and as learners of language teaching" (Freeman & Johnson, 2004: 123). According to Freeman and Johnson's model (fig. 1.11) there are three main areas that SLTE needs to take into account when providing novice teachers with educational experiences: the teacher as a learner of teaching, the activity of teaching and the context of teaching.
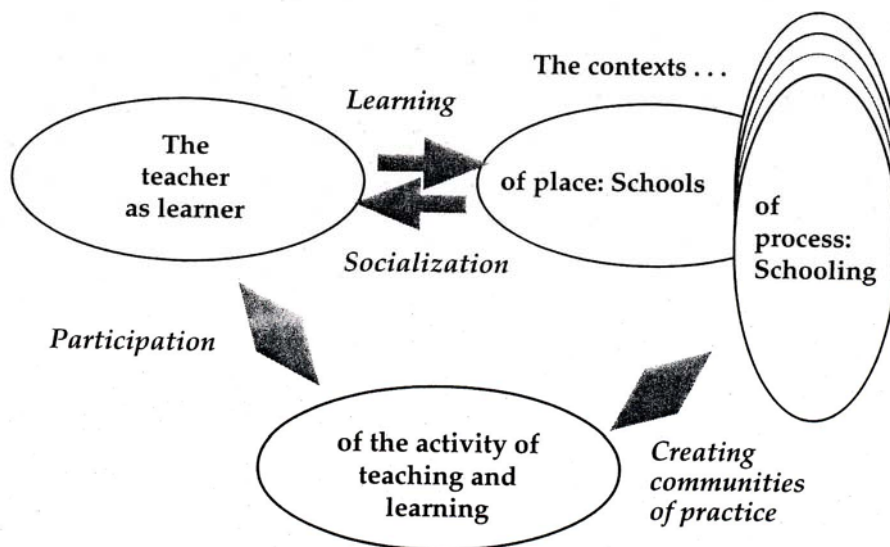
Figure 2.11: Freeman & Johnson's (1998) model of the knowledge base of LTE

Johnson argues that "[l]aw students must learn to reason like lawyers, medical interns must learn to diagnose like doctors, and novice teachers must learn to solve classroom problems like experienced teachers" (Johnson, 1996b: 26). Therefore:

> what teachers learn and how it is learned must resemble the knowledge that is held by those who already participate in that domain, in other words, teachers. Therefore, cognitive apprenticeship methods situate what is learned and how it is learned within

> authentic contexts, and engage novice teachers in activities which require them to think and act like real teachers in real classrooms (Johnson, 1996b: 26).

However, although academic knowledge is not directly pictured in this model, its importance is in no way seen as marginal. Similar to the proponents of a LA or a Task-Based approach to LTE, Freeman and Johnson see the value of academic knowledge, but only in terms of in terms of how it actually helps L2 teachers learn to teach.

> Our intention is to redefine what stands at the core of language teacher education. Thus we argue that, for the purposes of educating teachers, any theory of SLA, any classroom methodology, or any description of the English language as content must be understood against the backdrop of teachers' professional lives, within the settings where they work, and within the circumstances of that work (Freeman & Johnson, 1998: 405).

This does not mean simply elevating the status of folk theories of teaching over academic theories of language and language learning. Rather the idea is to use the practice of teaching as the organizational focus for making and evaluating theories of LTE, rather than theories applied linguistics or other academic theories.

> [W]e do not mean to ignore conventional notions of theory or to replace them with simply with knowledge of and from practice. Rather we seek a broader epistemological framework...within which both conceptual knowledge (known as theory) and perceptual knowledge (known as practice) are highlighted, valued, and experienced so as to inform and reform teachers' practices (Freeman & Johnson, 1998: 405).

Freeman and Johnson argue that the there is no reason to have academic disciplines as the central focus for SLTE because this traditional view is more the result of historical circumstances than of research on teacher knowledge and teacher learning.

> Thus… in these two, arguably parallel areas of language teacher education [ESL & FL], different sources of disciplinary knowledge have provided the sources of canonical knowledge and therefore professional identity…We acknowledge and professionally support the fact that SLA is a contributing source of knowledge for language teaching…We do contend that its apparent centrality in TESOL teacher education may be more of a historical than a functional reality (Freeman & Johnson, 2004: 121).

This view of SLTE may differ from the view that many academics receive as they make their way through their apprenticeship into the academic community (i.e., doctoral programs). However, it is not a radical break from other visions of SLTE that have come before it. Other views have also asserted (a) that teacher knowledge (the goal of LTE) is different than academic knowledge, (b) that SLTE needs to develop teachers' personal conceptions of L2 teaching, (c) that SLTE should focus on teacher-like tasks (e.g., evaluating activities, lesson planning, responding to student work, etc.), and (d) the importance of learning to talk like a teacher; all of which points to the teacher as learner, the activity of teaching, and the context of teaching as the focal points of LTE. By subordinating the learning of applied linguistics (and other academic knowledge) to the learning of teaching, the field of SLTE is beginning to establish itself as a field independent of other academic fields, a development many applied linguists have pleaded for (e.g. Larsen-Freeman, 1990; Ellis, 1997). "It is likely that language teaching will continue to be a child of fashion in linguistics and psychology until the time it becomes an autonomous discipline which uses these related sciences instead of being used by them" (Mackey, 1966: 200).

The scholarship reviewed in this section argues that the kind of general, abstract knowledge which forms the core of academic disciplinary knowledge is not very useful for professionals such as language teachers. Instead, these scholars argue that teachers need (a) to gain knowledge specific to the task of teaching, (b) to gain facility in practices that teachers are involved in, and (c) to learn to think and reason like outstanding teachers.

2.2.3   Reinvestment of cognitive resources

While reflection may be an important part of teacher learning, academic knowledge and reflection alone may not be enough. For example, many studies have found examples of teachers who, upon reflection, wished to change the way they taught, but were unable to (e.g., Johnson, 1994; Ulichny, 1996). Tsui's (2003) longitudinal case studies of the development of four language teachers indicate that other processes are also central in the development of teacher expertise. When they first started teaching, the teachers in the study invested significant amounts of time learning about teaching (classroom management, materials development, expanding repertoire of activities, etc.). Eventually they mastered those aspects of teaching they had been struggling with, which freed up the time that had been devoted to developing their teaching knowledge and skills. For example, while classroom management occupies a large portion of beginning teachers' cognitive resources, after a year or two it requires much less thought and planning to maintain classroom discipline. Tsui found that the less expert teacher in her study devoted the freed up time to her personal life, the more expert teachers used that freed up time in deepening their understandings of those aspects that they had been working on or working on other aspects of their teaching. "Like all teachers, the four ESL teachers were confronted with challenges of a different nature at different stages of their careers. They responded to them differently, however…Marina [the expert teacher] responded to the challenge in ways that helped her to gain more profound understanding of her role instead of simply carrying out prescribed duties" (Tsui, 2003: 272). Marina "constantly looked for challenges, moving from smaller to bigger ones." (Tsui, 2003: 273). She engaged in periodic cycles of identifying areas to work on and using a variety of methods (reflection, skill development, activity development, etc.) to develop expertise in that area. Working on increasingly challenging problems was key in helping her develop expertise in teaching because "in the process of responding to and taking on challenges, one has to go beyond one's current level of competence by developing new skills and new knowledge" (Tsui, 2003: 272).

When that aspect of teaching had been developed to the teachers' satisfaction, new goals were established and new methods of learning developed. Tsui concluded it was this process of reinvestment that led to expertise in teaching. "In the process of interpreting formal knowledge in the context of the specific problem they have to tackle, or in their specific context of teaching, their practical knowledge is enriched, and they gain further new knowledge that will serve as the basis for future action. This kind of knowledge renewal, or knowledge growth, is vital to the development of expertise" (Tsui, 2003: 267). Thus, expertise is not simply mastering a static body of knowledge, rather being an expert means engaging in the process of constantly reinvesting cognitive resources freed up in further learning: "one of the critical differences between expert and nonexpert teachers is the capability of the former to engage in conscious deliberation and reflection" (Tsui, 1996: 265).

According to this approach, reflection and general rules are not enough. To achieve expertise, teachers need to invest time and energy actively trying different ways of accomplishing their practice, honing their skills, and adding to their knowledge of activities, materials, and techniques. Knowledge is not understanding general concepts, but the gradual and incremental accumulation of specific ways of engaging in the practice of teaching.

2.3 Common hypotheses about teacher knowledge and learning

Underlying many of these conceptions of SLTE is a particular construct of human cognition in terms of what kinds of knowledge humans use and how they get it. The most significant issues or hypotheses in this concept of human cognition are:

1) Teachers can use explicit knowledge to guide their practice, and explicit knowledge can be the primary source of teachers' knowledge.

2) Because teachers work in a variety of contexts (and these contexts change), general, abstract knowledge is more useful for teachers than knowledge which is specific to particular contexts or situations. This hypothesis is contested by Freeman and Johnson (1998), among others, who argue that teachers rely mainly on situated and local knowledge for teaching.

3) Teachers gain the specific, practice-related knowledge that they need during school-based practicum experiences and subsequent teaching practice.

4) Teachers have principles or general conceptions which drive their teaching. If these principles are changed, then the teachers' practice will change.

5) The final hypothesis is that if teachers explicitly recognize (for example, through "reflection") what kinds of things they would like to do differently, they will generally be able to do this. Tsui (2003), however, argues that recognition of a problem alone is not enough for change; rather teachers need to invest significant amounts of time developing knowledge and skills before they are able to significantly change their practice.

One thing that stands out in these hypotheses is the tendency to value the kinds of knowledge academics have and produce, reflecting the tendency to value academic knowledge over teacher knowledge (Clarke, 1994). Academic research and scholarship is focused on creating explicit knowledge (hypothesis 1), whereby general knowledge is more highly valued that specific, context-bound knowledge (hypothesis 2) and general principles or laws receive the highest regard (hypothesis 3). Furthermore, academic research is principally interested in understanding and describing phenomena, not solving particular problems in specific contexts and dealing with the consequences of action (hypothesis 4) (Becher & Trowler, 2001). On the other hand, the kinds of implicit, context-specific knowledge that teachers would develop in their practice are not given much respect in these conceptions of teacher knowledge and teacher learning. Part of the problem is that those in SLTE have not admitted and confronted their own biases when working on these issues. Elsewhere I have argued that:

Applied linguists need to acknowledge and confront our fundamental conflict of interest in the area of language teacher education. We are not impartial, uninvolved observers on this issue because in arguing for the central importance of applied linguistics for language teacher education, we are arguing for something that brings us material and social benefits in the form of jobs (i.e., applied linguistics positions in language teacher education programs) and the perceived value of our work (Bartels, 2004: 131-132).

There are good reasons to suspect that this bias has produced problematic conceptions of SLTE. First of all, academic conceptions of SLTE are heavily based on introspection and folk theories of knowledge and cognition; rarely is relevant research integrated into these arguments (Bartels, 2004). The second problem is what is known as the *Curse of Knowledge* (Camerer, Loewenstein & Weber, 1989) or the *Expert Blindspot* (Nathan & Koedinger, 2000a; Nathan & Petrosino, 2003). This is a general property of human cognition where people tend to view the knowledge that they possess as being superior for performing other activities, even if this is not true. For example, Nathan and Petrosino claim that:

educators with advanced subject-matter knowledge of a scholarly discipline tend to use the powerful organizing principles, formalisms, and methods of analysis that serve as the foundation of that discipline as guiding principles for their students' conceptual development and instruction, *rather than being guided by knowledge of the learning needs and developmental profiles of novices* (Nathan & Petrosino, 2003: 906) [emphasis added].

In other words, one would expect academics to propose that academic knowledge and skills are what other people need, regardless of its actual usefulness. Thus, such hypotheses may reflect more what academics know in general than what SLTE needs to do. Of course, by the same token teachers may also be biased towards the knowledge they possess, so claims that SLTE needs to focus on knowledge teachers have may reflect a similar bias to a knowledge set. Thus, it is unknown whether hypotheses about SLTE are purely a result of such cognitive biases or whether there is some truth to them. Therefore, the following chapters will evaluate this construct of cognition and suggest a new concept of cognition which can guide conceptions of SLTE.

2.4 Conclusion

Those involved in SLTE programs have invested much time and energy in developing conceptions of teacher knowledge and learning which underlie their programs. However, it is only recently that researchers have begun to examine these conceptions in earnest. Given that these hypotheses are based on folk conceptions of human cognition and at least appear to be biased in favor of academic knowledge, it is important not only to evaluate these hypotheses empirically, but also to use more general knowledge of human cognition in evaluating such proposals. The following chapter will focus on these issues directly by looking at empirical evidence of the extent to which teachers use explicit, academic knowledge, skills in academic practices and general principles in their work as L2 teachers.

Chapter 3: Knowledge Transfer

> The construct of cognition underlying most hypotheses about SLTE assumes that using knowledge gained in such programs can be easily used in the practice of teaching; in other words, the knowledge which is learned in one context (SLTE programs) can be transferred and used in a different context (L2 teaching) without problems. This chapter reviews an extensive amount of research on this issue from a wide range of sources. Studies show that knowledge transfer from SLTE programs to L2 teaching is very difficult and problematic. Language teachers find it very difficult to use academic information or theoretical principles in their practice. Research shows that teachers of other subjects have the same problems with knowledge transfer; however, knowledge transfer is not just a problem for teachers. Humans in general are not very good at taking knowledge gained from one activity and using it in another and will even resist knowledge which contradicts knowledge they already possess. Transfer seems only to occur when the learning activities (SLTE activities) are similar to target activities (L2 teaching activities) at both surface and structural levels, what is known as near transfer. Far transfer, transfer when the activities are different, seems to occur only very rarely. Traditional conceptions of cognition within the SLTE literature do not account for the extensive data presented in this chapter; therefore, a new construct of cognition is needed which will account for what kinds of knowledge people use, how they acquire it, and how it is used. Such a construct of cognition and the evidence supporting it will be introduced in the chapters to follow.

3.1 Introduction

Underlying all of the perspectives on SLTE outlined in the previous chapter is the assumption that what novice teachers learn in SLTE programs is used later in teaching situations, in other words, transfers to teaching. If indeed applied linguistics is the, or at least a, central source of knowledge for language teachers, if general, abstract conceptions or beliefs determine teaching, if reflection and reinvestment are useful processes for teachers, then there should be evidence of the transfer of what is learned in SLTE programs in the everyday practice of teachers. There should be evidence of teachers using knowledge of linguistics, using conceptions developed in SLTE programs, and reflecting on their practice. For far too long, the concept of transfer has been assumed rather than examined empirically (Bartels, 2002). According to Donald Freeman "transfer has…emerged as a justification for the activity of language educators and teacher educators rather than as an empirical concept. Transfer in education has become an article of faith and, as such, it bears scrutiny and re-examination" (Freeman, 1994: 4-5).

If the field of applied linguistics is to be seen as an applied science (Brumfit, 1997), then the hypotheses it has set forth about the relationship between the discipline of applied linguistics and the field of language teaching need to be investigated. However, such an endeavor cannot be achieved only with logic and reference to findings about language and language learning, but rather through the examination of the effects of SLTE on language teaching or, in other words, transfer. "It is no more correct to assume that a theory of language learning is of relevance to teachers than it is to assume that a theory of language is. Relevance must necessarily be determined not from within SLA but from without – by demonstrating how the findings of SLA address the needs and concerns of practitioners" (Ellis, 1997: 32).

This chapter will look at the empirical evidence of transfer between SLTE programs and language teaching, as well as knowledge transfer in other areas of human cognition.

When doing this, however, it is important to remember that applied linguists claim that transfer from SLTE programs will be substantial and systematic, not that there is some effect no matter how small. Therefore, it is important, first, to investigate whether any transfer from SLTE programs is central or peripheral to language teaching, and, second, to be open to the possibility that the hypotheses about the importance of SLTE programs are not borne out by the evidence. As Freeman has pointed out: "[i]t is worth considering that perhaps the relationship is between teacher education and classroom teaching is one of zero transfer. It may well be that as teachers work in their classrooms, they draw upon sources of understanding other than those with which they are equipped in teacher education programmes" (Freeman, 1994: 2).

3.2 SLTE and knowledge transfer

3.2.1 Little evidence of transfer

> Often enough, teachers in training, particularly preservice, complain about the lack of relevance of the foundation courses they have taken to the actual task of teaching (Ellis, 1997: 22).

Given the common complaints about SLTE programs, it should not be too surprising that studies looking at general transfer from SLTE programs to language teaching have failed to provide evidence for the kind of knowledge transfer predicted by applied linguists. For example, Johnson (1994; 1996c) looked at five teacher students (four in the first study, one in the second) who had completed their coursework and entered the practicum phase of their SLTE program. She found that the program had not provided teacher students with "adequate procedural knowledge about how classrooms work and what students are like" (Johnson, 1994: 450). According to Johnson, these novice teachers were not able to use the knowledge gained from the SLTE program to develop the kind of teaching they wanted. "All four teachers were critical of their own teacher-directed instructional practices, nonetheless, they described feeling powerless to alter their instructional practices because they had few, if any, alternative images of teachers and teaching to act as a model for action" (Johnson, 1994: 449). The EFL teacher interviewed by Johnston, Pawan, and Mahan-Taylor (2005) also reported that her SLTE program did not provide her with knowledge which she could use in teaching. On the other hand, Almarza (1996) reported that SLTE had an effect on student teaching of the four novice teachers in her study. However, closer examination revealed that the main influence on their teaching was the specific methods and techniques taught in their SLTE program. Almarza also found that the SLTE program had little effect on their knowledge about language teaching beyond these techniques (which the novice teachers had to display to pass the practicum), and there was no evidence that these teachers would continue to use these methods and techniques after they left the program.

Studies looking at teachers' use of specific knowledge taught in SLTE programs also report a lack of transfer to language teaching. Pennington and Richards (1997) studied five novice teachers in Hong Kong through their first year of teaching. These teachers had been trained in Communicative Language Teaching (CLT) and believed in that approach to teaching. However, they found it very difficult to create CLT lessons within the context of Hong Kong schools and all of them abandoned CLT by the end of the year. Similarly, Li (1998) looked at the use of CLT by a group of 18 teachers who had done a four-week course in Canada on CLT and found that these teachers found that their training did not enable them to teach CLT in their context. Lamb (1995) found that very

few of the ideas presented in an intensive two-week course on reading were used by the 12 teachers he studied. The four inexperienced ESL teachers in Mackey, Polio, and McDonough's (2004) study participated in a short workshop which aimed to help them increase the amount of incidental focus-on-form feedback they gave their L2 students. They found that after the workshop the teachers were increasingly able to recognize opportunities for incidental focus-on-form feedback, but despite this, their ability to actually use such feedback had not increased.

3.2.2 Knowledge about language

Studies looking at L2 teachers' use of knowledge about language (KAL) for language teaching also suggest that language teachers do not or are not able to use such knowledge for teaching. (KAL refers to knowledge that can be used to analyze language, language use and language learning, but not the knowledge used to produce or understand language.) Andrews (1999a) used a 60-item test to assess the knowledge of 20 experienced EFL teachers in Hong Kong. Although these teachers showed solid knowledge of grammar and linguistic metalanguage, this did not help them to explain grammatical rules or mistakes as they scored only 42% on the 15 items requiring explanation. A follow-up study of three of these teachers showed that additional teaching experience as well as the completion of post-graduate degrees in EFL teaching or Applied Linguistics did not increase their ability to explain grammar rules or mistakes (Andrews, 2006). Myhill (2003) used observations, stimulated recall and interviews to investigate the explanations and examples on the passive used by one L2 teacher. She found that despite the teachers' solid knowledge of the passive voice, the explanations and examples were often unclear or misleading. She concluded that "the teaching of metalinguistic knowledge requires more than an ability to identify and define terminology, and…an overemphasis upon content can lead to a failure to acknowledge the cognitive and conceptual implications of pedagogical decisions" (Myhill, 2003: 355). In another study by Andrews (1997), 14 novice teachers were given samples of L2 student work and asked to identify what should be brought to the students' attention and why. The novice teachers found this task very difficult despite solid knowledge of grammar, leading Andrews to conclude that the problem was in how knowledge was used, rather than lack of KAL. "Many of the apparent weaknesses in the performances described above seem to relate to metalinguistic awareness in operation rather than to problems with the underlying declarative KAL" (Andrews, 1997: 160).

Studies of elementary school teachers also show that using KAL gained through coursework when teaching is very difficult. For example, Cajkler and Hislam found that regardless of the level of the KAL (low to high), the ten elementary teachers in their study did not feel that their knowledge was broad or solid enough for teaching (Cajkler & Hislam, 2002). A follow-up study used classroom observations and interviews to investigate the use of KAL by four elementary teachers. The teachers in this study found it difficult to impossible to use their KAL to create grammatical explanations which were clear and not misleading (Hislam & Cajkler, 2005). In addition, the teachers reported that it was through preparing lessons and teaching grammar to children, not coursework on KAL, that they were able to acquire KAL that could be used for teaching. The teachers also reported that they did not find traditional sources of KAL, such as grammar books, useful. "Many grammar books, websites and textbooks, including those on recommended course lists, were deemed inaccessible, did not help them explain points of grammar or exceeded their current level of knowledge" (Hislam & Cajkler, 2005: 328).

Three studies provide evidence that the difficulties teachers have in using KAL to create explanations is not due to a lack of linguistics training. One study (Morris, 1999) looked at the knowledge of 93 teacher students in an SLTE program who had completed a course on pedagogical grammar. (Some had also taken additional linguistics courses.) The teacher students completed a questionnaire which asked them to explain the errors in eight sentences. Each answer was graded on a five point scale with 4 being "basically correct" and 2 being "basically incorrect". Despite their solid knowledge of English grammar (according to assessment in the grammar course), the teacher students' explanations were poor: the average score was 2.68, well below "basically correct". This was true for all items on the test, the highest average score for any one item was 3.60, and for all the teacher students, the top third of the teacher students only averaged 3.51. Morris repeated this study with another 36 teacher students enrolled in SLTE programs who took two-courses: an introduction to English grammar and a pedagogical grammar course in which, in addition to other things, students practiced responding to learner errors. After passing the two course sequence, the teacher students' average score was only 2.85, again under the 3.0 "basically correct" rating. In addition, for 17% of the items there was either no answer given or the answer was "wildly wrong" (Morris, 2002: 199). On the bright side, teacher students' scores did improve slightly from the beginning of the year to end of the year, 2.21 to 2.85 average score, 35% to 17% "wildly wrong" or no answer, so it cannot be said that the courses had no effect whatsoever. However, these studies do not support the hypothesis that such a course sequence forms the basis for teacher practices such as explanation of grammatical errors. Finally, Gregory (2005) researched the knowledge use of 22 novice Spanish teachers in a Spanish Phonetics and Phonology course. The teacher students were provided with video samples of learner language several times during the course and asked to provide the L2 students with feedback on their pronunciation. Only three of the 22 novice teachers showed evidence of using knowledge from the course in their feedback.

Research investigating teachers' use of KAL in their own classrooms has also shown that teachers find it difficult to use their KAL. In particular, these studies have shown that teachers have difficulties using their KAL under many of conditions typical of L2 teaching. The teacher in Tsui's (1996) case study understood the process approach to teaching writing, but did not know how to implement this approach in the product-oriented Hong Kong school system. Her attempts at process instruction were so problematic that she abandoned her effort. While she eventually did use some aspects of the process approach in her writing instruction, her approach was significantly different from the approach that she learned in her SLTE program and was only used sporadically. Xiao (2005) found that teachers of Chinese could use their knowledge of Chinese orthography to spot and explain L2 students' problems if there were no time constraints, but were not able to do this when actually teaching. Burns and Knox (2005) observed that the two teachers in their study did use knowledge of systemic functional linguistics (SFL) in ESL teaching, but only in subtle ways. In general they found that there were numerous institutional, pedagogical, personal, and physical factors which made such transfer difficult. For example, pressures of high stakes exams which did not take a SFL view of grammar, L2 student conceptions of grammar, the teachers' own language learning experiences, and the summer heat all caused difficulties in the teachers use of their KAL for teaching. The teachers in McKenzie's (2005) study were able to use their KAL in constructing tests for their own classes, but had difficulty using this when helping construct institution-wide end of the year tests over which they had less control.

While one can sympathize with the difficulties of trying to use academic ideas under the constraints of normal L2 teaching contexts, teachers need knowledge which they can use within the constraints of such normal teaching contexts, and the KAL they acquire in SLTE programs does not seem to provide this.

Further studies show that the issue of the transfer of KAL is complex. The novice teachers in Bigelow and Ranney's (2005) study were able to transfer their knowledge of content-based instruction (CBI) to issues of grammar teaching, but were not able to transfer their knowledge of grammar to CBI teaching. Similarly, Brzosko-Barratt and Dahlman (2005) found that the six novice teachers they followed could use their knowledge of literacy for literacy instruction and KAL for grammar instruction. However, they found it difficult to use their KAL during literacy instruction and their knowledge of literacy during grammar instruction. The non-native speaker teachers in Karatepe's (2001) study were able to use their knowledge of pragmatics to *recognize* whether a response was pragmatically appropriate or not, but they were not able to use their knowledge to *generate* multiple examples of appropriate pragmatic responses. Finally, Ma and Luk (1996) found that, despite their knowledge about reading instruction, the 27 novice teachers in their study were not able to write clear instructions for EFL reading tasks.

There is one study which did provide evidence of such transfer of KAL to teaching. After her SLTE program the novice teacher in Grabe, Stoller and Tardy's (2000) study "had a heightened understanding of English grammar...which allowed her to explain to students, for example, when to use English articles and when and why different tenses and aspects are used" (Grabe, Stoller & Tardy, 2000: 20). Unfortunately, this study did not provide any detail on how exactly KAL was used, whether this was an occasional occurrence or a central part of her teaching practice, or the extent to which these KAL-based explanations were understood better and proved to be more helpful to her L2 students than the explanations she used before entering the SLTE program.

3.2.3 General conceptions or principles: L2 teachers

As mentioned in the previous chapter, many earlier studies found that teachers' conceptions (or beliefs) about teaching or language were similar to how they taught (Johnson, 1992a; Richards, Tung, & Ng, 1992; Smith, 1996; Woods, 1996). This led to the hypotheses that (a) general conceptions controlled teaching, and therefore (b) if SLTE programs could change teachers' conceptions, this would result in these teachers teaching differently (MacDonald, Badger, & White, 2001; Peacock, 2001). This was very convenient for two reasons. First, because academics' main focus is abstract generalizations about language and language learning, so a focus on general conceptions did not require much change in SLTE practices. Second, SLTE courses proved to be good at changing teachers' conceptions. MacDonald, Badger and White (2001) used a Liker scale beliefs inventory questionnaire to examine the conceptions of 55 novice teachers about language and language learning before and after a course in SLA. There were significant changes in many of the scores, showing a movement by most of the teacher students towards academic conceptions of language and language learning. Peacock (2001) used Horwitz's (1985) BALLI questionnaire to examine the conceptions of 146 novice teachers' before and after an SLTE program. He also found that teachers' conceptions had become more like academic conceptions during the SLTE program.

These studies looked only at very general, abstract conceptions. However, Attardo and Brown (2005) developed a similar questionnaire which not only assessed such general conceptions on language variation, but also asked about specific (if hypothetical) classroom behavior, such as: "A student who says *I don't speak no French* in the classroom should be corrected" (Attardo & Brown, 2005: 102). In their study there were significant differences between the novice teachers' conceptions of language variation before and after an introductory course in applied linguistics. Riegelhaupt and Carrasco (2005) used data from teacher student journals to show that a seminar on applied linguistics was effective in changing the 27 ESL teachers' attitudes toward non-standard varieties of English and teaching children who spoke such varieties. Villamil and Guerrero (2005) looked at the evolution of novice teachers' metaphors for writing instruction over the course of a semester long class on L2 writing instruction and found significant changes in the metaphors of all 9 of the teachers in their study.

Unfortunately, studies examining whether changes in beliefs effect parallel changes in teachers' practice have consistently shown that this is not the case: changes in conceptions do not cause a corresponding change in teachers' practices. For example, the three teachers in Chaves de Castro's (2005) study participated in a series of workshops on pragmatics. After the workshops the teachers declared that they would make pragmatics a focus in their teaching and that they would give L2 students feedback on their pragmatic errors. However, analysis of recorded lessons by these teachers revealed that the teachers did not comment or focus on the L2 students' pragmatic difficulties at all. Kennedy (1996) reported on a study of Malaysian EFL teachers that showed that when they were in the UK, they held very interactive and student-centered view of language teaching; however, when they returned to Malaysia, their teaching reverted to traditional teacher-centered instruction. Studies of task-based learning (TBL) in Hong Kong show that EFL teachers there profess using TBL, but observation shows that, in fact, very little TBL instruction occurs in their classrooms (Carless & Wong, 1999; Carless, 2003).

Other studies indicated that teachers would often not use their conceptions of language or language learning to guide their teaching if they felt that it conflicts with other priorities they had for their class. Apparently, having particular conceptions about learning and instruction does not mean that teachers will know how to use that conception in less than ideal circumstances. For example, Graden (1996) studied six Spanish and French teachers. She found that while the teachers had very definite conceptions about reading instruction, they often ignored these in designing instruction in order to increase L2 student motivation, which was seen as a more important issue when designing instruction. In a survey of foreign language teachers, Berne (1998) found that while almost all agreed that teachers should include activities which focus on listening skills, only 25% of the teachers in the survey actually did this. In the study mentioned previously, Liu, Ahn, Baek, and Han (2004) found that local constraints, such as time, local instructional norms, and classroom management issues, prevented the 13 Korean EFL teachers in their study from implementing their conceptions of when the L1 should be used in the classroom.

Teachers may have difficulty using general conceptions or principles for teaching when they only have a superficial understanding .of that concept. Research indicates that just because teachers understand a particular concept in general in no way means that they

understand the concept in terms of language teaching in specific contexts. For example, Nunan (1987) observed the lessons of five ESL teachers. According to Nunan:

> All of the teachers taking part in the study were knowledgeable about and committed to communicative language teaching…On the surface, the lessons appeared to conform to the sorts of communicative principles advocated in the literature…However, when the patterns of interaction were examined more closely, they resembled traditional patterns of classroom interaction rather than genuine [communicative] interaction (Nunan, 1987: 137).

Another example is an in-depth study of 14 French teachers by Mitchell (1988), who found that these L2 teachers were not able to distinguish between communicative and non-communicative activities. Sato (2002) spent a year studying 19 EFL teachers and found that they did not use communicative language teaching (CLT) because did not know how to achieve it given constraints in school context. Similar findings have been reported by Karavas-Doukas (1996) and Andrews (2003).

It is not just with CLT that teachers have problems figuring out what their conceptions mean in practice. Johnson (1994, 1996c) looked at novice teachers in their practicum. She found that these novice teachers used conceptions or images which they found inadequate because they lacked knowledge of alternatives. Schocker-von Ditfurth's (2001) study of 16 novice teachers in their practicum produced similar findings. The college-level ESL teacher in Ulichny's (1996) case study wanted to have her students engage in rich discussion of the readings, but did not know how to create the conditions for such discussion in her teaching context. Kerekes (2001) investigated the effect of an inservice course on SLA. While the teachers conceptions did change somewhat, when asked what they had learned which was useful for their practice, the teachers cited specific activities and techniques they had learned in the class, not general SLA findings.

Finally, recent studies indicate that a good deal of teaching may not be guided by teachers' conceptions. For example, Tsang's (2004) study of 3 novice teachers showed that only about 50% of their teaching actions were due to identifiable teaching principles. Likewise, the three teachers in Basturkmen, Loewen and Ellis' (2004) study sometimes used activities and practices which reflected their conceptions of focus-on-form, but sometimes they did not. For example, one of the teachers, Mark, stated that (a) feedback on pronunciation was more important for him than feedback about grammar and (b) feedback should not interrupt communicative tasks but should happen after such tasks are complete. The data on Mark's actual teaching showed that Mark did indeed give more feedback on pronunciation (29% of feedback) than grammar (20%), but, contrary to his stated position, 62% of his feedback interrupted communicative tasks the L2 students were engaged in. In addition, Almarza (1996) found that the teacher students she studied did not use their conceptions of language learning to guide their practice. Instead, their instruction followed the teaching methods that their SLTE program expected them to follow, regardless of whether this reflected their conceptions or not. Finally, Liu and his colleagues found that EFL teachers' use of code-switching was only partially consistent with their stated principles.

> [T]he teachers' code switching followed certain patterns and principles, although …other cases appeared not to be governed by such principles. For instance, teachers often switched from English to Korean to say something very simple, which they could have said easily and time cost-effectively in English, a practice that

contradicted their stated principle of using L1 to explain difficult material (Liu, Ahn, Baek, & Han, 2004: 605).

These problems have often been framed as a problem of teaching contexts preventing teachers from using their general conceptions for teaching, rather than SLTE programs failing to prepare teachers to use conceptions under such local constraints. "A considerable body of literature now exists documenting the role of context, and particularly constraints, that can hinder teachers from implementing their stated beliefs" (Basturkmen, Loewen & Ellis, 2004: 246). However, every practitioner needs knowledge which takes into account the normal constraints of their practice. Architects need to know about the strength of building materials or the effect of wind on buildings, cooks need to know how to vary their menus due to the availability of ingredients in different seasons, and teachers need to be able to use concepts given the constraints of their practice. If knowledge gained in SLTE programs does not include knowledge of how to adapt concepts to the everyday constraints of teaching, then it is not surprising that teachers do not find such knowledge very useful.

3.2.4   Summary

Studies of language teachers consistently show low levels of transfer from SLTE programs to teaching. Even in terms of knowledge about language, there was little evidence that teachers could use the knowledge and language analysis skills learned in SLTE courses when engaging in teaching or teaching tasks. Even in cases where teachers explicitly recognized that they were not teaching they way they wanted, they were not able to change their practice. Transfer only seemed to occur in situations where what was learned was very similar to what the teachers had to do in practice. The research also shows that L2 teachers' conceptions do not consistently guide L2 teachers' practice and that changing teachers' conceptions does not have the expected influence on their practice. It appears that efforts to alter teachers' conceptions has mainly influenced how teachers talk about language teaching, but not how they actually do language teaching.

3.3 General teacher education research and knowledge transfer

3.3.1   Knowledge transfer is problematic for teacher education in general

It is not just SLTE that has such problems with transfer, studies of teacher education programs for different subjects show that they suffer the same difficulties. According to Kagan "practicing teachers have remained virtually impervious to [research] literature. Once teachers leave their university programs, their pedagogical beliefs and practices are shaped not by research, but by their own classroom experiences and those of fellow teachers." (Kagan, 1993a: 3) Bullough (1989) and Clift (1992) each did year-long case studies of one beginning elementary school teacher. The teachers did not appear to use much of what they had learned in teacher education when teaching. For example, "with respect to planning, little seemed to have transferred from Kerrie's teacher education to her actual classroom practice: She did not plan as taught, nor did she plan in advance for management" (Bullough, 1989: 140). The teacher in Clift's study was not able to use her academic knowledge in negotiating the complex problems in her classroom because her teacher education program had not prepared her for such complex problems. One of the novice teachers in Kagan's (1993) study also complained about not learning enough local knowledge during teacher education. "We didn't learn anything about what to

expect from high school students or what to do as teachers…I had been out of high school for a long time and I felt I needed to get back in touch with students" (Kagan, 1993a: 132).

Subject matter knowledge gained during or before teacher education programs seems to have little impact on teachers' practice. Feiman-Nemser and Buchmann (1987) studied two novice teachers during student teaching and found that although they were knowledgeable about the subject matter, they were not able to use this knowledge to identify or utilize learning opportunities for L2 students. Even worse, these novice teachers seemed to ignore their subject matter knowledge when evaluating their learning as teachers. They thought that learning to teach was a matter of learning classroom management. When they had managed to learn to keep their classes under control, they felt as if they had become successful teachers regardless of the level of their students' learning.

Likewise when Calderhead and Shorrock (1997) followed the progress of four beginning elementary school teachers from the last year of their teacher education program through their second year of teaching, they found that the teachers did not rely on their subject matter knowledge to guide teaching decisions. Instead, these teachers relied more on their knowledge of specific teaching activities and knowledge of the learning of the students in their class to guide their planning. The National Center for Research in Teacher Learning (NCRTL) investigated the learning of novice teachers in ten different teacher education programs, following teacher students from entry to their exit from these programs. They found that the teacher students in all but one program did not deepen their subject matter knowledge during teacher education. These teachers also reported valuing teaching experience over academic knowledge. "Teachers at all career stages value firsthand experience as the major source of knowledge and a means of learning to teach" (NCRTL, 1991: 69). In addition, Schuyler and Sitterley (1995) studied a class for novice teachers in the practicum aimed at promoting reflective practice. They found that the class resulted in very little acceptance or use of reflective practice. Wideen, Mayer-Smith and Moon (1998) summed up their review of research on teacher education thus: "In this review of recent empirical research we found very little evidence to support an approach to learning to teach which focuses primarily on the provision of propositional knowledge…Beginning teachers were not able to integrate those experiences in ways that would help them learn to teach" (Wideen, Mayer-Smith and Moon (1998: 160).

Other studies have also shown that teachers tend to rely on experiential knowledge instead of academic knowledge. Gitlin and colleagues investigated the attitudes of two cohorts of teachers (one elementary one secondary) towards research both before and after their teacher education program. They found that these teachers did not see academic research as the foundation for their teaching. "It wasn't research that provided a frame to analyze teaching but instead, their intuition on what was working with their students" (Gitlin, Barlow, Burbank, Kauchak, & Stevens, 1999: 764). Another problem was that the teachers had not been trained to access research in teaching contexts where access to academic literature was often very difficult.

Teachers in general do not seem to regard their experiences in teacher education classes as important for teaching. Kremer-Hayon (1994) surveyed 199 teachers from a variety of schools, levels and subjects about what knowledge they used in their teaching. The

teachers rated personal/practical knowledge significantly higher than formal knowledge (3.28 vs. 2.61 on a 5 point scale). In a survey of 1,789 teachers (47% elementary, 53% secondary) Smylie (1989) found that teacher education and inservice education were rated last as sources of knowledge for teaching.

Despite the general lack of transfer between teacher education programs and the practice of teaching, there is evidence that some programs do have a positive effect on teaching. For example, Grossman (1990) studied six secondary English teachers in their first year of teaching. Three of the teachers had gone through a teacher education program while the other three had gotten alternative certification based mainly on their level of subject matter knowledge. Grossman found that the teachers who had gone through teacher education programs better understood student learning and how to structure the subject matter for learning than the alternative route teachers. Since the alternative route teachers had at least the same subject matter knowledge as the other teachers, this represents transfer from the methodological and experiential aspects of the teacher education programs.

One program studied by the NCRTL (1991), did succeed in providing subject matter knowledge for teaching. This was due to a program that differed from traditional teacher education programs by specifically aiming to provide subject matter knowledge for teaching, rather than subject matter knowledge for academic research.

> One preservice program managed to alter prospective teachers' knowledge and beliefs about good mathematics teaching through an intense and innovative three-course mathematics sequence followed by a math method course. In these courses, students had opportunities to experience the learning of mathematics in ways that differ radically from their own encounters with mathematics as elementary and high school pupils. The emphasis was on problem-solving through the creation of a mathematics learning community. Students also saw demonstrations of this kind of mathematics teaching live and on videotape (NCRTL, 1991: 67).

Other evidence supports the hypothesis that if information is presented in ways that make it easy to use, teachers will indeed use such knowledge in their practice. For example, Huberman (1993a) studied 12 research projects aiming to help vocational education programs. He found that the more researchers were in contact with the teachers whose practice they wanted to change and the more the researchers explained their findings in the terms of teachers' practice, the more research knowledge was used.

> When researchers essentially hand over a study to a set of practitioners, low levels of 'problem awareness' and low 'permeability to un-welcome findings' usually spell instant oblivion for the study, no matter how valid and well-packaged its findings…When, on the other hand, researcher teams remain active in the setting over time, and negotiate their presence carefully, we are likely to get an upward shift in the level of problem awareness and a far clearer sense of which findings are, in fact, discrepant with local objectives and mores (Huberman, 1993a: 47).

Finally, a survey of 1,027 teachers showed that they felt professional development activities were successful when they helped integrate new knowledge into the teachers' existing practice and provided extended time for teachers to work on and understand the ideas presented (Garet, Porter, Desimone, Birman, & Yoon, 2001), much like the qualities of the programs cited above (e.g., Grossman, 1990; Huberman, 1993a; NCRTL, 1991).

3.3.2   General conceptions or principles: teachers in general

Within educational research, studies also show that teachers find it difficult to acquire or use new conceptions of subject matter or teaching in their practice. Both Foss and Kleinsasser (1996) and Tillema (1998) surveyed novice elementary teachers' conceptions before and after a methods course. Neither study found changes in conceptions as a result of the course. Furthermore, Kennedy (1999) engaged 53 novice teachers in 4 different kinds of teacher education programs in a series of teacher-like tasks, for example commenting on a student paper. She found that "there is very little relationship between the ideas teachers mentioned as generally important in learning to organize a text and the ideas they saw as relevant when they examined this particular disorganized text" (Kennedy, 1999: 65). This led her to conclude "[t]here is also a strong likelihood that even if novices are persuaded by their faculty's ideas and are persuaded to adopt a different frame of reference to thinking about teaching, they will not know what actually to do to enact these new ideas" (Kennedy, 1999: 71).

Similarly, Borko and Niles (1982) gave 67 elementary school teachers a task involving sorting students into work groups. They also found that the teachers did not use their conceptions of what makes a good group in forming student groups. Hoffman and Kugle (1992) used a questionnaire to assess the teaching conceptions of 35 elementary school teachers. However, observations of their classes revealed no direct relation between the conceptions recorded in the questionnaire and the patterns of instruction in their classrooms. Phillips and Owens (1986) investigated the effects of an inservice teacher development course for a cohort of teachers from Indonesia. They found that despite the teachers accepting the validity of the conceptions presented in the course, they did not use them in their practice because these conceptions clashed with local values for educational practice. Lederman (1999) studied the extent to which two experienced and three novice science teachers used their conceptions of what science in planning lessons. His data showed that "neither of the two [experienced] teachers was intentionally attempting to teach in a manner consistent with their perceptions of the nature of science. Indeed, neither teacher had students' understandings of the nature of science as an instructional objective or specified as a goal" (Lederman, 1999: 923). In addition there was no evidence that the novice teachers used a concept of the nature of science to construct and carry out science lessons.

Duffy and Anderson (1984), in study of 24 elementary school teachers found that the main organizational influence on teachers' instruction was not their conceptions of subject matter or teaching, but the teaching materials that they had access to. Likewise, when Duffy and Roehler (1986) investigated the effect of an inservice course on reading instruction, they found that the teachers only used ideas from the course when they were being observed by the inservice course instructors. The NCRTL study reported on one teacher education program which did seem to have a significant effect on teachers' conceptions of subject matter and teaching. However, while "[t]eacher candidates in this program displayed dramatic changes in their conceptions of mathematics, of themselves, and of mathematics pedagogy. Still, intensive longitudinal case studies of students in this program revealed that they were nevertheless inclined to teach in more traditional ways in the classroom" (NCRTL, 1991: 29). Holt-Reynolds (1999) found that an English teacher did not use her personal knowledge of reading when thinking about or designing reading instruction.

There are a few studies, however, showing that in some circumstances transfer of conceptions to practice is possible. For example, two summer math programs for teachers were successful in changing elementary teachers' conceptions of math and math teaching in ways that these new conceptions were used to guide subsequent teaching. These programs differed from traditional teacher development programs in that (a) over 50% of the time was spent exploring what the general principles of the program meant in terms of each teacher's specific practices in their contexts and (b) teacher educators met periodically with these teachers over the course of a school year to help them implement the approach in their teaching (Carpenter, Fennema, Peterson, Chiang, & Loef, 1989; Fennema, Carpenter, Franke, Levi, Jacobs, & Empson, 1996; Schifter & Fosnot, 1993). Richardson, Anders, Tidwell and Lloyd (1991) found that the conceptions of the 39 elementary school teachers in their study often did not match their practices. However, in a follow-up study of one of these teachers, they found that over a year this teacher slowly changed her practice, showing that it is possible for conceptions to help develop practice. Unfortunately, there was only one teacher in this study, so it is unclear how common this phenomenon is.

Cohen's (1990) longitudinal study of one elementary teacher's development shows that academic theories can be used by teachers, but perhaps not in the ways that academics intended.

> The teacher used a new mathematics curriculum, but used it in a way that conveyed a sense of mathematics as a fixed body of right answers, rather than as a field of inquiry in which people figure out quantitative relations….Mrs. O was teaching for understanding. The work with number sentences certainly was calculated to help students see how addition worked, and to see that addition and subtraction were reversible…Yet it was difficult to understand how or how well they understood it, for the didactic form of the lesson inhibited explanation or exploration of student's ideas. Additionally, mathematical knowledge was treated in a traditional way…No answers were unpacked (Cohen, 1990: 313).

It is not just school teachers who experience difficulties in using their general conceptions for teaching. For example, Foss (1997) studied a university professor's teaching of a teaching methods class. Although the professor had well developed conceptions of what good teaching should be based on constructivism, she had great difficulties developing teaching activities that matched her conceptions and finally gave up and taught the class in a traditional manner despite her conceptions of what teaching needs to be like. Luneberg and Korthagen (2003) investigated the teaching of five Dutch teacher educators. They found that, for the most part, the teacher educators' teaching did not match their conceptions about what teaching should be like. For example, while they saw the construction of knowledge and mental models by teacher students as central to their teaching, none of them invested time in helping their own teacher students construct their own knowledge and mental models of the subject being studied. Finally, it is important to point out that it is not just teachers, but many kinds of university graduates, who find it difficult to use conceptual knowledge gained in university settings to solve new problems in different contexts (Gräsel, 1997a).

3.3.3 Summary

Research on teacher education in other subject matter areas shows that, just like SLTE programs, these programs suffer from a lack of transfer to actual teaching. Not only do teachers not seem to use knowledge gained from teacher education programs, but they do

not seem to regard that knowledge as important for their development as teachers. Similar to findings in LTE, it seems that it is only those aspects of teacher education which are very similar to teaching and those programs which actively focus their courses on future teaching which achieve some measure of transfer. Furthermore, many studies show that general principles do not guide teachers practice. Teachers of a variety of subjects as well as teacher educators seem to find it difficult to use general concepts in their teaching practice. The only situations where significant transfer was found were programs which focused not only on how teachers *talked about* teaching, but also on how they *actually performed* teaching and teaching-related tasks.

3.4 Knowledge transfer research

3.4.1   Knowledge transfer is difficult for everyone

Research looking at transfer between teacher education programs and the practice of teaching seldom refers to the research on general transfer of learning done within cognitive psychology. For several decades psychologists have been studying the phenomenon of knowledge transfer and their findings have been remarkable similar to research on teachers' knowledge transfer (or lack of it). Initial research used abstract, rather contrived tasks which were not part of everyday life. For example, Thorndike (1901) had participants in his study practice estimating the volume of rectangles. When they had become very accurate at this, he gave them other geometric forms such as triangles to work with, but the experience with the rectangles did not help them estimate the volume of these shapes. Asch (1969) gave participants lists of random number-letter pairs and asked them to memorize them. Later they received another list which contained some of the number-letter pairs from the first list and asked them to memorize this list. The results showed that having memorized a number-letter pair in the first list did not help participants memorize it in the second list. Puzzle stories have also been used to test transfer. For example, in the classic Duncker radiation problem (Duncker, 1945) participants are told that a patient has an inoperable brain tumor. However, the ray that can destroy the tumor would also destroy all the healthy tissue it passes through. At the intensity that would not harm surrounding tissue, the ray would not kill the tumor. The solution is to send several beams of the ray at low levels from different parts of the body so that they all converge at the tumor. Individual beams would not be intense enough to kill the tissue they pass through, but they unite at the tumor where together they are intense enough to kill it. After hearing this story, participants are given another such story, such as a general who wants to attach an enemy holed up in a fortress. There are several roads to the fortress but none that will take the amount of troops needed to take the fortress. (The answer is to divide the troops needed to attack the fortress into groups small enough to travel on each road and send each on a different road, but have them converge on the fortress at the same time.) Studies show that people find it very difficult to use one such puzzle story to solve another (Gick & Holyoak, 1980, 1983; Perfetto, Bransford & Franks, 1983; Reed, Ernst & Banerji, 1974).

Research on transfer of knowledge and conceptions in contextualized tasks also shows that humans just are not very good at transferring knowledge from one context or activity to another. Wicker (1969) reviews a number of studies, all of which show that attitudes or conceptions do not determine people's actions. For example, attitudes towards cheating on exams were not related to actual cheating, but rather on how well the student had prepared for the exam. Haag and Stern (2003) investigated whether learning Latin

would help students learn Spanish, as is commonly suspected as these languages are very similar. They found, however, that students who had studied French (which, while it did develop from Latin, is not as similar to Latin as Spanish) learned more Latin than those who had learned Spanish. Lave (1988) studied housewives' math abilities in supermarkets and with similar problems on school-like, paper and pen tests. She found that although the housewives were very good at supermarket problems, for example, comparing the prices per unit of two products of different sizes, they did very poorly with the same kinds of problems, for example comparing fractions, on school-like math tests.

Other evidence for the difficulties of transfer comes from studies of learning in science courses. Trowbridge and McDermott (1981) looked at the learning of 400 students who had taken a semester-long university physics course. They found that even after a university course, at least a third of the students had not been able to translate the experience of the course to solid knowledge of physics, for example by confusing the scientific concepts of velocity and acceleration with everyday conceptions. Halloun and Hestenes (1985a) developed a multiple-choice questionnaire which elicited participants' conceptions of motion and acceleration. They found that physics courses did not help students create accurate and consistent conceptions about physics. Forty-nine high school students scored barely higher than random (30%) after a year of physics. Of the 478 college students tested, a course in physics only raised their score from 51% to 65%.

3.4.2   Resistance to new knowledge

Much of the transfer research also shows that humans often ignore knowledge which conflicts with their own conceptions. Clement (1982) looked at 150 university students who had taken a physics class. He found that the physics course had not enabled most of them to form a basic qualitative model of how forces affect motion. While 11% could solve a typical problem before the course, only 23% could successfully solve the problem after the course. In fact, when studying an additional cohort of engineers who had taken a minimum of two university physics courses Clement found that they only managed to solve 35% of the problems. More vexing, however, was what the qualitative data revealed about the unwillingness of students to integrate new knowledge. "Newtonian ideas are simply misconceived or distorted by students as to fit their existing preconceptions; or they may be memorized separately as formulas with little or no connection to fundamental qualitative concepts" (Clement, 1982: 70).

In a follow up study, Halloun and Hestenes (1985b) collected qualitative data on students learning and solving of physics problems. They found that the students did know the content of the physics course, but could not use this to solve physics problems. "Most of the interviewed students…could enunciate Newton's laws on request, but usually they were unable to see how the laws applied to a particular question" (Halloun & Hestenes, 1985b: 1059). They also found that physical demonstrations were no better than abstract explanation in helping students use knowledge in problem-solving.

> During interviews with several of the students, typical classroom demonstrations were given of the physical situations described in a few of the tasks on the diagnostic test. The demonstrations appeared to have no more effect on their opinions than mere discussion of the phenomena…Careful interviews of students who have just witnessed a demonstration are enough to make one dubious about the effectiveness of typical

classroom physics demonstrations in altering mistaken physical beliefs (Halloun & Hestenes, 1985b: 1058-59).

Similar to Clement's (1982) study, they found that students typically ignored physics knowledge that conflicted with their folk conceptions of motion and force.

> As a rule, students held firm to mistaken beliefs even when confronted with phenomena that contradicted those beliefs. When a contradiction was recognized or pointed out, they tended at first not to question their own beliefs, but to argue that the observed instance was governed by some other law or principle and the principle that they were using applied to a slightly different case (Halloun & Hestenes, 1985b: 1058-59).

Reif and Allen (1992) also found that the five physics students in their study did not attempt to integrate physics knowledge into their conceptions of force and motion, and that this was a major reason for their difficulties in solving physics problems.

> Students often invoked knowledge elements that they themselves recognized to be mutually inconsistent...they were lead to such paradoxes in almost 25% of the problems in Test A... These paradoxes were frequently due to students' invocation of erroneous case-specific knowledge and to their failure to make appropriate discriminations…It was striking that students did not try to resolve their paradoxes by trying to make inferences from more general knowledge, such as the definition of acceleration. Instead, they appeared to resolve them rather arbitrarily on the basis of what seemed more plausible to them... As might be expected, such ad hoc attempts at resolving encountered paradoxes were unlikely to lead to correct answers (Reif & Allen, 1992: 24-25).

This resistance to integrating scientific knowledge into personal conceptions is not just relegated to physics students. For example, Haller and Krauss (2002) created a multiple choice questionnaire which tested common misinterpretations of statistical research. Not only did 90% of the 39 psychology professors tested make at least one mistake, but 80% of the 30 statistics professors made at least one mistake, showing that even those proficient in a field may still maintain problematic conceptions of that field. Chinn and Brewer (1998) designed a series of experiments where participants first read about and had to explain one point of view on a certain issue (for example, if dinosaurs were cold or warm blooded). Afterwards they were presented with evidence that contradicted what they had read and asked how this evidence fit in with their view on the question. Participants generally invented reasons for ignoring the evidence rather than integrating it into their conception of the issue. Chinn and Brewer concluded that "the results…support our prediction that most people deny casual, impossible causal, and analogical links by proposing relevant causal factors…When participants could not adduce specific causes, they were often willing to deny a link by asserting that a nonspecific alternative cause might exist" (Chinn & Brewer, 1998: 366).

According to Chinn and Brewer (1993) there are seven ways which people react to information which contradicts their conceptions, (1) ignore the information, (2) reject the information, (3) exclude the information from own conceptions, (4) hold the information in abeyance, (4) reinterpret the information while retaining previous conceptions, (6) reinterpret the information and making peripheral changes to own conceptions, or (7) accepting information and changing own conceptions. As we have seen from the studies above, humans often fully utilize the first six possibilities before they accept new information and attempt to integrate it into their own conceptions. Chinn and Samarapungavan (2001) say that it is important to make a distinction between whether

someone understands an idea and whether someone actually believes in that idea. They cite other research to show that "students frequently do not believe what they are learning in school, in science, and in other classes" (Chinn and Samarapungavan, 2001: 235). One reason for the lack of transfer for teachers might be that they simply do not believe what they learn about language and language learning and do not integrate such ideas into those conceptions of language and learning that they use to design and carry out instruction. Therefore, ability to write solid papers and pass exams on these subjects cannot be taken as evidence that this knowledge has become part of their knowledge base for teaching.

Given that resistance to new knowledge which challenges previous conceptions seems to be a common trait for all people (not just teachers), the widespread resistance of L2 teachers to much of what they learn in SLTE programs should not be surprising. Despite this, these findings do contradict our visions of ourselves as rational people open to, and desirous of, new and more accurate knowledge. Given that all humans seem to share these problems, it is likely that this has something to do with general human cognitive constraints.

3.4.3   Near and far transfer

Not all transfer seems to be difficult; Detterman (1993) distinguishes between near and far transfer. Near transfer refers to situations where how something is learned and how it is used are "identical except for a few important differences" (Detterman, 1993: 4). The summer Math programs for elementary teachers (e.g., Carpenter, Fennema, Peterson, Chiang, & Loef, 1989; Schifter & Fosnot, 1993) would be an example of near transfer because the courses focused primarily on how to use knowledge of math for teaching in their particular contexts. Far transfer refers to situations where the learning task and the transfer task are significantly different. An example of far transfer would be reading an academic research study on some aspect of SLA and then trying to use this for teaching, since reading an article and teaching are two very different activities. Detterman argues that while near transfer is relatively common, far transfer is rare: "there is no compelling evidence that far transfer occurs spontaneously" (Detterman, 1993: 18). For example, Reed, Dempster and Ettinger (1985) looked at 48 students solving algebra word problems. The students practiced with the same problem and then were given either an equivalent problem (i.e., a problem where they can use the same basic formula to solve) or a problem that was only similar (i.e., a problem which requires them to reorganize the formula to solve the problem). For example, for the problem "Sam can type a manuscript in 10 hr, and Mark can type it in 5 hr. How long will it take them together?" an equivalent problem would be "Ann can mow a lawn in 20 min, while Mary can mow the same lawn in 30 min. How long will it take them to mow the lawn if they both work together?" and an equivalent problem would be "A carpenter can build a fence in 3 hr. but his apprentice needs 6 hr. to do the same job. When they work together to build the fence, the apprentice works 2 hr. more than the carpenter. How long does each work?" It was found that students were generally able to solve the equivalent word problems (near transfer), but if the practice problems were similar but not the same, practice did not significantly help solving the word problem (far transfer).

Studies of doctors also show the ease of spontaneous near transfer. For example, Brooks and his colleagues used 3 experiments to investigate doctors' diagnosis of skin problems. They found that "diagnosis of skin disorders by medical residents and general

practitioners was facilitated by similar cases previously seen in the same context" (Brooks, Norman & Allen, 1991: 278). A study by Patel, Groen and Norman (1993) provides more evidence of near transfer. All seven cardiologists in their study were at least partially successful in diagnosing a cardiology case (four completely correct, three partially), the six surgeons in the study were not as successful (one completely correct, six partially correct), but none of the psychiatrists (who had received full medical training) were able to come up with even a partially correct diagnosis. In a further experiment, the problem-solving methods of practicing doctors and researchers in the same area of medicine were examined. When solving a medical diagnosis task, each used the problem-solving methods used in their practice (much like Bassok's algebra students). The practitioners found a diagnosis by ruling out alternatives while the researchers tried to build an extensive picture of all the factors involved in the case (Patel & Groen & Norman, 1993).

Holyoak and Koh (1987) argue that both the surface and the structural similarity between practice and target activities are important. Surface similarity refers to the extent to which activates appear to be similar during a quick first impression. Activities would have structural similarity if the same fundamental processes are used to participate in the activates. Holyoak and Koh used the Duncker radiation problem mentioned above and fashioned four analogous stories about repairing a special kind of light bulb. In the story, either parts of the filament have become fused and need to be broken apart (structurally similar) or the filament needs to be fused (structurally different). In one story, ultrasound is used to break up or fuse (surface similarity) and, in another, lasers are used (surface difference). They found that participants who had the puzzle stories with high surface and structural similarity had little problem-solving the problem (69%). Those whose stories either structural similarity/surface dissimilarity (38%) or surface similarities/structural dissimilarity (33%) were still much better than those whose stories had both structural and surface dissimilarity (13%). Other research using such puzzle stories have produced similar findings (Lockhart, Lamon & Gick, 1988; Ross, 1989; Krauss & Wang, 2003).

In more contextualized tasks, surface and structural similarity of the practice task to the target task have also shown to be helpful. Chi, Slotta and de Leeuw, (1994) show how conceptual change in biology and physics happens more easily if new knowledge conceptualizes the object of study in a similar fashion to how the person already conceives of it. Thus, it is much more difficult to understand information about acceleration as a process if it is conceived as a thing rather than a process. Wineburg (1998) studied two history professors, only one of which was an expert on US Civil War history. They were asked to analyze and interpret a series of documents related to the Civil War. The professor with expertise in that era had framework for analyzing the documents before he began the process. The other professor had no such framework, but was able to construct one, perhaps because he used the same process in doing work in his own area (i.e., the process was near transfer). Using math problems, Novick (1988) looked at the effects of expertise (high or low math scores on SAT) and surface and structural similarity together. Students practiced a short set of math problems and then had to solve other math problems that either contained some combination of surface and structural similarity or none. Novick found that math novices benefited most from surface similarity while experts benefited most from structural similarity between the practice and test problems.

3.4.4   Experiential vs. theoretical knowledge or near vs. far transfer?

The issue of near vs. far transfer is important because this distinction is often confused with other issues, which makes addressing the problem of transfer more difficult. For example, conceptual knowledge is often contrasted with "experiential" knowledge (Hawkins & Irujo, 2004), although the terms vary. For example, Ellis (1997) contrasts *technical* with *practical* knowledge, Wallace (1991) compares *received* with *experiential* knowledge, and Freeman and Johnson (1998) contrast *academic* with *experiential* knowledge. Studies have shown that teachers primarily use experiential knowledge in teaching (Caspari, 2003; Schocker-von Ditfurth, 2001), and, therefore, are primarily interested in this type of knowledge. "SLA, as an academic discipline, is concerned with the production of technical knowledge, whereas language pedagogy, as a profession, is primarily directed at practical knowledge" (Ellis, 1997: 237). The tension between these types of knowledge is considered one of the principal problems in teacher education: "the distinction between technical knowledge and practical knowledge lies at the heart of the problem of the relationship between SLA and language pedagogy" (Ellis, 1997: 7).

However, there is a fundamental problem underlying this purported distinction. Listening to a lecture, engaging in research or thinking about academic ideas, each of which is a processes thought to engender technical or academic knowledge rather than experiential knowledge, are experiences just as observing a class or student teaching. Consider the following description of what teachers and academics do:

> while teachers must constantly struggle throughout their work day to find ways to meet student needs, motivate students to learn, and develop a curriculum that fits grade level requirements, academics, at best, do this sort of work for only part of the day. The rest of their work is likely to involve developing an understanding of educational issues, reviewing literature on a particular subject, writing up reports and research papers, and conversing with other academics about methodological issues and design questions (Gitlin & Burbank, 2000: 5-6).

Reviewing literature, writing papers and talking with other academics are experiences that will give rise to knowledge, as are reviewing new teaching materials, preparing lesson plans and talking with other teachers. In fact, it is relatively easy to apply Kolb's (1984) model of experiential learning, which includes the stages of (a) concrete experience, (b) observation and reflection, (c) forming abstract concepts, and (d) testing these in new situations , to such experiences. Take, for instance, the experience of an MA TESOL student reading a textbook chapter on phrase structure rules. The concrete experience of actually reading the words in the chapter is not enough to form solid knowledge in the subject. (I speak from experience when I report that it is perfectly possible to read all the words of a chapter and still have no idea what it is about.) After step (a), reading the chapter (or, realistically, parts of it), the teacher student can look back at what was read and reflect on what the main points are, what they think the teacher wanted them to learn, and what the teacher will expect them to be able to do to show they read the chapter, step (b). This will probably take a bit of rereading and looking at the examples, but it will hopefully give rise to some abstract concepts answering those questions, step (c). The teacher student then tests these concepts in the next class by observing whether the teacher focuses on the issues that they had predicted, if they can do the tasks the teacher sets (regardless of whether they actually raise their hand and offer to do this, as this can be done silently). They then bring the knowledge of

this whole cycle to bear on the next concrete experience, step (a) again, when reading the next assigned chapter.

Some may counter this argument by defining experiential knowledge as knowledge gained directly from the five senses without any higher cognition involved (e.g. Brookfield, 1983). Thus, experiential knowledge would be the result of "education that occurs as a direct participation in the events of life" (Houle, 1980: 221). This conception envisions a clear separation between the input from our senses and knowledge arising from using a theoretical idea when observing student actions, from seeking or reading empirical data or from thinking about something, even though these are all things that can be experienced (Jarvis, 1995; Weimer, 2001). Experiential knowledge, it has been postulated, comes from "direct encounters with the phenomena being studied rather than merely thinking about the encounter, or only considering the possibility of doing something about it" (Borzak 1981: 9).

The problem with this argument is that it is an inaccurate picture of how humans take in and process information. We do not record the reports of our senses like a videotape, analyze them in a subsequent operation, and then review them at leisure (LeDoux, 1996). For instance, even experiential knowledge, such as memories, is just as much a product of our conceptions and cognitions as is data directly from our senses. "Explicit memories, regardless of their emotional implications, are not carbon copies of the experiences that created them. They are reconstructions at the time of recall, and the state of the brain at the time of recall can influence the way in which the withdrawn memory is remembered" (Christianson, 1992a: 210). People's recollections of pivotal events change through time as they use different conceptions and cognitions when reconstructing their memories (Christianson, 1992b; Loftus, 1993; Loftus & Hoffman, 1989; Neisser & Harsch, 1992).

Instead, the information from our senses activates similar knowledge which is then used to construct interpretations of what the senses report (Berliner, 1994; Ericsson, 1996; Glaser, 1986). Our conceptions also effect how we perceive objects and situations (LeDoux, 1996). For example, in one study participants were given several identical stockings although they were told that each pair was different. Their task was to choose the one they liked the best and explain why. All the participants not only were able to choose one pair of stockings, but also offered reasons for their choice even though the stockings were identical. In other words, their conceptions of the situation affected the information they received from their senses (Nisbett & Wilson, 1977). Thus, there is no real separation between our senses, our conceptions, and our cognition, and, therefore, all knowledge can be considered "experiential".

I would suggest that instead of experiential vs. conceptual knowledge the real issue here is *near* vs. *far transfer*. It appears that what is called "experiential knowledge" arises from experiencing something very similar to what you will do later (like student teaching) while "conceptual/technical/received/academic knowledge" refers to the product of experiencing something different from what you would do later (like diagramming sentences unlikely to occur in a language classroom). For a language teacher, the first situation would require only near transfer to be used (since the two situations are very similar) while the second would require far transfer (since reading academic works is very different from language teaching). However, for someone who is interested in becoming a researcher in theoretical linguistics it would be the opposite. For

them diagramming sentences not normally used in classrooms would result in "experiential" knowledge (because it is similar to what they want to do later on), while student teaching would not. Since near transfer is generally much more successful than far transfer, the basic conflict here is exposing novice teachers to educational experiences that require far transfer vs. those that require only near transfer. In other words, when people call for more "experiential knowledge" they are calling for teacher education experiences which would only require near transfer to the practice of teaching.

Furthermore, the distinction between experiential knowledge and conceptual knowledge does not hold up to scrutiny. To begin, perception (e.g., what should lead to "experiential" knowledge) and processing (e.g., what should lead to "conceptual" knowledge) of information are not two separate process, rather humans construct their perceptions by combining input from the senses with previous knowledge all in one process. Furthermore, engaging in the learning of academic or theoretical knowledge is an experience itself and, therefore, would result in "experiential knowledge". The main question is what sort of learning experiences novice teachers are exposed to in teacher education programs, rather than whether learning is "experiential" or not. Learning experiences in SLTE programs (whether this is classroom experiences, doing homework, meeting with professors, etc.) which are similar to classroom teaching (and hence are usually labeled "experiential" learning) such as creating lesson plans, engaging in micro- or student teaching, evaluating tests for specific cases, and so on, are likely to result in near transfer. SLTE experiences which are dissimilar to classroom teaching (which are usually labeled "academic" or "theoretical" learning), for example writing papers or discussing academic theories, would require far transfer and, thus, would be less likely to produce actual transfer to language teaching.

3.4.5 Summary

It is not only teachers who have difficulty transferring knowledge. The evidence presented above shows that knowledge transfer is much more difficult than has been portrayed in the SLTE literature. In addition, people often resist integrating new knowledge into their knowledge base if the new knowledge contradicts previous knowledge. Knowledge transfer does seem to be possible, but this occurs principally when the activities where the knowledge is acquired share surface and structural similarity with the activities where the knowledge is to be used (near transfer). Thus, one possible reason novice teachers have difficulties using academic knowledge in teaching is that there is little similarity between academic work and the work of teachers.

> We know that changes in teacher belief are generally not effected by reading and applying the findings of educational research…Instead, teachers appear to obtain most of their ideas from actual practice, primarily from their own and then from the practice of fellow teachers…After entering service, teachers continue to solve instructional problems largely by relying on their own beliefs and experiences (Kagan, 1992a: 75).

This can also explain why teacher education seems to be able to change teachers' conceptions but not necessarily their practices. In teacher education, teachers do a lot of talking and writing about concepts. Talking about ideas and evidence is not a neutral, but a specific, situated activity, and by practicing this everyday in teacher education programs, novice teachers gain proficiency *in this practice* (although not necessarily in the practice of teaching). Thus, assessing the extent to which teachers use academic knowledge in *talking about* teaching (in general) is a test of near transfer (which is

relatively easy), while assessing whether they *use these for teaching* is a test of far transfer (which is difficult). This would mean that apprenticing novice teachers into the practices of academics (Bartels, 2004) would produce little transfer to teaching because it would require far transfer. From this perspective, then, such findings about teacher learning are not surprising at all.

3.5 Conclusion

This chapter has presented a wide range of research showing that knowledge transfer is not as simple or unproblematic as assumed by academic-oriented conceptions of SLTE. The studies here present significant evidence that the four hypotheses underlying such conceptions of SLTE are inaccurate. First of all, teachers (and other people) have difficulty using or can not use explicit academic knowledge in complex, situated activities such as teaching. Second, studies showed that general conceptions or principles do not guide teachers' practice and that changing teachers' conceptions does not result in parallel changes in those teachers' practice. Third, local factors and knowledge specific to the teaching context play a major role in teacher cognition, which contradicts the hypothesis that academic knowledge is or can be the knowledge base for teachers. Finally, even when teachers explicitly recognized that they wished to change their teaching, they were unable to do so. This data indicates that the most significant impact SLTE programs have on teachers is the growth of *inert knowledge* (Whitehead, 1924), meaning "knowledge that can be recalled when explicitly asked to do so, but is not used spontaneously in problem-solving *even though it is relevant*" (Johnson, 1996b: 24) [emphasis added]. The evidence for these conclusions is very solid as supporting data was collected in both naturalistic and laboratory conditions with not only general participants, but also with L2 teachers and teachers of other subjects.

Therefore, a new conception of cognition is needed which can explain issues such as (a) why it is difficult to use explicit knowledge or general principles for language teaching, (b) why far transfer is so difficult, (c) why both surface and structural similarity between learning and target activities are important, and (d) what SLTE programs can do to help teachers acquire transferable knowledge. The next chapter will begin to explain a new construct of cognition; beginning with the fundamental constraint on human cognition and one of the ways humans have of overcoming this problem.

Chapter 4: The Cognitive Bottleneck and Implicit Knowledge

Human cognition is not unlimited; there are some important constraints on the kinds of cognitive operations we can engage in. A central constraint is the limited amount of information that can be explicitly processed at any one time in working memory; what Bruer (1993) refers to as the "Cognitive Bottleneck". Because of this bottleneck, knowledge which needs to be explicitly processed, such as declarative knowledge, is very inefficient. On the other hand, implicit knowledge, which is largely processed outside of working memory, is cognitively efficient. Studies of experts have shown that they are able to perform better than others because they use their implicit knowledge to recognize important cues as well as actions which have good chances of achieving their objectives in that specific situation. A possible reason for the lack of transfer of knowledge from SLTE programs to language teaching is that teachers do not acquire enough implicit knowledge about teaching in SLTE programs. Therefore, it is suggested that SLTE programs need to focus on helping teachers acquire implicit knowledge for teaching. Implicit knowledge is acquired by participating in activities you want to gain facility in. However, such knowledge is specific to the activity: practicing diagramming sentences results in implicit knowledge about diagramming sentences, not in providing understandable grammatical explanations to students. This reinforces the finding from transfer research of the importance of similarity between SLTE activities and activities that L2 teachers engage in.

4.1 Transfer and the cognitive bottleneck

Most folk theories of cognition, like those put forth by applied linguists in reference to teacher learning, assume that the best form of cognition is that which explicitly works through the evidence, builds the most accurate model of the situation, and consciously works out the best course of action. The problem with such views of human cognition is that this would demand huge amounts of a resource that is in short supply: processing capacity in working memory. In order to explicitly think about something, we need to do that in working memory (LeDoux, 1996). However, humans can only process 7 ± 2 items at a time in working memory (Miller, 1956). Thus, while the human brain is a very versatile and powerful instrument, it is very limited in terms of explicit processing. Bruer (1993) calls this the *cognitive bottleneck* and it is one of the key constraints on human cognition.

The cognitive bottleneck has far reaching consequences for human cognition. For one, it means that we humans maximize our explicit cognition by reducing the amount of information we process explicitly. For example, an important part of expertise is knowing what information to attend to and what to ignore (Haider & Frensch, 1996, 1999); experts are not those who consider more factors (which would require a high cognitive load) but rather those who know which factors they do not have to think about, thus reducing the amount of information they explicitly process. One example of this is the cognitive strategies of market vendors in Brazil to reduce their calculating load during transactions. "In the Brazilian market prices change rapidly. In general, market sellers keep the prices in round units and change the quantities of produce at a given price. So unit prices remain relatively stable and easy to calculate" (Lave, 1988: 68).

According to Salthouse (1991) people develop expert knowledge precisely to circumvent human limitations such as the cognitive bottleneck. The human brain provides a variety of cognitive systems, only a minority of which use working memory, meaning that the rest can be exploited to maximize cognitive potential (LeDoux, 1996).

Laboratory analyses of expert performance in many domains such as chess, medicine, auditing, computer programming, bridge, physics, sports, typing, juggling, dance, and music reveal maximal adaptations of experts to domain-specific constraints…Acquired anticipatory skills circumvent general limits on reaction time, and distinctive memory skills allow a domain-specific expansion of working memory capacity to support planning, reasoning, and evaluation (Ericcson & Lehman, 1996: 273).

An example of this is provided by a study by Grabner, Stern and Neubauer (2003) on the relation between cognitive activity, IQ, and expertise. Taxi drivers were asked (a) to memorize a made-up city map, (b) think about possible routes in that fictional city (a task where they had little expertise), and (c) think about common routes in their own city (where they possessed expertise). They found that when the taxi drivers were thinking about the routes where they had little expertise, those with low IQs produced far more brain activity than those with a higher IQ. However, when thinking about routes where they had expertise, there was no difference in brain activity, suggesting that expertise reduces the amount of cognitive processing. As Camerer and Johnson summarized: "information processing is lest costly for experts than for novices...their memory allows more efficient encoding of task-specific information" (Camerer & Johnson, 1991: 204).

In other words, part of developing expertise in a particular activity (like teaching) is the development of those kinds of knowledge which generally do not need to be processed in working memory and, thus, requires little of our scarce explicit cognitive processing capacity. Such knowledge would not be hampered by the cognitive bottleneck, allowing for more efficient and more sophisticated action. The purpose of this chapter is to explore those types of knowledge which can do this.

The concept of the cognitive bottleneck helps explain why humans find near transfer relatively easy but have great difficulty with far transfer. With near transfer there are only a few factors that need to be calculated to see how one situation or experience is useful for a second situation. With far transfer, however, it is possible that the amount of cognitive processing needed to work out all the possible similarities and differences exceeds the amount of processing capacity we are willing to invest given the importance of the activity. Therefore, working out how to access L2 students' knowledge of English articles by explicitly calling on academic knowledge and theories may be *impractical and inefficient* because it requires far more working memory than is available for the task, given the constraints on time that teachers normally face.

Furthermore, the cognitive bottleneck might also explain why people resist information that challenges their conceptions rather that change their conceptions. It is possible that such a reorganization of concepts would require such large amounts of cognitive processing that it is actually more efficient to ignore contradictory information until it is absolutely certain that such reorganization is necessary and that it will have some positive effect on cognitive processing. Thus, any argument that teachers need to know certain findings about language or language acquisition would not only have to show that these findings were true, but also that the benefits of this knowledge would exceed the cost of integrating it into teachers' personal knowledge bases. Strange as it may seem, in some cases it may make more sense for teachers to continue with incorrect concepts than to integrate new ones.

The human brain is a remarkable cognitive machine but its abilities are not limitless. The most significant constraint on human cognition is the extremely limited explicit processing capacity in working memory. This means that part of expertise is minimizing the amount of explicit cognition to engage in a particular practice. Studies have shown indeed that experts think less than novices in most circumstances, but their thoughts are better quality. Thus, expertise requires knowledge which is not primarily processed in working memory.

4.2 Implicit knowledge

4.2.1   Cognition based on implicit cognition

Traditionally it is explicit, declarative knowledge which teacher educators have focused on in teacher education (Borg, 2003b; Wallace, 1991). For example, Fillmore and Snow claim that "[t]eachers *need to know* that spoken language is composed of units of different sizes: sounds…morphemes…words…phrases…sentences, and discourses" (Fillmore & Snow, 2002: 20) [Emphasis added]. This stems from views of cognition which stress the superiority of explicitly worked out ideas regardless of the situation. "The view of persona and human action which has long dominated Western culture is…that intelligent action requires deliberate thought" (Tomlinson, 1999a: 405). In some ways this is hardly surprising as one of academics main jobs is the production of explicit knowledge (Bartels, 2003; Becher & Trowler, 2001), thus they are simply assuming that the products of their labor are important enough for teachers (Bartels, 2004). This means that despite its importance, tacit knowledge has little status in many institutions. "Although tacit knowledge is important to success, organizations often give no recognition to it" (Sternberg, 1999: 232). One reason organizations tend to favor explicit knowledge is that it is only when ideas are made explicit that they can be clearly debated and empirically investigated.

However, different kinds of cognition each have different advantages and disadvantages. According to Tomlinson, implicit knowledge can be processed much quicker than explicit knowledge as it does not require working memory capacity: "humans have two major forms of information-processing: (i) a conscious serial mode that is deliberately focused and flexible, but also relatively slow and severely limited in capacity and (ii) a tacit parallel mode which is a very fast processor of much information simultaneously, but which is relatively inflexible and not open to direct access or control" (Tomlinson, 1999a: 415). Tomlinson (1999a) points out that declarative knowledge (knowing about something) can also be implicit. For example, you may notice that something is odd or wrong about an object or a situation, but not be able to explicitly say what that is. Furthermore, most knowledge likely consists of a mixture of knowing how and knowing about. In an MA exam on SLA one not only needs to know facts, models and research results; one also needs to know how to talk about them in ways that are seen as legitimate in the SLA community (Wright & Bolitho, 1997; Hedgcock, 2002; Kramsch, 2005; Ramanathan, 2002). Knowing also combines both explicit and implicit knowledge, rather than just one. For example, "explicit cognitive processes involve implicit processes embedded within them" (Tomlinson, 1999a: 13). Therefore, Tomlinson suggests that instead of thinking in dualist terms of declarative vs. procedural or implicit vs. explicit, we should think of knowledge in terms of two continuums. One continuum would range from "capacity for action" (i.e. being able to do things) to "awareness of

reality". The second continuum would track "the level of consciousness at which the knowledge is held": the explicit to implicit continuum (Tomlinson, 1999a: 416).

Many claim that implicit knowledge is what teachers use when engaged in their practice (Eraut, 2000a, 2000b; Furlong, 2000). "The knowledge embedded in expert systems is largely informal knowledge" (Bereiter & Scardamalia, 1993: 52-3). According to Schön "the workaday life of the professional depends on tacit knowing-in-action" (Schön, 1983: 49). Research on cognition and the brain supports the idea that most cognition (even academics) is implicit. "Consciousness and its sidekick, natural language, are new kids on the evolutionary block – unconscious processing is the rule rather than the exception throughout evolution. And the coin of the evolutionarily old unconscious mental realm is nonverbal processing" (LeDoux, 1996: 71). First of all, practitioners often find it difficult to explain what they do, which is often a sign of implicit knowledge (Bartels, 1999; Bereiter & Scardamalia, 1993; Schön, 1983). Furthermore, implicit knowledge, unlike explicit knowledge, would not need to be processed in working memory, so relying on knowledge that is mainly implicit would relieve the pressure on the "cognitive bottleneck" and allow teachers to process more knowledge more quickly. This is especially important for teachers because "the number and complexity of professional decisions made every working day by teachers…is such that they cannot be explained only in terms of the conscious application of specific, taught 'skills'" (Wallace, 1991: 50).

It has been shown that implicit knowledge can guide the participation in complex tasks. For example, Klayman (1988) had participants look at a computer screen with a few geometrical shapes on it. A straight line would begin from various points in the screen and participants would have to judge where the line would end. As with the artificial grammar experiments, participants became relatively accurate at predicting the endpoint of the lines, but could not explain how they knew where the line would end. Lewicki and his colleagues produced the same findings with similar tasks (Lewicki, 1985, 1986a, 1986b; Lewicki, Czyzewska, & Hoffman, 1987; Lewicki, Hill, & Bizot, 1988).

More everyday tasks were used by Berry and Broadbent in a series of studies (Berry & Broadbent, 1984, 1988, 1990). For example, participants learned to estimate the sugar production of a factory depending on the number of factory workers or to decide how to figure out which factory was polluting a river while keeping the number of tests for pollutants to a minimum. In each case there was a rule which depended on several factors to be learned. As in the other studies, Berry and Broadbent found that their participants learned the rules, but could not articulate them. In a study of 39 second graders, Siegler and Stern (1998) found that 90% of the students showed an implicit understanding of inversion problems (by solving math problems) before being able to explain their solutions. While these students were able to eventually explain their problem-solving, this came after they had developed proficiency in solving those types of problems, indicating that implicit knowledge was used for problem-solving and explicit knowledge was more used for explanations after the fact. This has led some to conclude that the use of explicit knowledge is used more for constructing explanations of one's actions than in carrying out the actions themselves (Camerer & Johnson, 1991).

This is not to say that implicit knowledge cannot be faulty or highly problematic for teachers. "Preservice and inservice teachers can be strongly influenced by intuitions, myths, and folk theories, which at times coincide with well-informed views and which at

others fly in the face of axiomatic principles widely held among LT professionals" (Hedgcock, 2002: 302). For example, some teachers implicitly decide that students with a different socioeconomic background than themselves will do poorer academically, regardless of actual skill or academic achievement (Hauser-Cram, Sirin & Stipek, 2003). Therefore, it has been proposed that acquiring implicit knowledge should be accompanied by processes which help make such knowledge explicit in order to examine it and compare it to more rigorous knowledge (Freeman, 1991a; Torff, 1999). However useful explicit knowledge may for developing, examining and influencing implicit knowledge, this should not obscure the fact that ultimately it will be mainly implicit knowledge that teachers will use in teaching and, therefore, it is the ultimate growth of implicit knowledge, not explicit knowledge, which should primarily be the ultimate goal of teacher education and teacher development. This means that implicit knowledge should be a major focus in teacher education programs. "[T]he main case I want to make here is for taking implicit learning much more seriously in teacher preparation, not just passively, but by seeking to harness such features as the 'exquisite sensitivity' connectionist studies point to in human awareness" (Tomlinson, 1999b: 534).

SLTE programs, like most higher education programs, focus primarily on the development of explicit knowledge, especially that of academic disciplines. However, there is mounting evidence that people rely principally on their implicit knowledge, not explicit, in guiding their actions. Implicit knowledge is vital to professional performance because it requires little of scarce explicit working memory processing capacity and, thus, allows us to avoid the cognitive bottleneck. This does not mean, however, that all implicit knowledge is helpful. It is important to help teachers make their implicit knowledge explicit so that this can be analyzed and evaluated. However, this can only be done if SLTE programs focus on personal, implicit knowledge rather than discipline-based explicit knowledge.

In addition, humans are adept at using implicit knowledge for learning and reasoning, areas which were once thought to be exclusively controlled by explicit knowledge. For example, Lewicki and his colleagues found that if people start categorizing something according to an implicit rule, they will categorize subsequent information the same way regardless of whether the categorization really fits or not. For example, in one experiment they showed participants slides of brain scans. Certain features in half the brain scans were shown darker, but to an almost unnoticeable extent. (The participants reported not seeing these markings.) The marked brains were given as examples of "intelligent" brains and the others as examples of "unintelligent brains. Subsequently, the participants rated brains with the markings as more intelligent than non-marked brains, even though they received no further feedback that these brains were really more intelligent (Hill, Lewicki, Czyzewska, & Boss, 1989; Lewicki, Hill, & Sasaki, 1989). Furthermore, Lewicki was also able to show that such implicit learning is not limited to noticing patterns, but also applied to reasoning. In a series of experiments participants were shown pictures of an actor engaging in everyday activities (opening a jar, drinking from a can, etc.) except the video was processed so that all they saw were lines and dots written on the actors' arms and legs. In a pattern somewhat similar to figuring out that if "a=b and b=c then a=c", participants first learned that if there was a large distance between the stripes on the actor but the dots were small, then this was a likeable person. Then they learned that if the distance between the stripes was small and there were no dots, then the person was likeable. On subsequent trials they tended to rate the pattern of no stripes and large dots as likeable, even though they had not been trained to notice this.

When asked, none of the participants had explicitly noticed any of these patterns, but still clearly rated pictures according to these rules (Lewicki, Hill, & Czyzeska, 1994).

4.2.2 Schemata

A schema is a key type of implicit knowledge. Rumelhart defines schemata (the plural form of schema) thus:

> According to schema theories, all knowledge is packaged into units. These units are the schema. Embedded in these packets of knowledge is, in addition to the knowledge itself, information about how this knowledge is to be used…There are schemata representing our knowledge about all concepts: those underlying objects, situations, events, sequences of events, actions and sequences of actions (Rumelhart, 1980: 34).

These knowledge packages are very useful as they can be used to recognize promising actions or potential problems without straining scarce explicit processing capacities. "Experienced teachers appeared to have organized their knowledge of students and classrooms in particularly effective patterns (schemata) that could be retrieved unconsciously from long-term memory via classroom cues" (Kagan, 1988: 489).

4.2.2.1 Evidence from problem-solving tasks
One of the earliest studies was one on a telegraph operator (Bryan & Harvey, 1899). Bryan and Harvey compared the operator's understanding and production of regular words and nonsense words of the same length. They found that the operator was much faster understanding and producing the regular words than the series of letters. However, they found that uncommon words often took the same time as the nonsense words. This was taken as evidence that the telegraph operator generally understood and produced words as chunks, which takes less processing capacity, and only broke words into individual letters for difficult or uncommon words.

Further evidence that skilled or knowledgeable performance is based on schemata comes from a series of studies by de Groot (1965). Some had speculated that expert performance was the result of the ability of experts to analyze a situation more thoroughly or in more complexity than those who were not as expert. In one study, de Groot had chess experts play a game and explain what they were thinking as they played. The results showed that experts did not consider more moves than novices; rather the moves they considered were simply of better quality. In other words, experts are not those who think more, since this would require inefficient usage of working memory, but rather their knowledge is organized into schemata and these are used to *recognize promising solutions* to a problem, rather than considering every possible solution.

Lesgold and his colleagues (Lesgold, 1984; Lesgold Rubinson, Feltovich, Glaser, Klopfer, & Wang, 1988) obtained similar results in their studies of how doctors of various levels of expertise diagnosed medical problems on the basis of patient x-rays. Quantitative data included number of findings (case specific pieces of information mentioned), number of findings connected to other findings, number of clusters (group of findings all linked together), and length of "reasoning chains" (meaning levels of deduction made on the basis of findings, i.e. certain spots on the x-ray meant blood was pooling meaning heart failure). The results showed that experts produced more of everything when compared to the other doctor groups: more findings, more clusters, more findings connected to other findings, and longer reasoning chains. The non-experts

were also more likely to mention details which were not directly related to creating their diagnosis. These results, especially the superior number of clusters and reasoning chains, were thought to reflect the experts' greater number of diagnostic schemata, further supporting the hypothesis that well-developed schemata are central to expertise.

Studies of teachers provide evidence that experienced teachers have richer schemata for teaching than novices. Peterson and Comeaux (1987) showed ten experienced teachers and ten novice teachers three videotaped scenes from high school classrooms and asked them to describe what was going on in the classroom. The descriptions of general classroom features and activities by both groups of teachers were very similar. However, the experienced teachers' descriptions of principles and procedures underlying the actions in the videos were much richer: "experienced teachers have better-developed knowledge structures or schema for phenomena related to classroom teaching than do novice teachers (Peterson & Comeaux, 1987: 326). In a study of language teachers, Richards, Li and Tang (1995) also had ten experienced EFL teachers and 10 novice teachers complete a task. They were given materials and asked to prepare a reading lesson for a fictitious class. As in other such studies, the experienced teachers recognized many more possible objectives for such a lesson, were able to see the lesson from both the teacher and student perspective (while the novices only operated from the teacher perspective) and recognized many dilemmas and complexities of implementing their lesson plans. Studies like these provide evidence that teachers rely on schemata to recognize possibilities and problems when constructing teaching.

4.2.2.2 Evidence from memory tasks
Memory tasks have provided much of the evidence for schemata and their importance to expertise. In memory tasks participants are briefly exposed to input (typically a picture) and then asked to recreate or recall the input material as exactly as possible. For example, de Groot (1965) used a task where participants saw a chess board in mid-game for 5 seconds. Then their view of the board was blocked and they had to reconstruct the chess positions from the first chess board onto a second chess board. The chess grand masters were much better at this task than chess novices. However, when the chess pieces were placed in random positions, grand masters were no better than chess novices in recreating the chess positions. This provides evidence that experts possess game-specific schemata because these schemata help chess masters in remembering chess boards from games (because remembering a few offensive and defensive formations is easier than memorizing the positions of 26 individual pieces) but not at all for remembering pieces placed randomly (as there are no "chunks" to be recognized, so the experts have to try to remember all the pieces just as the novices do).

These findings were replicated by Chase and Simon (1973) who added an additional twist to the task. They videotaped three of the participants in their study reconstructing the chess positions and measured the amount of time between the placing of each piece. Using data on human recognition and movement, they estimated that all moves with less that a two second interval would belong to one "chunk" of information or knowledge. They then analyzed the relationships of the various chess pieces, i.e. which were part of the same defensive or offensive formation, same type of pieces, place on board, etc. They found that when the interval between the placing of two pieces was below two seconds, there were a lot of relations between the two pieces, whereas when the pause was more than two seconds there was very little relation. Chase and Simon took this as evidence

that the participants were thinking about the chess board in terms of "chunks" or groups of pieces, rather than thinking about each piece individually.

Further evidence for the robustness of experts knowledge of chunks, or schema, was provided by Charness. He used the same memory task with six high-level chess players, but they (a) asked the participants to wait 30 seconds before reconstructing the chess board and (b) had some participants engage in a distracter task (i.e. add a series of random numbers, etc.) during that 30-second period. He found that these experts' performance suffered very little after the distracter task (only 7-8%), indicating that these experts did not need much working memory capacity for storing their chunks of chess piece positions. The advantage of experts in memory tasks has been shown in a wide variety of activities: the game of bridge (Engle & Bukstel, 1978), electronics (Egan & Schwartz, 1979), medicine (Oppewal, 1993), music (Slobaba, 1976), basketball (Allard & Burnett, 1985), and soap opera watching (Reeve & Aggleton, 1998).

Similar results have been found in studies of teachers' knowledge (Behets, 1996; Bromme, 1989; Peterson & Comeaux, 1987). Carter, Cushing, Sabers, Stein, and Berliner (1988) used a different kind of memory task. They had experienced and novice teachers view a series of slides taken in school classrooms and explain what they saw. This revealed a qualitative difference between experienced and novice teachers' schemata. The novices' reports focused on surface aspects of what they saw, for example they would say things like: "A room full of students sitting at tables" (Carter, et al., 1988: 27). Experienced teachers, however, focused on the activity, saying for the same scene things like: "It's a hands-on activity of some type. Group work…" (Carter, Cushing, Sabers, Stein, & Berliner, 1988: 27). They concluded that experienced teachers "possess comparatively richer schemata for ascribing meaning to visual classroom information" (Carter, et al., 1988: 25).

4.2.2.3 Uses of schemata
One of the principal uses of schemata is to help people decide what to pay attention to. In any situation there are many things which can be focused on. Explicitly calculating the value of each factor for the task you want to accomplish would require a good deal of working memory processing capacity, so it is cognitively efficient to use schemata to recognize which factors are likely to be most useful. For example, in studies of analysis of x-rays, the experts seemed to have a very small, but specific, set of prerequisites which needed to be fulfilled before a particular diagnosis was seriously pursued, while non-experts either did not use such prerequisites or only a very limited number of prerequisites (Lesgold, 1984; Lesgold Rubinson, Feltovich, Glaser, Klopfer, & Wang, 1988). Nurses also use schemata to recognize what kind of diagnosis and symptoms should be given priority. Leprohon and Patel (1995) studied the problem-solving of nurses in an emergency room and found that the nurses used a number of cues to recognize and sort cases according to how urgent the need for treatment was.

In planning tasks with experienced and novice teachers, the experienced teachers are much more selective in terms of the information they require for planning (e.g., Carter, Sabers, Cushing, Pinnegar, & Berliner, 1987; Housner & Griffey, 1985). For example, in the study by Carter and her colleagues (1987) the experienced teachers ignored much of the information which the novices felt were important (such as students' previous test results); while in Housner and Griffey's study of PE teachers "five of eight experienced teachers had to view the facility before they could plan, whereas none of the

inexperienced teachers made such a request" (Housner & Griffey, 1985: 47). These studies show that part of the advantage of schemata is that they help people avoid considering irrelevant or less useful information, thus lessening the amount of cognitive processing for a task. "[D]eep analysis is not in fact the hallmark of expert reasoning…An alternative explanation is that experts have developed schemata that filter out irrelevant material… If this material is not filtered out, attempts will be made to process it. The normal result will be some kind of unnecessary search" (Patel & Groen, 1991: 117).

In addition, there is evidence that well-developed schemata help people focus on what is and is not possible in specific situations, what Greeno, Moore and Smith (1993) refer to as "affordances" and "constraints". They define "affordances" as "the support for particular activities created by relevant properties of the things and materials in the situation" (Greeno, Moore & Smith, 1993: 101-2). For example, an overhead projector "affords" everyone in the class being able to concentrate on one set of pictures or text at the same time, but is constrained by the limited amount of readable text and identifiable pictures that can be projected at one time. The term "affordnaces" can sound esoteric to some people, so Woods refers to this as "resources" at teachers' disposal.

> With the large number of external factors which potentially need to be taken into account, the teacher must have some process for dealing with them. One way teachers seem to do this is by treating them as 'resources' and 'constraints'…We can take the term 'resources' to refer to factors which increase the number of possibilities or options open to a teacher…The term 'constraints', on the other hand, refers to factors which narrow, limit or decrease the number of possibilities or options open to a teacher (Woods, 1996: 170-1).

Haider and Frensch (1996) say that focusing on the resources and constrains in a situation is cognitively efficient because it reduces the amount of information to be processed. They proposed an "information reduction hypothesis" which "holds that people learn, with practice, to become more selective in their use of information, that is, to distinguish between task-relevant and task-redundant information and limit their processing to task-relevant information" (Haider & Frensch, 1999: 172). They investigated this hypothesis by teaching an artificial grammar for letter strings to 107 university students. After an initial learning stage where the grammar was explained and examples of correct and incorrect letter strings were given, the participants practiced with 100 examples of letter strings. While they did this their eye movements were recorded. The results showed that as the students progressed through the practice material they looked less and less at parts of the letter strings which were irrelevant for determining the correctness of the string, which was taken as evidence for the information reduction hypothesis.

Schemata allow people to recognize good courses of action quickly and accurately with minimal demands on scarce working memory capacity, rather than explicitly considering the advantages of each possible course of action. For example, Borko and Livingston (1989) observed three experienced teachers and three novice teachers and interviewed them about their lesson planning. Like the expert doctors, the experienced teachers were much quicker to plan ways of achieving their goals compared to novice teachers. Novice teachers also got off track more easily and found it difficult to stick to their goals for the lesson. Studies of experts in other fields have yielded similar results. Joseph and Patel (1990) had doctors diagnose cases in (experts) and out (non-experts) of their

specialization. The experts found accurate diagnoses very quickly and used further information to check their diagnosis, but not to entertain other possible diagnoses. The non-experts, however, spent most of their time investigating possible diagnoses and entertained many more solutions than the experts did. In the field of education, research has produced similar results.

Another function of schemata is to help us recognize aspects of a situation which are not directly observable. For example, in studies of doctors examining x-rays in cases when two or more anatomical features overlapped each other in the x-ray, the radiology experts were able to clearly distinguish each in detail; something non-radiology experts were not able to do. The experts, but not the other doctors, also recognized what kinds of things the x-ray would not reveal (due to position or location of x-ray) but could be important for diagnosis (Lesgold, 1984; Lesgold Rubinson, Feltovich, Glaser, Klopfer, & Wang, 1988). In the field of education, Chi and Bassok (1989) had students "think aloud" while reading textbook problem examples. They found that the "good" students looked for clues about the textbook problems that were not explicitly stated: "good students tended to infer additional tacit knowledge, whereas the poor students' explanations were often paraphrasings of the diagram, with no new information generated" (Chi & Bassok, 1989: 269-270).

4.2.2.4 Summary
Research indicates that schemata play a crucial role in the efficient use of our cognitive resources. They allow people to decide what information to pay attention to, to recognize the significance of the information, to infer important information which is not directly present, and to generate good suggestions for immediate or future action.

> When I open a textbook and see an exercise where students have to fill in the blank with conjugated verb forms, I do not have to analyze it in detail because I already have a well developed schema which can inform me about typical contents, uses, and problems with such exercises. Schemata are cognitively efficient because they allow people to just recognize a situation and possible courses of action without having to think about it, which allows teachers to save their information processing capacity for other problems. Studies have shown that expert teachers have well developed schemata about students, the subject matter and their instructional activities (Berliner, Stein, Sabers, Clarridge, Cushing, & Pinneger, 1988).

Because schemata are generated through the perceptive process and are not explicitly calculated they only require minimal use of scarce explicit processing capacities, making them very important for fields such as teaching where time pressures and the uncertainty of student action combine to place a premium on explicit cognitive resources. One likely reason for the lack of transfer from SLTE programs to language teaching is the lack of development of teaching-based schemata in such programs, suggesting that there needs to be an increased focus on the development of teaching related schemata in SLTE programs.

4.3 Procedural knowledge

4.3.1   Procedural knowledge as a central part of teacher knowledge

Procedural knowledge refers to knowing how to do something (Ryle, 1949), for example routines of grouping students, ways of representing Anglo-Saxon turn-taking patterns, or explanations of the perfect aspect in story telling. This kind of implicit knowledge, at

least as it pertains to teaching, is not well respected in most teacher education programs. Kagan claims that "according to the university perspective – one of the best things a teacher can do is avoid consistency and routines" (Kagan, 1993a: 110). Procedural knowledge is often seen as a "bag of tricks" which does not help teachers as much as conceptual knowledge: "routines are not meant to solve problems in the long term, but, rather, to offer quick fixes or prevent the emergence of problems entirely" (Crookes & Arakaki, 1999: 19). Some see learning to use routines more as something to be used to keep students under control rather than something to be used to increase student learning. For example, Kagan (1993a) studied two teacher educators and two high school teachers doing a variety of tasks revolving around the learning of two student teachers in a practicum. One of the teacher educators claimed that routines were used to avoid the struggle to understand teaching. "[H]er stronger methods students use some of the techniques she suggests when they student teach, but she admitted that many never do, 'because they have no imagination and never stop to think: what am I doing?'... So many teachers are afraid of losing control of a class, and they see routines as one way to maintain control" (Kagan, 1993a: 56).

Research on teaching, however, has shown that rich procedural knowledge is an integral part of expertise in teaching (Calderhead & Shorrock, 1997; Carter, Sabers, Cushing, Pinnegar & Berliner, 1987; Johnson, 1994; Schocker-von Ditfurth, 2001; Tsui, 2003; Woods, 1996). Tsui (2003) conducted intensive case studies of four EFL teachers. One thing she found was that the expert teacher in her study had developed routines which addressed multiple goals at the same time. The less expert teachers tended to have separate routines for each goal they had, which resulted in less intensive use of class time. For example, the expert teacher (Marina) began the year with an activity where her students choose adjectives to describe the student they were working with, which then led into a discussion of which adjectives describe good (polite, hard-working, etc.) and bad (rude, lazy, etc.) students. This activity not only fulfilled the language goal, but also the goal to discuss class discipline and encourage classroom dynamics by getting the students to learn something about other students. Marina's expertise was not only in her knowledge of specific routines, but her knowledge of when to use which routine. "Marina's expertise in handling classroom discipline is realized not only in establishing routines but also in her ability to judge when noises made foreshadowed disciplinary problems and must be curbed, and when they could be usefully exploited to achieve instructional objectives" (Tsui, 2003: 142).

Leinhardt and Greeno's (1986) study showed the importance of procedural knowledge for experienced teachers. They studied eight expert and four novice elementary teachers, observing the teachers' classrooms for over three ½ months and supplementing this with stimulated recall and pre- and post-interviews. They found that the experts used a wide variety of instructional routines, from passing out work to types of activities which followed similar patterns. These routines were crucial for increasing the amount of student focus on the content and decreasing the amount of focus on learning how to do a certain activity. "The expert teachers had, with the class, a large repertoire of routines, usually several forms of each one…The main feature of these mutually known routines were that (a) they were very flexible, (b) order could be shifted and pieces taken from one segment and applied to another, (c) little or no monitoring of execution was required, and (d) little or no explanation was required for carrying them out" (Leinhardt & Greeno, 1986: 94). It is important to note that while the expert teachers made extensive use of routines, this did not result in boring, repetitious work (which is often supposed to be the

result of routinized teaching). The teachers were able to combine routines in different ways and different permutations so that the lessons could seem distinct from other lessons but still be based on a limited number of routines.

Novices, however, did not have the same procedural knowledge as the expert teachers and the result was that their students spent more time understanding what to do and less time understanding the material to be covered in class. Leinhardt and Greeno (1986) found that the novice teachers in their study lacked the routines to make instruction predictable, which increased their cognitive work load. "[N]ovices did not act in a routine or habitual way, so each portion of a lesson was different from the next and each day was different. Students, therefore, had to be instructed in their roles and the teachers had to take time and energy to explain each action" (Leinhardt & Greeno, 1986: 94). The four ESL novice teachers in Johnson's (1994) study wanted to change their teaching but were not able to because they lacked knowledge of activities, representations, and strategies which would help them achieve their goals in teaching. Another example is Schocker-von Ditfurth's (2001) longitudinal study of 16 novice EFL teachers during their student teaching. One of her findings was that because the novice teachers had so little procedural knowledge of EFL teaching, they had to evaluate each possible action and reaction explicitly, which greatly reduced the amount of things they could consider.

4.3.2 Procedural knowledge helps avoid the cognitive bottleneck

Trying to figure out the result of any action in such a dynamic and complicated environment as the classroom would overload the working memory capacity of the most able teacher. Therefore, teachers use implicit procedural knowledge (such as routines) to create instruction in ways that do not overload the cognitive bottleneck.

> Routines …permit instruction to take place in a focused, predictable, and fluid way…Routines help free up cognitive processing space for both teachers and students by making automatic a subset of the cognitive processing tasks that would confront teachers and students if the problems for which these solutions had to be solved anew each time. For routines to become established, they must be taught and rehearsed (Leinhardt, Weidman & Hammond, 1987: 135-6).

Studies have shown that teachers use their procedural knowledge to lower the cognitive demand of teaching. For example, Appel (2000) interviewed and observed the teaching of 10 EFL teachers in Germany. He found that one of the main factors impacting teachers' practice was the limited time to gather information and make decisions, both in class and out. To compensate for this the EFL teachers in his study used a range of strategies and routines to make instruction more predictable. This predictability reduced the number of factors and issues teachers had to pay attention to with their limited time.

Expecting teachers to simply "figure out" activities, routines, and explanations from general knowledge seems unrealistic. Such computation would be very difficult given the amount of explicit cognitive processing capacity it would demand and the limitations of the cognitive bottleneck. Studies show that teachers have difficulty generating procedural knowledge from explicit, declarative knowledge. For example, it is often difficult for teachers to generate representations that both illustrate the point well for all students and which students do not find misleading (Smith & Neale, 1989). "[M]any classroom activities and materials represent disciplinary knowledge poorly. That is, they promote conceptions or encourage patterns of thought and action in pupils that do not

correspond to the ways of thinking and knowing in history, mathematics, literature, or science" (McDiarmid, Ball & Anderson, 1989: 194). Svalberg (2001) and Svalberg and Hjh (1998) show how EFL teachers' representations, such as line diagrams representing tense and aspect, caused the Brunei and Malay EFL students in their studies to mislearn the meanings of grammatical items such as the present perfect. This is especially important if teachers are to incorporate some focus on form (Doughty & Williams, 1998) because grammar oriented activities are more difficult for L2 students to understand than communicative activities (Toth, 2004). In addition, the four experienced ESL teachers in Johnston and Goettsch's (1999) study relied heavily on examples to illustrate aspects of grammar that they wanted their students to understand. Nevertheless, despite their solid knowledge of grammar, they still often found it very difficult to think up good examples for the points they were trying to cover.

The cognitive efficiency of procedural knowledge is especially important given the complexity of teaching. McDonald notes this complexity is often overlooked by those not directly involved in teaching: "people often imagine empty slots in kids' heads and ready-made data to put there. They overlook the fact that the most important things to learn continuously change shape, while minds continuously impose their own designs" (McDonald, 1992: 2). Instead of teaching as providing bits of knowledge, McDonald sees it as a process where the teacher and the students share the task of meaning making and this is what that makes teaching so complex.

> The teacher authors a community of struggle and growth that we call a course in algebra or the third grade, but shares the work of constructing its meaning with its principal readers, the students. With their connivance and often against their resistance, the teacher builds a text from the elements of the classroom medium: time, space, talk, task…In the end, she cannot control this text amid the swirling and immensely uncertain influences, yet she takes responsibility, signs her name to it (McDonald, 1992: 16-17).

4.3.3   Procedural knowledge as a central to teacher learning

Some claim that procedural knowledge hinders teachers' learning. For example, in Kagan's (1993a) study one of the teacher educators claimed that the student teachers had learned from her methods class but did not use this knowledge in student teaching. She blamed routines for this, saying these novice teachers are "up against the routines that their cooperating teachers have established. Sometimes pupils don't want those routines interrupted... Some student teachers try innovative activities, but if they don't work the first time, they're reluctant to try again. Instead, they fall back on the standard routines already in place" (Kagan, 1993a: 102). While it would seem that the solution to this situation would be to bring more focus in teacher education on routines which fit the kind of conceptions that are being taught, some academics continue to conclude that routines should not be the focus of tertiary education (e.g., Kagan, 1993a).

Procedural knowledge is also very important for learning in that it can free up teachers' cognitive capacity in order to focus on understanding the classroom and learning to teach. This directly contradicts assertions that routines *prevent* teacher learning. For example, Tsui, in her case studies of four EFL teachers, found that procedural knowledge such as routines were vital in the process of teacher learning: "the mental resources freed up by the use of routines will be 'reinvested' in the pursuit of new goals and problem-solving at a higher level, which they did not have the capacity to deal with earlier" (Tsui,

2003: 19). Pennington (1995) conducted a longitudinal study of eight EFL teachers and their efforts to implement a process approach to writing in their classes. One of her findings was that "in the earliest stage of their adoption, the teachers were focused on materials, techniques, and the constraints interfering with their attempts at innovation" (Pennington, 1995: 718). This is not to say that procedural knowledge alone will automatically lead to expertise. Instead, procedural knowledge is seen as a necessary but not sufficient factor in the development of knowledge about teaching. For example, one teacher in Tsui's (2003) study did learn a lot of teaching activities and tricks, but, despite this, did not or was not able to develop expertise in EFL teaching.

Kagan goes so far as to claim that to be able to understand and learn broader concepts such as student learning, novice teachers need to have a stable repertoire of procedural knowledge *beforehand*. "[S]tandard routines that integrate instruction and management are needed. Only when they are in place can novices begin to focus on pupil learning. In the acquisition of procedural routines, novices move from an initial stage where performance is laboriously self-conscious to more automated, unconscious performance" (Kagan, 1992b: 154). While not denying the importance of procedural knowledge, Grossman (1992) argues that procedural does not necessarily precede broader conceptual knowledge. First, studies (e.g., Grossman, 1990; Grossman & Richert, 1988; Wilson & Wineburg, 1988; Shulman & Colbert, 1988) have shown that novice teachers do struggle with issues of subject matter and student learning before acquiring a set of "established classroom routines" (Grossman, 1992: 174). Second, procedural knowledge is neither neutral nor divorced from broader conceptual knowledge, so the process of developing a set of routines affects these larger issues. "How teachers manage classrooms enables or constrains the possibilities of teaching, classroom discourse, and student learning. How teachers manage classrooms must depend on their ultimate goals for students. Management is not neutral but carries within it its own implicit theories of instruction" (Grossman, 1992: 174). This indicates that learning procedural knowledge concurrently and integrated with conceptual knowledge (i.e., learning what kinds of routines foster communication among language learners and learning to use such routines flexibly in a wide variety of circumstances) would be most beneficial for novice teachers.

4.3.4   Acquiring procedural knowledge

It would also be erroneous to expect that novice teachers will acquire the procedural knowledge they need and desire in a practicum or student teaching component in a teacher education program. While beginning teachers generally do develop some sort of procedural knowledge base during the first year of teaching, a range of studies show that teacher students generally do not acquire the procedural knowledge needed to teach as they or their teacher education program would like simply from teaching practice alone (Appel, 2000; Feiman-Nemser & Buchmann, 1985, 1989; Gabel, 1997; Johnson, 1994, 1996c; Marks, 1990; Schmidt, 1995; Schocker-von Ditfurth, 2001). "[S]tudent teachers may learn to manage pupils and classrooms *without learning to teach*" (Feiman-Nemser & Buchmann, 1989: 367) [emphasis added]. For example, all the four teachers in the Schmidt (1995) study felt that they were failures after completing their student teaching because they still lacked the procedural knowledge to teach. In fact, all of these teachers decided not to enter teaching at the end of student teaching because they felt they had not learned to teach in their teacher education program. This indicates that SLTE programs must do much more to help novice teachers acquire procedural knowledge in their

regular courses, rather than assuming that the practicum or student teaching will take care of this.

However, this does not mean that there is no procedural knowledge learned in SLTE programs. In such programs novice teachers learn how to participate in university classes, what topics are of interest in such settings, how talk and write in academic discourses, how cite references, how to do a literature review, etc., so there is a wealth of procedural knowledge that novice teachers learn in SLTE programs. Ultimately, the problem may be that these procedures have little to do with teaching (for example, writing extensive papers is not a central part of teachers' work) and thus would require far transfer to be applicable to teaching.

4.3.5 Summary

The acquisition of procedural knowledge is a central and crucial part of the development of teaching competence because procedural knowledge does not require scarce working memory capacity and, thus, can help teachers avoid the cognitive bottleneck. In addition, evidence suggests that procedural knowledge might be necessary for teachers to understand and develop broader conceptual knowledge of language learning and teaching. Unfortunately, the acquisition of procedural knowledge is rarely a central focus in SLTE programs. This may be because it is difficult to teach such knowledge in typical university classrooms, because teacher educators possess little procedural knowledge about language teaching, or because academics overlook the importance of such knowledge since it is not central to their practice. The lack of procedural knowledge gained in SLTE programs may be a significant factor in teachers' difficulty in transferring knowledge gained in SLTE programs to their practice of teachers. Furthermore, sophisticated procedural knowledge does not develop easily from teaching experience either. The reason may be that explicitly figuring out what to do in a classroom based on a general academic principle would require more explicit cognitive processing capacity and time than most teachers can spare, given the fast-paced and unpredictable nature of teaching. Therefore, SLTE programs probably should focus more on the acquisition of procedural knowledge for teacher tasks (planning lessons, carrying out instruction, etc.) rather than on procedural knowledge for academic tasks (writing reports, reading academic material, etc.).

> A primary goal of preservice programs should be providing procedural knowledge to novices…Procedural routines appear to be the sine qua non of classroom teaching; novices sense this and continue to express their frustrations with the abstract content of most education courses. *Instead of decrying student teachers' interests in quick fixes and tricks of the trade, perhaps teacher educators should acknowledge that this is a genuine, mostly unmet need*. Novice teachers may engage in technical rationality rather than other levels of reflection *because that is where their developmental needs lie*: in understanding what works and why it works (Kagan, 1992b: 162) [emphasis added].

4.4 Images and gestalts

One kind of knowledge which is not discussed much in terms of teacher education is images (Elbaz, 1983; Kosslyn, 1985; Johnson-Laird, 1983, 1987; Brewer, 1987). Despite this, images of teaching, language, and learning appear to be powerful tools for teachers when planning and instructing. Calderhead and Robson (1991) investigated the knowledge of 12 novice primary teachers using a variety of methods (interviews,

responses to vignettes, scripting out imaged lessons, etc.). They found that all the teachers had images of teaching, of learning, of subject matter, or all these combined. These images contained a variety of kinds of knowledge, including both conceptual and procedural knowledge. "Images…represent knowledge about teaching but might also act as models for action, and in addition they frequently contain an affective component, being associated with particular feelings and attitudes" (Calderhead & Robson, 1991: 3). These images allowed the teachers to represent complex ideas in a relatively simple package, much like how one notes down key words to guide a talk on a complex subject. "Images of teaching appeared to be ways of representing knowledge that could readily be translated into action, sometimes synthesizing quite large amounts of knowledge about teachers, children, teaching methods, and so on" (Calderhead & Robson, 1991: 7). Such an arrangement is cognitively efficient; instead of having to process complex thoughts in working memory during instruction, teachers can rely on an image which can guide instruction but does not require much in terms of explicit processing capacity.

Images may also be important for teacher learning. For example, one of the novice teachers in a study on the role of homework in the education of MA students felt he needed some kind of image of whatever he was studying in order to learn it. "One of the things I rely on heavily is imagery. *I like to imagine in my mind exactly how I would use a certain principle*, and what the Olstein book did for me was it helped *create an image in my mind of a setting, imaginary students and me in that setting*, and I could picture myself teaching using this principle" (Bartels, 2005b: 4). However, images developed during novice teachers' *apprenticeship of observation* (Lortie, 1975), which refers to the 13,000 or so hours they have spent as students observing teaching, are particularly difficult to change. For example, Johnson (1994) looked at four novice ESL teachers in their practicums using observations, interviews, stimulated recall and reflective journals. One of her findings was that the teachers continued to teach according to old images of teaching even when they did not agree with these images.

> Probably the most striking pattern that emerged from these data is the apparent power that images from prior experiences within formal language classrooms had on these teachers' images of themselves as teachers, teaching, and their perceptions of their own instructional practices. *This occurred in spite of the fact that these preservice teachers were cognizant of the inadequacy of these images*…All four teachers were critical of their own teacher-directed instructional practices, nonetheless, *they described feeling powerless to alter their instructional practices* because they had few, if any, alternative images of teachers and teaching to act as a model for action (Johnson, 1994: 449) [emphasis added].

Similar to images is the idea of "gestalt", an idea developed by German psychologists to represent larger patterns of knowledge which guide cognition but which cannot be reduced to smaller units (Koffa, 1935). Korthagen and Lagerwerf (1996) say that gestalts are "a unity of perception, internal processing and a tendency to behave in a certain way" (Korthagen & Lagerwerf, 1996: 164) and see developing gestalts as central to teacher education. "Learning about teaching is a process of developing existing gestalts and *not* a question of learning to apply theories form academic textbooks" (Korthagen & Lagerwerf, 1996: 182). Like images, gestalts are difficult to change, especially through conceptual or declarative knowledge.

> We consider it a fundamental mistake to try and offer student teachers an alternative conception in the hope they will then use this in their teaching practices. At best, they will be capable of formulation of the alternative conception. In practice, however,

they will unconsciously act upon their own gestalt of teaching, which, because it is
rooted in lifelong experiences as students, remain unaffected (Korthagen &
Lagerwerf, 1996: 167).

It seems that to change or replace gestalts (and images) teachers need new experiences
with teaching and learning which are similar to the kind of gestalt they want to develop.
"In effect, what they need is sufficient *new experiences* to help built an alternative gestalt
of teaching. Through reflection on this new gestalt, student teachers can develop their
own conscious and alternative conceptions of teaching. Only if the new experiences are
appropriate will this new conception match their educator's view" (Korthagen &
Lagerwerf, 1996: 167).

One advantage of images and gestalts may be that, like procedural knowledge, the may
require little of scarce working memory processing capability. Instead, they may allow
teachers to look at a situation or imaging potential action and simply recognize of it fits
their image of language and language teaching. However, more research on how teachers
use images and Gestalts in their practice is needed to confirm such a hypothesis.

Images and gestalts appear to be important to language teachers' knowledge, despite the
lack of attention they receive in teacher education and in the literature on teacher
education. They do not require explicit calculation or assessment of a particular situation
or principle. Instead, images and gestalts allow people to perceive whether a situation is
similar to or different from the image of what they are trying to accomplish, which is
cognitively efficient because it avoids the cognitive bottleneck. Thus, one possible
reason for the lack of transfer from SLTE programs to teaching may be that teachers do
not acquire or develop corresponding images and gestalts for the knowledge, principles
and concepts they learn in such programs. Without such images and gestalts, teachers
would have to rely too heavily on explicit cognitive processing to attempt to figure out
what these knowledge, principles and concepts mean in practice, and the cognitive
bottleneck would make significant progress in such an endeavor extremely difficult.
Given the evidence presented here, it is likely that SLTE programs should provide
learning experiences which allow novice teachers to develop and refine their images and
gestalts related to teaching and language. Helping novice teachers to diversify their
images of teaching, so that these are not primarily based on their *apprenticeship of
observation*, might also be important in this process.

4.5 Acquiring implicit knowledge

According to Bereiter and Scardamalia, implicit knowledge is acquired by problem-
solving or participating in activities similar to those one wants to gain facility in. "There
is no magic to how expert knowledge is acquired, but it is not enough to say that it comes
about through study, experience and practice. Those terms explain mediocrity as well as
expertise…problem-solving provides the dynamic element in the growth of all kinds of
expert knowledge" (Bereiter & Scardamalia, 1993: 74). Schön claims that this process is
driven by reflection-in-action. In reflection-in-action the very act of participating in a
process and solving problems leads people to notice what is important or less important
for the task, what is problematic, possible ways of getting around such problems, etc.

Usually reflection on knowing-in-action goes together with reflection on the stuff at
hand. There is some puzzling, or troubling, or interesting phenomenon with which the
individual is trying to deal. As he tries to make sense of it, he also reflects on the

> understandings which have been implicit in his action, understandings which he surfaces, criticizes, restructures, and embodies in further action (Schön, 1983: 50).

Schön distinguished between reflection-on-action, i.e., looking back and analyzing what has happened, and reflection-in-action, which refers to the monitoring, experimenting, and evaluational processes one goes through while engaging in professional practice. "Much reflection-in-action hinges on the experience of surprise…But when intuitive performance leads to surprises, pleasing and promising or unwanted, we may respond by reflecting-in-action…reflection tends to focus interactively on the outcomes of action, the action itself, and the intuitive knowing implicit in the action" (Schön, 1983: 56). Schön saw reflection-in-action as the process that drives professional learning and practice. "It is this entire process of reflection-in-action which is central to the 'art' by which practitioners sometimes deal well with situations of uncertainty, instability, uniqueness, and value conflict" (Schön, 1983 : 50). Ironically, while referring to Schön as their central inspiration, the focus in SLTE has instead been on reflection-on-action, for example stressing activities such as teacher diaries, analysis of classroom transcripts, thinking about theoretical concepts in terms of practice, etc. (Farrell, 2006; Richards & Lockhart, 1994; Wallace, 1991).

Despite the popularity of Schön's ideas in the field of teacher education, his work has been effectively criticized for arguing "mainly by example and metaphor rather than sustained argument" (Eraut, 1995: 13), for not addressing the complex contextual factors professionals have to deal with, and for failing "to link his analysis to the work of other researchers in this field" (Eraut, 1995: 21). Despite this, there is some evidence of the importance of reflection-in-action for professional learning and action. A series of studies has shown that having learners verbalize what they are doing and why improves their learning and performance on a number of different tasks (Berry & Broadbent, 1990; Chi, de Leeuw, Chiu, & LaVancher, 1994; Renkl, Stark, Gruber, & Mandel, 1998; Sengupta & Xiao, 2002). Furthermore, there has been evidence of such on-line cognition in professional practice. Szesztay (2004), for example, used stimulated recall to study the cognition of seven L2 teachers. She found that all the teachers did engage in this kind of in-action monitoring of action, student's reactions, and instructional plans. The data also indicated that such monitoring is so enmeshed with the action of teaching that it is not explicitly verbalized. "The word 'reflect' might be somewhat misleading, as it refers to a process which often does not happen in the medium of words" (Szesztay, 2004: 130); instead, "reflecting in the midst of action is a movement of the mind that may or may not be accompanied by verbal thought" (Szesztay, 2004: 132). In addition, Chi & Bassok (1989) found that such self-monitoring during performance was important to learning and performance in math problem-solving. Students who engaged in self-regulation of action and learning learned more and performed better presumably because this allowed them to recognize what they did not understand and focus their efforts in these areas.

> [T]he good students generated a large number of statements that reflected their failure to comprehend …the poor students not only did not realize that they did not understand, in fact, they thought more often that they did understand. …Basically this suggests that the poor students do not accurately monitor their own comprehension. Not only do they not realize that they have misunderstood, they in fact think that they do understand…The advantage of having an accurate monitoring of one's understanding is that the realization that one does not understand should elicit attempts to understand. This is exactly what we found...in the majority of the cases (85% of the time for good students and 60% of the time for poor students) realizations of comprehension failures triggered episodes of self-explanations (Chi & Bassok, 1989: 273-4).

Participation in teaching-similar activities is important because implicit knowledge is acquired for the specific task which people engage in. (Berry & Broadbent, 1984, 1988, 1990; Klayman, 1988; Lewicki, 1985, 1986a, 1986b; Lewicki, Czyzewska, & Hoffman, 1987; Lewicki, Hill, & Bizot, 1988). As mentioned earlier in this chapter, humans are good at implicitly noticing patterns in practice and using them to solve difficult, non-linear problems such as estimating the trajectory of a moving object in a computer program (Klayman, 1988) or deciding which chemical factory was secretly dumping chemicals into the river (Berry & Broadbent, 1990) without explicit knowledge of how they were able to solve these problems (Berry & Broadbent, 1984, 1988; Kuhn & Dienes, 2005; Lewicki, Czyzeska, & Hoffman, 1987; Reber, 1989; Roßnagel, 2001; Stadler, 1989). This suggests that, for example, engaging in a discussion about recasts as feedback for L2 learners results in implicit knowledge, but implicit knowledge about engaging in such academic discussions. To gain implicit knowledge about using recasts in actual teaching situations, teachers need to engage in activities, with the same time constraints as teaching, which require them to decide when and how to use recasts.

Furthermore, learners need to be actively involved in the task, rather than passively observing. Studies have consistently found that active learning activities lead to more learning that passive activities (Klayman, 1988; Moreno, Mayer, Spires, & Lester, 2001; Natter & Berry, 2005; Stern, Aprea, & Ebner, 2003; Wagenaar, Scherpbier, Boshuizen, & van der Vleuten, 2003) For example, Borg (2005) found that teachers who actively sought out knowledge about grammar knew more than those who did not. Moreover, Yates and Wigglesworth (2005) found that teachers who actively prepared materials for learning about pragmatics were much more likely to use their knowledge of pragmatics in instruction that teachers who had simply had these materials explained to them in workshops.

There are several reasons why active learning (in most situations) is more effective than passive learning. To begin with, active participation generally has more structural similarity with the target activity (i.e., teachers usually teach rather than observe others teaching). Ellis, Whitehall, and Irick (1996), for example, found that when learners were assembling a motorized crane, action-oriented explanations explaining what to do (similar to the task of assembling the crane) were much more effective than static explanations which explained the purpose of a part or what the crane should look like or do (which is not similar to the action the learners were engaged in). In addition, active learning may focus participants' attention on crucial aspects of an activity; while in passive learning situations observers may not be able to differentiate between crucial and peripheral aspects of the activity. Learning from such passive experiences would then result in more cognitive load because learners would have to focus on a wider range of information than those actively working on the problem. For instance, Berry (1991) had some learners work on a simulated problem of managing a sugar factory. Learners who only followed the managerial changes by the other learners only exhibited any learning on the task if it was very clear why the changes were made, while those who actively participated learned regardless of the situation. Finally, it is also possible that in passive situations learners do not pay as much attention to information because they do not need to use it in the near future. For instance, Mathan and Koedinger (2005) studied students learning to use a spreadsheet program. They found that students whose mistakes were simply pointed out and corrected learned less than students who were prompted to figure out the problems with their work and to improve it.

Although it is possible for explicit knowledge to be helpful in the acquisition of implicit knowledge, explicit knowledge is not central to the process of acquiring implicit knowledge. Research shows that it is very difficult to develop implicit knowledge from explicit knowledge and explicit knowledge is often derived from implicit knowledge rather than the other way around. Some psychologists have noted that in many areas (typing, computer programming, etc.) people can use explicit knowledge to develop implicit knowledge, for example by engaging in typing practice (Anderson, 1993; Singley & Anderson, 1989). In SLTE it has been implied that novice L2 teachers can use explicit knowledge from academic fields to develop implicit, practice-oriented knowledge (e.g. Hedgcock, 2002; Wallace, 1991). The problem with this argument is that, according to the research presented in the previous chapter, L2 teachers do not use the explicit knowledge they learned in SLTE programs to develop practice-specific implicit knowledge. Furthermore, in many cases implicit knowledge precedes explicit knowledge; in other words, people can learn something first (implicit) and only later learn to explain what they know (explicit). Thus, explicit knowledge may be a product of implicit knowledge, not the other way around (Dulany, Carlson, & Dewey, 1984; Graff, Squire & Mandler, 1984; Howard & Ballas, 1980, 1982; Millward, 1981; Reber, 1967). In fact, it has been shown that explicit knowledge can hinder the implicit rule learning process and often does not even lead to explicit rule learning (Berry & Broadbent, 1988, 1990; Roßnagel, 2001). While explicit instruction has not been shown to help develop knowledge useful in actually solving problems, it does increase inert knowledge in that the quality of the participants' explicit comments and answers improves but not their ability to solve the problems (Berry & Broadbent, 1988, 1990).

Finally, some claim that the implicit knowledge we gain by participating in activities is cognitively more useful than explicit, declarative knowledge. "A considerable amount of evidence indicates that as compared with consciously controlled cognition, the nonconscious information-acquisition processes are incomparably faster and structurally more sophisticated" (Lewicki, Hill, & Czyzeska, 1992: 796). This may explain why people often reject new information or concepts when this is presented explicitly. If it comes to choosing between fast and flexible implicit knowledge and difficult-to-process explicit knowledge, people will generally rely on their implicit knowledge to guide practice regardless what the explicit empirical evidence shows.

Implicit knowledge is acquired by actively participating in activities relevant and central to the practice being learned. It seems that the processes of participating in activities force learners to pay attention to relevant cues, correlations, causes, and constraints, and that this attention aids the acquisition of implicit knowledge about that practice. This body of research has lead many scholars to conclude that most of our knowledge is acquired through implicit learning (Berry & Dienes, 1993; Jacoby, Lindsay, & Toth, 1992; Lewicki, Hill, & Czyzeska, 1992; Moors & de Houwer, 2006; Underwood & Bright, 1996). "[A] person typically learns about the structure of a fairly complex stimulus environment, without necessarily intending to do so, and in such a way that the resulting knowledge is difficult to express" (Berry & Dienes, 1993: 2). Contextualized activities similar to tasks and processes that teachers regularly engage in would be in a much better position to take advantage of human beings' natural tendency for implicit learning than "read and discuss" seminars focusing on explicit knowledge. (Novice teachers would also gain implicit knowledge in such activities, but this would tend to be implicit knowledge about reading and discussing academic literature, not teaching.)

Explicit knowledge may be useful in this process, but the possession of explicit knowledge itself does not necessarily lead to the growth of implicit knowledge. It is likely that explicit knowledge most helps the acquisition of implicit knowledge if it is used to engage in tasks similar to teaching activities.

4.6 Conclusion

The research presented in this chapter indicates shows that the central factor in a new construct of cognition for SLTE is the limited amount of explicit cognitive processing capacity in our working memory: the cognitive bottleneck. Because of the cognitive bottleneck, we rely heavily on knowledge which requires little explicit cognitive processing capacity, for example, implicit knowledge such as schemata, procedural knowledge, images and gestalts. Using schemata, teachers can recognize student or instructional cues which then trigger procedural knowledge such as routines, activities, or representations of subject matter without having to "figure out" exactly what cues mean and which courses of action are most efficient. This suggests that implicit knowledge is the base of teacher cognition and, as such, should be the focus of SLTE. "Contrary to common sense assumptions about cognition, the implicit system plays the dominant role in skilled thinking" (Boreham, 1994: 172). There is a good deal of evidence that people in general rely on implicit knowledge. Evidence that teachers rely on implicit knowledge comes mainly from findings that teachers cannot articulate how or why they do what they do and from results showing the importance of procedural knowledge for teaching. Studies are needed to show (a) the extent to which SLTE experiences can help teachers acquire implicit knowledge for teaching and (b) that language teachers use implicit knowledge from SLTE experiences for their own practice.

One possible explanation for the lack of transfer of knowledge gained in SLTE programs is that the educational experiences in these programs do not help novice teachers develop implicit knowledge about language teaching. This is not to say that the kind of explicit, declarative knowledge typically acquired in SLTE programs is useless for teachers; however, as its usage typically requires a high degree of working memory processing capacity, it is simply not efficient to use it directly for teaching. Important uses of explicit, academic knowledge for teacher learning will be addressed in Chapter Six.

Implicit knowledge seems to be acquired by actively participating in activities and engaging in problem-solving. However, the implicit knowledge acquired will be for the activities engaged in. Thus, reading articles and discussing themes in SLA will result in implicit knowledge of reading articles and discussing themes in SLA, not of using information from SLA in language teaching. This further supports the finding of transfer research (presented in the previous chapter) that practice tasks need to be similar to those specific tasks and activities you want learners to be able to do. The next chapter will further explore the need for similarity and the cognitive reasons for this phenomenon in human cognition.

Chapter 5: Practice-Specific Implicit Knowledge

> SLTE programs typically focus on general knowledge about language, language learning and language teaching. However, teachers need and use knowledge specific to the practice of teaching. For example, teachers' knowledge is different from knowledge of academic fields. On the one hand, only a portion of academic knowledge is useful for teaching, on the other hand, teachers draw on significant kinds of knowledge not included in academic fields of study. Teachers' and academics' also engage in practices which are different, and different knowledge is required for different practices. For example, while *talking about* language and language learning is a central practice of academics, *doing* things with such knowledge to help learners acquire language is central to teachers' practice. Furthermore, evidence suggests not only that other kinds of practitioners rely on knowledge specific to their practice, but also that such practice-specific knowledge is central to competence and expertise in any kind of human activity because such knowledge is cognitively efficient. Two other factors point to the practice-specific nature of teachers' knowledge. First, one needs such practice-specific knowledge to truly understand any concept for practice. Second, teachers' decisions are based to a large extent on factors specific to their particular contexts and students, not on general principles or issues. Practice-specific implicit knowledge is acquired when participating in activities in which detailed, context- and teaching-specific information is available as well as necessary for participating in the activity.

5.1 Introduction

It has been widely assumed that knowledge produced by the field of applied linguistics fulfills the role of subject matter knowledge for L2 teachers (Stern, 1983; Richards, 1991a, 1991b; Hedgcock, 2002; Ramanathan, 2002). Others have expressed doubts about this assumption: "it is not evident that there is consensus regarding what constitutes the subject matter knowledge of ESL teachers and whether such knowledge should be explicitly taught" (Tsui, 2003: 136). Ellis adds: "teachers have very different agendas and operate from a different knowledge base. Whereas researchers are concerned in establishing the truth, teachers are interested in finding out what works" (Ellis, 1997: 20-1). Zydatiß (1988) argues that it is the target language itself which is the subject matter knowledge of L2 teachers because this is what language teachers are trying to teach. This argument makes sense given that the main purpose of language teachers is to teach the target language, not to teach knowledge about language or language analysis. Thus, L2 teachers' subject matter may be even more distant from academic fields than for teachers of other subjects (such as math or history). Kathleen Graves has agued that "unlike history, for example, where part of what a history teacher might do is help learners understand how to be historians, I don't think that one of a language teacher's jobs is to help students become linguists" (Hawkins & Irujo, 2004: 91).

Lee Shulman (1986, 1987), drawing on research from the Knowledge Growth in Teaching Project suggested that there are several kinds of knowledge that teachers need which are specific to teaching: (a) subject matter knowledge, (b) general pedagogical knowledge, (c) pedagogical content knowledge, (d) curricular knowledge and (e) knowledge of students. Pedagogical content knowledge (PCK) refers to knowledge directly pertaining to the teaching of the subject, such as knowledge of the topics taught most regularly, ways the subject matter can be represented to learners, knowledge of what makes aspects of the subject matter difficult or easy for learners, etc. Shulman has been widely praised for pointing out the practice-specific nature of teachers' knowledge. However, his conception of a PCK as a separate category has come under some criticism. Bromme (1995) claimed that the concept of PCK was too vague to be properly

researched and Freeman concluded that "while PCK has helped to refocus both research and teacher education on the kinds of knowledge and know-how that teachers actually use in their classroom practices, as an epistemological concept it was seriously flawed" (Freeman, 2002: 6). For example, Marks (1990) engaged in an in-depth study of eight 5th grade teachers. He found that these teachers' PCK did contain many things that did not originate from either their subject matter knowledge or their pedagogical knowledge; these aspects could be considered 'pure' PCK. However, most of their PCK contained elements of both subject matter and general pedagogical knowledge, and thus cannot be considered completely distinct from these categories: "the three primary types of knowledge – of subject matter, pedagogical content, general pedagogy – are more overlapping and integrated than discrete" (Marks, 1990: 10). Thus, what we are left with is not clearly distinct knowledge categories, but the practice-specific nature of teachers' subject matter knowledge. Below I will review the evidence for teachers' knowledge as practice-specific, rather than general, and explain why there are good cognitive reasons for this.

5.2 Teacher knowledge is different from knowledge of academic fields

5.2.1   Much of academic knowledge is not useful for teaching

A good deal of research has shown that knowledge of academic disciplines only supports teaching if it focuses on the actual situated activity of language teaching. Studies have also shown that teachers find that SLTE courses which are similar to the practice of language teaching (i.e., "practical" courses focusing specifically on teaching or teaching matters such as assessment) are much more helpful in learning to teach than courses which are similar to the practice of being an academic (i.e., "theory" or "research" courses) (Richards & Hino, 1983; Hedgcock, 2005).

Studies looking at correlations between teachers' coursework and the quality of their teaching provide evidence that teaching knowledge is distinct from disciplinary knowledge. Specifically only academic coursework which focused on those areas of subject matter central to what is taught in schools had a significant impact on teaching and subsequent student achievement. Teachers' coursework in "more advanced" courses had no such impact on instruction and learning. For example, Veenman (1984) reviewed 83 studies and found that teachers who attended teacher education programs which stressed subject matter knowledge were less effective as teachers than those who attended programs which stressed professional knowledge. In another example, Ferguson and Womack (1993) looked at 266 student teachers, measuring their teaching effectiveness with a variety of instruments such as questionnaires and evaluations by cooperating teachers, university supervisors, and the student teachers themselves. Ferguson and Womack found that grades in education courses were much better predictors of teaching effectiveness than grades in subject matter courses. In addition, Monk (1994) looked at the math and science learning of 60 10th grade students (as measured by achievement tests) and the university preparation of their math and science teachers. Like others, he found that the number of undergraduate education courses taken correlated with student learning to a greater extent than the number of subject courses taken. More interesting is the finding that while the first four or five subject matter courses correlated strongly with students achievement, *additional courses did not*. In addition, graduate level subject matter courses correlated *negatively* with student learning. These and similar studies support the contention of Everston, Hawley and

Zlotnik (1985) who concluded from their review of research that subject matter knowledge coursework which does not focus on the areas taught in schools is not central to what teachers will do and thus is not effective in increasing teaching effectiveness. For example, in reference to elementary math teaching, Leinhardt, Putnam, Stein and Baxter state:

> a teacher will not become a better teacher simply by taking increasingly more advanced math courses...but will become better if the depth of knowledge about a particular school topic such as integers, rational numbers, or functions is enriched. This deep knowledge includes knowledge about ways of representing and presenting content in order to foster student learning or construction of meaningful understanding (Leinhardt, Putnam, Stein & Baxter, 1991: 88).

Studies of elementary teachers' knowledge of math provide additional evidence of the practice-specific nature of teachers' knowledge. Ball and Wilson (1990) looked at abilities of 19 elementary school teachers in three tasks typical of teaching: (a) find and explain a false conclusion in a student answer, (b) create a representation of a fraction problem, and explain what 7/0 is and why. They found that all the teachers had difficulty with these tasks. Those with high levels of mathematics also had problems and were no better than those elementary teachers with lower levels of math knowledge, indicating that advanced math knowledge is not central to the math knowledge needed for elementary teaching. In survey of over 700 elementary teachers, Ball and her colleagues found that teachers' level of *teaching-specific* knowledge of mathematics strongly correlated with the learning of their students (Hill, Rowan, & Ball, 2005). In addition, Empson and Junk (2004) studied the knowledge of all the $3^{rd} - 5^{th}$ grade teachers in one school, a total of 13 teachers. They presented the teachers with scenarios where students were having problems with mathematics and asked the teachers to explain the problems the children had with that aspect of mathematics. They found no relationship between the level of teachers' knowledge of mathematics as a discipline and the teachers' knowledge of the mathematics understanding of their students.

Studies of science and literacy teachers have produced similar results. Smith (1999) gave 46 elementary teachers one test which assessed their science knowledge and one test which assessed their knowledge of teaching science. Interestingly enough, she could not find any correlations between their knowledge of a particular part of the science curriculum and their knowledge of how to teach that aspect of science, indicating that these are two separate types of knowledge. Tamir (1992) surveyed 213 high school science teachers on their conceptions of the field of biology. The teachers reported that the molecular level of biology was the least important for teaching, yet this was the aspect of biology most stressed in tertiary biology education. Duffy and Anderson (1984) used data from surveys and classroom observation to investigate how the 24 teachers in their study conceived of reading. They found that each of the teachers had definite conceptions of reading, but all of them were different from any of the five conceptions common in the academic literature on reading. Kinzer and Carrick (1986) asked 27 1st and 3rd grade teachers to (a) chose 10 of 30 statements about teaching reading according to which were most important for teachers to know and (b) to choose which of three lesson plans most reflected their ideas about reading. They found that their choice of lesson plan reflected the teachers' concepts of how reading develops, but not their statements of what the process of reading is. This makes sense because the teachers' job is to help with the acquisition of reading, not to explain the phenomenon of reading.

Finally, many teachers are very successful at teaching without acquiring much academic knowledge, making it doubtful that such knowledge is central to the practice of teaching. For example, there is evidence that teachers who have little academic knowledge can still be successful and knowledgeable in the domain of L2 teaching. Andrews and McNeill (2005) studied the knowledge of three EFL teachers whose teaching had been rated exceptional on the basis of observation of their lessons. Each of the three teachers had very uneven levels of KAL, such as language structure, morphology, etc., and one teacher had low levels of KAL. The fact that these teachers were able to perform very well despite lacking high levels of academic knowledge indicates that teaching knowledge is distinct from academic knowledge. As discussed in Chapter Three, the academic knowledge which teachers get in SLTE programs does not seem to answer the questions and problems novice teachers have when they enter teaching and, thus, is rarely used by teachers (Johnson, 1994, 1996c; Johnston, Pawan, & Mahan-Taylor, 2005; Gabel, 1997; Lamb, 1995; Pennington & Richards, 1997; Schocker-von Ditfurth, 2002). Johnson (1996c) says that novice teachers beginning teaching after academic study still have a "critical lack of knowledge" about L2 students and language teaching.

5.2.2   Teachers' conceptions focus on a greater variety of knowledge

Teachers use a wider range of knowledge than academic conceptions do for their practice, including a good deal of knowledge specific to the practice of teaching, providing further evidence that teachers' knowledge is different from academic knowledge. For example, many studies of teachers' conceptions of teaching reading have shown that academic issues such as the nature of reading are only a small portion of the factors taken into account in teachers' practice. Other factors such as student motivation, curriculum, and school politics are, in addition to academic issues, integral parts of the conceptions teachers use to guide their practice (Davis, Konopak & Readence, 1993; Duffy & Anderson, 1984; Graden, 1996). The six foreign language teachers in Graden's (1996) study used their knowledge of what increased student motivation more than their conceptions of reading in designing reading-focused instruction. Mori (2002) looked at the reasons for the corrective feedback of two ESL teachers. While one teacher based his feedback practice mainly on knowledge about language, the other teacher principally used her knowledge of fostering student autonomy, so that her feedback practice supported this goal. The three PE teachers in Chen and Ennis' (1995) study felt that student enjoyment was a more important goal than learning many of the basic skills for volleyball, and their lessons reflected this.

Studies of literacy education have produced similar results. For example, Konopak, Readence and their colleagues conducted several studies of elementary school teachers. They found that other factors (such as state-mandated curriculum, student interests, school climate, etc.) were often at least as important as conceptions of reading for the design of the teachers' reading lessons (Davis, Konopak and Readence, 1993; Wilson, Konopak, & Readence, 1992). This finding was supported by Brindley and Schneider's (2002) survey of 124 4th grade teachers. As Duffy and Anderson said about the 24 elementary teachers in their four year study: "[the] teachers made decisions about what to do for a variety of reasons. While some of these reasons reflect implicit beliefs about reading, many reflect beliefs about the nature of instruction and of classroom life" (Duffy & Anderson, 1984: 101-2).

Differences between teachers' and academics' knowledge has also been found in research on teacher educators' conceptions of teaching. In Kagan's (1993a) study of two teachers and two teacher educators, she found that the teacher educators' conceptions of teaching excluded many factors important for teachers.

> [The teacher educators] have not only objectified the task of classroom teaching, they have also narrowed its function to that of cognition: to help students acquire knowledge and problem-solving skills. To [the teachers], a teacher's job goes far beyond helping children achieve academically: it includes building children's self-esteem and self-discipline; teaching them to distinguish fact from opinion, to question their own values, and to interact effectively with individuals from different backgrounds (Kagan, 1993a: 123).

Teachers' knowledge has been shown to be different from academic knowledge of the same concepts. Early studies showed L2 teachers' understandings of communicative language teaching (CLT) is different from academic conceptions. For example Mitchell (1988) found that the conceptions of communicative competence of the 59 foreign language teachers in her study differed significantly from academic conceptions, for example by not including grammatical competence within a definition of communicative competence or viewing oral work as the only way to teach it. Fox (1993) gained similar findings from her survey of 147 teaching assistants [TAs] who were teaching university-level French classes. According to Fox, "TAs do not conceptualize language according to the model of communicative competence proposed by Canale and Swain…For instance, the TA model [of communicative competence] does not have a discourse component and elements such as determiners are treated as sentence level grammatical phenomena" (Fox, 1993: 320). Later studies showed that teachers' knowledge of CLT was different in that it focused on those aspects which are specifically important for language teaching. For example, Sato and Kleinsasser (1999) used interviews, a questionnaire and observations of teaching to study the CLT conceptions of ten teachers of Japanese as a foreign language. Some of these conceptions were clearly teaching-specific: that CLT involves time consuming activities (both in classroom and preparation time is obviously important, domain-specific knowledge for L2 teachers). For the teachers, even conceptions such as "CLT uses mainly speaking and listening" involved teaching-specific knowledge, for example, the problems with assessing oral language skills in ways considered legitimate in their institutions. Furthermore, the teachers in their study included knowledge in their conceptions of CLT missing from academic conceptions, for example how to maintain class discipline while using CLT activities or how to implement CLT at different grade levels.

Studies by Mangubhai and his colleagues produced similar results. In a case study of a German teacher's conceptions of CLT, they found that her conception included many aspects which were important for her teaching in her specific context, but were either not part of academic conceptions of CLT or where not central to such conceptions. For example, for her part of CLT were things like: "seeking to develop in students' tolerance of others", "Helping the students form an integrated view of the German language and not see it as isolated individual topics", "Building up student confidence" or "going from the known to the unknown" (Mangubhai, Marland, Dashwood, & Son, 2004: 307). "In summary, Doreen's understanding of CLT as revealed in her practical theory incorporates many of the commonly listed features of CLT, other features of CLT not usually listed and many features of her general approach to teaching" (Mangubhai, Marland, Dashwood, & Son, 2004: 308). A follow up study of six foreign language teachers' conceptions of CLT (Mangubhai, Marland, Dashwood, & Son, 2005) showed a

similar mix of academic and non-academic ideas. This study included a questionnaire which included 62 aspects attributed to CLT by academics. In general, the teachers agree with these 62 items as defining CLT: all six teachers agreed with 71% of the items and the majority (four) with 95% of the items. The interviews and stimulated recall protocols, however, showed that the teachers in the study only included half of these 62 items in their own conceptions of CLT and that these academic ideas only represented 30% of their ideas of what CLT is. Mangubhai and his colleagues concluded that "the six teachers have a different conceptualization of CLT approaches from that represented by the experts' list of 62 criterial attributes" (Mangubhai, Marland, Dashwood, & Son, 2005: 52).

In an interesting study, Pinnegar and Carter (1990) compared the theories of learning of 38 experienced teachers with 3 educational psychology textbooks. They found that the *teachers' conceptions were more sophisticated* than those presented in the textbook and included many factors missing from academic conceptions of student learning.

> Teachers not only transformed theories of psychology as they applied to practice, but they also presented theories of classroom learning which were absent from educational textbooks…the relationship between responsibility, respect and rapport…the dynamics of confidence, trust, and success…the relationship between personal interest, honesty, and relevance (Pinnegar & Carter, 1990: 23).

They also found that the teachers' conceptions were more complex and contained much more detail. Part of the reason for this may be that the textbooks aimed to give general information about an academic discipline rather than to explain specific problems or issues in teaching. "The purpose of the textbooks seems to be to present the discipline of educational psychology for the student in preservice teaching programs. The purpose of the cooperating teachers' theories of classroom learning was to explain their understanding of classroom practice to novice teachers" (Pinnegar & Carter, 1990: 21). They conclude that "[t]hese differences in purpose suggest that one explanation for why students believe that university courses do not prepare them for teaching is that the textbooks do not represent information in ways that allow students to identify the concepts presented in the textbooks in the practice they encounter" (Pinnegar & Carter, 1990: 26).

Research also shows that teachers focus on specific details, not general ideas, for teaching. For instance, Calderhead and Shorrock (1997) studied four elementary school teachers in the first two years of teaching. They found that during this time teacher learning centered mostly on developing knowledge specific to their contexts (e.g., knowledge of specific students, reactions of students to specific activities, advantages and drawbacks of assessment instruments for their context, etc.). Kagan (1993a) studied the teaching theories of two teacher educators and two teachers. She found that the teacher educators' theories were considered valid for all contexts, whereas the teachers' theories were for specific situations. Finally, Sabers, Cushing and Berliner (1991) compared experienced and beginning teachers' responses to a task where they had to watch three TV monitors showing different views of a classroom and comment on what they saw. Sabers and her colleagues found that the experienced teachers related what they saw to their wealth of knowledge about specific classrooms (student grouping, student motivation, possible developments during an activity, etc.) and this comparison enabled them to make more sophisticated commentary on what transpired in the classroom video. Furthermore, research on experienced teachers who switch teaching

contexts often report that they feel like novices in their new contexts, rather than experienced teachers (Bullough & Baughman, 1995; Burns, 1996), indicating expertise, at least in teaching, is context specific.

In general, studies show that academic knowledge tends to be overly simplistic and not to describe the complexities of teaching well. For example, Sosniak, Ethington and Varelas (1991) used questionnaire data in attempting to categorize teachers as either 'traditional' or 'progressive', but found that none of the teachers cleanly fell into either of the categories. Furthermore, McIntyre and Freppon (1994) observed two elementary teachers, one who taught a whole language classroom and one who taught a skill-oriented classroom. However, they found that neither teacher strictly used either of these conceptions when teaching. "Both instructional settings provided explicit phonics instruction (albeit contextualized differently), and both settings provided time for children to read self-selected books and to write" (McIntyre & Freppon, 1994: 391). In addition, Kinzer and Carrick (1986) have shown that the conceptions used for reading instruction by 27 elementary teachers in their study not did rely on their concepts of reading, but rather on their conceptions of how reading is learned.

If academic conceptions do not include many issues important for teaching, then they likely are not very useful for teachers, in the same way that a theory of bridge design which focuses solely on the building material but does not take into account wind and traffic patterns would not be very useful for engineers entrusted with the task of bridge design. Therefore, one possible reason why teachers do not seem to be able to use academic conceptions for teaching is that academic conceptions are simply not sophisticated enough to be of much use to teachers. It is for this reason (among others) that Larsen-Freeman (1990) has suggested that we need more than a theory of SLA, which focuses almost exclusively on language issues, but rather a theory of second language teaching which would include all issues significant for language teachers

In-depth, longitudinal studies focusing on the teaching of individual teachers report similar results. Clift (1992) followed one English teacher through her first two years of teaching. The teacher reported that the conceptions learned in her teacher education program did not seem to cover many of the situations in which she found herself. For example, "she found that she was not prepared to work with students who had not completed the reading assignment or to decide how much explanation to provide them…When we reviewed her course work at the university, she identified many experiences with the analysis of literature but none in which she examined how students come to engage in that process" (Clift, 1992: 368). Cohen (1990) looked at one experienced teacher and her attempt to use the concept of constructivist learning (acquired in an inservice workshop) to guide her teaching. He found that the teacher struggled to use this concept because of the superficial way she had learned it in the workshop. "[T]he framework's mathematical exhortations were general; it offered few specifics about how teachers might respond, and left room for many different responses" (Cohen, 1990: 313).

5.2.3 Different practices require different knowledge

Teachers engage in activities that are different from the activities of academics. "Teachers and scholars have different primary goals…These different goals require related but distinct understandings of the subject matter" (Grossman, Wilson & Shulman,

1989: 24-25). Bromme (1992) claims that while researchers define, investigate and solve problems, teachers are constantly involved with creating things: activities, materials, relationships, class atmosphere, etc. Furthermore, for teachers there is no "solution" to their questions and teachers are part of the process, rather than outside observers. If teachers are to take advantage of near transfer (i.e., transferring knowledge between two similar activities) then they need knowledge about engaging in teaching practices, not academic practices. In fact, in a study of 20 first-year elementary school teachers, Loughran, Brown and Doecke (2001) found that one of the reasons that these teachers found it difficult to use the knowledge gained in their teacher education program was the differences between the practices they had been taught in that program and the practices of classroom teaching.

5.2.3.1 Talking about vs. doing
One of the practices central to being an academic is *talking about* and debating issues. Generally academics are supposed to explain phenomena and their practice is judged by how well phenomena are explained. Teachers' practice, on the other hand, is centered around *creating instruction* rather than expressing or debating ideas about language and language learning. "[T]he way linguists conceive of their task is inherently different from the way teachers conceive of theirs. Linguists are concerned with the precise description of language and with its explanation. Teachers are concerned with the effective use of language and with its propagation" (Ellis, 1997: 31). For example, the EFL teachers in Appel's (2000) study reported that being able to *embody and represent* the target culture was more central to the practice of teaching than simply being able to *talk about* culture. Studies which use a variety of data collection methods have found that there is a difference between the conceptions teachers use when they *talk about* teaching (i.e., what questionnaire and general interview data reveal) and the conceptions they *use when teaching* (i.e., what observation and stimulated recall data reveal) (Foss & Kleinsasser, 2001; Wilson, Konopak and Readence, 1992; see also Bartels, 2004). "The teacher's responses seemed to reflect what should be done rather than what is done in her classroom" (Wilson, Konopak & Readence, 1992: 481). Foss and Kleinsasser (2001) used questionnaires, interviews and classroom observation to look at the conceptions of 22 novice elementary teachers had about teaching math. They found that when *discussing teachers' ideas in general*, their conceptions were similar to the academic ideas they had been exposed to (i.e., students need to learn how to reason about math problems, etc.). However, when *teaching* or *talking about* teaching, their conceptions were much more traditional. For instance, "teachers touted in their interviews the use of 'hands on' materials…The classroom presentation showed a different story. Only 4 of 22 presentations showed any signs of involving such materials" (Foss & Kleinsasser, 2001: 281-282).

Mangubhai and his colleagues found that ESL teachers' conceptions of communicative language teaching (CLT) which they used to discuss CLT in academic contexts were separate from the conceptions of CLT they used for their teaching. The teachers had:

> two conceptions of CLT. First, they hold a theoretical or academic conceptualization that has been constructed from study, readings and inservice courses on CLT…Secondly, they hold a practical conceptualization of CLT that is grounded in their classroom experience of this approach…*This is the conceptualization that directs classroom practice* (Mangubhai, Marland, Dashwood & Son, 2005: 58) [Italics added].

Focusing on the practice of *talking about* CLT may result in deficits for knowledge about *engaging in* CLT. Sakui (2004) investigated the CLT conceptions of 12 EFL teachers through interviews and observations. She found that when the teachers *spoke about* CLT in general, their definitions were similar to academic definitions, but when talking about *teaching CLT*, their versions diverged from academic positions. For example, they stressed that learners should guess grammatical meanings from context, but when talking about teaching, the teachers asserted that learners had to be taught grammar before engaging in communicative activities which required those aspects of grammar. "These data show that teachers' understanding of CLT is more semantic than conceptual. In defining CLT, they reported lists of features which included exchanging messages and self-expression, but their definitions lacked the coherence of a methodology incorporating goals, planning, and tasks" (Sakui, 2004: 160). In other words, these teachers had learned to *talk about CLT*, but not to *do CLT*. Similar deficits in teaching-specific knowledge of CLT have also been found in studies by Karavas-Doukas (1996), Andrews (2003) and Sato (2002).

The distinction between learning to talk about and to do CLT may explain the studies showing that SLTE programs were good at changing how teachers talked about teaching, but not how they did it. What that research may have measured is that teachers in SLTE programs learn the practice of how to *talk about* language and language teaching in new ways, but not the practice of *using knowledge* about language and language learning *to create lesson plans, guide interaction with learners, assess language learning, etc*. Thus, the central problem of teacher education may not be one of "theory" vs. "practice", but of academics' practice vs. L2 teachers' practice. When Schlessman (1997) argues that there really is no difference between theory and practice, she is right in the sense that "doing" theory *is a practice in itself*. Academic is not neutral, but rather vocational training for a specific kind of practice.

> Consider…what it is to engage in a theoretical practice like psychology, sociology or philosophy. To undertake any one of these pursuits is to engage in a distinctive social activity by means of specific procedures and skills and in accordance with the way of thinking and acting appropriate to the institutional setting in which this activity is pursued. Each of these ways of thinking and acting incorporates an interrelated set of beliefs and assumptions providing rules and maxims which operate both as instructions about how events and situations are to be interpreted and as prescriptions about how to proceed if one's practice is to be interpreted by others as the practice of a theoretical activity of a particular sort (Carr, 1986: 178).

Thus, when Clarke (1994) talks of "theory" being considered more important than "practice", he may be referring to academic practices (explicit explanation and discussion of general ideas, use of external data, etc.) which are considered superior to teachers' practices (knowledge-in-action and reliance on internal data).

5.2.3.2 Gaining knowledge
Because they engage in different activities, teachers and academics have different ways of gaining and using knowledge for their practice. For example, in a study of three language teachers and three language researchers (Bartels, 2003), the researchers viewed the purpose of knowledge as helping to build a public knowledge base about language and language learning. The teachers, on the other hand, felt that the purpose of knowledge was to enrich and improve their own, personal knowledge bases. Furthermore, the language teachers decided to accept or reject information based on how well it explained their own personal experience in language learning and language

teaching, in other words they were relying on their internal knowledge; whereas the researchers relied on external knowledge sources such as statistics, descriptions, research designs, etc. Ironically, when one of the researchers took on the role of teacher in explaining her own practice as a teacher of graduate students, she relied on her internal data for validation, just as the language teachers did (Bartels, 2003).

Cognitively, both of these practices make sense. Teachers have lots of internal, experiential knowledge (or data) on language learning and huge time pressures, but little pressure to achieve extremely exact answers to the questions or to communicate their findings. Therefore, relying on a quick and roughly accurate comparison with their internal data fits well with the requirements of their practice. Researchers, on the other hand, have far more time to search for answers, but have much greater pressure for accurate and public answers and typically lack the extensive internal data of experienced language teachers. It makes sense for them to rely on external data because (a) this provides more accurate and communicatable findings and (b) they do not face the kinds of time pressures that teachers face. (They do have their own time pressures, but these are far more lenient than the day-to-day and moment-to-moment time pressures that teachers face.) Kennedy frames this in terms of how each occupational group deals with uncertainty: "the problem, then, has more to do with how each group tries to cope with uncertainty. For researchers, it is a matter of improving study designs, checking and verifying, and replicating. Certainty comes about through intellectual processes. For teachers, certainty is often achieved by creating predictability within the classroom" (Kennedy, 1997: 6).

5.2.3.3 Participating in public discourses
Some academics have claimed that SLTE programs should apprentice L2 teachers into academic practices, for example how to participate in academic discourse by learning to write like academics (Ramanathan, 2002). It is said that this is necessary so that teachers can access and contribute to the professional debate on language and language learning (Wright & Bolitho, 1997; Tyler & Lardiere, 1996; Hedgcock, 2002; Ramanathan, 2002). "To deny classroom access to the genres of power in favor of local knowledge, folk discourses – or even those insights based solely on reflective teaching – would place teachers and learners at a distinct disadvantage relative to their counterparts who are exposed to the broader ideological context of their education" (Kinginger, 2002: 196).

There are several problems with this argument. First, it demands that a central goal of SLTE is to teach practices which are peripheral to L2 teaching. The practice of writing for academic genres is something few teachers do (Burns, 2005; see Smargorinsky, 1995, for extended discussion). It is not part of what is seen as teachers' practice and is not recognized or rewarded as such (Crookes, 1997). In addition, teachers generally do not access academic material once they have left university programs (Block, 2000; Gitlin & Burbank, 2000; McDonough & McDonough, 1990; Zeuli, 1994).

> Informal contacts over the years with teachers of a number of languages in a number of contexts reveals that few, if any, regularly read articles in journals such as Language Learning, Studies in Second Language Acquisition (SSLA) and Second Language Research…even those who have completed MA programmes generally do not keep up with reading of academic material upon their return to full-time employment (indeed, many never really start to read such literature with any consistency in the first place!) (Block, 2000: 130-131).

The reason that teachers do not generally read academic genres is that they do not find the investment of time and effort that this practice requires to be worth what they get out of it, which suggests that such practices are not central to teaching (Kagan, 1993a, 1993b; Gitlin & Burbank, 2000, Bartels, 2003). "Teachers'...criticism is not that research doesn't try to be practical, doesn't have practical goals, but rather that when put into practice research doesn't achieve these goals…Teachers' criticism of research...[is] centered on the claim that doing research is an ineffective way to keep up and know what is happening in the classroom" (Gitlin & Burbank, 2000: 6).

Second, training in academic language does not guarantee access to public academic discourse. Not only do teachers with MA degrees often have difficulty understanding academic articles (McDonough & McDonough, 1990, Macrory, 2002; Bartels, 2003), many professors have difficulty understanding literature within their own subject area which uses a different perspective than they are used to, for example cognitive psychologists reading literature on situated learning (Clancey, 1993; Kirshner & Whitson, 1998).

Finally, it is a stretch to call academic literature "genres of power" outside of the university setting (and most L2 teachers work outside of the university setting). Academic research and theory play little role in the organization of schools and academic findings are routinely ignored by those making educational and language policy (Bartels, 2003; Kagan, 1993a; Zeuli, 1994; Schocker-von Ditfurth, 2001). Academic genres are most powerful within SLTE programs where academics are the gatekeepers to degrees and certification, not in actual teaching contexts. In university settings teachers can be punished for not becoming proficient in academic language and academic practices with lower grades and negative feedback on their work. For example, Morris and Cobb (2004) studied the relationship between acquisition of academic jargon and grades novice teachers received in their SLTE program. They found that the more proficient teacher students were in academic language, the better grades they received, suggesting that SLTE students are assessed, at least partially, for picking up academic discourse rather than their proficiency in L2 teaching.

Furthermore, it is not just teachers who do not find engaging in the academic literature in their area to be central to their practice. Other professional groups also rely on knowledge gained in their specific contexts rather than from academic contexts. Morrow-Bradley and Ellist (1986) reported on a survey of 384 psychotherapists (response rate: 73%). Only 10% of those psychotherapists reported research articles and books (i.e., general, industry-wide knowledge) as one of their primary sources of professional information. Instead, experience with clients (i.e., knowledge specific to practice of individual psychotherapist) was by far the most common source for informing their practice. In addition, Morrow-Bradley and Ellist reviewed research showing that psychotherapists do not see research knowledge as being specific enough to help their practice. For example, they feel that research rarely addresses research questions which are relevant for clinical practice, that the variables included in studies are different than the variables the therapists encounter in their own practice, and that research focuses on group behavior while therapists focus on individuals, etc. In addition, Patel, Groen, and Scott (1988) found that in memory experiments doctors performed like other experts in terms of clinical knowledge, but not in terms of bio-science knowledge. In addition, while recall performance of clinical knowledge improved dramatically from the beginning to the end of clinical training (40% to 65%), recall performance of science

knowledge did not (36% to 40%). They interpreted this as evidence that doctors rely on specific clinical knowledge rather than more general bio-science knowledge when diagnosing cases. "Basic science does not provide the axioms, the analogies, or the abstractions required to support clinical problem-solving" (Patel, Evans & Groen, 1989: 120).

5.3 All practitioners rely on practice-specific knowledge

Research in other areas of human activity show that each such area engages in practices specific to their field. For example, Hativa (1995) compared the instruction in two courses on the same subject: quantum physics. The courses had similar prerequisites, played similar roles in their programs, and but were for different majors: one for physics students and one for engineering students. Hativa found that each instructor emphasized very different activities in their courses.

> The physics professor emphasized the importance of understanding how the techniques presented were arrived at, how they were derived mathematically, why they were correct, and how to use them effectively for certain computations. The engineering instructor, on the other hand, emphasized the importance of understanding how electronic devices work in order to be able to make these devices. He deemphasized the need to fully understand how the formulas were derived mathematically or physically and instead emphasized the importance of when (in what cases) and how to use them (Hativa, 1995: 25).

Even though they are both teaching the same basic subject, each professor was teaching his students a different practice. Thus, to be a physicist one needs to learn how to investigate the validity of mathematical formulas describing physical phenomena, while to be an engineer, one must learn to use such formula to design devices (but not waste time with investigating the formula itself). Obviously, while each of the specific practices would draw on a common knowledge base, knowledge specific to each of these practices would be needed for someone to become proficient in one. For example, Hativa found that while both courses used around the same number of specialized terms and concepts during instruction, the physics lesson relied heavily on knowledge from prerequisite courses in physics and mathematics (50% of the specialized vocabulary), the engineering lesson did not (only 10% of specialized vocabulary). This suggests that while physics and mathematical knowledge is important for learning from the engineering lesson, they are not as central to that practice as the practice focused on in the physics lesson.

Similar findings were reported by Patel, Groen and Arocha (1990). They looked at how doctors and medical researchers diagnosed medical cases in and outside their area of expertise (cardiology and endocrinology). They found that the researchers relied primarily on bio-medical information and tried to build a full, detailed picture of the case. The doctors, on the other hand, relied primarily on clinical information and used this to rule out possible alternatives, rather than describe fully any possible condition. Patel and her colleagues also found that the doctors used more case information when they were working on a case outside of their area of expertise, while the researchers did the opposite. This makes a lot of sense given the professional goals of the two groups. Ruling out alternatives is highly cognitively efficient because it allows doctors to focus on one possibility at a time, which reduces the amount of information that needs to be processed in working memory, compared to building a full model of the clinical situation, and thus avoids problems with the cognitive bottleneck. Doctors need to treat a

condition, so if they can obtain the information they need to treat the patient by ruling out alternatives; they do this and cease their investigation. To continue would be a waste of cognitive resources that could be used for other purposes, such as working with the next patient. Obviously, when working outside of their specialty, they would need to go through more information before being able to rule out all alternatives. Researchers, on the other hand, have very different goals, mainly to publish research. Therefore, they need to obtain enough information to give a full picture, so that a wide variety of readers will find the particular details they are interested in. The cognitive bottleneck is not as much of a problem for researchers as they usually have time to build their model of the situation and the process of writing allow them to add aspect after aspect to their written description of the case, which also reduces the cognitive load.

5.4 Activity-specific knowledge is a central component of human cognition

One of the major finds of studies of human expertise is that one central factor which differentiates experts from non-experts is a specialized knowledge base specific to the activity in which they hold expertise (Gruber & Mandl, 1996). "Expertise seems to be very specific. Expertise in one domain is no guarantee of expertise in other areas" (Glaser, 1986: 922). For example, chess experts are no more intelligent than good chess players (Djakow, Petrowski, & Rudik, 1927) and professional mathematicians are not any better at algebra that above average college students (Lewis, 1991). One set of evidence that has led psychologists to conclude that expertise relies primarily on activity-specific knowledge (more commonly referred to as domain-specific knowledge) consists of memory studies comparing experts and novices in a particular field. As mentioned in the third chapter, experts exhibit remarkable memory capacity within their domain but not outside of it. For example, when briefly shown (5 seconds) a picture of a chess board from the middle of a normal match, chess grandmasters are much better than chess beginners at recreating the exact position of all the chess pieces on the board. However, this is not due to a general ability to remember the position of chess pieces; when the pieces are randomly placed on the board, chess masters do no better than chess novices (de Groot, 1965; Chase & Simon, 1973; Charness, 1976; Saariluoma, 1989; Schneider, Gruber, Gold & Opwis, 1993). The explanation for chess experts' superior memory ability is simply that they have a vast store of knowledge about chess positions. When looking at a picture of a chess board a novice sees 32 pieces (or less if some have been taken), whereas an expert will see a limited number of defensive and offensive formations. While trying to remember the places of 32 different figures is extremely difficult, remembering the position of 3-5 formations is not, which is why experts perform so well on such tasks. Similar results have been found with experts in electronics (Egan & Schwartz, 1979), computer science (McKeithen, Reitman, Rueter & Hirtle, 1981), the card game of bridge (Charness, 1979), reading music (Slobada, 1976), TV soap operas (Reeve & Aggleton, 1998), playing basketball (Allard, Graham & Paarsalu, 1980) and watching baseball (Walker, 1987).

Moreover, these memory effects are only evident for aspects of an activity centrally important to that practice, indicating that expert knowledge is practice-specific, not general. Chess masters were no better than novices in reconstructing random chess pieces (de Groot, 1965), musicians are superior in remembering melodies judged to be "good" but not for melodies judged "bad" (Halpern & Bower, 1982), and volleyball players show no superior memory for positions of volleyball players, but are much quicker to spot the ball in photos of volleyball games (position of the ball, but not the

players, is the key factor in high-level volleyball) (Allard & Starkes, 1980). Doctors remember more critical cues than medical students in medical cases presented in ways typical for the medical profession. However, when case information is presented randomly, doctors' recall of information declines significantly, but not the recall of medical students (Coughlin & Patel, 1987). In studies of teaching, Sabers, Cushing and Berliner (1991) found that experienced teachers remember oral information better than novices, but not visual, indicating that they have developed sophisticated schemata for audio cues students give: whispers, coughs, pauses, snickers, rustling of paper, etc. In addition, Bromme (1989) found that the teachers in his study remembered student comments better if they felt these were important for that class: "student contributions were remembered when they had a strategic value" (Bromme, 1989: 217).

Furthermore, experts' use of forward reasoning (starting with the evidence and working towards a solution) and novices' use of backward reasoning (postulating solutions and seeing if they fit the evidence) also support this position. The thought is that experts use their large accumulation of domain-specific knowledge to build a detailed representation of the problem and possible solutions to the problem. Lacking the knowledge to build a full representation of the problem, novices start with possible answers and try to see which fits the evidence (Patel & Groen, 1986; Larkin, McDermott, Simon, & Simon, 1980, Sweller, Mawer, & Ward, 1983). This is further supported by research showing that experienced doctors use forward reasoning when working in their specialty area, but backwards reasoning when diagnosing problems in a different medical area, indicating that expertise can be very specific (Patel, Groan, & Arocha, 1990). Studies of individual history and ESL teachers working outside of their areas of expertise have found similar results (Wineburg, 1998; Burns, 1996). All this research points to the conclusion that a large part of expertise is a wealth of specific knowledge about the task that is to be performed, rather than general knowledge or abilities.

Domain- or activity-specific knowledge is particularly effective for humans because it helps us to avoid the cognitive bottleneck. When we see a piece of furniture we recognize it as a chair not because we are following general rules about what a chair is but because we have an extensive data base of specific chairs we have seen throughout our lives and we can recognize the piece of furniture as being similar to exemplars of this group. Similarly, domain-specific knowledge allows us to simply recognize a situation as being similar to other such situation, (e.g., off-task activity by the two boys on the left or problems an L2 student is having with the use of auxiliary verbs in question formation) instead of having to use working memory to conceptualize and work through different interpretations of a situation. "[E]xperts' superior need, perception, and memory were *domain-specific* and reflect acquired complex cognitive skills. These skills allow the experts to circumvent limits imposed by general capacities, *but only for activities with the corresponding domain* of expertise" (Ericcson, 1996: 28) [emphasis added].

5.5 Understanding concepts means knowing what the concepts mean in specific instructional contexts

Practice-specific knowledge is also important because understanding a concept requires a depth of knowledge of what that concept means and how it is used in specific contexts. This is especially true in terms of teaching: "ideas about the nature of educational theory are always ideas about the nature of educational practice and always incorporate a latent conception of how, in practice, theory should be used" (Carr, 1986: 177). Being able to

give an explicit description of a concept does not mean that you know how to use it for teaching. "Simply knowing that metaphor can be a useful pedagogical tool, for instance, does not go far in helping beginning teachers select helpful and appropriate metaphors for teaching specific topics" (McDiarmid, Ball & Anderson, 1989: 195). Consider the following excerpt from a Monty Python sketch of a TV program called "How To Do It":

> Alan: How to play the flute. (*picking up a flute*) Well here you are. You blow there and you move your fingers up and down here.
> Noel: Great, great, Alan…
> (Chapman, Cleese, Gilliam, Idle, Jones, & Palin, 1989: 63-4)

While this does distinguish playing the flute from playing the violin, it is a fundamentally superficial conception of "playing the flute" and includes none of the detailed information one would need to actually learn how to play the flute. In the same vein, to really know a concept such as "negotiation of meaning" or "ZPD" would mean that one would know what these conceptions mean in specific contexts. Without being able to recognize such concepts in terms of teaching practice, activities, and assessment tools, one cannot be said to really know these concepts. Instead, this would be indicative of a superficial conceptual knowledge similar to Alan's knowledge of playing the flute.

Unfortunately, a growing body of research shows that the conceptions learned in teacher education are relatively superficial. While teachers learn to discuss academic conceptions in SLTE programs, they may not learn what these concepts mean in terms of teaching or what (in detail) these conceptions can be used for in teaching (Leinhardt, 1988; Mandl, Gruber & Renkl, 1996). "There is also a strong likelihood that even if novices are persuaded by their faculty's ideas and are persuaded to adopt a different frame of reference to thinking about teaching, they will not know what actually to do to enact these new ideas" (Kennedy, 1999: 71). Studies of teachers who have attended teacher education programs stressing constructivist approaches to teaching show that after leaving the programs, these teachers still had little idea of what constructivist concepts meant in terms of everyday teaching activities such as planning, instruction and assessment (Cook, Smagorinsky, Fry, Konopak, & Moore, 2002; Smagorinsky, Gibson, Bickmore, Moore, & Cook, 2004; Smagorinsky, Lakly, & Johnson, 2002). Kyraicou and Cheng (1993) looked at 16 novice teachers' views of humanistic teaching. While their answers to a questionnaire indicated they held strongly humanistic conceptions of teaching, subsequent interviews about their answers revealed that they had little idea what such views would mean for teaching.

> [S]tudent teachers generally held positive attitudes towards the humanistic approach, but during their teaching practice there was an evident recognition of a distinction between holding such attitudes as 'ideals' and the difficulty, or even inappropriateness, of such attitudes being reflected in their actual behaviour when constrained by the constraints and realities of classroom life (Kyraicou & Cheng, 1993: 163).

A further problem with this situation is that it may lead to frustration on the part of teachers who wish to use academic concepts they have learned in teacher education in their teaching, but find they do not know what the conceptions mean in practice. For example, Spalding (1997) studied one beginning English teacher. The teacher began the year firmly focusing on the academic content of the class. However, she found that she did not know how to implement this approach without causing major problems with class management and student-teacher relationships. Therefore, "Celia shifted her focus from literature to the well-being of the 'whole child.'… But in restructuring her teaching to

meet her student's needs, her own needs for intellectual stimulation and innovation were not being met. Although her students appeared to be thriving in her classroom, Celia was not" (Spalding, 1997: 184). After this year the teacher was strongly considering leaving the profession.

Research on SLTE also shows a lack of sophisticated knowledge in terms of teaching. For example, while many teachers may have a general idea of the role of communication in L2 teaching, studies have shown that teachers are often not able to distinguish communicative from non-communicative activities. Mitchell (1988) interviewed 59 foreign language teachers and found (a) a wide variation in their ability to explicitly define "communication" and (b) an inability to make clear distinctions between activities involving communication and those not. Nunan (1987) interviewed and observed lessons of five ESL teachers. In the interviews the teachers showed solid conceptual knowledge of communicative language teaching (CLT). The lessons observed also seemed, at first glance, to be examples of CLT in practice. Nunan discovered, however, that "in terms of the patterns of classroom interaction, there was little genuine communication between teacher and student (or for that matter, between student and student). There was also a great deal of 'traditional' language work" (Nunan, 1987: 141). Sakui (2004) interviewed 12 EFL teachers and then observed 3 of these over a school year. She found that when discussing general principles, the EFL teachers' conceptions of CLT seemed very similar to academic definitions. However, their practice revealed very different understandings of CLT. For example, one of the ideas underlying CLT is that through interaction in the target language learners will notice and acquire grammatical knowledge. The teachers, while valuing communication, felt that the EFL students needed to be taught all the grammar needed before engaging in communicative activities; a direct contradiction to CLT principles. In addition, Karavas-Doukas (1996) investigated 37 ESL teachers' conceptions of CLT. She found that the teachers agreed with the general principles of CLT in the questionnaire. However, when observing their teaching, she found that the activities they chose most often did not represent the CLT principles that the teachers referred to. Furthermore, detailed study of the questionnaire answers revealed that many teachers agreed both with items that argued for a certain CLT principle as well as items that argued against that same principle. This indicates that the teachers; knowledge of CLT was superficial. "This lack of understanding, or confusion, was also verified in interviews held with the teachers , where teachers either did not understand or were not able to see the practical implications of many of the principles of the communicative approach" (Karavas-Doukas, 1996: 193).

Teacher educators also seem to have the same problems with deficient conceptual knowledge. In a study mentioned in Chapter Two, Foss (1997) did a case study of a beginning teacher educator. The teacher educator was committed to teaching according to her concepts of constructivism. Although she had an extensive knowledge of constructivism from her doctoral studies, she did not know what activities and types of classroom interaction would achieve this and result in student learning and cooperation. Frustrated by her inability to use her conceptions of constructivism, the teacher eventually switched to a more traditional mode of teaching. Presumably she was able to do this because she had a deeper understanding of traditional teaching, having experienced it for thousands of hours as a student in her *apprenticeship of observation.* Wideen, Boote and Mayer-Smith (2000) did case studies of four teacher educators. These teacher educators all had conceptions of what they wanted to do in class, but, unfortunately, their conceptions were not detailed enough to guide them in actually

teaching their classes. Attempts to change their practice over years were unsuccessful. For example, they concluded the following about one teacher educator: "Over the years Bill has found himself increasingly frustrated and confesses to having few solutions as to how to work with preservice teachers in a manner that will move them to change their views...he expressed concerns about not knowing how to engage beginning teachers in ways that would help them change their views about teaching" (Wideen, Boote & Mayer-Smith, 2000: 4).

A number of studies show that even when teachers and researchers agree on something, each will interpret the idea differently according to their specific domain of knowledge. Minnes-Brandes and Seixas (1998) described a meeting of high school teachers and university academics who met regularly to discuss new developments in the humanities in order to develop an integrated curriculum for the humanities. They reported that there was a conflict between the two groups as to what sort of knowledge they should be focusing on in the meetings. The academics wanted to focus on general concepts and "the basics" of their subjects; the teachers wanted to focus on curriculum, activities and lesson plans. In addition, Morris (1984) conducted a survey of 118 Hong Kong high school Economics teachers. He found that although the teachers agreed with the general ideas behind the new curriculum reform, which had been formulated by university academics. However, when presented with specific classroom activities (developed by academics) incorporating the new curriculum, the teachers disagreed that such activities would help their students learn. In a slightly different study, Allen (2002) surveyed almost 3,000 foreign language teachers. The data revealed differences between how teachers and academics understood the implementation of new standards for foreign language teaching.

In summary, knowledge of what concepts mean in terms of situated practice is necessary for sophisticated knowledge and understanding of concepts. Teachers have consistently made it clear that they expect and desire these kind of detailed conceptions by consistently asking for information about what concepts mean in terms of specific teaching techniques or explanations of "what to do on Monday" (Calderhead & Shorrock, 1997; Christ, 1990; Crookes & Arakaki, 1999; Kagan, 1993a; Kerekes, 2001; Popko, 2005). Occasionally this has been interpreted as teachers rejecting academic conceptions. "Empirical evidence has substantiated anecdotal reports that pre- and inservice teachers tend to resist theory and scholarship. Rather than viewing academic inquiry in LT-related fields as useful, practicable, or applicable, candidates may *resist theory*, arguing that *what they need the most is to develop practical skills*" (Hedgcock, 2002: 300) [emphasis added]. Based on the evidence presented here, a more likely explanation is that such calls for specific techniques and activities represents a legitimate request for the kind of information that would allow them to develop a full and sophisticated knowledge of the concepts being looked at.

5.6 The importance of local knowledge

Teachers need practice-specific knowledge because local, contextual factors are central to teachers' decision making. For the nine elementary ESL teachers studied by Sharkey (2004), knowledge of specific teaching contexts, played a central in their professional cognition, for example in defining the needs of their program. "The teachers used their knowledge of context to define and articulate their needs and concerns regarding the curriculum. In this way, the teachers grounded the curriculum in specific challenges and

issues facing ESOL teachers in Millville" (Sharkey, 2004: 291). For example, making it easy for ESL students to switch schools in the district (and, thus, switch ESL classes) and to move into mainstream classes with little disruption to their language and academic development were two of the central issues in developing and implementing the curriculum. Carless (2003, 2004) observed and interviewed three secondary EFL teachers' use of task-based teaching. He found that implementation depended more on contextual factors, such as EFL students' L2 proficiency or the current topic in their textbook. This indicates that teachers' knowledge needs to be contextualized in terms of the teachers' practice in order to be useful. In Duffy and Anderson's (1984) 4-year study of 24 elementary school teachers' literacy instruction, it was found that knowledge about context influenced teachers' decisions more than general ideas about reading. "The teaching context seems to be more powerful than any particular theoretical belief. For instance, conceptions tend to change if the grade level and/or the ability of the pupil(s) being taught changes…[For instance] instruction appeared to be based more on the basal textbook than on the espoused reading theory" (Duffy & Anderson, 1984: 102). Similar findings were reported by Richards, Gipe and Thompson (1987) and Hoffman and Kugle (1992). Smagorinsky and his colleagues studied one novice elementary teacher during student teaching (Smagorinsky, Gibson, Bickmore, Moore, & Cook, 2004). They found that although the teacher had general ideas (such as student-centered teaching), it was the teachers' knowledge (or lack of knowledge) of what these general ideas meant in actual classroom interaction, given the constraints of the classroom, which determined how she taught.

Specific knowledge of teaching contexts is also important for language teachers. Holliday (1996) found that expatriate teachers in an Egyptian university struggled in teaching in traditional smaller classes (15-25 students) compared to their Egyptian counterparts because they lacked knowledge of the specific culture of such classes within that context. However, in newly instituted classes of over 50 students, the expatriate teachers had less trouble than the Egyptian lecturers because they had knowledge of teaching such classes while their colleagues did not. Borg (1998; 1999a) found that, in order to decide when and which grammatical terminology to use in instruction, the EFL teachers in his studies mainly used knowledge of a range of local situational, institutional, and interactional factors, rather than general knowledge about language and language learning. A survey of ESL and EFL teachers by Eisenstein Ebsworth and Schweers (1997) found that ideas about grammar teaching were specific to the contexts in which teachers worked, in part due to the role of L2 teaching in that context. Several studies have reported that EFL teachers who learn general conceptions about language learning and teaching in academic contexts are not able to use this knowledge in local, non-western contexts because they lack knowledge of what those concepts mean in terms of practice in their specific context (Kennedy, 1996; Lo, 2005; Shamim, 1996).

This is one reason why teachers' knowledge needs to be situated in the activity and contexts of teaching (Freeman & Johnson, 1998; Roberts, 1998). "The activity in which knowledge is developed and deployed, it is now argued, is not separable from or ancillary to learning and cognition. Nor is it neutral. Rather, it is an integral part of what is learned" (Brown, Collins & Duguid, 1989: 32). For example, Anders (1995) engaged in a longitudinal study of one elementary teacher's teaching of mathematics. One of her findings was that the teacher's knowledge of mathematics was not separate from teaching, but was integrated into her knowledge of teaching, the students, and her school. "Mrs. G rarely spoke about content in isolation from students. This suggest that content

is not 'free-floating'; rather, it is embedded in classroom events" (Anders, 1995: 321). Gess-Newsome and Lederman observed ten novice biology teachers reorganizing their knowledge during the teaching practicum. They concluded that "it may be impossible to view subject matter as separate from the manner in which it is, or will be, used" (Gess-Newsome & Lederman, 1993: 39).

Knowledge of specific constraints (what is difficult to do and why) in a particular situation is another set of specific knowledge which is vital for teaching. While many teacher educators see local constraints as barriers preventing teachers from carrying out "good" ideas; Long (2004) suggests that they are factors which need to be taken into account in any presentation of subject matter. She recommends that knowledge of how to deal with such constraints needs to be provided in teacher education programs. The two teacher educators in Kagan's (1993a) study also considered local constraints on teaching to be a side issue (mainly concerned with how to implement general, academic knowledge) and not important for teaching. The two teachers in the study, however, saw knowledge of constraints on teaching to be central to their knowledge of teaching. Laura, one of the teachers in Kagan's study said "Beth [a teacher educator] alludes to pressures from policies and other constraints, but she seems to pass these off as relatively minor obstacles for teachers to overcome. There are very real expectations for performance that teachers must acknowledge…By denying the importance of meeting those expectations, Beth may be giving her methods students an unrealistic picture of what a teaching career will demand of them" (Kagan, 1993a: 67).

Studies have consistently pointed out the importance of local constraints for teaching (Appel, 2000; Burns & Knox, 2005; Clarke, 1994; Duffy & Roehler, 1986; Gitlin, 1987). For example, Xiao (2005) found that teachers of Chinese could provide clear feedback on learners' character writing if given plenty of time, but they were not able to provide adequate feedback in the time available during actual classroom teaching. Duffy & Roehler (1986) studied the literacy instruction of 11 elementary school teachers. They found that what the teachers could do in the classroom was constrained by the goals of the curriculum, the expectations of the school administration and students, the classroom routines that students were used to, as well as the regular cognitive limitations of elementary school students. For instance, the teachers had problems explaining reading strategies to the children because their teacher education program did not provide them with training or examples of explaining such strategies to elementary age students. One example of the importance of knowledge of constraints is shown by a study by Lam (2000). She studied the non-use of computer technology by ten L2 teachers. Until that time it had been assumed technophobia was the reason that teachers did not use such technology resources. The study showed, however, that teachers did not use technology because they lacked the knowledge of how to use technology given the constraints of their facilities, the needs of their students, and their limited knowledge of technology.

5.7 Acquisition of practice-specific knowledge

As was shown in the previous chapter, implicit knowledge is acquired by actively participating in activities relevant and central to the practice being learned. People seem to acquire knowledge that is important for the practice or activity involved. Therefore, practice-specific implicit knowledge is learned by participating in activities where such detailed, context and teaching-specific information is available as well as necessary for participating in the activity. Tasks such as deciding whether to recast a problematic

student utterance given (a) the aims of that particular activity, (b) the objectives of the class or unit, (c) information on past utterances by that student, and (d) the time limitations available to teachers in such situations would likely result in such practice-specific implicit knowledge. Reading a research article would not, although it could very well result in practice-specific implicit knowledge of reading academic articles or the structure of conducting such research. The former task is similar to the processes of teaching, so it would seem to only require near transfer while knowledge acquired by participating in the latter task would require far transfer to be used for teaching.

5.8 Conclusion

As mentioned in the second chapter, Larsen-Freeman (1993) has made clear that it is not possible for SLTE programs to provide L2 teachers with the specific knowledge for teaching in all of the teaching situations they might find themselves in. For a long time the answer to this problem has seemed to be that SLTE programs should provide teachers with abstract knowledge about language and language teaching because such general knowledge would not be limited to particular teaching contexts. However, the research presented here indicates that teachers need and use situated practice-specific knowledge. Academic knowledge cannot fulfill this function because teachers' knowledge is different from knowledge of academic fields. On the one hand, only a portion of academic knowledge is useful for teaching; on the other hand, teachers draw on significant kinds of knowledge not included in academic fields of study. Teachers' and academics' also engage in practices which are different, and different knowledge is required for different practices. For example, while *talking about* language and language learning is a central practice of academics, *doing* things with such knowledge to help learners acquire language is central to teachers' practice.

Furthermore, evidence suggests not only that other kinds of practitioners rely on knowledge specific to their practice, but also that such practice-specific knowledge is central to competence and expertise in any kind of human activity because such knowledge is cognitively efficient. For example, if a teacher has knowledge of a number of communicative activities and how they worked with a class of 7th grade EFL students in Germany, then recalling and adapting one of those activities requires far less explicit processing than trying to invent an activity from an explicit explanation of communicative language teaching. In addition, using knowledge of specific communicative activities in deciding whether a new activity is communicative or not requires little explicit cognition because it involves near transfer. The same process using only a general description of communicative activities would require far transfer and significant amounts of scarce explicit processing capacity. Two other factors point to the practice-specific nature of teachers' knowledge. First, teachers need such practice-specific knowledge to develop sophisticated knowledge for teaching. Understanding content based instruction (CBI) means knowing specific CBI activities, how they are developed in classrooms, how they fit in with larger institutional objectives, how different kinds of L2 students respond to such activities, etc. Second, teachers' decisions are based to a large extent on factors specific to their particular contexts and students, not on general principles or issues. The practice-specific implicit knowledge that teachers need is acquired when participating in activities where such detailed, context and teaching-specific information is available as well as necessary for participation. Thus, there is a significant amount of evidence that (a) reliance on practice-specific knowledge is a general phenomenon in human cognition, (b) that teachers rely on knowledge which

is specific to the activities they engage in and the contexts in which they engage them, and (c) teachers (and other humans) cannot easily use general knowledge to guide their practice. However, there is little research which shows whether and to what extent L2 teachers would use such knowledge for teaching if they were provided with practice specific knowledge in SLTE programs.

That teachers need practice-specific knowledge does not solve the problem that Larsen-Freeman (1983) put forward. If teachers need such specific knowledge, how can SLTE programs prepare them for all the different teaching contexts and situations which they might find themselves in? One hypothesis is that teachers need a solid knowledge base of specific, situated exemplars of a particular idea. If the teacher has a wide variety of exemplars, then she will be able to recognize a new situation as being similar to another situation where the idea was used and then she will only require near transfer to figure out how to use that idea (Anderson, Reder & Simon, 1996). In other words, if a teacher has extensive experience with CLT in elementary ESL, adult EFL, and high school EFL classrooms, then using figuring out how to use CLT in middle school ESL classrooms will not be that difficult. Other factors which will help prepare teachers for a variety of situations will be explored in the next chapter.

Chapter 6: Dynamically Linked Practice-Specific Implicit Knowledge

Teachers' knowledge is specific to their practice. Nevertheless, how their knowledge is organized is just as important as the amount of knowledge a teacher possesses. A well organized knowledge base helps teachers match student cues or their instructional agenda with options for action automatically without demanding much of their scarce explicit processing capacity. However, teachers' knowledge organization is different from the organization of explicit, academic knowledge. Instead of general conceptions which account for all relevant factors, teachers rely on a dynamic network of practice-specific knowledge, which allows teachers to continually construct interpretations of student behavior, instructional goals and other classroom issues as activities unfold in the classroom. As efficient users of their cognitive capacities, teachers do not construct full models of the situation, but rather they use only as much knowledge as necessary to create temporary, on-the-spot understandings of key issues and options at hand. The better a teachers' knowledge is organized into such a practice-specific network, the easier it is to create these on-the-spot conceptions of classroom issues. This answers the dilemma posed by Larsen-Freeman (1983) that SLTE programs cannot provide teachers with the specific knowledge for teaching in all situations. If teachers have a well organized network of knowledge based on a wide variety of context and practice specific knowledge, this will allow them to create such on-the-spot understandings of practice for teaching contexts they have not been prepared for. Such a network is acquired by participating in teaching-similar activities which focus on comparing, contrasting and linking knowledge. Teachers also acquire such knowledge by engaging in deliberate practice activities, meaning activities which they design for the purpose of adding to and enriching their knowledge for practice. Although explicit, academic knowledge is not *the goal* of these processes, it can be helpful. Academic knowledge can (a) help scaffold acquisition and link practice-related knowledge and (b) help teachers generate feedback about their performance in the practice task. Academic knowledge, therefore, can be an important tool for helping acquire the kind of implicit, practice-specific, dynamically organized that teachers need.

6.1 Introduction

The previous chapters looked what kinds of knowledge are useful for teachers. This chapter addresses the question of how such knowledge can be acquired in SLTE programs. I will begin the discussion of what qualities of learning experiences in SLTE are more likely to encourage novice teacher learning by summarizing findings already discussed in detail in previous chapters of this volume.

6.2 Practice specific knowledge organization is important

The amount of actual knowledge teachers have is important, but how this knowledge is organized is also crucial (Kagan, 1988; Ericsson, 1996; Bereiter & Scardamalia, 1993). "Professional knowledge consists of not only the quantity of information a teacher possesses, but of how that information is organized" (Kagan, 1988: 498). Knowledge of the article system in English is not much help to a teacher if this knowledge is not connected to explanations, representations, activities, and routines which can be used to teach this aspect of the English grammar. Knowledge organization is also cognitively efficient. When knowledge is organized, then information (such as a student response or textbook activities) is automatically recognized as belonging to a particular category (i.e., as a type of student response or type of textbook activity), which triggers schemata explaining the response and suggesting possible courses of action. Such activation of schemata would not require working memory and, thus, avoids the cognitive bottleneck (Ericsson, 1996; Bruer, 1993).

6.2.1 Experienced teachers have more organized knowledge

Evidence of the importance of knowledge organization comes mainly from studies which show that the knowledge of experienced and expert teachers is more organized around the practice of teaching than the knowledge of novice teachers. For example, in Tsui's (2003) study of four EFL teachers of various levels of expertise, she found that one thing that distinguished the most expert teacher in the study from the less expert teachers was knowledge organization. For example, the expert teacher designed tasks which met several diverse goals at once, while less expert teachers only focused on one goal at a time. The eight experienced teachers in Woods' (1996) longitudinal study also exhibited a high level of organization between their conceptual and procedural knowledge in that recognition of ESL student cues triggered appropriate routines and actions. Clarke and his colleagues studied three teachers who had very different teaching approaches but whose students showed high levels of achievement (Clarke, 2003). They found that the expert teachers in their study were not successful because of the use of particular methods, but because of the cohesiveness of their knowledge and their instruction. They concluded that the teachers were more successful than other teachers because each activity they used directly related to other activities and to central goals for their instruction.

Further evidence that knowledge organization is important is the finding from a number of studies that the knowledge base of experienced teachers is much more organized and integrated than beginning teachers. For instance, Borko and Livingston (1989) observed the teaching of 3 experienced and 3 novice teachers and interviewed them before and after the observed class. They found that while the experienced teachers' comments were organized around a few specific issues (student understanding of material and the extent that students were active in the lesson), novices commented on almost any aspect of teaching without any noticeable organizational principles. Westerman (1991) studied five expert teachers and five novices using a variety of data (planning interviews, observation, stimulated recall, self-reports, and documentation). The data showed that the experts' knowledge was integrated while the novices possessed isolated bits of knowledge. For example, the novice teachers either worked on lessons or classroom management. The expert teachers, on the other hand, were able to integrate their work on content and classroom management, a finding replicated in Tsui's (2003) study.

Data of teachers' reactions to classroom vignettes have produced similar results (Swanson, O'Connor & Cooney, 1990). For example, Copeland and his colleagues (Copeland, Birmingham, DeMeulle, D`Emidio-Caston & Natal, 1994) showed classroom vignettes to 28 teachers at four levels of experience. In describing the vignettes, the more experienced teachers noted many more links between individual observations, such as connections (a) between teacher action and student action, (b) between observed actions and general pedagogical principles or academic goals, or (c) between actions observed and actions not observed. They concluded: "As people gain education and experience in teaching, the understanding they express of classrooms they observe is characterized by an increase in quantity and complexity of linkages among ideas and by a shift in the focus of these linked ideas toward issues more central to classroom teaching, including content taught and learned, pedagogical processes used and experienced, and basic educational purposes" (Copeland, Birmingham, DeMeulle, D`Emidio-Caston & Natal, 1994: 166).

In a more recent study, Tan (1996) used stimulated recall to elicit the perceptual cues that ten PE teachers had used to trigger feedback during an observed lesson. He found that the five experienced PE teachers' concept maps (he refers to them as perceptual maps) were more organized, with cues being organized into more general groups and these general groups forming general principles, compared to the five novices. "The perceptual map of experienced teachers can be described as an elaborate network containing clusters of related information hierarchically organized. The network for inexperienced teachers was sparse by comparison, with relatively few intricately connected clusters" (Tan, 1996: 166). In addition, Llinares (2000) studied one experienced elementary teacher's knowledge using interviews, observations, critical incidents, and a task of sorting textbook problems. He found that the teacher's knowledge of math was integrated with her knowledge of her students, for example what they understood or had trouble understanding, how to elicit their level of understanding, and the typical effect of specific classroom activities on their knowledge of functions. "One important aspect of teacher mathematics-specific pedagogical content knowledge was...the interrelationship between subject matter knowledge and knowledge about the way in which pupils manage to learn mathematics topics" (Llinares, 2000: 51).

6.2.2   Mental models show knowledge organization

At a larger scale teachers' knowledge is organized into mental models (Haim, Strauss & Ravid, 2003; Mevorach & Strauss, 1995; Strauss, Ravid, Magen, & Berliner, 1998; Strauss, Ravid, Zelcer & Berliner, 1999). Mental models are domain-specific cognitive representations of pertinent information of an object, system or event. The purpose of these models is not just to recognize, which is how schemata are used, but to enable the user to understand a situation, predict possible outcomes as a consequence of proposed actions, and evaluate potential actions on a range of criteria (Johnson-Laird, 1983; Norman, 1983; Holyoak, 1984; Brewer, 1987; Greeno, 1989). Mental models "have explanatory, control, and predictive power in that they allow teachers to: explain how learning occurs in children's minds, control learning through teaching, and predict how learning will take place when they teach as they do" (Strauss, Ravid, Zelcer & Berliner, 1999: 260).

The quality of teachers' mental models does not seem to be related to teachers' acquisition of subject matter knowledge. In a series of studies, Strauss and his colleagues looked at the mental models of teaching issues such as Wh- questions or literacy in teachers with varying levels of knowledge about the aspect of language being taught (Strauss, Ravid, Magen, & Berliner, 1998; Strauss, Ravid, Zelcer & Berliner, 1999, Strauss, 2001). In all these studies they found no relation between the level of subject matter knowledge and the quality of mental models.

Teachers' mental models of particular lessons are often referred to as "agendas" (Leinhardt, 1988; Leinhardt, Putnam, Stein & Baxter, 1991).

> The agenda is the teacher's dynamic plan for a lesson. It is a mental plan that contains the goals and actions for the lesson…It is not, however, a static lesson plan. Rather it is a dynamic plan in which elements are modified in the course of instruction…As the teacher's own mental note pad for the lesson, the agenda includes all major action schemas that will be used…along with markers for points in the lesson to obtain specific information about students (Leinhardt, Putnam, Stein & Baxter, 1991: 89-90).

The mental models that teachers have of the content to be taught are sometimes referred to as "curriculum scripts" (Leinhardt, 1988; Leinhardt, Putnam, Stein & Baxter, 1991).

> A curriculum script…provides the overall goal structure for the content presentation for a particular lesson. It consists of a loosely ordered set of goals and actions that a teacher has built up over time for teaching a particular topic. It contains layers of accumulated knowledge about how to teach the topic, including sequences of ideas or steps to be introduced, representations to be used, and markers for concepts or procedures that are likely to cause student difficulties…Thus the curriculum script provides the structure for the content of a lesson. Unlike the agenda, however, whose elements may change during a lesson, the curriculum script is relatively stable during a given lesson and is revised or updated in a cumulative way over time (Leinhardt, Putnam, Stein & Baxter, 1991: 89).

6.2.3 Organization important part of superior performance generally

Knowledge organization is not only important for teaching, but seems a general quality of advanced practitioner knowledge. Studies have consistently found that one thing that clearly separates experts from non-experts is that their knowledge is tightly organized around the tasks they engage in. "The outstanding performance of experts derives from how their knowledge is structured for processing" (Glaser, 1986: 924). Many of the studies in this area focus on medical expertise. Feltovich, Johnson, Moller and Swanson (1984) found that advanced medical students tended to organize their observations of medical conditions around categories similar to medical textbooks, such as types of anatomy. The experts, however, structured their thoughts around specific groups of medical problems and symptoms related to the area of the body under study. Norman, Trott, Brooks, and Smith (1994) looked at diagnosis of nephrology cases by medical students in their 1st or 2nd year of residency and by experienced physicians. They found that the in each case the experienced doctors clustered the facts and their observations together in meaningful ways to a much greater extent than the residents. Similarly, when Groothuis, Boshuizen and Talmon (1998) had three advanced medical students and three doctors diagnose endocrinology cases, they found that the experts developed their diagnosis by situating the facts of the case within pathological processes and timelines of the development of the pathologies in question, but the medical students did not. This was interpreted as evidence of superior knowledge organization where recognition of the correct interpretation of medical evidence at one level led automatically to options and interpretations at another level without explicit computation of the data.

> Essentially, the elements of the text base [when reading the facts of a case] will activate general schemata, which in turn will activate more specific subschemata until the final diagnosis is obtained. The advantage of such a mechanism is that its diagnostic accuracy is determined not by the content of the text base alone but by the properties of preexisting schemata, based on situations. This would explain how two different schemata might be activated by the same text base (Patel & Groen, 1991: 115).

Most of the evidence for the importance of knowledge organization comes from research using sorting tasks. For example, Chi, Feltovich and Glaser (1981) had physics experts and novices (college students) sort 24 sample physics problems. They found that the "novices tend to categorize them into types as defined by the entities contained in the problem statement" (Chi, Feltovich, & Glaser, 1981: 150), such as whether the problem involved rotation or a slope. The experts, on the other hand, "tended to categorize problems into types that are defined by the major physics principles that will be used in solution" (Chi, Feltovich, & Glaser, 1981: 150). This was taken as evidence that recognition of a problem belonging to a category of similar problems is not simply a by-

product of expertise, but rather a central part of problem-solving. Instead of having to survey all possible solution strategies, which would require significant investment of scarce working memory processing capacity, the recognition of a problem as belonging in a category of problems also suggests specific strategies for solving the problem, and, thus, is cognitively efficient. "[T]he physics expert's initial categorization restricts search for a particular solution to a small range of possible operations" (Chi, Feltovich, & Glaser, 1981: 150). Similar results have been found in sorting task studies of experts in basketball (Allard & Burnett, 1985), Chess (Gruber & Strube, 1990; Gruber & Ziegler, 1990; Freyhof, Gruber, & Ziegler, 1992), and teaching (Stein, Baxter, & Leinhardt, 1990; Jones & Vesilind, 1996). For example, Borko and Niles (1982) gave descriptions of students to 67 experienced and novice teachers and asked them to sort them into reading groups. The experienced teachers were able to integrate content and personal information in constructing groups, while novices relied solely on personal information about the students. In addition, Leinhardt and Smith (1985) had four expert and four novice elementary teachers sort math topics. The expert teachers' grouping revealed a refined hierarchical organization of their math knowledge, for example in terms of the difficulty of teaching the topic, while the novices' categories showed no such knowledge organization. "[The] experts sorted 45 math topic cards into approximately 10 categories and ordered the topics by difficulty to teach or perform…Novices made categories for every one or two problems and noted little differentiation in problem difficulty. They also indicated almost no internal connections" (Leinhardt & Smith, 1985: 252).

6.2.4 Teacher education does not result in organized knowledge for teaching

Problems with knowledge organization have been noted in reference to SLTE programs. Tedick and Walker listed this among the most significant problem facing SLTE programs. "Fragmentation and isolation are prevalent in the various second language teaching contexts in programs that prepare teachers for those contexts, and in the profession at large" (Tedick & Walker, 1994: 303). Cumming (1989) provides evidence that a disciplinary approach does not help teachers develop the knowledge organization they need. He used concept maps to investigate the knowledge organization of 37 novice ESL teachers. He found that the teachers' knowledge was fragmented and not well organized for teaching. "The majority of the schematic charts represented ESL curriculum through obvious disjunctures between elements. In these cases, knowledge about curriculum appeared fragmented, in such a way that it would be difficult for teachers (using such models) to integrate their thinking about different aspects of the curriculum in order to make instructional decisions" (Cumming, 1989: 36). In a more in-depth study, Schocker-von Ditfurth (2001) studied 16 novice teachers throughout their practicum experience. She found that novice teachers were only able to make use of knowledge gained from their academic classes if it was integrated into their personal conceptions of teaching. Furthermore, their knowledge was also fragmented, for example teaching routines were not integrated into general conceptions of teaching that might relate to those particular routines (e.g., concepts of CLT were not related to routines which promote communication between students).

Summaries of research on teacher learning have concluded that this is a general problem in that most teacher education programs do not help novice teachers organize their knowledge for teaching (Goodlad, 1990; Grossman, 1990; Tatto, 1998; Wideen, Mayer-Smith, & Moon, 1998), but instead promote "fragmented" knowledge (Ginsburg & Cliff, 1990: 458). For example, Carpenter and his colleagues looked at 40 experienced 1st

grade teachers and their knowledge of children's problem-solving strategies and typical 1st grade math problems. One of their findings was that "knowledge was not organized by the teachers into a coherent network that related distinctions between problems, children's solutions, and problem difficulty to one another" (Carpenter, Fennema, Peterson, & Carey, 1988: 398). In a similar study, Ball (1990) looked at how 19 novice teachers solved fractions problems and how they could represent such problems to students. She found that while teachers had good operational knowledge of fractions, this knowledge consisted of isolated facts, what she called "egg cartons of mathematical ideas" (Ball, 1990: 140). Simon (1993) used a written task with 33 experienced teachers and an interview task with another eight experienced teachers to examine their knowledge of division problems. He, too, found that the teachers "seemed to have appropriate knowledge of the symbols and algorithms associated with division, but many important connections seemed to be missing, leaving a very sparse 'web of knowledge'" (Simon, 1993: 251)

Furthermore, studies have shown that novice teachers need to reorganize their knowledge gained from their tertiary education when they begin teaching. Gess-Newsome and Lederman (1993) used concept maps, questionnaires, and interviews to follow the changes in the subject matter knowledge of ten biology teachers during their practicum semester. They found that all of the teachers rearranged and reworked their knowledge of biology to make it organized around the task of biology teaching. For example, "topics were broken down and reorganized into smaller pieces to more accurately reflect what occurs in the classroom" (Gess-Newsome & Lederman, 1993: 41). They concluded that "college biology students are not being provided with a readily accessible explicit or implicit structure of biology as part of their content preparation" (Gess-Newsome & Lederman, 1993: 35). Hauslein and her colleagues used a sorting task to investigate the knowledge structure of 14 preservice or novice teachers, 10 experienced teachers, and 15 scientists of different levels of expertise (Hauslein, Good & Cummins, 1992). They found that teachers, in contrast to the scientists, organized their knowledge of biology around the curriculum of the courses they taught. "Without exception, each of the experienced teachers referred to the concepts in a pedagogical context…one teacher…chose to exclude certain topics from categorization because she did not teach them" (Hauslein, Good & Cummins, 1992: 957). Furthermore, they found that the experienced teachers exhibited much more depth and stability to their knowledge organization than the novice teachers did.

One reason for this might be that textbooks used in teacher education may not organize knowledge as it is needed for teaching. For example, Pinnegar and Carter (1990) had 38 mentor teachers reflect on their own practice as they would explain it to a student teacher. This data was compared with an examination of how knowledge presented in three common textbooks on educational psychology was organized. They found that there were stark differences in how the textbooks and teachers organized knowledge. The textbooks organized knowledge around the academic discipline and questions of defining what things are, while teachers organized their knowledge around the classroom and questions of how things functioned. In a similar study, Nathan and Koedinger (2000b) asked 67 experienced math teachers to organize 12 math problems according to their difficulty for students. They found that teachers' predictions for problem difficulty deviated systematically from actual student difficulty in that they thought that symbolically presented problems (i.e. "1a+3b=4c") would be easier than story problems or word problems. Since math textbooks typically present symbol problems before word

problems, the researchers concluded that teachers' organization for problem difficulty was derived from textbook presentation rather than actual student performance. Tamir (1992) used a sorting task for biology concepts with 213 science teachers. One of her findings was that the level of biology which is the primary focus in tertiary education (the molecular level) was seen as the *least important* by the teachers.

6.2.5 Reorganizing knowledge is difficult

Knowledge organization may be central to competent and exemplary performance in teaching, but there is some evidence that reorganizing knowledge is a difficult task. Significant change in people's conceptions or mental models would require changing the entire organization of that area of knowledge, which would likely be a very difficult and resource consuming endeavor. For example, in his in depth-study of eight ESL teachers Woods found that "bits of knowledge are interrelated in structured ways, and thus…one piece of knowledge cannot be changed without having effects on other pieces of knowledge in the system. The growth of knowledge, then, implies a reorganization of the system" (Woods, 1996: 62).

This might explain the human tendency to resist new knowledge which contradicts their existing conceptions, as discussed in Chapter Three (Trowbridge & McDermott, 1981; Clement, 1982; Halloun & Hestenes, 1985b; Reif & Allen, 1992; Chinn & Brewer, 1998; Haller & Krauss, 2002). Given the potentially enormous resources required to reorganize one's knowledge in order to integrate new perspectives and the debilitating effect this could have on cognition, it actually might make sense in some cases to ignore new knowledge unless (a) there is a clearly demonstrated benefit from integrating the new knowledge and (b) the resources needed to integrate new knowledge (i.e., time, expert help, etc.) are easily available. Far transfer is difficult to achieve because it requires such intensive work in reorganizing and filling holes in entire knowledge networks. Therefore, it is possible that ignoring new evidence might be a very rational and professional choice if the benefit of the new knowledge does not outweigh the costs of knowledge reorganization.

6.2.6 Summary

Well organized knowledge allows people to avoid the cognitive bottleneck by producing accurate diagnoses of situations and options for action without excessive amounts of explicit computation. Because of this, knowledge is much more likely to be used if it is organized for the activity it is to be used in. In addition, knowledge organization is even more important in SLTE because of the complex nature of the task of teaching. Unfortunately, current evidence indicates that the knowledge with which teachers enter teaching is not organized for teaching and does not integrate disciplinary and non-disciplinary knowledge. Thus, lack of knowledge organization in the knowledge gained in SLTE programs is likely another factor contributing to the lack of transfer from SLTE programs to language teaching.

6.3 Teaching requires dynamically organized knowledge

The importance of knowledge organization does not imply, however, that humans use explicitly constructed, static models of a phenomenon to calculate the value of potential activities. It merely implies the importance of lower level knowledge being linked to

each other in ways that allow perception to trigger quality action possibilities without explicit computation. Applied linguists have argued that teachers can use the kind of abstract, static models of language and language learning to understand teaching and learning in their classrooms. "In order to teach effectively, one must have an adequate theory of the language to be taught, and the best developed theories have been those developed by linguists" (Flynn, 1991: 548). The implication is that teachers could use such explicit, static models to test the effectiveness of different teaching actions and strategies in order to decide what to do in their teaching. "Stern…works on the common-sense premise that judgments that are informed, based on sound theoretical foundations, will provide better results than those that are not" (Ellis, 1997: 2). This premise, however, is not supported by research data. Instead it seems that teachers need and use a flexible network of knowledge which can be used to create dynamic, on-the-spot understandings of a situation.

6.3.1 Uncertain nature of teaching necessitates dynamic knowledge

Teaching situations differ so widely, even for one teacher in one school, that it is next to impossible for teachers to anticipate all the factors which they feel should be considered over the course of a whole lesson.

> The presence of 20 to 30 children in a single classroom means there are 20 to 30 possibilities for an interruption in one's plans. Even apart from these routine disturbances, though, students may get into fights with one another, get sick, or simply ask a question that is difficult to answer. All of these actions, from major to minor, are disruptions to the scenarios that teachers have planned and make it difficult for teachers to predict with any certainty how a lesson will proceed, how long it will take, whether students will find it engaging, or whether they will 'get it' (Kennedy 1997: 6).

McDonald (1992) considers uncertainty a central characteristic of teaching. "Teaching is not like building bridges between stable points, but like building flexible webs among constantly moving points – among, for example, the evanescent images of a poem and twenty-two different minds, including mine" (McDonald, 1992: 20-21). It is impossible to get rid of this uncertainty because "too many contingencies within the school are beyond the control of teachers" (Huberman, 1989: 48). Therefore, teachers only make a rough plan for teaching and further develop this plan in class using information from student interaction with materials and activities (Llinares, 2000). For instance, one of the findings from Wood's (1996) intensive study of eight ESL teachers was "how tentatively the course was planned, even by the most organized and prepared of teachers, and how much of what was planned was scrapped or altered as further information became available" (Woods, 1996: 168). The 20 EFL teachers in Appel's (2000) study also reported that they were only able to plan a lesson to a limited extent and that additional planning was made in class in response to student cues. Similar findings in teachers of other subjects indicate this is common in the practice of teaching. Borko and Livingston studied the planning and teaching practice of three expert math teachers. They found that "these teachers work from mental scripts that consist of general outlines of their lessons. They fill in the outlines during interactive teaching to ensure that their instruction is responsive to student performance" (Borko & Livingston, 1989: 483).

Christine, the 5th grade art teacher in Field and Latta's (2001) study, clearly articulated the dynamic nature of teaching in her reflection of how an activity went in her class:

> I realized halfway through that it was not working. I felt comfortable to abandon [the lesson] and move on…The reaction from the class caused me to make that decision. Something just clicked as I was teaching…I thought they've got it, I do not need to go further with this particular activity – it is not going to make a difference (Field & Latta, 2001: 890).

Not only classroom instruction, but other areas of teachers' practice were also developed in dynamic, unpredictable ways, for example Christine's report on her lesson planning:

> As I rehearsed the lesson in my mind in advance I discovered that reading the story was going to feel way too long. I knew I needed to find ways to get the students more deliberately involved. I needed to find ways to get them to shift from listening to role-playing, to looking, to guessing, and so on. I made these changes before I actually taught the lesson (Field & Latta, 2001: 888).

Due to the inherent uncertainty of their practice, teachers are constantly using their implicit, practice-specific knowledge to evaluate student understanding, student interest, and possible ways of further developing the activity they are engaged in. Such knowledge is dynamic because different bits of knowledge are continually being combined to form on-the-spot conceptions of what is going on in class and what the teacher could do next. Evaluating such factors using general, a priori frameworks would not be possible in most cases because of the lack of time and the explicit cognitive processing capacity it would require. Furthermore, given the time constraints on teachers outside of class such as planning instruction, marking student work, cooperating with the school administration, and extra curricular activities, it is not likely that teachers would have much more time and processing capacity outside actual instruction than when engaged in teaching. Schön (1983; 1987) refers to this kind of dynamic knowledge as "knowing-in-action", a kind of knowledge embedded in and created by the process of participating in the activity rather than knowledge acquired beforehand: "in much of the spontaneous behavior of skillful practice we reveal a kind of knowing which does not stem from a prior intellectual operation" (Schön, 1983:51).

One example of such dynamic knowledge-in-action comes from a study by Borg (1999b) on the use of grammatical terminology by four experienced EFL teachers. He found that:

> decisions about the use of terminology were also influenced by events which occurred in specific instructional contexts. For example, students' questions about grammar sometimes prompted teachers to use terminology; on other occasions, when teachers saw that students were confused about an explanation they had given, terminology was avoided in the subsequent explanation. To a certain extent, then, teachers' decisions about terminology were also taken interactively, in real-time during the course of their work, and not simply predetermined (Borg, 1999a: 121).

As mentioned previously, actions by teachers are principally guided by dynamically generated knowledge rather than static, general rules (Tudor, 1998, 2001, 2003). For example, in their longitudinal study of the literacy instruction of 24 elementary school teachers Duffy and Anderson (1984) found that the teachers' instructional decisions were based more often on the teaching materials and the students' reactions to them than their espoused theories on learning to read. Furthermore, Liu, Ahn, Baek, and Han (2004) studied the L1 use of 13 EFL teachers in Korea. They found that although the L1 use often followed from principles the teachers had develops, L1 use was just as frequently used in ways and situations that did not follow from these principles. In addition, the

three novice ESL teachers in Tsang's (2004) study showed that their actions followed their general personal teaching maxims only about 50% of the time.

This is true even at the level of mental models. Mental models are not for explicit, serial computation of all the factors involved in the model. Rather they help their users to focus on important information and solutions emerge from the interaction of this information with the mental model (Groen & Patel, 1988; Patel, Groen & Arocha, 1990). In fact, mental models are not static, but are reconstructed each time with different feature depending on the needs of the task. For example, when crucial parts of patient x-rays were obscured by overlapping organs, the radiologists in Lesgold's (1984) study were able to construct mental models which helped them decipher what was happening with parts of anatomy which were blocked or obscured by other anatomical parts in the x-ray. The flexibility of mental models may also be very important in teaching. As mentioned earlier, not only did the experienced PE teachers in Housner and Griffey's (1985) study of lesson planning demand much more information about the teaching context than the novices, five of the eight experienced teachers flatly refused to complete the task until they were personally shown the gym where the lessons would take place. This is evidence that teachers build new mental models of each teaching situation.

The dynamic nature of teachers' knowledge is what leads teachers to answer "It depends…" when asked about their understanding of language learning or language teaching. Such "It depends…" statements do not indicate indecision or lack of knowledge by the teacher, but rather that classroom situations cannot be reduced to simple formulas such as "Get it right at the beginning" or "Teach what is teachable" (Lightbown & Spada, 1999). Instead, it appears that teachers' knowledge needs to be flexible and dynamic enough for teachers to construct understandings of specific situations in specific contexts. "As we listen to teachers' voices and their stories, we realize that the comment, 'It depends…' doesn't represent fuzzy thinking; it gives voice to a deeper wisdom and understanding" (Freeman, 1991b: 15). For example, Carless (2003) investigated three EFL teachers' use of task-based teaching. One finding was that task-based teaching was much easier to perform with more proficient L2 students than with less proficient L2 students. Thus, the decision whether and to what extent to use task-based methodology depends not solely on the teachers' judgment of the general effectiveness of task-based teaching; it also depends on the effectiveness of the approach for different groups of students, in different contexts, and using different materials.

With academic knowledge the focus is constructing a full model of a situation which explains all factors in the question under study. Teachers, however, need a flexible network of (implicit, practice-specific) knowledge which can be used to quickly combine elements to form ad hoc conceptions of a particular problem or situation. Spiro and his colleagues call this "Cognitive Flexibility" and claim that it is central to professional competence (Spiro, Coulson, Feltovich, & Anderson, 1988a, 1989b; Spiro, Feltovich, Jacobson, & Coulson, 1991a; 1991b; Spiro & Jehng, 1990; Spiro, Vispoel, Schmitz, Samarapungavan, & Boerger, 1987). They claim that professional practice such as teaching is *ill-structured*: "all domains which involve the application of knowledge to unconstrained, naturally occurring situations (cases) are substantially ill-structured" (Spiro, Feltovich, Jacobson, & Coulson, 1991: 26). This refers to practices which are complex, not amendable to simplistic solutions, and for which there is no way of knowing what the optimal course of action was or will be. According to Cognitive Flexibility Theory, generalized conceptions will not provide answers to specific

problems or questions in such practice. Instead, professionals need to be able to generate or assemble representations of the specific situation (and possible solutions) quickly and effortlessly.

> A key feature of ill-structured domains is that a single prepackaged schema or prototype case will typically be inadequate as background knowledge to support the processing of a new case. Thus, intact schema retrieval (or prototype retrieval) as a knowledge-based processing mechanism must be replaced by situation-specific schema- and precedent-case assembly (Spiro & Jehng, 1990: 186).

Such dynamic construction of knowledge does not have to be done explicitly. In general, knowledge is not recalled whole, but the very process of recognizing something and recalling knowledge fundamentally involves the dynamic construction of knowledge to fit the situation (See LeDoux, 1996, for review of this research). "Information is created by the observer, not given, because comprehending is conceiving, not retrieving and matching" (Clancey, 1993: 91). However, for this to happen teachers need to have an organized network of implicit, practice-specific knowledge that they can use for this process.

Teaching is an activity filled with uncertainty. The activity that went so well in your 4th hour class may bomb in your 5th hour class; students who used relative clauses with great facility in one activity may struggle to do this in a different activity. This means that teachers are constantly constructing on-the-spot understandings of what is happening in the classroom. To do this teachers need dynamically linked knowledge; in other words, knowledge which is linked in such a way that each piece can be combined easily with other relevant pieces if a need arises. This might also be the answer to the problem pointed out by Larsen-Freeman (1983) that one cannot give teachers the specific knowledge they need for all teaching situations in an SLTE program. If teachers have a solid variety of knowledge about teaching in specific contexts, it is more likely that they will recognize the similarity between what they already know and phenomena in another context. In some cases recognizing similarity may not be not enough, so teachers need to be able to create understandings and practices which fit the particular configuration of factors in that contexts. If their knowledge is organized into a tight network for teaching, it will be easier for teachers to create dynamic, on-the-spot understandings of that context. For example, Gott and his colleagues studied aviation mechanics who were required to learn new activities due to restructuring in their organization. It was found that those mechanics who had actively worked on developing a deeper network of understanding of what they did before were able to use knowledge of their previous activity for the new one. Those whose knowledge was not as well connected were not able to do this and learned the new activity like beginners (Gott, Hall, Pokorny, Dibble & Glaser, 1993)

6.3.2   Dynamic knowledge as a tool, not a framework

Given the local and dynamic nature of knowledge, it has been proposed that a simple formula for action is often better than an expertly calculated model, for example in predicting disease and death rates for insurance companies (Camerer & Johnson, 1991). Gigerenzer and Todd (1999), for example, claim that people do not act by processing all relevant information and creating full explanations for situations (which would be cognitively inefficient) but by heuristics, or rules of thumb, which may be less accurate but require much less processing capacity. "Our premise is that much of human

reasoning and decision making can be modeled by fast and frugal heuristics that make inferences with limited time and knowledge. These heuristics do not involve much computation, and do not compute probabilities and utilities" (Gigerenzer & Todd, 1999: 6). As an example, they cite emergency room procedures which classify heart attack patients according to only three variables, instead of taking all possibly relevant information into account. "Its simplicity raises the suspicion that it might be highly inaccurate, compared to standard statistical classification... Yet it is actually more accurate in classifying heart attack patients according to risk status than are some rather complex statistical classification methods" (Gigerenzer & Todd, 1999: 4-5). Thus, knowledge is used more as a tool, working on specific problems, than as an overall framework.

Knowledge as a tool suggests that people only use the minimal knowledge needed for completing a task, rather than constructing a complete representation of the situation to guide practice. For example, Chase (1983) did a very interesting study of taxi drivers in Pittsburgh by asking them to draw maps of the city. Instead of precise, 1-1 maps of the city, their maps accentuated features that were important for taxi drivers while mineralizing features that were not important to them. For example, distances on the maps were more related to time it took to drive those routes than actual physical distances. "If taxi drivers have access to a bird's-eye metric view of the city, they certainly can't draw it" (Chase, 1983: 396). Instead, taxi drivers have a lot of specific information about driving routes specific to particular neighborhoods which are linked together. When deciding on a route from A to B they activate only the knowledge of those routes and neighborhoods relevant for the specific task. Thus, instead of using their knowledge as a complete framework of the city to access all possible routes, the taxi drivers use their knowledge as a tool to figure out only the task at hand with minimal cognitive resources. Chase suggested that this eases the cognitive demands of memorizing locations in the city.

> The absence of any skill effects in the various cognitive mapping tasks lends little support to the idea that taxi drivers navigate by means of a map in the head. The results do, however, suggest that the large-scale representation of locations is hierarchically organized such that locations are nested within neighbourhoods, and neighbourhoods are nested within large regions and larger regions are located with respect to more global features…Finally, it is suggested that the hierarchical organization of neighbourhoods is important in terms of *economy of storage*, and that this hierarchy serves as an integral part of planning a route…Hierarchical storage means that one need only store relative locations of places within a neighbourhood (Chase, 1983: 404) [emphasis added].

This emphasis on heuristics or knowledge as a tool rather than knowledge as an explicit calculational model is echoed in Vygotsky's emphasis on the importance of tools for cognition. Vygotsky argued that humans do not work directly on reality in exactly its scale and with all its details. Instead, we use tools, both physical and mental, to help us process information both in terms of perception and in terms of controlling actions we wish to carry out.

> The most fundamental concept of sociocultural theory is that the human mind is mediated…humans do not act directly on the physical world but rely, instead, on tools and labor activity, which allows us to change the world, and with it, the circumstances under which we live in the world…we also use symbolic tools, or signs, to mediate and regulate our relationships with others and with ourselves and thus change the nature of these relationship (Lantolf, 2000: 1).

These tools are taught to subsequent generations of users who continue to develop and improve them. "Physical as well as symbolic (or psychological) tools are artifacts created by human culture(s) over time and are made available to succeeding generations, which can modify these artifacts before passing them on to future generations. Included among symbolic tools are numbers and arithmetic systems, music, art, and above all language" (Lantolf, 2000: 1). Tomasello (1999) has even argued that the principal difference between humans and other animals is not superior brain power, but our ability to collect and pass down cultural knowledge and tools, resulting in a gradual growth of knowledge for human communities. Feltovich, Spiro and Coulson argue that if people have "a large toolbox of cognitive (and interpersonal) processes and methods", they will be able to act ably in a variety of circumstances (Feltovich, Spiro & Coulson, 1997: 138). It has also been argued that physical and cognitive tools are important part of learning to teach languages (Freeman & Cazden, 1991; Freeman & Johnson, 2005; Hawkins, 2004; Winsor, 2001).

If teachers are not guided by general conceptions or knowledge, however, why have a number of studies shown a strong correlation between teachers' general conceptions and their practice (e.g., Burns, 1992; Johnson, 1992; Woods, 1996)? One possible explanation comes from complexity (or chaos) theory. According to complexity theory, what looks like an overall pattern may be a dynamic combination of local factors, not an overall rule (Gleik, 1987; Larsen-Freeman, 1997; 2003; Merry, 1995). For example, the flocking behavior of birds cannot be modeled by general "rules" for the whole flock. However, Reynolds (1987) showed three simple rules about how birds should relate to those birds in its immediate vicinity ("avoid collisions with nearby flockmates", "attempt to match velocity with nearby flockmates", "attempt to stay close to nearby flockmates") could account for the overall patterns of flocking birds, even though these rules did not refer to flocking behavior at all. The same may be true for teachers: they may seem to use general rules at times; however, this may be a situation where they are acting according to local rules or factors but it looks like they are guided by general rules.

Take, for example, the study by Breen and his colleagues (Breen, Hird, Milton, Oliver, & Thwaite, 2001) on patterns of 18 ESL teachers' practice. Through observations, interviews and grid tasks they identified specific practices that teachers engaged in while teaching (e.g., group work, recasts, gestures, etc.) and elicited the pedagogical principles underlying these practices. One finding was that for any one teacher, there were several principles which supported the use of a particular practice and many practices which could be used to carry out particular principles. Furthermore, they found that the teachers' patterns were idiosyncratic; teachers did not use the same practices to carry out the same principles and used different principles to justify the use of the same practices. However, when the results were aggregated, the group of teachers as a whole did exhibit consistent patterns of practices clearly associated with principles and vice versa. Like the patterns made by migrating birds result from interactions between individual birds and not from any master plan to make a v-formation with a specific number of other birds, it may look like these teachers hold a common conception of teaching principles and the practices which support them. However, a more likely explanation for this is that these macro patterns emerge from the dynamics of teachers' local rules and the local conditions of language teaching in that context.

In SLTE it has long been maintained that L2 teachers need to acquire well-developed, static knowledge of language and language learning in order to teach. It has been

suggested that teachers can use such knowledge, in a linear fashion, to figure out what to do in the classroom: if recasts are better than grammar explanations, then teachers should do the former and not the latter. As we have seen, however, research results indicate that it is not cognitively efficient for practitioners to use complete frameworks to address specific problems of practice. Instead, it seems that people seek and use only as much knowledge as they need to obtain a reasonably accurate understanding of their situation and options. In other words, knowledge is not used as a framework to explain a whole situation, but rather it is used like a tool to work on very specific, situated problems. For teachers, this means instructional decisions that can flow well and seem to help learning. Nevertheless, such knowledge is not accurate enough for teachers to feel certain about what they are doing.

> Although I never learn exactly where to stand in relation to my students, I develop a reliable sense of what is too close and what is too far. Within these limits, I craft a workable relationship for the moment…I tune my stance continually to the values that seize me. Similarly, though I remain chronically unsure of what to teach and how to teach it, I develop an eye for productive linkage (McDonald, 1992: 1).

The organization of teachers' knowledge is just as important as the amount of knowledge teachers possess. Knowledge organization helps teachers quickly build on-the-spot representations of a teaching issue or situation and recall appropriate responses without demanding much scarce explicit cognitive processing capacity. However, explicit, rigid theories which try to explain every factor of a phenomenon are not helpful for teachers. First, teachers' practice is very unpredictable, which results in teachers using their knowledge to create on-the-spot understandings of classroom issues such as student learning, student interest and the teachers' objectives for the class. Continually working out a full model of the situation including all factors would require much more explicit processing capacity that is available. Second, people usually use only the minimum amount of knowledge necessary for solving problems such as judging L2 students' language production or attention span because this is cognitively efficient. Therefore, teachers need knowledge which contains multiple linkages between different parts, for example linkages between communicative activities which could go before or after each other easily or types of student behavior that signal that they are not paying attention.

6.4 Acquisition of dynamically linked knowledge

Given the dynamic, schema-based nature of professional practice, teacher learning is not simply gaining units of knowledge, but to a large part in enriching and organizing knowledge that already exists. One way to do this is to give general principles and then provide a wealth of details of what each principle means in practice, hoping that teachers will be able to use this to "populate" these general conceptions "with their own intentions and their own voices (Johnson, 2006: 240). However, Spiro and his colleagues argue that such conventional instruction stresses processes that do not engender cognitive flexibility (Spiro, Coulson, Feltovich, & Anderson, 1988a; 1989b). Conventional instruction produces knowledge which works well for the tasks common in higher education classes, such as summarizing and explaining academic research and conceptions, but does not work well for complex, messy professional practice.

> Instruction is too often based upon simplified mental models that filter out complexity that doesn't fit in these models. Those mental models unfortunately will not accommodate or adequately explain the natural complexity that exists in most applied knowledge domains, such as medicine, engineering, and so on …Complex ideas are also

easier to study if they are simplified…But these kinds of knowledge structures are pre-packaged and tend to be rigid and therefore not easily adapted to learning contexts outside the immediate instructional context (Jonassen, 1992: 388).

6.4.1 Link specific knowledge

Research indicates that novice teachers need to experience multiple examples of practice and to work on connecting ideas and concepts derived from these examples in many ways (Bereiter, 1997). In order to acquire a dynamically organized network of teaching knowledge, teachers need to engage in teaching-similar activities in which they have multiple opportunities to link knowledge in different ways. In such activities teachers should abstract more general concepts from concrete teaching-related examples, cases or experiences. (Cobb & Bowers, 1999; Guskey, 1986; 2002; Kumaravadivelu, 1999; Tigchelaar & Korthagen, 2004; Triggs & John, 2004; Wubbels, Korthagen & Brekelmans, 1997). In other words, begin with "what to do on Monday" but then teachers also need to work on what happens on Tuesday, what happened on Friday to justify the Monday plan, how the Monday plan needs to be changed for different groups of students, how the Monday plan for beginning students could be adapted for more advance students, etc. "For learners to develop cognitively flexible prossessing skills and to acquire contentive knowledge structures which can support flexible cognitive processing, flexible learning environments are required which permit the same items of knowledge to be presented and learned in a variety of different ways and for a variety of different purposes" (Spiro, Feltovich, Jacobson, & Coulson, 1991: 24).

This can be seen in Tsui's (2003) documentation of the learning of four EFL teachers in Hong Kong. While one teacher (Ching) did not seem to progress much with her teaching, the others all showed signs of this process. The other teachers, however, actively sought to generate generalizations from their experiences, a process Tsui calls "theorizing practice".

> In contrast to Ching, Eva often engaged in theorizing her role as a teacher and her classroom practices…while Ching followed the textbook and the scheme of work drawn up by the form coordinator closely, Eva asked questions relating to what the objectives meant and whether they were put down in the scheme of work for their own sake…Eva formulated her own theory of 'continuity' in the curriculum…As Eva implemented process writing, she formulated her own theory of process writing (Tsui, 2003: 262-263).

In a number of studies it has been shown that linking information and schemata in multiple ways helps learners to use knowledge in new situations in fields such as history (Jang, 2000; Spiro, Vispoel, Schmitz, Samarapungavan, & Boerger, 1987), biology (Jacobson & Archodidou, 2000), psychology (Fitzgerald, Wilson, & Semrau, 1997), and literature (Eilam & Poyas, 2006). Jonassen, Ambruso and Olesen (1992) claim that computer-based hypermedia programs should be ideal for generating flexible knowledge and two subsequent studies have investigated this hypothesis. Jacobson and Spiro (1995) had college students work on short history texts which were either linked in typical linear fashion or which contained multiple links to each other. Demetriadis and Pombortsis (1999) worked with computer science students learning about computer networking. Both studies showed when students received linear presentation of material, they were able to remember and recount much more information than in the other condition. However, when information was presented with multiple linkages, students were much more likely to actually use that information in working on other problems. Thus, while

linear presentation may seem like a better instructional method because students appear to have learned more (due to higher recall), this view is short sighted. If we want to prepare teachers to actually use knowledge gained in SLTE programs in their practice, then we need to provide opportunities for teachers to develop multiple and flexible linkages within the knowledge gained in SLTE courses and programs.

Furthermore, many studies have shown that learning by comparing examples of a practice is important for gaining competence in that area (Catrambone & Holyoak, 1989; Gentner, Loewenstein, & Thompson, 2003; Mason, 2004; Thompson, Gentner, & Loewenstein, 2000). For example, in a study of college students solving physics problems, VanLehn (1998) found that those students who actively attempted to extract the salient features of the example learned more than those who simply tried to solve those types of problems. These students enriched their knowledge by going beyond the specific information in the example to surmise other information implied by the example problems and solutions. In a similar study, Chi and Bassok (1989) found "the explanations generated by the good students tended to be qualitatively better than those granted by the poor students. That is, the good students' explanations tended to infer additional tacit knowledge, whereas the poor students' explanations were often paraphrasings of the diagram, with no new information generated" (Chi & Bassok, 1989: 269-270).

Research shows that people are good at abstracting more general ideas about a situation or course of action from examples in practice. For example, Chi and her colleagues studied two groups of high school students solving problems related to human blood circulation. One group were asked to use the examples provided to solve the problems whereas the other group was specifically asked to compare the examples, saying what they had in common or not, before using them to solve the problems. This second group performed much better on the circulation problems, indicating that students can abstract from examples and that such abstractions help problem-solving (Chi, de Leeuw, Chiu, & LaVancher, 1994). Ross and Kennedy (1990) used a similar series of experiments with college students learning about probability. The results indicated that learners who compared examples had abstracted generalizations from them and used these in problem-solving. In a more in-depth study, Chi and VanLehn (1991) had college students think aloud while solving physics problems. The data showed that students used generalizations from previous problems when working subsequent physics tasks. This also seems to be the case for professionals; for example, research has shown that experienced doctors abstract disease schemata from individual cases rather than using general bio-chemical frameworks (Hatala, Norman & Brooks, 1999; Kulatunga-Moruzi, Brooks & Norman, 2001; Norman & Brooks, 1997; Norman & Eva, 2005; Norman, Rosenthal, Brooks, Allen & Muzzin, 1989).

Learning from practice seems to be a bottom-up process. For example, Anderson, Fincham and Douglass (1997) had participants work on a series of abstract rules. They found that the learners went through three basic stages in abstracting information. First, they used examples individually, finding one example to help them with a current problem and not using other examples. Next, they related several examples or problems to each other to create generalizations used for problem-solving. Through this process they developed abstract concepts and, in the final stage, referred exclusively to the principles rather than specific examples. "[I]nitial problem-solving involves explicitly referring to examples…With repeated practice, however, general rules develop and the

specific example is no longer accessed" (Anderson, Fincham, & Douglass, 1997: 932). The knowledge of pathological in medicine appears to develop in the same way (Boshuizen, 2003; Boshuizen & Schmidt, 1992; Boshuizen & Schmidt, 1995; Boshuizen, Hobus, Custers, & Schmidt, 1992; Boshuizen, Schmidt, Custers, & van de Wiel, 1995; Schmidt & Boshuizen, 1992; Schmidt & Boshuizen, 1993). Each step is basically a bottom-up process of organizing knowledge already acquired, rather than a top-down process of starting with generalizations and adding information to them.

Teachers each possess a very different internal knowledge base acquired through different experiences in education. "[k]nowledge is always idiosyncratic, reflecting the vagaries of a person's own history" (Alexander, Schallert, & Hare, 1991: 317). The personal nature of teachers' knowledge can be seen in the idiosyncratic ways teachers learn in SLTE programs. For example, Almarza (1996) studied four L2 teachers taking part in a year-long teacher certification in the UK. Despite similarities in their teaching performances, interviews revealed that each teacher had acquired a very individual, rather than general, set of knowledge from the program. "[A]t the end of the course, they left with different kinds of knowledge about the dynamics of teaching and learning languages" (Almarza, 1996: 69). Even when teachers are educated with a very uniform and narrow conception of teaching, they do not implement the teaching approach uniformly, but rather in a personal, idiosyncratic way. Richards, Ho and Giblin studied five novice teachers on a 4 week certificate course in TESL. They found that "while a program such as the UCLES/RSA Certificate is built around a well-articulated model of teaching, the model is interpreted in different ways by individual trainee teachers as they deconstruct it in the light of their teaching experiences and reconstruct it drawing on their own beliefs and assumptions about themselves, about teachers, about teaching, and about learners" (Richards, Ho, & Giblin, 1996: 258). Schocker-von Ditfurth (2001) studied 16 novice teachers before, during and after their teaching practicum. One of her findings was that the teachers only used academic knowledge when they were able to adapt it to and integrate it into their own personal knowledge base. Research has also shown that teachers do not use academic models of instruction as designed, but combine them with other models and adapt them to fit their own personal knowledge base and interests (McIntyre & Freppon, 1994; Scott, 2003).

Thus, teachers' eclectic use of knowledge is perfectly normal given the nature of human cognition. When teachers' understandings diverge from academic knowledge and they resist academic perspectives, SLTE teachers should not respond by trying to "correct" their knowledge. Instead, SLTE teachers should understand teacher resistance as a signal that the academic knowledge or conception does not fit with their personal knowledge base. For example, Silin and Schwartz (2003), as a result of a 5 year study on curriculum development, argue that we should see teacher resistance to new knowledge as a positive part of this process. They "came to read smaller moments of teacher resistance…as a form of communication to be interpreted rather than a roadblock to be overcome…Resistance can be an occasion for people with divergent perspectives to join together to make sense of the situations in which they find themselves" (Silin & Schwartz, 2003: 1599). Resistance can be seen as an opportunity to explore these ideas and teachers' knowledge more deeply in order to create more sophisticated knowledge, rather than as a call for a clearer explanation of the academic knowledge.

> The suggestion that teachers should construct their personal theories by testing, interpreting, and judging the usefulness of professional theories proposed by experts creates only a narrow space for teachers to function fruitfully as reflective individuals.

> Indeed, this suggestion leaves very little room for self-conceptualization and self-construction of pedagogic knowledge (Kumaravadivelu, 2001: 541).

A dynamically organized network of implicit, practice-specific knowledge for teaching is acquired by participating in a wide variety of teaching-similar activities which require participants to focus on a variety of knowledge specific to particular teaching situations and to compare, contrast and link knowledge (such as knowledge about teaching activities, student cues, curriculum, feedback, input, etc.) in multiple ways. Humans appear to excel at abstracting from specific examples and such processes result in professional competence and knowledge which is easier to transfer from one context to another. This is a bottom-up process and the result is not all encompassing abstractions like academic theories, but rather idiosyncratic, dynamically organized "theories for practice" (Burns, 1996).

6.4.2   Deliberate practice

It is not possible for teachers to acquire all the knowledge they need to be competent teachers in SLTE programs. Research has shown that teachers generally need about 5 years to gain a basic level of professional competence in teaching (Huberman, 1993b). Many teachers, however, do not continue to improve after reaching this point, perhaps because teachers rarely reflect and even when they do, they principally focus on superficial aspects of instruction (Beijaard & de Vries, 1997; Liou, 2001; Schocker-von Ditfurth, 2001; Ward & McCotter, 2004). This should not be so surprising because SLTE programs often fail to teach and practice reflection with novice teachers and schools fail to provide support for such activity (de Jong, Korthagen, & Wubbels, 1998; Francis & Dawn, 2005; Korthagen, 1999; Lee, 2005; Orland-Barak, 2005; Schocker-von Ditfurth, 2001; Ward & McCotter, 2004). It seems that to gain real expertise in teaching, one must engage in what is known as "deliberate practice". According to Ericsson and his colleagues, expertise in an activity is gained by deliberately designing and participating in activities which help you learn more about a particular aspect of the activity (Ericsson, 1998; Ericsson & Charness, 1994; Ericsson, Krampe & Tesch-Römer, 1993; Ericsson & Lehman, 1996).

Essential aspects of deliberate practice are (a) learners are motivated to participate in the activity because they want to learn and improve their practice, (b) the activity is designed to be challenging (i.e., not something learners can already do well) while not too challenging (i.e., something learners can achieve with practice), (c) learners should have access to immediate feedback on their performance, and (d) learners should repeatedly perform the same or similar tasks until there is little left to learn from doing that task (Ericsson, 1998; Ericsson & Charness, 1994; Ericsson, Krampe & Tesch-Römer, 1993; Ericsson & Lehman, 1996). Deliberate practice can involve (a) working on skill in carrying out classroom activities, techniques, or routines (i.e., linking ideas with ways of doing this in different contexts), (b) using student cues (i.e., making links between student behavior and their knowledge, learning and motivation), (c) ways of combining objectives and activities into coherent teaching agendas and curriculum scripts (Leinhardt, 1988).

Engaging in deliberate practice is a necessary part of gaining expertise. Most people do not gain expertise in most areas of their lives because they do not invest in deliberate practice. "[T]he vast majority of active individuals spend very little, if any, time on

deliberate practice. Once amateurs have achieved an acceptable level of performance, their primary goal becomes inherent enjoyment of the activity, and most of their time is spent on playful interaction" (Ericsson & Charness, 1994: 738). For example, while I can drive a car, I am not willing to invest the time and effort to practice various aspects of driving to become a world class car driver. "Experts…tackle problems that increase their expertise, whereas nonexperts tend to tackle problems for which they do not have to extend themselves" (Bereiter & Scardamalia, 1993: 78). Experts engage in deliberate practice because they want to continue to improve, while others are satisfied with being merely adequate. "For experts, the mental resources freed up by the use of routines will be 'reinvested' in the pursuit of new goals and problem-solving at a higher level, which they did not have the capacity to deal with earlier. Nonexperts, however, will simply have a diminished number of problems to solve as they develop routines to handle them" (Tsui, 2003: 19).

Learners develop deliberate practice by first noticing aspects of performance which could be better (although they may be adequate already) and then designing practice activities which allow them to work on those aspects of the activity. "[T]he critical distinction between experts and experienced nonexperts is not that the former do things well and the latter do things badly, but rather that experts problematize what seem to be routine practices and address them, whereas experienced nonexperts simply carry out practiced routines. 'Reinvestment' and 'progressive problem-solving'…are two aspects of the same process" (Tsui, 2003: 19). This is also true for teachers. For example, beginning teachers work on maintaining classroom discipline during their beginning years of teaching (Kagan, 1993a; Tsui, 2003). Once they have developed and mastered schemas and routines for class control, teachers have a significant amount of time and energy free which they used to invest in learning how to keep their classes under control. At this point some teachers may choose to invest this in non-teaching activities (e.g., thinking about non-school responsibilities, saving energy for after school, etc.). However, those who want to be good (or excellent), and not merely adequate teachers, can invest this time in figuring out, for instance, whether the students are not just quiet, but are also learning. They can work on their schemata for recognizing when students are engaged in learning or not and hone their skills in routines which can foster student engagement.

Self-regulating activities such as deliberate practice do not necessarily have to be explicitly controlled, but can also be habitual and automatic. For example, Tsui (2003) reports on the nonconscious nature of one teacher's deliberate practice in developing a classroom routine.

> The vocabulary consolidation routine is something that Marina has developed subconsciously over the years…This routine emerged through what Martina described as a 'gradual process.' She realized the importance of recycling and consolidation in learning after her unsuccessful experiences in the first two or three years of teaching when she found that the students did not remember what was taught in class, did very poorly on tests, and had very limited vocabulary, and constantly made the same grammatical mistakes, even though they enjoyed the lessons thoroughly and were interested in learning (Tsui, 2003: 202-3)

Deliberate practice has been shown to be important for the development and maintenance of expertise in fields such as sports (Baker, Côté,& Abernethy, 2003; Cleary & Zimmerman, 2001; Soberlak & Côté, 2003; Starkes, Deakins, Allard, Hodges, &

Haynes, 1996), music (Jørgensen, 2002; Krampe & Ericsson, 1996; Nielsen, 2001) medicine (Hatala, Brooks, & Norman, 2003; Issenberg, McGaghie, Gordon, Symes, Petrusa, Hart, & Harden, 2002; Wayne, Butter, Siddall, Fudala, Lindquist, Feinglass, Wade, McGaghie, 2005; Wayne, Butter, Siddall, Fudala, Wade, Feinglass, & McGaghie, 2006) and software design (Sonnentag, 1998). Even insurance agents engage in deliberate practice. Sonnentag (2000) studied 100 insurance agents and found that the most successful agents arranged the activities required for their job in ways that let them work on things that needed improvement. For example, they may choose to call on people who are known for creating problems in order to practice working with difficult customers. It has been found that expert organizational consultants also engage in more activities that stretch their competence than merely competent consultants (Van de Wiel, Szegedi, & Weggeman, 2004). Deliberate practice has even shown to help university students learn informal reasoning (van Gelder, Bissett, & Gumming, 2004). Studying can be a form of deliberate practice, but only if it is done right. For example, Plant and her colleagues found that the general number of hours spent studying did not correlate with the grades of university students. However, grades did correlate with having a plan for studying and studying in a quiet environment (Plant, Ericsson, Hill, & Asberg, 2005).

Berliner (2001) claims that deliberate practice is rare in teaching in most western contexts. He does point out, however, that in other cultures teachers engage in deliberate practice by observing a variety of teachers, talking about different ways of approaching teaching, collectively working on lesson plans, etc. (Lewis & Tsuchida, 1998). Dunn and Shriner (1999) used questionnaires (n=142), activity logs and interviews (n=8) to study what kinds of deliberate practice activities elementary teachers engaged in. They found that almost all of these were activities that they performed anyway, such as preparing materials, mental planning, and evaluating written work. Tsui (2003), however, studied four EFL teachers in Hong Kong and found that three of them engaged in some forms of deliberate practice, while one used it to a great extent.

Deliberate practice, however, does not just happen whenever you engage in an activity. "[T]he deliberate practice hypothesis is not the banal claim that reasoning skills improve with practice. Rather, it asserts that high-level skills result from practice of a very special sort. Activities that might be called practice but do not amount to deliberate practice, such as simply engaging in reasoning and argumentation, are predicted not to help people go beyond ordinary competence" (van Gelder, Bissett, & Gumming, 2004: 149). Furthermore, in many activities simply engaging in the practice does not normally provide learners with the feedback they would need to focus their learning. "Deliberate practice differs from other domain-related activities because it provides optimal opportunities for learning and skill acquisition. If the regular activities in a domain did not offer accurate and preferably immediate feedback or opportunities for corrected repetitions, improvements in performance with further experience would not be expected" (Ericsson & Charness, 1994: 739). Another problem is that opportunities to work on specific aspects of practice are not always present.

> During play even individuals who desire to improve their performance do not encounter the same or similar situations on a frequent and predictable basis. For example, a tennis player wanting to improve a weakness such as a backhand volley, might encounter a relevant situation only once per game. In contrast, a tennis coach would give that individual many hundreds of opportunities to improve and refine that type of shot during a training session (Ericsson & Charness, 1994: 738).

Finally, if learners are engaged in real practice, they many not be able to afford the luxury of experimenting with new ways of doing things. "The costs of mistakes or failures to meet deadlines [may be]…generally great, which discourages learning and acquisition of new and possibly better methods during the time of work. For example, highly experienced users of computer software applications are found to use a small set of commands, thus avoiding the learning of a larger set of more efficient commands" (Ericsson, Krampe & Tesch-Römer, 1993: 367).

Some evidence supports the hypothesis that deliberate practice needs to be separate from normal participation in the activity. For example, studies of chess players from a variety of countries have shown that expertise in chess correlates well with time spent on deliberate practice activities such as studying games played by Grand Masters, but expertise does not correlate with the amount of time spent playing chess games (Charness, Tuffiash, Krampe, Reingold, & Yasyukova, 2005). Furthermore, Cleary and Zimmerman (2001) studied 43 basketball players. They found that the boys who were much better than the others (e.g., experts for their age group) selected specific goals and worked on specific techniques during practice, whereas other boys tended to just play around.

However, other studies point to the possibility of engaging in deliberate practice while carrying out the activity. As mentioned above, expert insurance agents and organizational consultants construct their practice in a way to work on their knowledge and skills (Sonnentag, 2000; van de Wiel, Szegedi, & Weggeman, 2004). Marina, the teacher in Tsui's (2003) study also incorporated deliberate practice into her teaching practice. Davis & Krajcik (2005) claim that teachers can learn from using curriculum materials if these are designed to promote teacher learning: "educative curriculum materials serve as cognitive tools to help teachers add new ideas to their repertoires" (Davis & Krajcik, 2005: 7). Schneider and Krajcik (2002) followed three middle school science teachers using such curriculum materials to teach a unit on physics. They found that because the materials asked teachers to engage in deliberate practice activities such as eliciting student explanations for phenomena and accounting for them in explanations, the use of the materials did help teachers change their knowledge and facility in science teaching. Collopy's (2003) findings were slightly different. She studied two elementary teachers teaching a unit on math using new curricular materials. Callopy found that the teaching style of the teacher determined whether the materials were used for deliberate practice or not. One of the teachers wanted to understand why and how to use the new materials while the other teacher used the materials as directed without working on understanding the ideas behind the materials. The first teacher used the material to deepen her knowledge of and facility in math teaching, but the second teacher was not. In fact, Ericsson does suggest that, in some circumstances, what experts do in practice can be both (a) aimed at performing the task well and (b) used to increase knowledge and skill. "Many of the mechanisms of superior expert performance serve the dual purpose of mediating experts' current performance and of allowing continued improvement of this performance in response to informative feedback during practice activities." (Ericsson & Lehman, 1996: 273)

Deliberate practice should not be confused with the training model of teacher education (Larsen-Freeman, 1983; Widdowson, 1990). In teacher training, as opposed to teacher education, teachers learn procedures to use during L2 instruction. Teachers were supposed to use these procedures in the way they were taught and not much attention

was put on having teachers understanding the reasons behind the procedures (Freeman, 2002; Widdowson, 1990). While deliberate practice does stress skill development, procedural knowledge is not the only thing learned in deliberate practice. Schema and theory development can also be part of deliberate practice, as long as these are generated from the experience of practice, not from abstract discussion. For example, Tsui (2003) reported on a teacher who spent several years trying new activities and new activity arrangements until she figured out what she wanted in terms of vocabulary instruction.

Furthermore, the purpose behind deliberate practice is not the automatic and mindless use of techniques. Deliberate practice can be used to increase skill and knowledge, so that learners gain the facility to do more than they have been taught. "The experienced chess player learns many patterns. But for the expert these do not become patterns that restrict thinking and result in stereotyped, predictable play. Instead, they are used as building blocks for increasingly sophisticated analyses and strategies of play" (Bereiter & Scardamalia, 1993: 110-11). In addition, if creativity and innovation are part of the activity being learned (as in teaching), it should be part of deliberate practice. "[O]ne of the requirements of adaptation is to participate in the pursuit of ideal goals of the group, and this necessitates continued progressive problem-solving. Adapting to a scientific subculture, for instance, requires more than mastering a body of scientific knowledge and skills. One is expected to make some advance on an unsolved problem between this year's convention and the next" (Bereiter & Scardamalia, 1993: 104-5).

In summary, to move from basic competence to expertise, teachers need to engage in deliberate practice. This is not specific to teaching; the need for deliberate practice seems to be a general requirement for the acquisition of expertise in any practice. The research presented in this section indicates that while some kinds of knowledge can be gained with deliberate practice during the actual activity (e.g., teaching), other kinds of knowledge need deliberate practice outside of the activity for expertise to be acquired. The implicit, practice-specific and dynamically organized knowledge acquired from quality deliberate practice is the basis for sophisticated and creative teaching.

6.4.3   The role of explicit, academic knowledge

There are many reasons to doubt the usefulness of general, declarative knowledge and to question whether it should be part of SLTE programs. Such knowledge does not seem to be used by L2 teachers in their practice, it is not the kind of knowledge that teachers use for guiding action, and it is part of a very different practice than L2 teaching. Furthermore, it has been argued that the focus on explicit knowledge in SLTE programs may well represent an attempt to impose the values and practices of the academic discourse community on language teachers (Bartels, 2004) or to control teachers: "theory [is used] as a tool used by experts to assert control over practitioners" (Kumaravadivelu, 1999: 33). Despite these shortcomings, there are some important uses for explicit, public knowledge in teacher learning.

6.4.3.1 Scaffolding teacher learning and designing deliberate practice
One role for explicit knowledge is to help teachers understand, articulate and analyze the knowledge they already possess about language teaching, regardless of whether they acquired this knowledge as students, as observers, or from their own teaching. Because such knowledge is typically tacit, it is often difficult for teachers to articulate why they do what they do. Explicit knowledge can scaffold this process, help teachers name what

they do, help them analyze and view their knowledge critically, and provide ideas for deliberate practice. "The role of external input of theory, prescriptions, and the experiences of others lies in how these can help the individual teacher to articulate her experience and thus make sense of her work" (Freeman, 2002: 11). For example, Tsui (2003) reported that the exposure to public, academic knowledge was critical in the development of the expert teacher in her study.

> It was only when she attended the PCEd course [a graduate program in Hong Kong] that she began to understand the theoretical rationale behind her classroom practices and to reflect on her teaching in a more systematic and principled way. The *theorization of her own practice* became the basis for her future pedagogical decisions…The more profound theoretical input in the Master's course in English language teaching enabled her to formulate her own theories of grammar teaching. For example, her analysis of the problems with textbooks confirmed her own conviction of using authentic materials for teaching (Tsui, 2003: 201: Emphasis added).

The four L2 teachers in Freeman's study also used public conceptions and explanations to develop their understandings of their own practice. "The new discourse…enables them to perceive and articulate their own feelings and thoughts about teaching in new ways" (Freeman, 1991a: 446). While public knowledge is used in this process, the focus is on understanding the teachers' internal data (i.e., what the teacher has experienced as a teacher and as a student) not on the public, external data on which the academic conceptions are based.

In fact, there are situations where explicit knowledge can be much more effective than having learners abstract their own theories from their own internal data. Learning from experience in professional contexts alone can be very difficult, even those requiring little sophisticated knowledge (Huet & Mariné, 2005); this difficulty stems from the fact that cases can be complex, similar cases do not occur with regularity, decisions need to be made quickly without time for analysis, feedback is missing or highly selective, etc. (Strasser & Gruber, 2004). If learners have enough experience in the practice, general conceptions can be helpful in scaffolding their learning. For example, Schwartz and Bransford (1998) conducted a series of experiments with college students learning psychology. The data consisted of classic psychology cases and the students either compared the cases, compared the cases and received a short lecture connecting the cases, or did a number of related tasks. The results showed that comparing cases and a lecture were much more effective for using the cases to understand new psychology cases than, reading, summarizing, or comparing cases without a lecture.

> Although contrasting cases are effective at scaffolding the development of differentiated knowledge, there is a limit to what we can reasonably expect people to discover…This is where direct teaching can play a valuable role. It can offer a higher level explanation that would be quite difficult or time consuming to discover. A higher level explanation is important because it provides a generative framework that can extend one's understanding beyond the specific cases that have been analyzed and experienced (Schwartz & Bransford, 1998: 510).

6.4.3.2 Feedback
Feedback on the result of deliberate practice is vital as learners (or those helping learners) use information on previous performance (e.g., problems or differences between what was expected and what happened) to refine deliberate practice tasks in order to focus on those aspects of practice which need more facility. "[S]ubjects actively try out different methods and refine methods in response to errors and violated

expectations" (Ericsson, Krampe & Tesch-Römer, 1993: 367). One of the principal uses of explicit knowledge is to check the results of implicit cognition and provide feedback. "The explicit system has a largely regulatory function, overriding the implicit system when it encounters novel situations for which it has no response" (Boreham, 1994: 172). While implicit cognition is relied upon because it is quick and uses few scarce cognitive resources, it is a quick and rough cognitive system which is not always accurate. For example, Gilhooly and his colleagues found that doctors interpreting ECG data would make a diagnosis quickly and then use their explicit biomedical knowledge to check on their diagnosis. "From the trace description a clinical diagnostic hypothesis tends to be retrieved quite quickly. This may then be checked by biomedical reasoning about the kind of trace the hypothesized condition would produce" (Gilhooly, McGeorge, Hunter, Rawles, Kirby, Green, & Wynn, 1997: 219). Similar results were obtained in a series of studies by Richter and Späth (2006). For example, participants were given information on safety of different airlines but were also told that the biggest international airlines (i.e., the airlines which the participants would be most likely to recognize) were the safest. Then the participants were asked to rate pairs of airlines in terms of which was the safest airline. When a well-known airline was paired with a lesser-known airline with an excellent safety record, reaction times were much slower, leading to the conclusion that participants were implicitly recognizing the well known airline as safe, but then using explicit knowledge to check that assessment.

As LeDoux (1996) explains, the reason why the role of explicit knowledge to check on the products of implicit cognition but not guide action has to do with how the brain works. The cortical areas (where most of the explicit processing tasks place) process information more precisely "The subcortical pathways provide a crude image of the external world, whereas more detailed and accurate representations come from the cortex" (LeDoux, 1996: 165). However, subcortical processing (where, to oversimplify, much of implicit cognition takes place) has the advantage of faster processing: "Although the thalamic system cannot make fine distinctions, it has an important advantage over the cortical input pathway to the amygdale. That advantage is time…it is a quick and dirty processing system" (LeDoux, 1996: 163). LeDoux suggests humans use each processing system to do what it does best: subcortical (mainly implicit) processing is used for generating conceptions, understandings and courses of action, while the "cortex's job is to prevent the inappropriate response rather than to produce the appropriate one" (LeDoux, 1996: 165). Thus, although we do not rely on explicit knowledge to guide action and cognition, it is a good tool for making sure that our "quick and dirty" cognition does not make too many mistakes.

As we saw in the third chapter, changing or refining teachers' conceptions does not mean that the teacher will automatically know how to teach in accordance with new understandings (e.g., Halloun & Hestenes, 1985a; 1985b; Pennington & Richards, 1997; Reif & Allen, 1992). This process is made more difficult because *interpretations* of the causes of a situation are often processed in the brain as if they were *knowledge* (LeDoux, 1996). For example, if two boys are throwing a ball to each other and the ball hits me, I might conclude that they meant to hit me with the ball. I would then act as if I knew that they had thrown at me on purpose, even though I do not really know that this is true. "Illusions created by misidentifying the source of effects distort the subjective experience…their products are experienced as direct or 'true' perceptions or memories, rather than as interpretations…Subjective experience is important because it serves as a basis for judgments and action" (Jacoby, Lindsay, & Toth, 1992: 804). This makes it

especially difficult to change teachers' conceptions because they usually enter teacher education with extensive subjective experience with teaching and schooling as students due to their *apprenticeship of observation*. Furthermore, novice teachers' conceptions are rarely challenged during student teaching (Feiman-Nemser & Buchmann, 1987). "The average student teaching experience entails little cognitive engagement, which may account, in part, for the absence of conceptual change. Instead of challenging student teachers to examine and evaluate their personal beliefs, university supervisors and cooperating teachers simply tend to provide moral support and exclusively positive feedback" (Kagan, 1992a: 76).

Explicit knowledge, however, can help. It appears that people need to be confronted with the differences between their knowledge and new knowledge in order for fundamental knowledge change to take place. For example, in a longitudinal study of 14 elementary teachers and their conceptions of assessment, Borko and her colleagues (Borko, Mayfield, Marion, Flexer, & Cumbo, 1997) found that the teachers only changed their conceptions when their initial ideas were directly challenged. Moreover, when VanLehn and his colleagues (VanLehn, Siler, Murray, Yamauchi & Baggett, 2003) looked at 125 hours of recorded tutoring of physics students, they found challenging student's knowledge did not always produce evidence of learning, but there was no evidence of learning when students' conceptions were not directly challenged. This seems to be true not only for individuals but also for groups. Rousseau (2004) studied a group of five teachers who attempted to reform the pre-algebra math curriculum and teaching at their school, but failed despite strong commitment to the idea and cohesive group dynamics. Rousseau claimed that the principle reason for this failure was that many of the concepts that teachers were using to work on reform conflicted, both internally and with the conceptions of other teachers, but these conflicts were neither addressed directly nor resolved.

According to Dann (1992) there are three steps that need to be taken to use explicit knowledge to organize implicit knowledge. First, "[t]he already existing knowledge and problem-solving capacity has to be activated,…[then, the] individual subjective theories have to be confronted with new knowledge, [and, finally, to] guarantee that the newly generated knowledge becomes better than the old one, it has to be used within the relevant context" (Dann, 1992: 166). For example, the four L2 teachers in Freeman's (1991a; 1993) study were able to change many of their conceptions of teaching and students once they were able to articulate their tacit ideas. The last idea might be the most crucial for the use of explicit knowledge: people have to see what the concept means in terms of their day-to-day practice before they are able to integrate it. For instance, in Borko's study of elementary teachers the teachers reported that it was through talking about general concepts in terms of specific situations in their own teaching which helped them understand and integrate these ideas into their professional knowledge base. "[S]ituating the change process in the actual teaching and learning contexts where the new ideas will be implemented is an effective strategy for helping teachers change their practices" (Borko, Mayfield, Marion, Flexer, & Cumbo, 1997: 267). Another interesting example is McDonald's (1986) study of a group of teachers who met regularly to talk about teaching. They also read academic articles in preparation for these meetings because they found it helped them understand and articulate their own conceptions and understandings of their practice. McDonald argues that the key part of this process was that their focus was on their experiential knowledge of their practice,

not on explicit academic knowledge. Academic knowledge and theory was a means to an end, not the end in and of itself.

Explicit, academic knowledge may not be the basis for professional cognition, but it does have important uses for teacher learning. First, it can scaffold the process of bottom-up learning by providing concepts for teachers to look for and explanations for patterns that teachers might notice. Second, explicit knowledge can provide teachers with feedback about their performance in deliberate practice and discontinuities between their present knowledge and the knowledge they are aiming for. Without some kind of deliberate practice, however, such insights alone are not likely to help teachers develop and enrich their practice. While academic concepts can be useful in this process when they are used as a tool to scaffold the creation of personal and context-bound conceptions of practice, not for organizing personal, professional knowledge (i.e., internal data) in terms of academic categories.

6.5 Conclusion

A large knowledge base may be important for teaching, but in order for knowledge to be useful it needs to be organized into a flexible network for the specific practices it is to be used for. It is not possible to predict everything that will happen in a lesson, so teachers are constantly constructing on-the-spot understandings of the situation and guiding further instruction on the basis of these understandings. Such a flexible network, where student cues are linked to each other so that the teacher can decide what they mean (*Does that puzzled look mean that they did not understand the question, the grammar needed to answer is too difficult or that it is 7th hour and they are just too tired for such an activity?*), and cues are linked to action (rephrase the question or model what I want them to do, do some quick grammar work on the aspects needed for the task, or switch to an easier task for tired students), makes it easier for teachers to plan lessons, guide activities and react to students because little needs to be worked out explicitly in limited working memory. Studies have shown that knowledge organization also helps experts know what aspects of a problem are most important. This allows them to use only the minimum knowledge necessary to evaluate a situation and decide on what to do. However, more research is needed to investigate the extent to which teachers' knowledge is dynamic and to what extent it is an organized into more rigid structures.

SLTE programs can help teachers gain such an organized network of practice-specific implicit knowledge by having them engage in teaching-similar activities where the focus is on understanding similarities and differences between specific teaching situations. Deliberate practice, where teachers design activities (either in teaching or outside of teaching) so that they will learn, is another way to develop and organize the kinds of knowledge teachers can use. Explicit, academic knowledge has important roles to play in this process. First, it can scaffold teachers' learning by suggesting things to pay attention to and to work on. Second, it can help teachers evaluate the results of their implicit cognition and deliberate practice which provides them with feedback on their performance. However, most of the evidence for this position is mainly circumstantial. Further studies are needed which investigate directly to what extent SLTE experiences which supposedly help teachers organize and link their knowledge actually accomplish this and what effect this has on actual teaching practice.

As was mentioned at the end of the last chapter, teachers' knowledge is specific to their practice, not general. However, as Larsen-Freeman (1983) has made clear, L2 teachers may end up working in a wide variety of contexts and it is just not possible for SLTE programs to help teachers acquire specific knowledge for each possible context which they could find themselves teaching in. The research here suggests that the answer to this problem is not to provide teachers with general knowledge (which is not specific to particular contexts); instead, SLTE programs should provide teachers with specific knowledge of a variety of contexts and help them connect this knowledge into a network of knowledge for practice which should help them create on-the-spot understandings in the situations they find themselves. For example, to help teachers understand Content Based Instruction (CBI), SLTE programs could provide specific examples of CBI in several contexts (e.g., elementary ESL, high school EFL, EAP for medical personnel), including activities, how activities combined to form curriculum scripts, student reaction to activities, student learning through activities, etc. When the teachers participate in teaching-similar activities (i.e., selecting instruction, developing instructional units, evaluating student reactions and work, changing instruction due to student work) for particular contexts, they also need to work on how and to what extent their decisions would be different (say in choosing a specific activity) if they were teaching in a different context (i.e., one of those mentioned above). The research presented here suggests that teachers who have engaged in such experiences will find it easier to use CBI in a context they are totally unfamiliar with (for example, an ESL history or math class), than someone who has only read and discussed the academic construct of CBI and the empirical research on that construct.

This brings up a further problem. Humans have very little capacity for explicit cognitive processing. The activities mentioned above, however, would probably require a substantial amount of processing. It is unclear whether such activities would really work given the cognitive bottleneck. The next chapter will investigate this problem in greater detail.

Chapter 7: Managing Cognitive Load

Research indicates that for teachers to acquire the kind of practice-specific dynamically organized implicit knowledge in SLTE programs they need to have explicit cognitive processing capacity available for learning during SLTE activities. If teachers need to pay attention to too many factors, they will suffer from cognitive overload and will not be able to learn much. Therefore, one of the central responsibilities of SLTE teachers is to manage the cognitive load of their students. For instance, they can scaffold teacher learning by directing teachers' attention to the most salient factors, supporting performance, and using assessment of teachers' knowledge to design activities which do not overload working memory. Another way to reduce cognitive load is by designing SLTE activities which are superficially and structurally similar to the activities that make up the practice of teaching. If SLTE tasks are truly similar to teaching, teachers will be able to simply recognize the connections to teaching, which greatly reduces the need to mentally work out this connection. Finally, the extent to which an activity is easy, challenging or results in cognitive overload depends on the teacher's knowledge base, their learning styles, and their values for teaching. In other words, SLTE programs should not be "one-size-fits-all". Instead, activities need to be designed and scaffolded according to the knowledge, styles and interests of the teachers involved.

7.1 Cognitive load and learning

Sweller (1988) suggested that more working memory capacity a learning activity needs, the less will be learned. People do not learn directly from the process of solving problems or engaging in activities if there is no excess processing capacity in working memory for learning. If all of a learner's processing capacity is engaged with the learning activity, then little to no learning will take place (Kirschner, 2002; Moreno, 2006; Sweller, 1988). If a learning activity is complex, the "cognitive-processing capacity needed to handle this information may be of such a magnitude as to leave little for schemata acquisition, even if the problem is solved" (Sweller, 1988: 261). According to Paas, Renkl and Sweller (2003) processing demands from learning are referred to as *germane cognitive load*, while processing capacity used for anything besides learning (looking up information, problems solving, etc.) is called *extraneous cognitive load* (Paas, Renkl & Sweller, 2003). Theoretically, activities with high germane cognitive load and low extraneous cognitive load will lead to more learning than those with a high extraneous load (when a lot of busy work is required for the activity) or low germane cognitive load (when the activity does not lead to much learning regardless of level of cognitive load). For example, student teaching is an activity which can often lead to cognitive overload in novice teachers, so sharing a student teaching assignment between two student teachers might lower extraneous cognitive load for both. Bullough and his colleagues investigated one such situation and found that the mentor and both student teachers felt that this arrangement made learning during student teaching easier (Bullough, Young, Birrell, Clark, Egan, Erickson, Frankovich, Brunetti, & Welling, 2003).

Evidence for the Cognitive Load Hypothesis has been provided by a series of studies on learning with *worked out examples* (examples of a problem where each step of finding the solution is presented to the learner). In such research, one group of learners works on problems typical for a field and another group studies *worked out examples* (i.e., the same problems, except the answers are given as well as each step in the solution process). The second group, because it does not need to seek a solution and has all information provided to them, has much more cognitive processing capacity free for

learning. In such studies it has consistently been found that groups studying such worked examples do better on subsequent problems, which as been interpreted as evidence of greater learning, in fields such as math (Mwangi & Sweller, 1998; Sweller & Cooper, 1985), statistics (Paas, 1992), and electronics (Kalyuga, Chandler, & Sweller, 2001; van Gog, Paas, & van Merriënboer, 2006). Furthermore, as learners develop schemata for a particular area, these schemata enable learners to process more information using the same amount of working memory capacity. At this stage, the amount of information in the worked examples can be reduced until learners need no additional help to learn from problems, a teaching strategy called *fading* (Renkl, Atkinson, Maier, & Staley, 2002).

Other evidence comes from split attention studies. In this research, one group of learners works on problems where the supporting formulas and diagrams are integrated into the text of the problems, another group works on problems where the text and supporting information are separate, so that their attention is divided between the problem text and visual information. Studies in areas such as math (Mwangi & Sweller, 1998; Tarmizi & Sweller, 1988), physics (Ward & Sweller, 1990), and electronics (Kalyuga, Chandler, & Sweller, 1998) have shown that learners working on integrated problems (which lessen cognitive load) learn more than those which require learners to split their attention.

7.2 Scaffolding learning

7.2.1 The construct of "scaffolding"

Providing novice teachers with contextualized learning activities which are similar to the practice of teaching is important in teacher education, but there are some drawbacks to immersing novice teachers into the kind of complex, ill-defined situations that are typical of teaching. "A severe risk …is that learners have difficulties learning because they are overwhelmed by the task complexity" (van Merriënboer, Kirschner & Kester, 2003: 5). For example, Dahlman (2005) conducted case studies of six L2 teachers who were involved in a masters-level SLTE program while also teaching full time. Although their practice as teachers did help to contextualize much of what they learned in their masters program, often the complexities of the classroom would prevent them from understanding concepts they were exposed to in the SLTE program. Dahlman gives the example of one teacher who was not able to understand ideas about assessment in terms of her context because of day-to-day demands related to assessment (collecting and keeping track of information such as completion of homework, checking whether the students have missed a class, etc.) overloaded her cognitive processing capability, leaving little cognitive processing capacity for her own learning process.

Cognitive load during contextualized, activity-based learning experiences can be lessened by scaffolding (Rosenshine & Meister, 1992; van Merriënboer, Kirschner & Kester, 2003). The term scaffolding, coined by Wood, Bruner and Ross (1976) based on Vygotskty's (1978) concept of *Zone of Proximal Development* (ZPD) (Bruner, 1986; Wood, 1988), refers to "controlling those elements of the task that are initially beyond the learner's capacity, thus permitting him to concentrate upon and complete only those elements that are within his range of competence" (Wood, Bruner, & Ross, 1976: 90). Vygotsky's ZPD refers to what an individual can do with the assistance of others, but not on their own. Learning is thought to be most effective when the learner is in her ZPD and, by definition, scaffolding is needed for learners to work within their ZPDs. Scaffolding generally entails (a) directing learners' attention to "a meaningful and

culturally desirable activity beyond the [learner]'s current understanding or control" (Stone, 1998: 349), (b) assessing the learners' present knowledge and capabilities in terms of the activity, (c) providing a range of support for the learners' to engage and participate in the activity in meaningful ways, and (d) "fading" or gradually withdrawing support as the learners' knowledge and competence increases (Stone, 1998). In scaffolding, the support provided should "not direct the learner…but rather guide the learner during his or her work on complex learning tasks" (van Merriënboer, Kirschner & Kester, 2003: 5). Examples of such support can include "[c]oaching by providing hints, prompts, and feedback; modeling the use of cognitive strategies by thinking aloud; presenting cue cards, checklists and process worksheets; asking leading questions; and giving part of a solution" (van Merriënboer, Kirschner & Kester, 2003: 6). Scaffolding is thought to not only enable learners to complete tasks they could not do on their own, but also to frees up processing capacity for learning because the learner does not have to account for all factors and tasks in the activity.

Originally, scaffolding only referred to human-human interaction. However, given the work on distributed cognition, it is recognized that physical and mental tools can be used to scaffold learning (Freeman & Johnson, 2005). "Scaffolding is no longer restricted to interactions between individuals – artifacts, resources, and environments themselves are also being used as *scaffolds*" (Puntambekar & Hübscher, 2005: 1). For example, Hawkins (2004) found that a listserve for a SLTE course helped the teacher students to create a discourse community within their class which served to help scaffold the process of relating general ideas as they relate to schools. "The listserve…provided a venue for students to overtly discuss and critique issues of language and culture as they relate to social equality and access in schools. And they did this through identities they were able to assume in this specific context – namely, in shared discussion via e-communication in a specific graduate-level language-teacher education course" (Hawkins, 2004: 106). Mathan and Koedinger (2005) developed a computer program that helped people learn to use computer spreadsheet programs. One version of the program only pointed out learners' mistakes and gave feedback. The other version of the program, however, helped scaffold learning by asking probing questions ("Are you sure about X?", "Have you thought about Y?", etc.) and by modeling steps for solving specific, task-related problems. The programming students who used the latter program exhibited larger gains in spreadsheet activities, conceptual understanding and retention of information about spreadsheet programming.

Such support, however, only works if the help it provides is of good quality. For example, when Cajkler (2004) examined the copious number of documents provided by the British government to help teachers understand and use of the National Literacy Strategy, he found that they contained numerous problems. Many explanations were wrong: "The butler was dead" was listed as an example of the passive (Cajkler, 2004: 8), inconsistent: "English was given four tenses (past, present, future, continuous) at the top of the page…but three towards the bottom of the same page (past, present, future)" (Cajkler, 2004: 8), or only partially true, "Words ending in –f are said to change to v when verbs (which is the case for the nouns half, calf, and shelf, but not dwarf, loaf, brief, leaf, wolf" (Cajkler, 2004: 7). Even when examples were technically correct, they often made no sense at a discourse level, such as my personal favorite: "Julian is poking Jim. No! Jim is being poked by Julian" (Cajkler, 2004: 11). Carless and Wong (1999) found similar problems in documentation aimed at supporting the Target-Oriented Curriculum (TOC), which seeks to implement task-based teaching in Hong Kong's

schools. "[T]he definitions of tasks in the TOC documents are somewhat jargonistic and not easy for teachers to interpret… published exemplar tasks…often do not possess the characteristics of tasks as defined in TOC documents" (Carless & Wong, 1999: 9). In addition, they found that teachers' understanding of the TOC was low and that they were reluctant to use the TOC documents. Even the human resources provided to help scaffold learning of task-based teaching were not of the quality needed: "not all TOC teacher educators were confident in their understanding of the Hong Kong primary school context or of how children of primary age learn best" (Carless & Wong, 1999: 14).

7.2.2   Social contexts as scaffolds

Social contexts can also scaffold learning. If learners are familiar with a situation and know what is expected and what is not, they do not need to invest cognitive resources in monitoring and evaluating these factors, which leaves more cognitive processing capacity for learning. "Social norms and social imitation can also help us make decisions with limited time and knowledge" (Gigerenzer & Todd, 1999: 31). Furthermore, contexts can help scaffold learning by making the purpose of what is being learned clearer. For example, Beach (1995) looked at shopkeepers learning math in adult education programs and high school students apprenticing to be shopkeepers in Nepal. He found that the shopkeepers gained better and more flexible knowledge than the students. Furthermore, the strategies that the shopkeepers used to tackle math problems were the same regardless of whether the problems were in the context of school or the shop, whereas the apprentices used different strategies in school and in the shop. Beach concluded that the shopkeepers used the context of their practice to frame and understand the math they were learning, which allowed them to focus on salient aspects of math for their practice. The apprentices, lacking extended knowledge of shopkeeping, were not able to do this. The social nature of many kinds of knowledge and the role of social context in scaffolding learning is incorporated into the conception of Legitimate Peripheral Participation (LPP). The idea behind LPP is that learners should learn a practice by engaging in different parts of a process, first more peripheral aspects and, as they learn more and their ZPD expands, participating in practices which are more central to the activity they are learning (Lave & Wegner, 1991; Sutherland, Scanlon, & Sperring, 2005).

Contexts can be used to scaffold learning by distributing cognition over a group so each person in group work does not need to know about or work through each aspect of an activity (Hutchins, 1990; 1991; 1995; Lave, 1988). Distributed cognition refers to how we lessen our cognitive load by using our environment to structure and process information. Cognition "is often distributed by off-loading what could be elaborate and error-prone mental reasoning processes as action constraints of either the physical or symbolic environments…the environments in which humans live are thick with invented artifacts that are in constant use for structuring activity, for saving mental work, or for avoiding error, and they are adapted creatively almost without notice" (Pea, 1993: 48). This allows people to avoid the kinds of mental processes they are not good at (e.g., multiple and rapid explicit calculations of numbers or activities), instead relying on processes that we are good at (pattern recognition, creating simple models of the world, manipulating objects in an environment). This led Barab and Plucker (2002) to suggest that exemplary practice is often the result of "smart contexts" rather than smart people. In other words, people can improve their practice by rearranging their environment to distribute cognition resulting in a situation where they appear more intelligent (because

they are performing the activity better) without having actually improved their individual cognitive abilities.

For example, position of large ships is often determined in three minute cycles. This was not because three minute intervals were in any way better than information provided at two or four minute intervals. The advantage was that with minute intervals the ship's speed can be determined with very little mental computation. "Since three minutes is one-twentieth of an hour and 100 yards is one-twentieth of a mile, the number of hundreds of yards…a ship travels in three minutes…is its speed in nautical miles per hour…In order to 'see' the answer to the problem posed, the navigator need only imagine the number that represented the distance travelled in yards, 1500, with the last digits removed: 15" (Hutchins, 1990: 204). Thus, someone determining a ship's speed at three minute intervals has a much simpler cognitive task (and, thus, might appear more intelligent) than someone doing the same thing at four minute intervals.

Research on teacher cognition provides evidence that teachers distributed cognition in the classroom. For example, Swanson and his colleagues (Swanson, O'Connor & Cooney, 1990) provided 24 experienced and 24 novice teachers with written vignettes of classes with discipline problems. The teachers "thought aloud" while reading the vignettes and thinking of classroom management strategies for those situations. One finding was that the experienced teachers tended to rely on the classroom environment to solve problems (changing position of students or teacher, using visuals to focus attention, etc.) while novices relied on more general (and cognitively taxing) strategies (talking to students about the problem, etc.). For example, as noted earlier the majority of the experienced PE teachers in Housner and Griffey's (1985) study demanded to see the actual facilities they would be using before they would plan the experimental lessons asked of them. Without knowing the layout of the gym and the exact kinds of equipment available, it would have been difficult for these teachers to distribute the cognition during instruction. In Carless' (2003) study of 3 secondary teachers' use of task-based activities, task-based textbooks lessened the cognitive complexity of implementing a task-based approach by allowing some classroom cognition (choosing tasks, thinking of questions, etc.) to be done by the textbook. One of the teachers explained that the new textbook "is quite task-based, I need less time to think about what activity to do, it saves my time designing activities, I just follow most of the tasks suggested in the book" (Carless, 2003: 10).

Nyikos and Hashimoto (1997) examined three groups of three graduate students working on tasks in a class on cooperative development. They found that students scaffolded learning for each other and that a division of labor within groups promoted learning. Socially interactive learning activities are not additive in the sense that the advantage does not seem to lie in each group member simply learning knowledge that the other has. Ohtsubo (2005) looked at the learning in groups of three college students working on puzzle problems. There were 7 clues needed for solving the puzzle; each member of 19 triads received all seven clues while in the other 19 triads the clues were distributed in the group so that no one member had all the clues. Those groups which needed to share the information (because no one had all the clues) were much better at solving the puzzle (66% to 17%). However, this was not due to learning the clues better; "members of successful groups were less likely to recall items assigned to other members than those in the unsuccessful groups" (Ohtsubo, 2005: 1229). Instead, Ohtsubo concluded that the groups who needed to share clues succeeded because "each member in the successful

groups did not have to store the entire set of seven cues in his or her long-term memory" (Ohtsubo, 2005:1229-1230), which saved scarce cognitive processing capability. In addition, research has shown that groups are more likely to bring up information and this information is more likely to be repeated if not all members of the group possess the same information (Stasser, Taylor & Hanna, 1989; Stasser, Stewart, & Wittenbaum, 1995). However, as Bailey (Bailey, F., 1996) found in his study of group work on a TESOL methods course, simply putting novice teachers into a group does not necessarily result in effective distributed cognition in group work, especially if some group members have an external locus of control (Smith-Jentsch, Salas, & Brannick, 2001). "Getting small groups of learners together does not guarantee learning" (Bailey, F., 1996: 227). For instance, some group members may not speak up or not be heard by others (Bailey, F., 1996). In some cases it can help if group members are designated as experts for specific aspects of the activity (Stewart & Stasser, 1995) while a disrespectful group climate significantly reduces group achievement (Smith-Jentsch, Salas, & Brannick, 2001). Studies have also found that when teachers working together productively in groups, they learn more (Chalies, Ria, Bertone, Trohel & Durand, 2004; Kazemi & Franke, 2004; Wang & Paine, 2003).

It is not only teachers and ship navigators who take advantage of distributed cognition. Studies of cognition in medical settings have produced similar findings. Patel, Kaufman and Magder studied the decision making in a hospital emergency room. They concluded that:

> the immediate physical and social resources outside the person participate in cognition, not just as a source of input and a receiver of output, but as a vehicle of thought. The claim is that the individual and the environment are viewed as dynamically interacting, resulting in cognitive performance and learning. Interaction would mean that although the combined products of a cognitively distributed system cannot be accounted for by operation of its isolated components, each of the entities or individuals can still be seen as having qualities of his or her own, some of which are an integral part of the 'distributed partnership' and others which are no" (Patel, Kaufman & Magder,1996: 140).

For example, Lebeau (1998) shows that the activity of taking a patient's medical history is not simply collecting a variety of historical facts about the patient. Instead, the questions are ordered and phrased in ways which will produce information which automatically supports or rules out potential diagnoses. This allows doctors to easily narrow their search for possible diagnoses without having to calculate a full model of the patient's condition with all possible information, a very cognitively taxing activity. In addition, Bang and Timpka (2003) found that emergency room doctors and nurses use patient records to off-load memory tasks, to support joint attention, and to coordinate expertise in specific aspects of the problem at hand. Similar results have been found outside the medical field. Faraj and Sproull (2000) used questionnaires to assess the coordination of expertise (taking advantage of expertise specific members had in different aspects of the problem while not asking members to engage in practices where they had little expertise) in 69 software development groups. They found that those groups who reported high levels of expertise coordination were much more successful in meeting their production goals than groups that did not.

Another form of distributed cognition occurs when groups of people manage to scaffold cognition for each other. Nyikos and Hashimoto (1997) point out that "[w]ithin a group, each person has an individual zone of potential. However, in a dynamic interrelationship

of ideas and views, this potential may grow or be stymied, depending on various group conditions that may or may not be conducive to learning and social growth" (Nyikos & Hashimoto, 1997: 507). They suggest that groups have their own ZPD which can be quite different from the ZPD of the individuals in the group. This can be seen in Faraj and Sproull's (2000) results showing that groups which operated on an individual basis had lower ZPDs than those that shared information. Surowiecki (2004) claims that groups are smarter than individuals as long as (a) the groups contain a relative diversity of opinion, (b) members are independent of each other, (c) group processes are decentralized, and (d) the group has ways of aggregating opinions. He provides numerous examples of the superior abilities of groups, for example the finding that the TV studio audience of "Who Wants to be a Millionaire?" has the correct answer 91% of the time (meaning the answer preferred by the highest percentage of the audience, not all the audience, is correct 91% of the time), while the actual contestants only get the right answer 65% of the time. Therefore, if group activities are used in SLTE experiences, SLTE teachers needs to scaffold learning for the group ZPD, not individual ZPDs alone.

Unfortunately, schools are often not set up in ways to take advantage of group cognition for teacher learning. Lima (2003) studied the socialization of two novice teachers into two different high school English departments which were both perceived to be "collaborative". He found that "the student teachers were socialized through isolationist processes and were treated as a separate category of teachers; their contacts with experienced teachers were minimal and the few formal ties that they entertained within the department (especially with the cooperating teacher) were strongly hierarchical and evaluative in nature" (Lima, 2003: 214). In addition, Farrell (2001) followed one novice teacher in the practicum. He found that the support system for that teacher existed more on paper than in reality and the student teachers in the school said that they "feel like strangers in this school" (Farrell, 2001: 54). Studies of school cultures show that collaborative processes between experienced teachers in a department can be just as rare as with student teachers (Corrie, 1996; Kleinsasser, 1993; Kleinsasser & Savignon, 1992). However, this does not mean that all schools are like this. For example, a few of the schools studied by Kleinsasser (1993) had cultures which were supportive of group cognition where "faculty see communication as a means to find out about and help each other with teaching duties" (Kleinsasser, 1993: 380) and "colleagues in the environment do not feel they are alone or ashamed about revealing frustration or inadequacies" (Kleinsasser, 1993: 381).

7.2.3 Mentoring as scaffolding

Another form of scaffolding that is central in learning to teach is mentoring (Koerner, 1992; Malderez & Bodoczky, 1999). Student teaching experiences can place an incredible cognitive load on beginning teachers. Lacking in-depth schemata for teaching, they need to pay explicit attention to many aspects of teaching that are simply recognized without explicit cognition by experienced teachers (Huling-Austin, Odell, Ishler, Kay, & Edelfelt, 1989; Veenman, 1984). Mentors can help novice teachers lower their cognitive load by, for example, (a) suggesting activities or providing materials (lessening planning load), (b) suggesting what the novice teacher should focus on (and should not focus on) during instruction or assisting the novice teacher in instruction (lessening teaching cognitive load), and (c) suggesting and modeling ways of assessing, keeping track of and giving feedback on student work collected during the class period (lessening marking

and administrative load) (Feiman-Nemser, 2001; Feiman-Nemser, Parker, & Zeichner, 1993; Hockly, 2000; Loughran, 1997).

In addition, it is possible that emotional support from mentors can also reduce cognitive load. If novice teachers are not worried about what their mentor or others will think about their teaching, they can concentrate more fully on instruction and their students. According to Hargreaves and Fullan (2000) it is very important for mentors to provide such emotional support to novice teachers. "Teaching is an emotional practice. It arouses and colors feelings in teachers and those they teach. Teaching involves not only instructing students but also caring for and forming relationships with them…Emotion energizes teaching but can also drain it. Thus, emotional support is one of the strongest needs of beginning teachers" (Hargreaves & Fullan, 2000: 53). Indeed, the 160 beginning teachers in Odell and Ferraro's (1992) survey and the 10 teachers in Gratch's (1998) study rated emotional support from mentors as the most important factor in learning in student teaching.

Furthermore, studies have indicated that mentoring does help novice teachers' learning. For example, Egbert, Paulus and Nakamichi (2002) found that after taking a seminar on computer assisted language learning (CALL) those teachers who had better support from colleagues and technical support people were much more likely to use CALL in their practice. In addition, a number of studies have shown that quality mentoring of novice teachers helps teacher learning and increases the retention of novice teachers in the profession (Ingersoll & Kralik, 2004; Odell & Ferraro, 1992; Smith & Ingersoll, 2004). Thus, it is no wonder that in Cooper's (2004) survey of 341 FL teachers, one of their strongest recommendations for teacher education was for better mentoring in the practicum. However, not all mentoring is necessarily positive. For example, in Farrell's (2003) case study of a novice EFL teacher in Singapore, he found that although an official mentoring program was in place, in reality there was little contact between the novice teacher and the mentor. "Singapore schools are required to conduct induction programs for new teachers…but there is not uniformity as to how these programs should be implemented" (Farrell, 2003: 106). Farrell concluded that this was a product of the professional culture of the school which stressed an isolated work style with little professional communication between teachers. This is similar to the findings in Kleinsasser's (1993). As described earlier, Kleinsasser studied what he referred to as the "technical cultures" of two schools and found that the teachers in one of the schools stressed collaboration and cooperation between colleagues. However, the other school stressed that teachers do their work alone, without any collaboration; what Lortie referred to as the "egg crate" (Lortie, 1975: 14) view of teaching where teachers are physically close to each other but do not interact, much like eggs in a carton.

7.2.4 Summary

Scaffolding learning is one way to reduce the cognitive load in an activity, leaving capacity for learning. In SLTE learning can be scaffolded by (a) taking teachers' knowledge levels into account when designing activities, (b) directing teachers' attention to the most important factors in the task, and (c) providing support for the activity, although such support should be reduced as teachers' knowledge and capabilities increases. People can scaffold learning, but so can physical and intellectual tools. Classrooms can also scaffold learning in cases where teachers use teaching contexts to off-load information processing, for example the OHP or class roster. Research shows

that teachers do distribute cognition in the classroom and that this seems to be true other areas of human activity. However, the quality of scaffolding is also important. If tools used for scaffolding are of poor quality, learning will suffer.

7.3 Similarity between learning and target activities

7.3.1   Similarity

Another way to reduce cognitive load is for SLTE to use activities which are very similar to the actual activities and processes teachers engage in during teaching. If they are similar, then there is less cognitive work for teachers to implicitly recognize that their knowledge is useful and to figure out how to use it. Only near transfer would then be required when attempting to use knowledge gained from such experiences in teaching. Similarity has been shown as an important factor in whether knowledge is used in practice. "The more 'distant' suppliers are from implementers…the greater likelihood that the innovation (materials) will not be used – or at least not as intended" (Kennedy, 1988: 337). Applied linguists have noticed this and increasingly suggest that novice teachers not only need to engage in language analysis tasks (typical of academics practice) in SLTE programs, but also to engage in tasks similar to language teaching, such as analyzing learner language or teaching materials and using these analyses to decide what sort of feedback to give L2 students or what sort of activities might be appropriate for L2 students (Borg, 2003a; Larsen-Freeman, 2003a; Master, 2003, Wright & Bolitho, 1993).

Supporting this view is the consistent finding that teachers regard teaching practice, both in the practicum and in the early years of teaching as by far their most important source of learning to be a teacher (Bullough, 1989; Calderhead & Shorrock, 1997; Hislam & Cajkler, 2005, NCRTL, 1991; Putnam & Borko, 2000; Smith, 1999. Further evidence was provided by a study by the National Center for Research on Teacher Learning (NCRTL) of ten teacher education programs. One of the central factors in effectiveness of such programs was engagement in activities similar to teaching. In addition, programs which have been able to demonstrate a clear impact on teacher practices are those which do not focus on general ideas, but what these ideas mean in terms of the specific teaching activities and in the specific contexts where the teachers worked. For example, in the two-week summer workshop on understanding students' cognition during math work that Carpenter and his colleagues gave for elementary school teachers, over 60% of the instructional time was devoted to what the ideas about children's cognition meant for elementary mathematics instruction in the specific contexts the teacher worked in (Carpenter, Fennema, Peterson, Chiang, & Loef, 1989). Later studies showed that of the 21 teachers who attended the workshops, all of them reported using what they learned in instruction and nearly all (90%) exhibited observable changes in their practices related to what they learned in the workshop (Fennema, Carpenter, Franke, Levi, Jacobs, & Empson, 1996; Franke, Carpenter, Levi & Fennema, 2001). More importantly, their students also scored better on math tests than students of teachers in a control group, strongly suggesting that changes in teachers' knowledge can improve students' learning (Fennema, Carpenter, Franke, Levi, Jacobs, & Empson, 1996). A similar 2-week workshop focusing on the use of constructivist views of learning in teaching elementary math showed a slightly lower rate of adoption: 66% fully or partially adopted this framework in their teaching (Schifter & Fosnot, 1993).Nevertheless, these are still

significantly better results than those reviewed in the third chapter, which showed a general lack of knowledge transfer from traditional teacher education experiences.

When teacher education experiences are dissimilar from actual teaching contexts and tasks, it is more likely that novice teachers will construct teaching ideas, schemata and techniques that will not work well for teaching. For example, Shkedi and Laron (2004) conducted case studies of five novice teachers through their teacher education program and into their first years of teaching. They found that when they began full-time teaching, the teachers abandoned the conceptions and techniques that they had developed in their teacher education program because they did not know how to integrate relevant factors in their specific contexts into these general ideas. Shkedi and Laron viewed this as a "regression" and a "loss of vision" because the teachers abandoned the knowledge which was being promoted by the teacher educators. However, another way of looking at these results is that the teachers progressed from unrealistic and unworkable conceptions to those which actually worked for them in those situations. I would suggest that the problem was not that the teachers abandoned the conceptions, but that the teacher education program did not help the teachers construct knowledge of how these conceptions worked in the kinds of specific teaching contexts that they would work in.

Other studies have shown that teacher education experiences which are similar to teaching activities lead to a higher level of transfer to teaching. Levin (2003) engaged in longitudinal case studies of four elementary teachers. These teachers attended a teacher education program which, among other things, had teachers use Piagetian ideas of cognitive development for developing classroom instruction. Like the summer workshops on math teaching (Carpenter, Fennema, Peterson, Chiang, & Loef, 1989; Schifter & Fosnot, 1993), this program focused primarily on what these ideas meant in terms of the practice of teaching, rather than the practice of discussing, providing evidence for, and arguing about general ideas about learning and teaching. The novice teachers "learned to use school subjects and readily available school materials to create additional Piagetian-like assessment tasks, viewed and analyzed videotapes of others conducting Piagetian tasks, and practiced asking the kinds of questions…that are designed to get at how students think about and understand various concepts…[T]he teachers were able to observe and practice what they had learned in classroom settings that matched and modeled what they were learning in their theory and methods classes" (Levin, 2003: 238). Levin reported that in their subsequent careers, these teachers were able to draw heavily on what they learned in this program in their teaching and their subsequent learning as teachers.

In a smaller study, Sweeney and Paradis (2004) studied two novice tertiary chemistry teachers who were taking a methods course in chemistry teaching while teaching college level chemistry. One of the findings was that one of the typical assignments for the methods class was to create lab assignments for college students. Not surprisingly, it was found that the two teachers' instruction for chemistry lab experiences improved dramatically. Furthermore, when one Dutch teacher education program reformed its curriculum to focus more on preparing teachers for the realities of school work, the percentage of new teachers reporting "practice shock" fell from 37% to 14% and the percentage of students entering teaching after completing their studies rose from 50% to 79%. Silin and Schwartz (2003) reported on a 5-year research project focusing on curriculum development. One of their findings was that teachers' acceptance of the

reforms depended greatly on the extent to which the proposed changes were adapted to the needs and problems of those teachers.

The need for similarity, however, in no way means that teacher education should only take the exact form of teaching. Indeed, as we have seen direct student teaching experience often overloads novice teachers' cognitive capacities that little processing capacity is left for learning (e.g. Johnson, 1994; 1996c). Therefore, many have argued that using experiences which are similar to certain aspects of teaching (e.g., cases, multimedia material, curriculum development projects, etc.) are actually better than actual teaching experience (at least in some situations) because they allow novice teachers to focus on specific parts of teaching while not requiring them to attend to clerical or redundant information present in normal classroom cognition (Merseth & Lacey, 1993; Sykes & Bird, 1992). This leaves novice teachers with plenty of cognitive processing capability open for learning. This is supported by the work of Catrambone (1996; 1998) on subgoal learning. Catrambone worked with college students learning about statistics. Through a long series of experiments he was able to show that if students broke down a general statistics problem into various subgoals, they not only were able to solve the problem better, but they were much more likely to use information learned from solving problems in later work in statistics.

In the area of teacher learning, several studies have shown that having teachers engage in tasks such as observing and speculating about their students' thinking during instruction can help develop the teachers' ideas about instruction. For example, Wolf, Carey, & Mieras (1996) had 43 preservice teachers investigate the thinking of children during literacy work. As a result of this work, the teachers tended to move from a comprehension-based to an interpretation-based conception of reading instruction. Steinberg, Empson and Carpenter (2004) conducted an in-depth, longitudinal study of one elementary school teacher's mathematics instruction. They reported how developing ways of asking her students about their thinking during instruction lead this teacher to move from a practice where she did not use student conceptions of math and math problems to a practice where using, addressing, and linking student conceptions was central to her practice.

In addition, there is evidence that artificial environments and activities can not only substitute for "real world" experience, but, in some cases, enable more teacher learning than actual teaching. For example, Eisenstein-Ebsworth and her colleagues showed either full videotapes or edited videotapes of ESL classrooms to teacher students in an SLTE class. The teacher students reported that the edited tapes were much more helpful in learning about teaching ESL, perhaps because they focused more clearly on key issues (Eisenstein-Ebsworth, Feknous, Barbara, Loyet, & Zimmerman, 2004). In addition, a computer program about a jungle adventure has been shown to help high school students learn math (Cognition and Technology Group at Vanderbilt, 1990) and simulated patients can help medical students learn how to diagnose patients even if the experience is not exactly like diagnosing a real patient (Edwards, Franke, & McGuiness, 1995). In the field of language teaching, Angelova (2005) has shown how specially designed mini-language lessons helps teacher students understand SLA concepts in terms of language teaching.

Just because an activity seems similar to the practice of teaching does not mean that it really is similar. For example, after a university-based teacher education program

beginning teachers in Germany have a 2 year practicum (the "Refendariat") where they slowly observe and then take over classes from their mentor teacher. This is meant to help beginning teachers understand what real teaching is like. However, when Appel (2000) interviewed 20 EFL teachers about their experiences, they reported that the experience was not at all like real teaching. They were constantly being evaluated by rigid standards of what their teaching should be like, which ended up making the experience seem like one big test where teachers had little say in the process, unlike regular teaching where teachers could basically do what they wanted. Another example is the use of portfolios in SLTE. Creating portfolios are thought to be more similar to teaching than other kinds of academic work, such as the thesis (Meeus, van Looy, & Libotton, 2004, Wade & Yarbrough, 1996). However, although it may involve things like lesson planning and assessment, just assigning portfolios in and of itself does not guarantee an activity like teaching practice. For example, novice teachers are often confused about the purpose of portfolios; they are unsure if they are for assessment or reflection, whether they should focus on the content of the teacher education course or on those questions they find more interesting, etc. (Breault, 2004; Loughran & Corrigan, 1995; Zeichner & Wray, 2001). In fact, in their study of their own student teachers, Loughran and Corrigan (1995) found that it was only when the novice teachers were able to conceive a specific and realistic purpose for the portfolio, in this case to present their knowledge and ideas about teaching to a potential employer, that they were able to use portfolios for learning. In addition, Breault's (2004) study of ten student teachers constructing portfolios found that the context of student teaching did not lend itself to portfolio-making due to the other myriad demands on student teachers time. In this context, portfolio construction was not similar to teaching. This suggests that teacher education activities should not only have surface similarity with teaching activities, but teacher educators need to be careful that they also are similar at a deeper, structural level, meaning that the underlying cognitive processes used to engage in these activities are similar to those used in teaching.

Together, research on knowledge transfer and on teacher education strongly suggest that the closer teacher education experiences are to the actual activities involved in teaching (and the more focus on such experiences, rather than only addressing this in the last ten minutes of class or in the last week of the term), the more useful these experiences will be for teachers. Thus a class in applied linguistics should *not* be:

> a series of facts about phonology, morphology, syntax, semantics, and so on, probably enlivened with humorous cartoons and the usual quotes from Alice in Wonderland, but not usually embedded in teaching practice and educational reality [but should instead] examine the reality of language use in relevant educational settings, preferably incorporating classroom observation and gathering of data by students, and activities reflecting the kinds of language teaching we wish to promote (van Lier, 1992: 95).

Examples of programs and materials which share surface and structural similarity with teaching include a mathematics teacher education program focusing on the kinds of teaching and learning that go on in schools (James & Ball, 1992), a web site integrating information on grammar and lesson teaching and revised according to teacher feedback and hits (Lock & Tsui, 2000) a multimedia CD focusing on mathematics instruction (Lampert & Ball, 1998), and a methods text for language arts teachers (Smargorinsky, 2002).

7.3.2   Focus on details

The need for similarity between teacher education experiences and teaching means that a focus on the details of language teaching is necessary. Knowledge gained from participating in teacher education generally "is too abstract, stripped of its particulars, and void of the very context that constructs the basis upon which decisions are made" (Johnson, 1996a: 765-6). As was discussed in the previous chapter, humans do not generally use abstract, general rules, but rather local, domain-specific knowledge which is dynamically linked in systems of related knowledge. This includes not just specific facts, but also schemata, procedures, and intellectual tools specific to teaching. For SLTE to be similar to L2 teaching, it must expose teachers to such practice-related details. Porter and Taylor (2003), for instance, argue that novice teachers: "need to know what to do in the classroom: how to plan and sequence lessons, how to select appropriate materials and tasks, how to evaluate how well their students have learned what has been taught, and how to address unexpected problems and situations as they occur" (Porter & Taylor, 2003: 151). Research suggests that such details of practice should be a primary, not secondary, focus in teacher education.

Detailed similarity between teacher education and teaching activities also means incorporating and learning to deal with the resources and constraints in specific teaching contexts (Burns & Knox, 2005; Xiao, 2005). For example, many L2 teachers prefer to engage in reflection in their L1 (Reed, 2002), so having reflective activities in the L1, even if the teacher educator does not speak the teacher students' L1, would increase task similarity. CLT takes more time to prepare than more traditional ways of teaching languages (Sato & Kleinsasser, 1999) and is more difficult to implement for when teachers' proficiency in the target language is low or language resources (print or multimedia) are not available (Hu, 2005). Therefore, activities for helping teachers understand CLT need to incorporate a focus on working with these kinds of constraints. Llinares (2000), in an intensive study of one math teacher, found that knowledge of resources and constraints related to classroom learning was integral to this teacher's knowledge. "The flexibility of Mrs. M's knowledge is backed by her knowledge about the limitations and advantages of using different ways for representing mathematical notions... Mrs. M justified the plan she had prepared (the agenda) from her knowledge about the way in which pupils manage to learn functions" (Llinares, 2000: 54). Many studies have shown that concrete, detailed examples are more useful for learning than general rules or practice in problem-solving. In a series of studies on college students learning math word problems, LeFevre & Dixon (1986) found that students tended to use procedures which they had encountered in worked out examples of math problem-solving, rather than procedures that had been directly described. Sweller and Cooper (1985) looked at algebra learning by a large number of high school and university students. Some learned by solving algebra problems and others learned by studying worked out examples of algebra problems. Those who worked with the examples made fewer errors on subsequent algebra problems and solved the problems more quickly. Zhu and Simon (1987) conducted think alouds with 20 college students to show that students can learn mathematical concepts by only using examples of problems and without any kind of direct explanation. Other studies have found similar results with children (Brown & Kane, 1988) and that that examples help learning just as much or more than rules (Fong, Krantz, & Nisbett, 1986; Stanley, Mathews, Buss, & Kotler-Cope, 1989). Lawson & Lawson (1993) even argue that good examples and analogies work better than explanations because they activate and strengthen neural patterns more than other types

of learning experiences. Apparently, this has been noticed by textbook writers as well: "examples seem to be the primary tool which textbook writers and instructors rely upon to teach students how to solve problems" (Chi & Bassok, 1989: 259).

7.3.3 Contextualizing information

One way of making teacher education activities similar to L2 teaching is to situate them in specific teaching contexts, real or imagined. However, traditional notions of schooling argue that the advantages of learning in schools is precisely because of differences between school activities and the "real life" activities which learners are being prepared for. "Schooling is viewed as the institutional site for decontextualizing knowledge so that, abstracted, it may become general and hence generalizable, and therefore transferable to situations of use in the 'real' world" (Lave, 1999: 18). In this view, embedding knowledge in specific contexts will make it more difficult to use such knowledge in different circumstances. For example, Bassok and Holyoak researched the extent to which embedding knowledge within specific tasks hinders transfer. In one experiment, six high school students learned to use algebra equations while another six students learned to use isomorphic equations in solving physics problems. All of the algebra students used the algebra solving methods they had learned when solving isomorphic physics problems, but only one of six physics students used the problem-solving methods in attempting to solve isomorphic algebra problems (Bassok & Holyoak, 1989). This seems to show that when knowledge is presented in an isolated manner, it is *easier* to transfer than when knowledge is embedded in specific contexts.

However, other studies show that people are able to use embedded knowledge in other contexts. All of the 12 college students in a further study were able to use equations embedded in word problems when solving isomorphic physics problems (Bassok & Holyoak, 1989). In a later experiment, college students who had learned to solve isomorphic problems embedded in either algebra word problems or banking problems were able to use the formulas they had learned in solving problems from the other context (Bassok, 1990). Thus, it does not seem that embedding knowledge in context per se makes transfer problematic. Why, then, did the physics students have such problems transferring what they had learned? Bassok speculated that "in studying physics, students learn that the physical concepts involved in word problems are critical to the applicability of the relevant equations. Accordingly, they do not expect, and fail to recognize, any direct relation between physics problem-solving procedures and isomorphic problems drawn from non-physics domains" (Bassok & Holyoak, 1989: 165). When learning algebra, students were only working on solving problems using formulas. However, in the physics condition they were not only learning to use equations, but also learning how to view concepts from a physics point of view. The transfer problems, however, only required the application of formula, but not new concepts. In other words, because of the lack of surface similarity (the algebra problems did not involve concepts central to problem-solving in physics), the students did not notice the structural similarity between the problems and, thus, did not use their knowledge even though it was relevant.

Increasingly, it is argued that SLTE programs need to contextualize the knowledge in order for it to be useful for teaching (Brown, 2000; Freeman, 1991b; Johnson, 1996b; Johnson, 2006). "[F]or teachers to make sense of theory, it must be situated in the familiar context of their own teaching" (Johnson, 1996a: 767). Contextualizing

knowledge is seen as one way to help teachers develop the kind of detailed, sophisticated professional knowledge they need. "[F]or the purposes of educating teachers, any theory of SLA, any classroom methodology, or any description of that English language as content must be understood against the backdrop of teachers' professional lives, within the settings where they work, and within the circumstances of that work" (Freeman & Johnson, 1998: 405).

Furthermore, there is a fair amount of research evidence that indicates that contextualizing information does indeed make it easier for learners to acquire and use knowledge. For example, Sherwood and his colleagues (Sherwood, Kinzer, Bransford & Franks, 1987) studied high school students learning about mass in science class. Students who received information that was contextualized were more likely to recall the information and use it in problem-solving. Similar results were reported by Bullock, Nunner-Winkler, Stern, Lopez, and Ziegler (2003). Huberman (1993a) studied researchers working with vocational education teachers. He found that when researchers spent time understanding specific educational contexts and adapted their findings to fit the questions and constraints of teachers in that context, there was a lot of use of research knowledge by the vocational teachers. However, where researchers simply communicated general research results without specifying them for a particular context, there was little use of such research.

Studies of teachers also indicate that contextualized information is easier to use for teaching. For example, Nunan (1987) found that the five teachers in the study "were knowledgeable about and committed to communicative language teaching" (Nunan, 1987: 137), but their lessons contained little actual communication. Nevertheless, when CLT was contextualized in terms of specific teaching activities, instruction became much more communicative. "[T]he teacher and researcher engaged in a short discussion on the ways of relating content of the picture sequences to the learners' own lives, and of encouraging learners to bring their background knowledge to discussion… The effect was immediately apparent, and…features, which are characteristic of genuine communication, appeared in the data" (Nunan, 1987: 143). Borko and her colleagues (Borko, Mayfield, Marion, Flexer, & Cumbo, 1997) studied the evolution of ideas about assessment of 14 elementary teachers participating in a year-long professional development project. One of their findings was that teachers found it much easier to implement new ideas about assessment when these ideas were discussed in terms of specific things happening in their classrooms, for example in discussions after class observations or in discussions with other teachers on what works or ways of implementing an idea in the classroom. Moreover, Ryan (2004) studied a high school English teacher and a university professor team teaching a high school English class. She found that they were only able to use the professor's ideas from the academic literature when these were discussed in terms of specific teaching activities. For example, the idea of using students' cultural resources in instruction was first integrated into instructional decisions after the teacher and the professor discussed this in terms of how to teach a novel.

These research results have led many to propose that knowledge is social in nature and that learning is not a process of acquiring facts and skills, but of learning how to such facts and skills as legitimate members of communities (Hemsley-Brown & Sharp, 2003; Johnson, 1996b; Nyikos & Hashimoto, 1997; Rogoff, 2003; Wegner, 1998). "I propose to consider learning not as a process of socially shared cognition that results in the end in

the internalization of knowledge by individuals, but as a process of becoming a member of a community and becoming knowledgeably skillful are part of the same process, with the former motivating, shaping, and giving meaning to the latter, which it subsumes" (Lave, 1991: 65). For example, Winsor (2001) studied 6 interns in an engineering center. One of her findings was that what the interns learned was not mainly facts or procedures for doing engineering, but an understanding of how to fit into the work culture of the center: "learning involved getting plugged into the activity system around them" (Winsor, 2001: 25).

One argument is that *all learning* is social in nature and that isolated, individual learning is not useful. For example, Rogoff has claimed that human "development can be understood *only* in light of the cultural practices and circumstances of their communities" (Rogoff, 2003: 3-4) [emphasis added], while others have argued that "learning always involves more than one person" (Nyikos & Hashimoto, 1997: 507). Another argument is that isolated, individual knowledge and skill does not play a major role in learning: "cognitive apprenticeship methods foster learning through cognitive and metacognitive processes rather than through skills and behaviors" (Johnson, 1996b: 26).

This view has been disputed by a number of researchers who argue that it does not account for a substantial amount of research on human learning (Anderson, Reder & Simon, 1996, 1997; Bereiter, 1997; Kirshner & Whitson, 1998; Vera & Simon, 1993). Others claim that that (a) the work on the contextualized nature of knowledge has examined central aspects of knowledge which were ignored by previous research, but (b) isolated, individual knowledge is also important in human activity (Greeno & the Middle School Mathematics Through Learning Project Group, 1998; Salomon, 1993). In other words, situated cognition augments and enriches cognitive conceptions of knowledge and learning, but does not replace it. "[I]t is undeniable that many human actions are socially and technologically distributed and that many of these distributions entail…'off-loading' cognitions onto others or onto technical implements…it is also undeniable that not all cognitions, regardless of their inherent nature, are distributed all the time, by all individuals regardless of situation, purpose, proclivity, or affordance" (Salomon, 1993: 113). Cobb and Bowers (1999) use the example of learning the tax code to exemplify the issues. When an experienced tax accountant receives training in new changes in the tax code, this new information is not understood as separate, isolated bits of information. Instead, the new information is understood within the social framework of the tax system, preparing returns, and typical dealings of clients (the situated perspective). However, if the tax accountant is very experienced, there will probably be no need to include all the social aspects of knowledge when presenting her the information; she can incorporate the new knowledge into her existing schemata without this. From a situated perspective, the tax accountant will not follow an exact blueprint from her schemata with robot-like precision when actually preparing a tax return, but her practice will arise out of an interaction of such schemata with social and contextualized factors such as the personality of the client, the present political climate toward tax returns at tax collection agencies, attitudes of supervisors and co-workers, and even the time of day and year. Those working from a cognitive perspective will point out that this may be well true, but the basis for the tax accountant's part in all of this will still be dependent on her individual knowledge, schemata and skill.

Thus, instead of seeing situated and cognitive perspectives as conflicting, attention has to be paid to both ends of the situated-individual continuum in SLTE. There needs to be

balance and connections between social and individual aspects of learning. Part of learning is understanding the significance of that knowledge for specific social practices. However, individual and isolated learning can also play an important role in learning. Such a cooperation is advocated by Salomon who suggests that learning opportunities feature "a spiral-like development whereby distributed…cognitions and one's own 'solo' competencies are reciprocally developed by each other" (Salomon, 1993: 123). Furthermore, even individual learning can be seen as part of social learning. When learning specific information about the tax code, an accountant is not just memorizing isolated facts, but is relating these new facts to situated processes of preparing typical tax reports.

Another perspective is that people need to acquire knowledge about social contexts in order to use knowledge. This would mean that knowledge of context is not an addition to content knowledge, but is part of the content that needs to be learned. "The activity in which knowledge is developed and deployed, it is now argued, is not separable from or ancillary to learning and cognition. Nor is it neutral. Rather, it is an integral part of what is learned" (Brown, Collins & Duguid, 1989: 32). Therefore, knowledge should not be seen as something neutral which can be passed on to learners directly. To take advantage of near transfer, teachers need to learn about contexts and how concepts and knowledge can and are used in a variety of contexts.

Knowledge of context is gained by participating in contextualized, dynamic activities typical such contexts. "The partnership whereby cognitions are distributed can be said to leave cognitive residues in the form of improved competencies, which affect subsequent distributed activities" (Salomon, 1993: 124). As mentioned previously, listening to a lecture is not a neutral activity, but a contextualized vocational practice. "[A]dvanced graduate students in the humanities, the social sciences, and the physical sciences acquire their extremely refined research skills through the apprenticeships they serve with senior researchers. It is then that they, like all apprentices, must recognize and resolve the ill-defined problems that issue out of authentic activity, in contrast to the well-defined exercises that are typically given to them in text books and on exams throughout their earlier schooling" (Brown, Collins & Duguid, 1989: 40). When novice teachers listen to many lectures, they may gain great facility with that specific vocational practice, but that does not mean that this will help them learn to teach. The activities used for learning about teaching are not just a means for acquiring knowledge, they are, to a large extent, what is learned. This is another reason why similarity between learning activities and target activities makes it easier to use new knowledge.

7.3.4   Problem Based Learning

One reaction to the need for similarity is Problem-Based Learning (PBL) where students learn by solving a series of problems common in the field rather than learning facts about the field (Gräsel, 1997b). "What distinguishes PBL from other problem-centered methods, such as the case method, is that in PBL the problem is presented first, before students have learned basic science or clinical concepts, not after… PBL problems differ from the typical case history in that they do not (initially) provide or synthesize all the information needed to solve the problem; thus they provide greater realism and free inquiry" (Albanese & Mitchell, 1993: 53). PBL has been used most extensively in medical education, but it has promise for making useful for many kinds of university-based training more useful for professionals (Gräsel, 1997a). For example, PBL has been

used to teach math (van Haneghan, Barron, Young, Williams, Vye, & Bransford, 1992; Stevens, 2000), educational psychology (Blumenfeld, Hicks, & Krajcik, 1996), and business (Capon & Kuhn, 2004). Despite the attraction of PBL in other fields, it is not as common in education itself. "While PBL has been utilized in the health sciences, its use as a pedagogical approach in fields such as teacher education has not been as evident" (Edwards & Hammer, 2006: 476). Noting the support for task-based language teaching, van Lier has proposed something similar to PBL for SLTE courses:

> Instead of the usual linguistic sub-topics such as phonetics, syntax, discourse analysis, and so on, I propose that we identify language-related themes from the teachers' own sphere of activity… Within each theme, it is inevitable that straightforward linguistic phenomena of phonology, syntax, discourse, etc. will need to be explored at some point. This exploration will necessitate a certain amount of linguistic study in the traditional sense, but it is very important that such study is now motivated by a real-life question that requires an answer. Interestingly, in this scheme of LA development, we treat 'the teaching of linguistics' in a way that is similar to the way in which we treat 'the teaching of grammar' in a task-based communicative approach. We do not teach linguistics 'because it is there', but because it helps us to solve language problems in real-life tasks (van Lier, 1992: 96).

Despite the theoretical support for educational programs based on PBL principles, studies have not shown much of an advantage for PBL programs. Research looking at PBL and traditional medical school programs consistently reports no significant differences in knowledge gained in the two types of programs (Albanese & Mitchell, 1993; Colliver, 2000; Norman & Schmidt, 1992; Prince, van Mameren, Hylkema, Drukker, Scherpbier, & van der Vleuten, 2003; Vernon & Blake, 1993). If anything, studies report that PBL students acquired slightly less biomedical knowledge than their peers in traditional programs (Albanese & Mitchell, 1993; Patel, Groen & Norman, 1993). Such results are very disappointing considering the significant extra investment in time, money and expertise needed to develop such programs.

However, finer meta-analyses of such studies have shown some advantages for PBL programs. Students in such programs may not have learned more in terms of quantity of knowledge, but there is some evidence that what they did learn, they learned better. PBL students were less likely to use rote memorization in studying (which may account in part for lower scores on standardized tests of biomedical knowledge), were able to use their knowledge more flexibly, demonstrated more self-directed learning and inquisitiveness about medical issues, and were more likely to use outside resources at their disposal (Albanese & Mitchell, 1993; Hmelo-Silver, 2004; Norman & Schmidt, 1992; Schmidt, Dauphinee & Patel, 1987; Vernon & Blake, 1993). Furthermore, while PBL students did not demonstrate greater quantity of medical knowledge in general, they did exhibit more clinical knowledge (knowledge of symptoms, of diagnosing, of treatment, etc.) and better retention of knowledge over time (Albanese & Mitchell, 1993; Norman & Schmidt, 1992). Another interesting finding was that there was less variation in achievement in PBL programs, indicating that while traditional programs may not work well with some kinds of students, PBL works well with a greater range of students than traditional programs (Albanese & Mitchell, 1993). Finally, PBL students show more interest in working directly with patients (rather than medical positions which do not require much contact with patients) than students who attended traditional programs. This can be seen as more evidence for the importance of similarity between training and practice (Vernon & Blake, 1993). Students who attend traditional medical programs (where the emphasis is on book and laboratory learning and there is little interaction with

patients) students prefer to work in situations which are similar to their training: research, laboratory or administrative posts. Students who attend PBL programs (which focus on patient care) likewise prefer job situations which are similar to their training: primary patient care.

One reason that research did not show a clear advantage for PBL programs is that while many programs seem to be engaging learners in PBL on a superficial level, in reality the instruction may not be significantly different from traditional programs. There is a growing amount of research indicating that there are significant structural differences between the activities learners engage in during medical education and during medical practice. For example, van de Wiel and her colleagues used focus groups to study the learning of PBL medical students (Prince, van de Wiel, Scherpbier, van der Vleuten, & Boshuizen, 2000; van de Wiel, Boshuizen, Schmidt, & Schaper, 1999). First of all, they found that the reasoning that students tended to use in PBL classes was very different than that of experienced physicians. Doctors tend to use forward reasoning (beginning with symptoms and using them to move toward a diagnosis), but the medical students in these studies used backwards reasoning (beginning with a diagnosis and checking the symptoms to see if they match typical symptoms of the diagnosis). Patel and her colleagues also found that such backwards reasoning was more typical of PBL students than those in traditional programs (Patel, Groen & Norman, 1993). The focus group data showed two reasons for the PBL students' use of backwards reasoning. To begin with, many of the cases they worked on were so easy that they ascertained the diagnosis very quickly, so more of their time on this task was spent showing why their answer was correct (which uses backwards reasoning) than on actual diagnosis. Furthermore, since the groups they worked in did not have instruction or guidelines calling for forward reasoning processes, workgroups tended to engage in backwards reasoning: speculating on possible diagnoses and then checking to see if the symptoms matched.

In addition, the actual cases which are used and the way they are used in PBL programs appear to differ significantly from typical cases and case treatments in medical Practice. For instance, van de Wiel and her colleagues found that the cases used in PBL differed in significant ways from those in normal medical practice. They did not have the same depth of detail that normal cases have and were not as complex or "messy" as average cases in clinical practice. Because the cases were so straightforward, they rarely provoked deep discussion in the PBL classes or study group sessions. Furthermore, during teaching, the instructors in the PBL program did not relate current cases to other cases the students had worked with previously, even through this is a fundamental activity in medical practice (Hatala, Norman & Brooks, 1999; Kulatunga-Moruzi, Brooks & Norman, 2001; Norman & Brooks, 1997; Norman & Eva, 2005; Norman, Rosenthal, Brooks, Allen & Muzzin, 1989). Finally, it was found that there was a washback effect that influenced how the cases were processed. Despite the PBL organization of the medical program, assessment primarily consisted of exams with true-false questions, not problem-based assessment instruments. The medical students in the study reported feeling little incentive to understand the cases in great detail because they felt that what they would learn through such a process would not be assessed on the exams.

In addition, Patel, Groen and Norman (1993) also found differences between how PBL students learn to structure their knowledge and normal medical practice. While experienced doctors consider very few possible answers during diagnosis, in PBL

activities consider all and any possible diagnoses. Contemplating all possible diagnoses might well result in a student knowledge base which has difficulties discerning important from unimportant information. "[T]he knowledge of the students at the PBL school appeared to be of the textbook type, where all possibilities were considered, regardless of whether they directly related to the problem or not...[T]he detailed biomedical knowledge, when elaborated in the context of a clinical problem, does not seem to help in narrowing the problem and making the diagnosis. However, it helped in providing coherence to an explanation when there was reasonable knowledge of clinical classification of disease (Patel, Groen & Norman, 1993: 373). Thus, while PBL activities may have surface similarity with the medical practice, in many instances they may lack underlying structural similarity, which would greatly lessen their effectiveness.

Other educational programs which attempt to use some kind of PBL activities may suffer from the same problem. For example, microteaching (where novice teachers "teach" an activity to their peers) is a common method for practicing teaching skills in SLTE programs, in part because it is seen as being similar to the actual practice of teaching (Politzer, 1969; Wolfe, 1971; DeLorenzo, 1975; Oritz, 1990; Klinzing, 2002) and is seen as a way to encourage reflective practice (I'Anson, Rodrigues, Wilson, 2003). Using information from an analysis of the discourse in 22 videotaped episodes of microteaching and teacher student questionnaires focusing on how they experienced the microteaching, Bell (2006) found that the activity of microteaching resembled performance (such as performing a play or a skit) more than it did actual teaching. Similarly, Chernobilsky, Dacosta, and Hmelo-Silver (2004) studied 34 college students in a PBL course on educational psychology. While they found that the PBL activities helped acculturate students to the field of educational psychology, this did not necessarily lead to more than superficial work. "[I]nteraction itself does not assure that the ideas being generated will reach a high level of knowledge and language development… Groups without sufficient shared knowledge before solving the problem…usually engaged in knowledge telling, just listening or mentioning the concepts without applying them to the problem" (Chernobilsky, Dacosta, & Hmelo-Silver, 2004: 348).

Another problem with PBL is that it is more work than traditional instruction and is difficult to achieve (Bennett, Gräsel, Parchmann, & Waddington, 2005). It is difficult to creating a whole program full of problem-based activities which work in teacher education contexts but still reflect the underlying conditions and processes of actual teaching. Just because an activity or program (e.g., an SLTE program) superficially *seems* to be similar to target activities (e.g., teaching activities and practices) does not mean that it is structurally similar at a deeper level. Just because an SLTE program asks teachers to construct lesson plans, use portfolios, and teach in a practicum does not mean that it is necessarily more similar to teaching than a program that does not do all these things. It all depends on how it is done. For example, the NCRTL studied ten very different teacher education programs: some were one year graduate programs and some were combined BA/MA programs; some were traditional and some were school-based programs. The data indicated that it was not the *form* of the program that made a difference, rather it was *how* the program was carried out which determined its impact on novice teachers. "You can't judge a program by its structure" (NCRTL, 1991: 64).

7.3.5 Summary

This section argues that the more similarity there is between the learning activities in SLTE programs and the activities which make up the practice of teaching, the more easily and better teachers will be able to actually use knowledge gained in SLTE experiences for teaching. Research shows that teachers are able to use knowledge gained in teacher education activities which focus on day-to-day teaching, but not in activities which are dissimilar to teaching. However, this does not mean that SLTE needs to be exactly like teaching in everyway. Artificial activities which are designed to reflect certain aspects of teaching have been shown to be helpful for teacher learning. Just because an activity seems to be similar to teaching on a superficial level (e.g., microteaching) does not mean that it really mirrors the same kinds of underlying cognitive processes as teaching. Important seems to be that SLTE activities are structurally similar to key activities in teaching and that they focus on specific details important for teaching.

> The problem is that any curriculum intended to be a specification of practice, rather than an arrangement of opportunities for practice (for fashioning and resolving ownable dilemmas) is bound to result in the teaching of a misanalysis of practice…and the learning of still another. At best it can only induce a new and exotic kind of practice contextually bound to the 'educational' setting…In the settings for which it is intended (in everyday transactions), it will appear out of order and will not in fact reproduce 'good' practice (Lave, 1999: 33).

As discussed in the last chapter, however, practices typical of academic vocations, such as pursuing and debating abstract generalizations of a phenomena, are not the same types of practices that teachers engage in. Describing general ways of providing opportunities for language learning is not the same activity as preparing a lesson which will provide such opportunities. When SLTE focuses on the former, the result is often inert knowledge. To be effective in the preparation of teachers (and not academics), SLTE needs to focus on the activities of teaching, not of academic scholarship.

7.4 Differentiating instruction

7.4.1 Different learning needs at different developmental stages

Managing the cognitive load of teachers in SLTE programs also involves providing the kinds of learning experiences needed for those specific teachers at that specific stage of their development (Freeman, 2001). Many researchers have reported that learners tend to go through different stages – usually a beginning phase where they acquire isolated facts and procedures, an intermediate phase where they start to assemble schemata, a further phase where they link schemata and make them more sophisticated, and a final phase where they refine the use of their schemata – and that different instruction is needed when learners are at different stages in their learning (Bereiter & Scardamalia, 1993; Boshuizen, 2003; Boshuizen & Schmidt, 1995; Patel & Groen, 1991; Patel, Glaser & Arocha, 2000; Schmidt & Boshuizen, 1993; Shuell, 1990).

> Initially, learning involves a significant degree of external environment support, and as competence is attained, there is an increasing amount of internalized self regulation that controls the learning situation and the fine honing of performance. The progression can be described in terms of three interactive phases: (a) *external support*, involving early environmental structuring influenced by parental dedication and interests and the support

of teachers and coaches; (b) *transition*, characterized by decreasing scaffolding of environmental supports and increasing of apprenticeship arrangements that offer guided practice and foster self-monitoring, the learning of self-regulatory skills, and the identification and discrimination of standards and criteria for higher levels of performance, and (c) *self-regulation*, a later phase of competence in which much of the design of the learning environment is under the control of the learner as a developing expert (Glaser, 1996: 305).

A similar argument has been made for the learning of L2 teachers. Freeman (1991b) has called this "InterTeaching" while Kleinsasser (1995) refers to it as "interknowledge".

> InterTeaching suggests that teaching has phases, each of which is internally coherent as a phase of InterTeaching, and these phases are linked together by a developmental logic, a continuum of InterTeaching. As with interlanguage, each phase of InterTeaching seems to be systematic and rule-governed for the teacher who is in it; it makes sense at some level. And those phases develop according to a pattern which has both predictable and idiosyncratic aspects to it (Freeman, 1991b: 14).

The important point is that at each stage different forms of learning may be more effective than at other stages. According to Paas and his colleagues, the problem is that "many instructional design recommendations proceed without an explicit reference to learner knowledge levels…a large number of CLT [cognitive load theory] effects that can be used to recommend instructional designs are only applicable to novices and can disappear and even reverse as a function of increasing expertise" (Paas, Renkl & Sweller, 2003:3). Supporting this position is a significant amount of research showing that beginners benefit from different kinds of instruction than more advanced learners.

First of all, novices seem to benefit when learning activities at least superficially resemble the activities practitioners engage in, while more advanced learners benefit more from deeper, structural similarity. For example, low achieving chemistry students benefited much more from contextualized, problem-based learning activities than high achieving students (Nentwig, Parchmann, Demuth, Gräsel & Ralle, 2005). Novick (1988) looked at the effect of worked out problem examples on solving math word problems by math novices (i.e., college students with low math SAT scores) and by experts (i.e., college students with high SAT math scores). The novices profited from examples which were superficially similar to the test problems, but the experts did not. The experts, on the other hand, benefited from examples which had the same underlying problem structure as the test problems, but the novices did not. Similar findings were reported by Robertson (2000). The reason for this, according to Roberson (2000), is that novices lack the schemata to recognize underlying patterns in the problems, so they rely on imitation to solve problems, and this is helped by surface similarity. For experts, on the other hand, problems with similar underlying structure are more helpful because these can trigger relevant schemata which can then be used in problem-solving, while examples that are only superficially similar would only trigger the wrong schema.

In addition, novices seem to benefit from assistance in problem-solving during learning experiences, but more knowledgeable learners do not. One example of this is a series of tasks on electrical circuits which Kalyuga and his colleagues performed with technical apprentices. The results showed that there are a number of learning aids that were useful or not depending on the developmental level of the learner. For example, having a text-based explanation and a diagram was helpful for novices, whereas the intermediate level learners only needed the diagram (Kalyuga, Chandler, & Sweller, 1998). The

intermediates also were not helped by exposure to worked out examples, but profited from solving problems (Kalyuga, Chandler, Tuovinen & Sweller, 2001). The beginners benefited from worked out problems, but only with difficult problems (Kalyuga, Chandler, & Sweller, 2001). Riesslein and her colleagues also looked at learning about circuits but with engineering students. They found that beginners benefited most when they received a worked out example problem first and then tried to solve a similar problem. Intermediates, on the other hand, benefited most from practicing problem-solving first and then receiving the worked out example (Reisslein, Atkinson, Seeling & Reisslein, 2006). Van Gog and her colleagues concluded that those with more expertise learn more from instructional formats which provide broader information (worked out examples, diagram plus explanation, etc.) because they can use their schema to quickly recognize what to focus on, so they do not need this information. They looked at eye movements of beginners and intermediates while solving electrical circuit problems. They found that the intermediates quickly fixated their gaze on the major fault in the circuit and spent less time in the problem orientation phase, indicating that they were able to quickly find the problem (van Gog, Paas, & van Merrienböer, 2005).

Teacher learners with little knowledge of L2 teaching may require significant assistance to learn from some learning activities, while more knowledgeable teacher learners will not require such help. Studies of beginning teachers have also revealed that their lack of sophisticated knowledge and schema makes it difficult to do some activities. Davis (2006), for example, found that the novice teachers in her study could critique materials and plans based on instructional goals, but, lacking extensive schemata, they were not able to critique how content was represented in materials and plans. Feiman-Nemser and Buchmann (1987) looked at novice teachers in their practicum. They found that these teachers could focus on classroom management issues, but were not very good at focusing on student learning in the classroom. More broadly, Teachers have shown themselves to be better at examining dynamics in the classroom than understanding the dynamics in the broader school context. "Students seem to have few or no concerns about things that have little bearing on the pupils or the instructional task of teachers such as things that happen outside of the classroom" (Swennen, Jörg, & Korthagen, 2004: 280). Finally, when observing classroom vignettes beginning teachers are not very good at defining and representing the nature of discipline problems. Instead, beginning teachers jumped right to finding a solution: "novices' problem-solving reflects a need to find a solution rather than any need to systematically define the problem…Expert teachers place a priority on defining and representing the problem as well as evaluating possible strategies, whereas novice teachers tend to represent problems in terms of their possible solutions" (Swanson, O'Connor & Cooney, 1990: 549).

In the cases mentioned above learning is much easier when you know more. However, there are some situations where knowing more makes learning more difficult. "Instructional techniques that are highly effective with inexperienced learners can lose their effectiveness and even have negative consequences when used with more experienced learners" (Kalyuga, Ayres, Chandler & Sweller, 2003). Sternberg (1997) suggests that there are not only benefits, but also costs to gaining expertise. "One such cost is increased rigidity: The expert can become so entrenched in a point of view or a way of doing things that it becomes hard to see things differently" (Sternberg, 1997: 347). As mentioned in the second chapter, this effect has been called "The Curse of Knowledge" (Camerer, Loewenstein & Weber, 1989) or the "Expert Blind Spot" (Nathan & Koedinger, 2000a; Nathan & Petrosino, 2003). "Better-informed agents are

unable to ignore private information even when it is in their interest to do so; more information is not always better" (Camerer, Loewenstein & Weber, 1989: 1232). In terms of teaching, this suggests that those with extended experience in teaching will find it more difficult to understand alternative ways of thinking about teaching and learning.

Evidence that those with more knowledge can be more inflexible in problem-solving comes from a variety of studies. For example, Wiley (1998) used a series of experiments with puzzle problems to investigate this effect. She found that "[a]cross all experiments, the subjects with the most domain-related knowledge were least able to solve problems correctly when their knowledge suggested an inappropriate solution" (Wiley, 1998: 726). It appeared that knowledge limited creative problem-solving in that those who knew more relied on what they knew and were less likely to look for alternative solutions to the problems. "[D]omain knowledge not only biases a first solution attempt but also fixates the high-knowledge subject by defining and narrowing the search space, preventing a broad search, and decreasing the chances of finding an appropriate solution" (Wiley, 1998:727). In a task simulating the running of a business, Stark and her colleagues found that business students did much worse than those with no business background because they used tactics important in the business world, but not in the simulation (Stark, Renkl, Gruber & Mandl, 1998).

Knowledgeable teachers appear to have similar problems. Teachers with high subject matter knowledge tend to have difficulties understanding students' thought processes and conceptions of the subject matter. For example, Nathan and his colleagues found that math teachers who had high math knowledge made more inaccurate predictions for which kinds of problems would be most difficult for students (Nathan & Koedinger, 2000a; Nathan & Petrosino, 2003). In fact, their predictions were more similar to how the textbook (and the field of mathematics) organized math knowledge than the natural progression of math students (Nathan & Koedinger, 2000a). In addition, Van Dooren, Verschaffel and Onghena (2002) found that novice math teachers clearly preferred the use of algebra, both in their own solutions and in their evaluations of students' work, even when an arithmetical solution was easier and more straightforward. This suggests that SLTE programs need to provide more knowledgeable teacher learners with activities which help them overcome the *Curse of Knowledge*.

Therefore, it may be beneficial for teacher learning if SLTE programs tailor their instruction to the needs of their teacher students depending on the kind of knowledge they bring to the program and the developmental stage of their expertise. This is not to suggest that it is easy to diagnose what level a learner is at. Learning "stages" can be more complex than they sound: "when acquiring a complex skill, a learner may be in the intermediate stage with respect to some subcomponents (i.e. when they still need to be understood), and he or she may be in the late stage with respect to some other subcomponents (i.e., understanding is already reached)" (Renkl & Atkinson, 2003: 21).

7.4.2 Differentiating due to personal knowledge base and learning styles

Research also indicates that SLTE learning activities should address the specific needs of individual teachers. Teacher education is often approached as if there is a canon of knowledge for the field that every teacher should acquire uniformly (i.e., Brown, 2000; Hedge, 2000; Shrum & Glisan, 2004). However, teacher education is not a one-fits-all activity. Studies of teachers' use of knowledge from teacher education programs have

shown that teachers learn such information in very idiosyncratic ways (Almarza, 1996; Ball, 1990; Cohen & Ball, 1990; Peterson, 1991; Richards, Ho, & Giblin, 1996; Schocker-von Ditfurth, 2001; Simon & Schifter, 1991; Wiemers, 1990; Wilson, 1990). Even in situations where teachers are strictly trained in a particular way of teaching, each novice teacher understands and uses the concepts differently.

> [W]hile a program such as the UCLES/RSA Cert is build around a well-articulated model of teaching, the model is interpreted in different ways by individual trainee teachers as they deconstruct it in the light of their teaching experiences and reconstruct it drawing on their own beliefs and assumptions about themselves, about teachers, about teaching, about learners (Richards, Ho, & Giblin, 1996: 258).

As discussed previously, people learn by using previous knowledge and schemata to interpret and construct new information, and information which does not fit well with existing knowledge and knowledge structures is more difficult to integrate and, hence, to learn and subsequently use for teaching (Belz, 2005; Carless, 1998; Dann, 1992; Hazelrigg, 2005; Urmston, 2003; Wood, Cobb & Yackel, 1991). Therefore, to maximize learning in SLTE programs, courses may need to focus on knowledge that teacher students are ready and able to integrate into their knowledge base (Edward & Worthy, 2001).

Furthermore, people have different cognitive styles or personal preferences which effect learning which should be taken into account when designing and carrying out SLTE activities. For example, Dahlman (2004) reported on a study of ten novice teachers working in schools. She found that they had different ways of, for example, deciding if an idea or activity was good for a certain purpose in a specific class. While some preferred to reason everything out, some used their gut feelings, and the remaining teachers used a trial and error approach. Some saw information from their university courses as valuable background knowledge; some only valued it as a source of classroom activities and problem solutions; and still others saw it as a source of personal inspiration. Stark and her colleagues discovered that the more tolerant of ambiguity business and accounting students were while completing simulated tasks, the more they were able to learn (Stark, Gruber, Renkl & Mandl, 1997; Stark, Mandl, Gruber & Renkl, 2002).

More importantly, Korthagen (1988) surveyed over a hundred teacher students from their teacher education program and found that "student teachers differ in the degree to which they prefer to learn via reflection. We call this learning by *internal direction* and we use the term *internal orientation*. Other students have an *external orientation*, that is, they prefer to learn through *external direction*, from a supervisor or a book, for instance. They want structure and guidelines from outside" (Korthagen, 1988: 42). He also reported that the teacher education instructors had difficulties understanding the learning styles of external oriented students: "teacher educators only understand the way reflective students learn, possibly because they themselves have a reflective style" (Korthagen, 1988: 45). Alarmingly, while most of the students who completed the program were seen to have an internal orientation, when Korthagen selected eight students from those who had left the program, all of these had external orientations to learning, suggesting that students might be leaving teaching simply because the teacher education instructors were not able to accommodate their learning styles. This suggests that SLTE programs need to provide teacher students with learning experiences which do not clash with the SLTE teachers' learning styles. In the same vein, SLTE teachers need to be careful that they do not create

learning experiences which fit their own learning styles, but not those of their teacher students.

SLTE programs also need to address the different needs of teachers from different work contexts. Students in teacher education programs are not only different in terms of their existing knowledge or their learning preferences, but also the kinds of knowledge they are interested in acquiring. For example, Anglo-American SLTE programs have often been criticized as not providing the kind of instruction that would help teachers from outside of the US or the UK (e.g., Li, 1998; Liu, 1998; Lo, 2005). For example, the teacher in Lo's (2005) longitudinal study was frustrated because the ideas he learned in his SLA class were not discussed in terms of the typical school contexts and questions of his home country. This can be a problem even outside of Anglo-American contexts. Ma and Luk (1996) studied 27 EFL teachers and found that the teacher education programs they attended in Hong Kong do not meet many of the needs as non-native speaking English teachers.

7.4.3   Summary

Managing cognitive load means being able to assess the knowledge level of teachers in SLTE programs and providing activities which challenge them but do not overload their explicit processing capacity. In many situations novice teachers require more support and more specific detail than experienced teachers. Due to the "Curse of Knowledge", however, teachers with high levels of knowledge in one area may use that knowledge even in areas where it is not appropriate or useful. Therefore, with more experienced L2 teachers, SLTE teachers need to make sure that their teacher students' knowledge does not prevent them from understanding and using new perspectives for language teaching. Learning styles and values for teaching also affect teachers' cognitive load for SLTE activities. Teachers' idiosyncratic internal knowledge base for teaching, mainly gained through their apprenticeship of observation (the 13,000 or so hours they have observed teachers in school) also means that the same activity might be within one teacher student's ZPD while it results in cognitive overload for another teacher student. SLTE teachers should try to tailor their instruction so that it meets the cognitive abilities and capacities of their teacher students.

7.5 Conclusion

Research indicates that for teachers to acquire the kind of practice-specific dynamically organized implicit knowledge in SLTE programs they need to have explicit cognitive processing capacity available for learning during SLTE activities. If teachers suffer from cognitive overload, they will not be able to learn much. Therefore, one of the central responsibilities of SLTE teachers is to manage the cognitive load of their teacher students. There is a substantial amount of evidence that managing load can have an effect on learning, but, as of yet, there is little actual evidence of the extent to which cognitive load is a problem for teacher learning in SLTE programs.

Scaffolding is one way to manage cognitive load, for example by directing teachers' attention to the most salient factors, supporting performance, and using assessment of teachers' knowledge to design activities which do not overload working memory. Another way to reduce cognitive load is by designing SLTE activities which are

superficially and structurally similar to the activities that make up the practice of teaching. If SLTE tasks are truly similar to teaching, teachers will be able to simply recognize the connections to teaching, which greatly reduces the need to mentally work out this connection. Indeed, research shows that teachers actually use knowledge gained in education programs which focus on the practice of teaching while they do not use knowledge from programs dissimilar to teaching. However, just because an activity superficially appears to be similar does not necessarily mean that the same underlying structural processes are involved. Therefore, SLTE teachers need to be careful that SLTE activities involve the same kinds of cognitive work and organization as are central to L2 teaching. Finally, the extent to which an activity is easy, challenging or results in cognitive overload depends on the knowledge base of the teacher, their learning styles, and their values for teaching. SLTE should not be "one-size-fits-all";, activities need to be designed and scaffolded according to the knowledge, styles and interests of the teachers involved.

Scaffolding learning, making SLTE similar to L2 teaching, and adapting each activity to the needs of specific teacher students is quite a lot to demand of SLTE programs. In fact, the attempt to do this might well result in cognitive overload for the ambitious SLTE teachers involved in such an effort. Therefore, in the next chapter a hypothesis about the relationship between SLTE and teacher learning which requires less change from SLTE teachers and programs will be explained and investigated.

Chapter 8: Investigating Long Term Teacher Learning

Studies of teacher learning have shown that teachers generally are not able to use academic knowledge to enrich or guide their practice in the short term; however, given that explicit, general knowledge can focus attention and guide deliberate practice, one could argue that teachers use explicit, academic knowledge to generate implicit, specific knowledge organized around L2 teaching. Unfortunately, there have only been a few minor studies which address this topic. Therefore, this chapter presents the results of three empirical studies undertaken to test this hypothesis by investigating to what extent very experienced teachers exhibited the kind of practice-specific networks of knowledge that the hypothesis predicts they will have developed. This was done by using three separate tasks selected because they are the prototypical tasks used to investigate expertise and knowledge organization and have shown consistent differences between experts and non-experts in a wide range of fields. The studies focused specifically on the teachers' knowledge of learners' interlanguage because previous research has indicated that this is a significant focus of language teachers and, thus, a logical target for deliberate practice. The first study used a memory task. The results showed no statistically significant differences in recall between the groups, neither in overall recall and nor in recall of L2 students' mistakes. The second study in this series used a sorting task. The results showed few differences between the teachers and the non-teacher participants. The final study used a performance task. The teachers displayed little complex reasoning in this task and their recommendations focused almost exclusively on the sample text rather than deeper categories of language learning and teaching, The results of these studies suggest that even over a lengthy period of time teachers do not use explicit knowledge about language to create deliberate practice activities which result in the kind of implicit, specific, and dynamically-organized knowledge which practitioners need.

8.1 Introduction

The preceding chapters have provided evidence that SLTE programs need to supply experiences which are similar to what teachers do as part of L2 teaching; that the knowledge teachers need to acquire is largely implicit, not explicit; that changing and enriching teachers' knowledge and performance requires enriching and linking specific, context-bound knowledge, rather than accumulating abstract, general ideas; and that deliberate practice, more than reflection, is central to gaining expertise as L2 teachers. There are, however, significant problems with expecting SLTE programs to implement such a practice-based or problem-based program. First, such programs are very difficult to implement and require more resources than traditional programs (Beck & Kosnik, 2001; 2002; Bennet, Gräsel, Parchmann, & Waddington, 2005; Fang & Warschaer, 2004; Schocker-von Ditfurth & Legutke, 2005). Moreover, there is no guarantee that a new program designed to be more practice-focused will indeed have such a significant effect on teacher learning to warrant the necessary changes. For example, as discussed in the previous chapter, differences in learning between medical students in such programs and in other programs is slight (Patel, Groen & Norman, 1993; Prince, van de Wiel, Scherpbier, van der Vleuten, & Boshuizen, 2000; van de Wiel, Boshuizen, Schmidt, & Schaper, 1999).

However, there may be good reason not to fully change traditional SLTE programs. Such programs enable L2 teachers to acquire significant amounts of explicit knowledge about language learning and language teaching. We know that such explicit knowledge can help guide deliberate practice, which can help develop the kinds of domain-specific, implicit knowledge which teachers need. We also know that humans have a talent for

pattern recognition, even in complex activities (e.g., Berry & Broadbent, 1984, 1988, 1990; Klayman, 1988; Lewicki, 1985, 1986a, 1986b; Siegler and Stern, 1998). Furthermore, studies showing that teachers rarely use academic knowledge have been carried out almost exclusively with teachers in their first or second year of teaching (e.g., Andrews, 1997; 1999a; Bullough, 1989; Burns & Knox, 2005; Calderhead & Shorrock, 1997; Clift, 1992; Johnson, 1994; Morris, 1999; 2002; Pennington & Richards, 1997). However, research shows that it takes teachers much longer, about 5-10 years, to develop basic competence and expertise in their practice (Huberman, 1993b; Ericsson, Krampe, & Tesch-Römer, 1993; Tsui, 2003). Therefore, it could be argued that L2 teachers can use the explicit, academic-based knowledge they receive in SLTE programs to guide their development, but this development has been missed because researchers have only examined short-term, not long-term teacher learning. If this is indeed the case, it may be that such radical, costly and unknown changes in SLTE programs will not be necessary. There are only a few studies which address this hypothesis in some way, so it was decided to conduct a series of studies to investigate whether experienced teachers possessed the levels of practice-specific dynamically organized knowledge that such a hypothesis predicts they will have.

8.2 The studies

8.2.1 Introduction

These studies focus on teachers' KAL, rather than on general knowledge. This focus was chosen for several reasons. First of all, it has been hypothesized that L2 teachers should and will use and develop knowledge of applied linguistics in teaching activities such as choosing input materials, targeting their own classroom language level, monitoring L2 students' language, and reacting to L2 student language production (e.g., Halliday, McIntosh & Strevens, 1964; Spolsky, 1979; Stubbs, 1986; Pica, 1997; Bardovi-Harlig & Hartford, 1997; Han & Selinker, 1999). Secondly, KAL is the major focus of most SLTE programs (Christopher, 2005), so data on the role of KAL in teacher development will say more about this hypothesis than investigating an area of knowledge less central to SLTE programs.

One final reason to investigate the development of teachers' KAL is that studies have shown that L2 teachers focus on language (i.e., students' interlanguage, the language of the task or the teachers' own language) during instruction. Language teachers focus on student errors, for example deciding which to respond to or which not (Andrews, 1997; Chaudron, 1986; Johnson, 1992b), although student error may be one of the least used student cues (Akyel, 1997). L2 teachers have also been found to focus primarily on managing L2 students' language production (Gatbonton, 1999; Mullock, 2006) and assessing L2 student competence to determine further instructional decisions (Bartels, 1999). L2 Teacher focus on KAL shows that language is an important part of teacher cognition, so KAL should be a central part of L2 teachers' knowledge. Furthermore, because language is a focus of L2 teaching, it is more likely that teachers' capacity for implicit pattern learning will help teachers develop implicit knowledge about language in teaching (i.e., learner language, teacher language, and language in input such as reading or listening materials).

It should not be surprising that language teachers focus on KAL as studies have shown that teachers generally pay attention to a variety of such cues in the classroom. Some

researchers have found that beginning teachers focus on the curriculum and materials, but not on student knowledge or student learning (Calderhead & Shorrock, 1997; Kennedy, 1998; Morine-Dershimer, 1987; Nathan & Koedinger, 2000b). Beginning teachers find it difficult to focus on student knowledge during teaching because their cognitive processing capacities are fully used keeping track of higher priority items such as student behavior and curriculum concerns (Ambrose, 2004). Novice teachers may have extended procedural knowledge of activities and techniques from their "apprenticeship of observation" (Lortie, 1975), but they do not have the perceptual schemata that enable experienced teachers to use student cues to trigger particular activities or techniques (Tan, 1996). Experienced teachers have been shown to focus on student knowledge (Carpenter, Fennema, Peterson, Chiang, & Loef, 1989; Fisher, Berliner, Filby, Marliave, Cahn & Dishaw, 1980) and teachers ability to predict how difficult tasks are for their students has been shown to correlate with their students' learning (Carpenter, Fennema, Peterson, & Carey, 1988). Assessment of student knowledge can be central to their planning (Schempp, Tan, Manross, & Fincher, 1998), but sometimes this only involves observation of surface level production and not on how well students actually understand the material (Stein, Baxter, & Leinhardt, 1990).

Previous studies have produced mixed results as to teacher learning of KAL over time. Studies have found that there is little difference between experienced and beginning teachers in classroom planning (Nunan, 1991), the complexity of classroom language (Pica & Long, 1986), or in error treatment (Polio, Gass, & Chapin, 2005). Akyel (1997) found experienced and beginning teachers "displayed similar frequency patterns in their use of student performance cues, as well as the ways in which they implemented instructional actions in response to students' deficient response, errors, and teacher elicited responses" (Akyel, 1997: 687). Andrews (2006) investigated whether the teachers who had participated in his study ten years before (Andrews, 1997) had gained more KAL in the intervening years. He was not able to find any growth of KAL, but there are major problems with self-selection in that study. Only 3 of the original 17 teachers agreed to participate in the study, and all 3 of these stated forcefully that they did not like grammar.

One the other hand, there is also evidence that learning to use KAL takes time. Andrews (1999a) found that years of experience and not amount of teacher education helped L2 teachers in their ability to explain student errors. Tsui (1996) and Pennington (1995) found that it takes a long time for language teachers to figure out how to use a process approach to writing and that many give up first only to take up these ideas at a later point in their careers. Furthermore, studies focusing purely on teacher behavior, such as those in the preceding paragraph, may be missing deeper patterns of perception and behavior. As such, it is unclear to what extent teachers develop sophisticated KAL for teaching over the course of time. "Further research into the processes through which language teachers' cognitions and practices are transformed as they accumulate experience is…required" (Borg, 2003c: 98).

8.2.2 The participants

The question for the studies in this chapter focused on the KAL L2 teachers develop over time after having acquired knowledge of language analysis in their SLTE programs. It was decided that all the participants should be non-native speakers to insure that this factor was the same for all, given that some native speakers are monolingual and some

multilingual. The focus was not on KAL acquired from simply learning a language or from courses in language analysis (i.e., syntax, applied linguistics, discourse analysis, etc.), so in all of the studies the knowledge of L2 teachers was compared to that of linguists and a control group. There were originally 20 in each group, however, 1 teacher, 1 linguist, and 2 from the control group had personal and professional problems which prevented them from participating in all parts of this research and were dropped from the studies, leaving 19 teachers, 19 linguists, and 18 in the control group. All of the participants lived and worked in Germany at the time of the study. All but one were native speakers of German.

The language teachers all taught English as their primary subject, were very experienced in their trade (20.7 years of teaching on average), and were recommended as engaged and reflective teachers by colleagues. For example, once a week 11 of the 19 teachers also helped train teachers engaged in the Referendariat (the two-year, post-university student teaching practice experience in Germany). A quarter of the teachers taught only English while the rest taught either German (7), Russian (4), French (2) or Math (1) in addition. This group, like teachers in general, was predominately female (16 women and 3 men).

German SLTE programs have changed significantly in the past few years, becoming significantly more oriented to the training of teachers. However, when these teachers attended university, the programs almost exclusively followed the traditional "Philological" model, focusing on traditional coursework in philological disciplines such as linguistics, literature, and cultural studies. All of the teachers reported having a thorough preparation in linguistics with courses covering traditional areas of linguistics such as Syntax, Morphology, Phonetics and Phonology, Lexicology, Semantics, and Language History. A few also reported having courses in newer areas in applied linguistics such as Text Linguistics, Pragmatics, Sociolinguistics and Stylistics. Teaching methodology, if present at all, was a very small part of their studies and none of the teachers reported receiving instruction on language acquisition. Though German university programs are very rigorous, all the teachers reported doing at least average in their linguistics classes and most claimed to have done better than average. This indicates that they had a solid knowledge base of language structure and language analysis when they began teaching.

The linguists all specialized in English linguistics and worked for university-based SLTE programs. They had a wide variety of specializations in language studies such as generative grammar, sociolinguistics, language history, lexicology, corpus linguistics, pragmatics, discourse analysis, language acquisition, and critical linguistics. This group was even more experienced than the teachers, with an average tenure of 30.5 years. All of the linguists were heavily involved in teacher education. For nearly 60% of the linguists half or a little less than half of their students were taking their classes for credit towards a teacher qualification degree, and no linguist had less than 30% teacher education students in their classes. Only one of the linguists had experience teaching languages within the last 15 years, and that had been at the university level 7 years beforehand.

The control group consisted of native speakers of German who were highly proficient speakers of English as an L2. Half were graduate students, 10% university professors, and 40% were professionals (lawyers, doctors, administrators, librarians, etc.).

8.2.3 Study 1: Memory task

8.2.3.1 Introduction
The first study examined the participants' knowledge and schemata of L2 learners' language production. This was done with a memory task, a common instrument for investigating expertise. The idea behind such domain-specific memory tests is simple: if participants are shown a picture of something which is too complex to be remembered by pure rote memory alone (i.e. a picture of a chess game after the 20th move, they will use their knowledge of that situation to reconstruct the stimulus material). Those with well developed schemata for the domain will thus be able to remember more on average than novices, and will remember aspects pertinent to their area of expertise. For example, in the classical expertise studies of de Groot (1965) or Chase and Simon (1973) (as well as more recent studies such as Charness, 1998; Gobet & Waters, 2003), expert chess players were highly successful in reconstructing chess board configurations when shown a slide of a chess board in the middle of the game. However, they were no better than chess novices in reconstructing a chess board where the pieces were placed randomly on the board. The explanation was that while novices tried to memorize each of the pieces on the board, experts used their schemata of chess formations remembered groups of pieces as units (attack units, defense units, and so on), so they had fewer units in total to memorize. In the random position condition, on the other hand, they were not able to use their schemata to chunk the pieces, so they faced the same type of memorization problem as the novices (Chase & Simon, 1973). This research instrument is widely used for research in field such as sports (Abernethy, Baker, & Côte, 2005; Allard & Burnett, 1985; Postal, 2004), music (Halpern & Bower, 1982), electronics (Egan & Schwartz, 1979), computer science (McKeithen, Reitman, Rueter, & Hirtle, 1981), medicine (Oppewal, 1993), bridge (Engle & Bukstel, 1978), and soap opera watching (Reeve & Aggleton, 1998). Similar studies have also been done with teachers (Carter, Cushing, Sabers, Stein, & Berliner, 1988; Cushing, Sabers & Berliner, 1989).

8.2.3.2 Procedures
The participants were shown video excerpts of German pupils' language production. After each excerpt, the researcher paused the video and participants tried to recount the exact language used in the excerpt word for word. The process was audiotaped.

8.2.3.3 Materials
The video contained a both classroom activities (a role play and an oral report) and videotaped written language production (a translation exercise and a letter) collected at a German high school (Gymnasium). A ten second pause was inserted within each segment, breaking up each part into smaller chunks. It was decided to vary the length of the chunks because it was not known what kind of chunks the participants were capable of memorizing. The oral segments ranged from 6-38 seconds and included 10 to 46 words. The written parts were presented in 25 second segments while the number of words ranged from 35 to 57. As an example, one of the role plays was presented in the following way:

> B: What's wrong with you? Do you not look fine?
> A: Oh, My legs are aching.
> [BREAK]
> B: Your legs are aching? Do you write a test at school?
> A: No, no, we don't write a test at school.

B: Is that true?
A: Yes.
[BREAK]
B: OK, then you must go to the doctor. I know a good doctor in this town.
A: Oh, but now I go to the bed.

8.2.3.4 Data analysis

The data was transcribed and examined for the percentage of the exact words from the stimulus material that the participants remembered correctly and to calculate the percentage of pupil mistakes that each participant correctly recalled. In addition, the data was examined for qualitative patterns as in other studies of teacher knowledge (e.g., Carter, Cushing, Sabers, Stein, & Berliner, 1988; Cushing, Sabers & Berliner, 1989).

8.2.3.5 Results and discussion

Contrary to expectations, the control group correctly recalled the highest percentage of the stimulus material (60%), the teachers the second most (55%), and the linguists trailing both those groups (50%). However, only the results of linguists and the control group differed in a statistically significant way (Mann-Whitney Test, $p < .05$). In terms of recall of student mistakes, the teachers did remember more (44%) than the other two participant group (both 39%), but this difference was not statistically significant (Mann-Whitney Test, $p < .05$).

Furthermore, the qualitative analysis did not reveal any particular pattern in the types of mistakes the teachers recalled in comparison with the other participants. For example, significantly more teachers (11) recalled the article in "In the school it isn't so good" compared to the linguists (7) and the control group (5). This might seem to indicate that the teachers have schemata regarding problems of the use of the definite article with nouns which do not usually take them. However, the teachers did not exhibit superior recall for other sentences with the same problem. For instance, in the sentence "After the school I can do some things who makes me happy" there was little difference between the number of teachers (15) who recalled this mistake and the number of linguists (16) and members of the control group (10). Instead of exhibiting schemata of learner language that separates salient from non-salient mistakes, the teachers seem to have only a slightly better recall for all mistakes in general. These results do not support the hypothesis that teachers use their KAL to acquire sophisticated schemata of learner language.

8.2.3.6 Summary

The data from the memory task did not yield any significant differences between the teachers and other participants. One reason for this may be that the teachers in this study have not developed complex and detailed recognition schemata for learner language. Perhaps they were (a) unable to do this despite thorough preparation in applied linguistics or (b) else they did not engage in the kind of deliberate practice (Ericksson, Krampe & Tesch-Römer, 1993) needed to develop this kinds of schemata because they did not see it as being necessary or useful. Another explanation could be that the teachers did possess such schemata, but they were not detected by this experiment. It is possible that this type of memory task needs to be altered in order to detect differences in such schemata. For example, instead of requiring participants to remember every word, they could be asked to remember only the mistakes or only the mistakes which should be pointed out to the pupils. Another possibility is to use material that contains common mistakes and mistakes that pupils never make or at least narrow the scope of mistakes by

only including one kind of mistakes, for example word order mistakes. Regardless, this study failed to provide evidence that teachers' acquire sophisticated knowledge of KAL over an extended period of time.

8.2.4 Study 2: Sorting task

8.2.4.1 Introduction
This study investigates whether teachers have acquired a network of practice-specific implicit knowledge using a sorting task. This type of task has been traditionally used to look at knowledge organization in a variety of disciplines (Chi, Feltovich & Glaser, 1981; Freyhof, Gruber & Ziegler, 1992; Gess-Newsome & Lederman, 1993; Gruber & Ziegler, 1990, 1993; Jones & Vesilind, 1996; Leinhardt & Smith, 1985; Llinares, 2000; Nathan & Koedinger, 2000; Stein, Baxter & Leinhardt, 1990; Tamir, 1992). In the sort task participants are generally asked to sort the stimulus material into any groups that make sense to them (for example by circling the groups given on one piece of paper or sorting stimulus materials of cards into piles) and to give each group a label. While the groups that the participants make are not thought to directly represent how they group their knowledge, it is thought that people use their knowledge structures to solve such tasks and that the results reflect their organization of tacit knowledge. For example, the classic study by Chi and her colleagues (Chi, Feltovich & Glaser, 1981) found that novices sorted the sample physics questions into groups based on superficial characteristics (i.e. "problems with a slope") while experts used structurally deeper categories to sort the stimulus material (i.e. "conservation of energy").

8.2.4.2 Procedures
In this study the participants were presented with 30 English sentences written by hand on index cards. The sentences had been selected from essays by pupils in a German gymnasium (high school). The selection criteria were (1) that the sentences should be understandable alone without any other contextual information and (2) that the sentences represent a wide range of correctness, i.e., correct sentences (*The government should raise taxes or pass stricter laws*) as well as a range of problems with usage of English grammar (*I didn't felt me well yesterday*), lexical knowledge (*This is one reason because I do not become a politician*), and pragmatics (*Hallo. I will interview you to see what you do to help protect the environment*). As this was an exploratory study, the widest variety of sentences possible was used in order to access as wide a range of knowledge structures as possible. On the back of each card was a letter code to make the recording of the data easier.

The participants were instructed to sort the cards into groups that made sense to them in terms of analyzing pupil's language and then to give each group a label or definition. The participants were then asked if there was any way to combine the groups they had already made to form bigger metagroups. When this was finished they were instructed to try and divide their groups into still smaller groups. This continued until the groups contained fewer than 3 cards or the participants could not divide a group further. The group labels and the cards in each group were recorded at each stage in the process.

8.2.4.3 Data analysis
The first step was to represent the categories and their connections in graphical form by making hierarchy maps which represent the groups and subgroups that the participants formed. Below is an example of such a hierarchy map.

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The primary analysis is qualitative as is the case with other studies using sorting tasks (Chi, Feltovich & Glaser, 1981; Freyhof, Gruber & Ziegler, 1992; Gess-Newsome & Lederman, 1993; Gruber & Ziegler, 1990; Leinhardt & Smith, 1985; Stein, Baxter & Leinhardt, 1990). The hierarchy maps were analyzed for coherence, for links between the groups (as was done in Chi, Feltovich & Glaser, 1981; Freyhof, Gruber & Ziegler, 1992; Gruber & Ziegler, 1990; Leinhardt & Smith, 1985) and for the ways in which categories were specific to the activity of teaching (as in Gess-Newsome & Lederman, 1993; Stein, Baxter & Leinhardt, 1990).
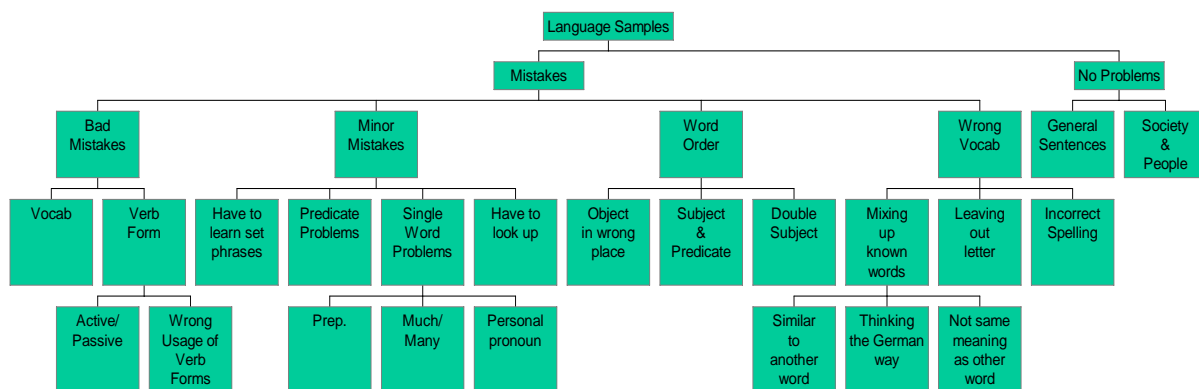

Figure 8.1: Katja's Hierarchy Map

A number of quantitative measures were also used to support the qualitative analysis. The number of categories (the groups made with the cards) and nodes (where one category is subdivided into others) were measured in order to measure the complexity and structure of the hierarchy maps. (See figure 8.1 for an example.) A content analysis labeled categories as being "linguist categories" (ones that focused exclusively on language analysis) and "teacher categories" (ones that focused on teaching or material for teaching). The remaining categories were classified as "Other". This was done by the author and another experienced teacher. The interrater reliability rate for the Linguist categories was 89% and for the Teacher categories it was 92%. It was also investigated which stimulus sentences served as prototypical models for each of these categories. A stimulus sentence was counted as prototypical for one of the participant groups if 25% or more of a participant group used it in a particular category.

8.2.4.4 Results and discussion
The qualitative analysis revealed no significant differences between the hierarchy maps the teachers made and those that the other participants made. The maps mainly consisted of different parts of speech, but even here these did not seem to be organized in deep, teaching-specific ways. There was little teacher specific organization or reference to actions teachers could take. Furthermore, there often seemed to be a lack of cohesion in teachers' maps. An example can be seen in Katja's hierarchy map above (fig. 8.1). "Wrong Vocabulary" is one of the categories under "Mistakes", but "Vocabulary" is also a category under "Bad Mistakes". Overall this data leaves the impression of a knowledge base focused only on identifying and describing mistakes, but no more.

8.2.4.4.1 Size and complexity

The teachers and linguists produced about the same number of categories (see table 8.1), with the teachers an average of 21.58, the linguists producing an average of 20.84 and the control group only averaged 15.27 categories per person. These differences between the teacher and the linguists, on the one hand, and the control group, on the other, were statistically significant (Mann-Whitney Test, $p < .05$). There was little variation between the participant groups in terms of categories per node, meaning that the linguists and teachers made more complex maps out of the content, rather than simply having a greater number of categories within a small conceptual map of the content.

Table 8.1 Categories and Nodes

	Categories		Nodes	
	Mean	SD	Mean	SD
Teachers	21.58	6.25	7.37	2.45
Linguists	20.84	6.20	6.79	2.88□
Control	15.27	5.50	5.44	3.18

The extent to which the categorizations were a product of the stimulus materials was also investigated. It has been shown that when experts are confronted with data that are unclear or fuzzy, they use their knowledge organization to impose an order the data (Lesgold, Rubinson, Feltovich, Glaser, Klopfer, & Wang, 1988). In other words, does the data reflect the schemata of the participants or was the data more defined by the stimulus materials than the participants own knowledge organization? As can be seen in table 8.2, the stimulus did not significantly restrict the participants' categories. All of the stimulus sentences were placed in a wide variety of categories by all of the participant groups. In fact, the majority of all stimulus material was put into a category by only one or two people from one participant group. For example, the stimulus sentence "H" was put into the category "Word Order" by 3 teachers but not by any linguists or members of the control group.

Table 8.2 Frequency of stimulus sentence representing a category for a participant group

Number of people in a participant group to classify a particular stimulus sentence in a particular category	1	2	3	4	5	6	7	8	9	10+
Number of occurrences	198	59	63	42	18	21	20	14	12	20

8.2.4.4.2 Categories

As can be seen in table 8.3, the teachers produced more "Teacher" categories than the other groups, a difference which is highly statistically significant (Mann-Whitney Test, $p < .005$). However, the teachers' percentage of "Teacher" categories compared with their total number of categories was almost the same as the control group (32.9% vs. 27.6%). In other words, the teachers formed more "Teacher" categories than the control group because they formed more categories in general, not because they were more likely to make a "Teacher" category than other participant groups. The other categories are similar in this respect. Teachers' percentage of "Linguist" categories was nearly halfway between the other two participant groups (i.e., teachers formed a greater percentage of "Linguist" categories than the control group but fewer than the linguists). The control group had the highest percentage of "Other" categories, but the teachers and the linguists

formed such groups with almost equal frequency. This data supports the results of qualitative analysis in that it shows very little difference between the categories teachers made and those of the other groups. While there were differences with one group or the other, teachers were always similar to one group or they were between the two other groups. In no way did teachers form groups that were different from both the other groups at the same time.

Table 8.3 Percentage Teacher and Linguist categories

	Teacher Cat. Mean	Teacher Cat. as % of total	Linguist Cat. Mean	Linguist Cat. as % of total	Other Cat. mean	Other Cat.
Teachers	7.11	32.9%	11.42	52.9%	3.05	14.2%
Linguists	1.05	5.0%	16.95	81.3%	2.84	13.7%
Control	4.22	27.6%	5.83	38.3%	5.22	34.1%

There were five main teaching categories in the data the participants produced: (1) Information about Students (e.g., "Advanced Level", "Shows Pupils Can Go Into Detail", "More/Less important", "Typical Mistake", etc.), (2) Opportunities For And Ways of Teaching (e.g., "Should Be Taught More Carefully", "I Never Teach This", "Opportunity To Talk About Relative Pronouns"), (3) Materials for Teaching (e.g., "Language Needed For Themes", "Example Of Comparing Things", "Ways to Express Facts"), (4) Marking Students' Work (e.g., "Would Mark Wrong", "Would Mark As A Style Problem"), and (5) Need Secondary Material (e.g., "Have To Look Up", "Would Look Up").

Table 8.4 Kinds of Teaching categories

	Information about Students	Opportunities For & Ways Of Teaching	Material For Teaching	Marking	Need Secondary Material
Teachers	11 (58%)	7 (37%)	11 (58%)	2 (11%)	2 (11%)
Linguists	8 (42%)	3 (16%)	6 (32%)	0	2 (11%)
Control	6 (33%)	3 (17%)	8 (44%)	0	0

There was only one "Teacher" category which the teachers used exclusively, "Marking", and this was only used by 11% of the teachers. Even including this example, none of the differences between number of teachers using any of the "Teacher" categories and the number of linguists was statistically significant (Mann-Whitney Test, $p < .05$).

8.2.4.4.3   *Prototypical stimulus sentences*
The teachers and the other participant groups show no significant differences in terms of the general categories they form. Nevertheless, it is possible that teachers have a much more specific idea of what their categories mean than the linguists or the control group. Therefore, the prototypical sentences for categories were compared between the participant groups. A stimulus sentence was counted as prototypical for one of the participant groups if 25% or more of a participant group used it in a particular category. There was said to be agreement that a sentence was prototypical for two participant groups if both groups had at least 25% of its members classify a sentence into that category but the difference between the groups was less than 25 percentage points. For

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example, 26% put stimulus sentence "B" into the "Correct" category, but 53% of linguists classified "B" as correct – a difference of 27 percentage points – so "B" was classified as being prototypical of the category "Correct" for the linguists only. Stimulus sentence "P", however, was placed in the "Correct" category by 53% of the teachers, 58% of the linguists, and 50% of the control group. Therefore, it was classified as being prototypical of "Correct" for all three of the participant groups.

Table 8.5 Prototypical stimulus sentences

Categories	Teachers & Linguists		Teachers Only		Linguists Only	
	Sentences	Example	Sentences	Example	Sentences	Example
Correct	P, R, S, Z	The government should raise taxes or pass stricter laws			A, B, G, O, Ü	This family is no real family
Grammar	F, H, I, K, O, Ö, T, V, W, X, Y ß	I was caught 3 fishs	U	The American pupils they stay a long time in school		
Word Order	C, I,	In every country are politics a dirty business	A, U	My mum is a secretary, what my dad is I can't say		
Form	F	I didn't felt me well yesterday			Ö	We haven't saw Mickey or Minnie
Vocabulary	N, Q	Hallo. Can I have some questions to you?	G, M, T, V	Hallo. I will interview you to see what you do to protect the environment		
Relative Clauses	T	My father and I saw a cake who was as expensive as 1000DM				

Table 8.5 shows that within the more general categories like "Correct", "Grammar", "Vocabulary", and "Form" there is broad agreement between the teachers and the linguists on what constitutes a prototypical example of that category. This was also the case for more the specific categories "Word Order" and "Relative Clauses", which were often used by both teachers and linguists. In addition, the teachers and linguists had other prototype sentences in these categories that they did not share with the other group; the teachers in "Grammar", "Word Order" and "Vocabulary", and the linguists in the

categories "Correct" and "Form". There were a few categories where only the teachers or only the linguists had prototypical sentences; however, this was mainly the case for the linguists. The teachers had only two exclusive categories "Tense" and "Passive" and each only contained one prototypical sentence. The linguists, on the other hand, had six exclusive categories with 15 prototypical sentences, and average of 2.5 per category. In summary, the teachers' prototypical categories were not significantly different from those of the linguists. This data further supports the notion that the teachers in this study have not acquired a rich, practice-specific network of KAL.

Table 8.6 Exclusive prototypical stimulus sentences

	Teachers Only		Linguists Only	
Category	Sent.	Example	Sent.	Example
Tense	Ä	There are a lot of jobs which are needed in the future		
Passive	ß	I was caught 3 fishs		
German Interference			C, E, I	They did not want that she become queen
Cohesion			L, M	This is one reason because I do not become a politician
Concord			H	There happen not so much things
Determiner			Y	The sports don't play an important role
Pronouns			D, T	The state has his own problems
Verb Prob.			F, Ö, U, V, X, ß	You make your own experiences later

8.2.4.5 Summary
The data in this study do not support the hypothesis that teachers develop a rich network of KAL for teaching. The qualitative analysis found that the teachers' responses were very similar to the other groups' responses. The categories for all the respondents were mainly different variations of parts of speech and other language categories. There were only a few cases where categories pointed to specific teaching activities. The qualitative data supported this view. The teachers and the linguists made about the same number of categories in general and the teachers and the control group made "Teacher" categories at approximately the same rate. The analysis of prototypical sentences indicated that linguists seem to have organized KAL, but not teachers. The data from this study further support the findings in the first study that these teachers have not acquired a practice-specific network of KAL similar to the knowledge base of other expert practitioners.

8.2.5   Study 3: Problem-solving task

8.2.5.1 Introduction
This study investigates teachers' knowledge and schemata for learner language in the context of evaluating student knowledge and lesson planning. As mentioned at the beginning of the chapter, the language teacher education literature has hypothesized that language teachers use their knowledge of language to monitor pupils' learning in order to plan lessons which address the problems their pupils have with the target language. This

study used a language-teaching problem-solving task in order to investigate this hypothesis.

Problem-solving tasks are activities which seek to emulate activities in a particular domain such as medicine (Boshuizen & Schmidt, 1992; Lesgold, 1984), political science (Voss, Greene, Post & Penner, 1983), or mathematics teaching (Ball, 1990). When participants engage in such tasks data (e.g., task results, steps taken, materials used, etc.) can be collected which provide information on the cognitive processes involved in participating in these activities. Studies of this kind have gathered information about the kinds of reasoning used in medical diagnosis (Boshuizen & Schmidt, 1992; Patel, Groen, & Arocha, 1990), the effects of teaching experience on error correction strategies (Andrews, 1999), and the complexity of experts' reasoning (Lesgold Rubinson, Feltovich, Glaser, Klopfer, & Wang, 1988). It is one of the most common research instruments in the field of education to investigate teachers' evaluation of student production (Andrews, 1997; Cajkler & Hislam, 2002; Carpenter, Fennema, Peterson, & Carey, 1988; Grossman, 1990; Kennedy, 1998; 1999), lesson planning (Carter, Sabers, Cushing, Pinnegar & Berliner, 1987; Housner & Griffey, 1985; Palfreyman, 1993; Richards, Li & Tang, 1995), and other educational issues (Bartels, 2003; Davis, 2005; Grossman, 1990; NCRTL, 1991). Of most interest for this study were Lesgold's (1984) findings that expert radiologists used their schemata to explore what information was *not* included in x-rays, for example a part of the lung that could not be seen from a certain angle. It was hoped that a problem-solving task could reveal the kind of schemata teachers use to incorporate information from students into their lesson planning.

8.2.5.2 Procedure
The task given to participants was to give help to an inexperienced colleague, similar to the task used by Sonnentag (1998). This scenario was chosen because language teachers have little practice in explicitly explaining what they know in depth and, thus, find it difficult to do so (Freeman, 1994). Asking for advice is useful because it helps focus on an actual teaching task, rather than calling for general knowledge. Furthermore, this task forces participants to make explicit much more information than if they were only talking about their own practice since another teacher would not necessarily know routines and concepts implicit in instructional suggestions.

The material used in the task was the following short essay written by a 10th grade pupil at a German high school (Gymnasium) for her regular homework.

> The education today is very hard. So in my opinion it is a good preparation for life of the young people. The students learn to help by themselves in every situation. But the big problem is that the pupils know the situation at school but not in the real world. I think at school it should be possible to speak about the looking for jobs more. The basic for this point was made in the whole education. And this is a very important part which must be in every school system. If a student finish the school after passing the exam he or she can have much knowledge. But mostly the young people only have the knowledges in mathematics or other lessons. So they have no preparation for their familiar life. It is a point that takes a very big places in the life of most of the students. So I hope that a lesson will be there for this kind of future any years later.
> At the end I can sum it up as a good education with any little problems. But if I look at the education in the past I am happy about our school system and education today. The ways of education are better, too. I do not share the opinion that the education today does not prepare young people for their own future.

The essay was chosen because it was easy to understand without further contextual clues such as the assignment question and had been judged by the teacher as being representative for that class.

The participants were given a copy of the essay and were given the following scenario and instructions:

> A colleague who is not a trained English teacher is taking over an English class for the rest of the semester because the teacher is ill. Here is an essay written by one of the pupils which is very typical of the kind of language they produce. Give the new teacher some advice in terms of what she needs to concentrate on, meaning aspects of language which the students are ready to learn, and what she does not need to concentrate on, meaning aspects of language which they either have already learned or are not ready to learn. You will be given 5 minutes for preparation and you can make notes on the paper if you wish.

It was thought that the task of abstracting the needs of a class from the language production of one student would not be problematic because research has shown that teachers do this. For example, experienced teachers generally keep track of the knowledge level and capabilities of their whole class, not individual students (Appel, 2000; Bromme, 1989; Carter, Sabers, Cushing, Pinnegar & Berliner, 1987). Bromme (1989) found that

> the number of recalled student problems and progress is surprisingly low. However, observer notes from the lesson indicate that a lot more than an average of 2 to 3 individual students had problems in understanding. However, these were hardly mentioned by the teachers in their reports…This is not to say that nothing at all was remembered. Instead, the teachers recalled the problems and progress of the class as a whole (Bromme, 1989: 216).

Bromme named this phenomenon the "collective student" (Bromme, 1989: 217) while it has also been referred to as teachers' merging information into "a group picture" (Carter, Sabers, Cushing, Pinnegar & Berliner, 1987: 9).

If teachers do use their KAL to develop a sophisticated network of practice-specific implicit knowledge, there should be evidence of it in the data of such a task. Examples of such a network of knowledge would be (a) detailed information about cues in the language produced by the learner and what the cues mean for teaching, (b) what aspects of language students need to work on and what they do not, (c) activities and methods for addressing those needs, (d) how these needs could be integrated into a larger unit of teaching organization such as a teaching routine, and (e) links between the student cues and stories or experiences from the teachers' own classroom.

8.2.5.3 Data analysis
The data was also analyzed qualitatively for evidence of links between the stimulus materials and teachers' practice-specific knowledge. Such analysis is common in problem-solving studies because it reveals more detailed information of the participants' knowledge (Cajkler & Hislam, 2002; Carpenter, Fennema, Peterson, & Carey, 1988; Carter, Sabers, Cushing, Pinnegar & Berliner, 1987; Grossman, 1990; Housner & Griffey, 1985; Kennedy, 1998; 1999; Lesgold, 1984; Lesgold Rubinson, Feltovich, Glaser, Klopfer, & Wang, 1988; Richards, Li & Tang, 1995; NCRTL, 1991).

The quantitative results can be seen in table 8.7. The teachers and linguists averaged virtually the same number of focus items. The control group also produced quite a number of focus items: 64% of the teachers' total, but still statistically significantly less than the other participant groups (Mann-Whitney Test, $p < .05$).

Table 8.7 Results of problem-solving task

	Focus Items		Outside Reference	
	Mean	SD	Mean	SD
Teachers	9.72	2.27	2.72	3.21
Linguists	9.42	4.14	0.59	0.71
Control	6.25	3.28	0.25	0.77

The teachers did make more outside references than the others, an average of 2.72 compared to 0.59 (linguists) and 0.25 (control group) and this is statistically significant (Mann-Whitney Test, $p < .05$). However, the average number of such references per teacher is very low, less than three for the whole task which represents just 28% of the focus items. In general the teachers did not say much about what the fictional teacher in the role play should do. The teachers' answers only averaged 732 words total (median 654). This low total was also true for the linguists (937 words on average, 649 median) and for the control group (460 words on average, median 327). In summary, the teachers' comments provide little evidence of rich, practice-specific KAL and few links between the cues in the text and any kind of practice-specific knowledge the teachers might have.

The qualitative analysis supports this finding. In general, the teachers' answers were not that different from those of the other groups. The suggestions offered by the teachers mainly consisted of finding mistakes in the text and correcting them. This ranges from comments on superficial errors:

> *Hans*: It think it would not be possible to speak about *the looking for jobs more more*, there is a typing mistake.

to more general problems:

> *Ruth*: I would suggest to practice general word order….For example in the beginning I think at school it should be possible to speak about the looking for jobs more and more. So when we have a long sentence I see problems…This more and more, this is what I don't like here.

Often the teachers cite a language rule or pattern that is violated in the text, but this is not grouped with other problems typical of such students and rarely with specific activities and strategies for combating the problem.

> *Lizzy*: Yes, should pay attention to the use of articles…The difference in using it when this is an abstract noun or not or any specific sport, for example –life of young people-. Of-phrase means the article has to be used whereas the education , ok, the education of today but I think it should be education because most specific education is meant but in general, education is general.

Another common response form was to name a general problem and give an example from the text, but not link this to further action.

> *Lizzy*: Yes, well, the use of countable/uncountable noun. It's knowledge only, it's one example but it often provides difficulties

The teachers' responses often referred to the specific author of the essay (i.e., "he" or "she"), rather than on the collective student (i.e., "they")

> *Billy*: *Education is very hard today.* Maybe word order. Aber *education today is very hard*. It depends on what **he** wants to say.

When teaching activities were suggested, they often pertained to using the specific text in this task rather than ways of addressing such problems in general.

> *Hans*: I would ask him and I would put it on an overhead projector on an overhead transparency. And then I would ask him to correct each sentences together with his students and write the corrected version underneath the text. I wouldn't split it up into grammar problems, I would do it as a whole.

Teachers' suggestions almost never referred to specific activities, materials, or experiences from the teachers' own practice. For example, the only advice for the problem with the ending for the first person singular present tense ending is to "remind" the students of this.

> *Sylvia*: And I also wanted, yes, this problem with the third person singular. It is very often, it's a really typical mistake students do, and they forget it, they don't know why, it's the only form of declination they have. So you should remind them he, she, it and then follows the –s.

The suggestions were so vague or lacking in detail that it is doubtful that they would be much use for a novice teacher.

> *Sandy*: Then I think another problem is to practice sentences wrong sentence building. I would practice making up easier sentences not that long sentences. I think these pupils make it in – that's German influence, again.
> *Interviewer*: Can you be a bit more specific? Again, this is a physics teacher and may not know what you are talking about.
> *Sandy*: He should find correct translations for different phrases. Takes a very big places. There is another problem with the –s again. And there are some false friends of German and English. Place is not the same as Platz in German.

There were a few occasions when teachers did use student cues to suggest further language problems students had which were not necessarily present in the text. However, even in those situations, the actual number of examples teachers were able to provide was surprisingly small.

> *Anna*: Sentence connectors should be practiced. For example here: "Education today is very hard. So in my opinion it is a good preparation for life of the young people". That doesn't really make sense. The sentences should be connected in a different way.
> *Interviewer*: Again, this is an inexperienced teacher, she'd like to know a little bit more information.
> *Anna*: Hm. However, although, but , because and so on.

Teachers rarely talked about what students had already learned in the target language and even then it was almost always prompted by a question from the interviewer.

Furthermore, the focus of what students could do centered around general composition skills. There were not comments on their acquisition of morphosyntactic elements of the target language.

> *Anna*: What I think they can do or this person here can do quite well is structuring…sorts of texts. It starts with some sort of introduction and then he goes into details a little and sums up at the end. And also expressing opinions. The way he expresses his opinion is quite good. In my opinion or I can sum it up as, this is a point that, so vocabulary, argumentative vocabulary is used quite good.

> *Inge*: I think they know how to build up an essay in English. There is an introductory sentence. There is a logical sequence of ideas and there is a summary in the end. So this is something she needn't care about so much.

8.2.5.5 Summary
The data from this task indicate that teachers have not constructed a practice-specific implicit network of knowledge about language. In general, the teachers' responses were not different from the other groups. They did make more outside references, but the total number was very small. Their comments focused on finding mistakes, correcting them, and citing the general language rule or pattern about those mistakes. There were few links to teaching activities and those that were mentioned were very vague. There were no links made between the student cues and teaching materials or experiences from the teachers' own practice. There was no evidence that the teachers possessed sophisticated schemata about the collective student. There were very few references to similar problems students might have and even these few lacked detail.

8.2.6   Conclusion

The studies in this chapter investigate the hypothesis that, in the long term, teachers in general use explicit, academic knowledge to generate practice-specific implicit knowledge organized around L2 teaching, for example through deliberate practice. According to this hypothesis, explicit, academic knowledge is not used directly for teaching, but is used over longer periods of time to develop the kinds of implicit, dynamically-organized knowledge that teachers need. This was tested by investigating the extent to which very experienced teachers exhibited the practice-specific networks of implicit knowledge that this hypothesis predicts they will. The focus was specifically on the teachers' knowledge of learners' interlanguage rather than on all knowledge. This was chosen because previous research has indicated that this is a significant focus of language teachers and, thus, a logical target for deliberate practice. The three separate tasks used to measure knowledge of learner language were selected because they are the prototypical tasks used to investigate expertise and knowledge organization and have shown consistent differences between experts and non-experts in a wide range of fields.

None of the tasks showed significant differences between the teachers and the other participants. This indicates that these teachers do not have a practice-specific implicit network of knowledge about learner language. These studies provide evidence that even over a lengthy period of time teachers do not or are not able to use explicit knowledge about language to create deliberate practice activities which result in the kind of implicit, specific, and dynamically-organized knowledge which practitioners need. It is possible that these teachers do possess such knowledge and that the research methods just did not measure this. However, the fact that all three measures (a) produced the same general result and (b) have been shown to be valid instruments for investigating knowledge in a

variety of fields (including teaching), suggests that this is probably not the case. Nevertheless, this is one of the first studies to investigate this hypothesis and more studies are needed to give a better rounded perspective of this issue.

The data presented in this chapter suggests that classroom teaching is not conducive to the kind of deliberate practice which results in knowledge organized for teaching, at least in terms of knowledge of L2 students' interlanguage. There are two reasons why classrooms are not optimal learning environments for teachers. First, their cognitive load during teaching is very high, leaving little capacity for learning. Second, they may not get the feedback they need to guide their own learning in the classroom. For example, teachers may very well estimate the readiness of learners to learn certain aspects of language during instruction, but they receive little information in class which would help them determine if their estimation was correct and why. The language students may perform either poorly or very well in the task for reasons that have nothing to do their level of interlanguage development. Such feedback is critical to implicit learning and deliberate practice, so lack of such feedback makes acquiring such KAL in the classroom extremely difficult.

This suggests that SLTE programs cannot supply academic knowledge and expect the teachers to "figure it out" later on. Instead, it is likely that SLTE programs will need to change their practices to make it easier to acquire practice-specific, implicit networks of knowledge. It might also be helpful to apprentice teachers into the practice of designing and carrying out deliberate practice for teaching. The implications of this for SLTE will be discussed in greater detail in the next chapter.

Chapter 9: A New Model of L2 Teacher Cognition

> This chapter begins by evaluating the hypotheses underlying traditional conceptions of SLTE which were presented in the second chapter. The evidence does not support these hypotheses, but does support the position of Freeman and Johnson (1998), Tsui (2003) and others who have argued that (a) SLTE needs to focus on the activity of teaching and the contexts of teaching and (b) that developing expertise requires reinvestment of cognitive resources into deliberate practice. However, neither of these approaches provides a full model of teachers' knowledge use and acquisition or explains why teacher cognition is this way, so a new construct of cognition is needed which better fits the data we have on knowledge and knowledge use. Such a model, focusing principally on teacher knowledge use and acquisition, is presented and discussed. The chapter ends with a series of recommendations or working hypotheses for SLTE programs.

9.1 Introduction

In the previous chapters a significant amount of research has been presented on human cognition relevant to questions and issues in SLTE. The focus of this chapter will be to explore the significance of that research for SLTE. First, the hypotheses underlying traditional conceptions of SLTE (as put forth in the second chapter) will be evaluated in light of the research presented in this volume. After this I present a working model of human cognition as it relates to SLTE and outline research questions which have not been addressed by present research. To make connections between this model and SLTE programs, it will be used to review several specific proposals for SLTE. Finally, the model will be used to make recommendations for SLTE programs and teachers interested in improving their practice.

9.2 Evaluating SLTE hypotheses

The first hypothesis was that explicit knowledge can and is used directly to guide teaching activities. The evidence presented in this volume indicates that this hypothesis is likely false. An extensive number of studies clearly show that L2 teachers are largely unable to use explicit knowledge directly for teaching (e.g., Andrews, 1997; 1999a; 2006; Burns & Knox, 2005; Gregory, 2005; Morris, 1999; 2002; Myhill, 2003; Pennington & Richards, 1997; Tsui, 1996; Xiao, 2005).

The second hypothesis stated that general knowledge (e.g., general factors important for second language learning, knowledge of how the target language is structured, etc.) is more important than teaching and context specific knowledge (e.g., specific teaching activities, knowledge of particular contexts and students, etc.). In addition, it is claimed that academic knowledge and skills are the knowledge base which teachers should use for L2 instruction. A wide variety of studies provide evidence that this hypothesis is faulty. To begin with, practice specific knowledge, especially procedural knowledge, has been found to be central to L2 teachers' knowledge (Appel, 2000; Schocker-von Ditfurth, 2001; Tsui, 2003; Woods, 1996), and L2 teachers' instruction suffers when they lack procedural knowledge (Berne, 1998; Burns & Knox, 2005; Johnson, 1996c; Sato, 2002; Xiao, 2005). Furthermore, teachers' knowledge is different from academics for the same general concepts such as CLT (Mitchell, 1988; Fox, 1993; Mangubhai, Marland, Dashwood, & Son, 2004, 2005; Sato & Kleinsasser, 1999). Knowledge of specific teaching contexts has been shown to be central to language teachers' knowledge (Burns, 1996; Holliday, 1996, 1997; Borg, 1998, 1999a; Lo, 2005). Finally, teacher education

programs which have shown success in helping teachers improve their teaching have been those which focus on the act of teaching in specific contexts (e.g., Carpenter et al., 1989, Fennema et al., 1996; Schifter & Fosnot, 1993). That teachers need practice-specific knowledge should not be very surprising since their practices are different from those of academics (Appel, 2000; Bartels, 2003; Foss & Kleinsasser, 2001; Zeuli, 1994; Sakui, 2004).

The third hypothesis said that teachers gain the specific, practice related knowledge that they need during student teaching and subsequent teaching practice. This assumes that classrooms are good contexts for teacher learning. The studies presented in Chapter Eight suggest that this is not true; the teachers did not exhibit specialized learning despite their extended experience in the classroom. Other studies also have shown that teacher learning in the classroom is very difficult and often does not result in the kind of dynamically-organized, practice-specific, implicit knowledge that teachers need (Andrews, 1999a, 2006; Nunan, 1991; Pennington, 1995; Pica & Long, 1986; Tsui, 1996).

The fourth hypothesis claimed that teaching practice is guided and controlled by general principles (or "beliefs"). Quite a number of studies presented in Chapter Two show that changes in teachers' *explicit* conceptions or principles do not cause parallel changes in their teaching practice (e.g., Berne, 1998; Carless, 2003; Carless & Wong, 1999; Chaves de Castro, 2005; Foss & Kleinsasser, 2001; Lamb, 1995). However, research has shown that complex action can be guided by implicit rules or principles (e.g., Berry & Broadbent, 1984, 1988, 1990; Klayman, 1988; Lewicki, 1985, 1986a, 1986b). Thus, it is possible that if teachers abstract *implicit* principles from situated, practice-specific examples, such principles can guide their practice.

The final hypothesis asserted that if teachers explicitly recognize (through "reflection") what kinds of things they want to do differently, this is enough for them to change their practice. Several studies show that teachers find it very difficult to change how they teach even when they are explicitly aware of what they would like to change (e.g., Johnson, 1994; Spaulding, 1997). Even teacher educators do not seem to be able to use reflection to directly change their practice (Foss, 1997; Wideen, Boote, & Mayer-Smith, 2000). It may well be possible, however, that explicit recognition of what a teacher wants to change can change practice indirectly when it is used to design deliberate practice activities.

In summary, research shows that all of the hypotheses underlying traditional notions of SLTE are highly problematic. It also supports the position of Freeman and Johnson (1998), Tsui (2003) and others who have argued (a) that SLTE needs to focus on the activity of teaching and on the contexts of teaching and (b) that developing expertise requires reinvestment of cognitive resources into deliberate practice, not simply understanding local meanings of general ideas. However, these approaches do not provide a full model of teachers' knowledge use and acquisition or explain why teacher cognition is this way. Therefore, we need new a construct of cognition which better fits the data we have on knowledge and knowledge use. In the following section I map out a theoretical model of human cognition which is suggested by current research on cognition and teacher learning.

9.3 A working model of L2 teacher cognition

Because of the cognitive bottleneck, humans generally use implicit, practice-specific, dynamic knowledge for practice. Therefore, teachers' implicit knowledge is central to the model presented here and is the only part of the model which is a focal point of both the process of knowledge acquisition and the process of knowledge use. (See figure 9.1.) There are many links between the various aspects of cognition presented in this model. The links with double lines represent those processes central to knowledge use, the single lines represent processes central to knowledge acquisition, while the dotted lines represent processes which can, but not necessarily do, have an impact on knowledge acquisition. Despite the numerous linkages pictured here, it is important to remember that human cognition is far too complex and multilayered to be fully represented by such a model. The model does not attempt to explain all aspects of human cognition, but rather to highlight important relationships between different types of cognitive processes which are central to understanding SLTE and the process of learning to teach.

9.3.1   Cognition and action

Teachers' knowledge use is pictured in figure 9.2. The local factors important to a teacher's action (e.g.., the teacher's agenda for that class, the physical and social context of instruction, the students, what has been done before in that class, etc.) stimulate the teacher's implicit knowledge. This activates the teacher's explanatory and procedural schemata, knowledge of specific activities and pedagogical representations, classroom routines and other kinds of implicit knowledge until a conglomeration of knowledge forms an explanation of the situation and/or a possible series of actions. The teacher can either accept or reject this product of implicit cognition. Explicit knowledge can be used to help with the evaluation. (The dotted line from explicit knowledge signifies that this process does not necessarily happen.) For example, if the teacher wants to create a communicative oriented lesson, she can explicitly check what, if any, information is actually communicated by students in the proposed activities. If the teacher accepts this constructed conception, then she uses this to guide further action. If the representation is rejected, the process continues until a conception is constructed which the teacher accepts.

Important in this process is the similarity between the teacher's implicit knowledge and the local factors significant for the specific activity the teacher is engaged in. If a teacher is planning a lesson for a 6th grade EFL class in a German school where the teacher is expected to engage in CLT, this process will be easiest if the teacher has already experienced planning and carrying out CLT lessons with similar classes in similar schools. This does not mean that teachers need to first practice teaching activities in the exact situation as they will be facing later (although that would be easiest for them!). As Larsen-Freeman (1983) pointed out, it is impossible to prepare teachers for every possible situation they may face as teachers. The point is that the more similar teachers' knowledge is to the professional situation with which they are faced, the more easily they will be able to construct representations of the situation and what could be done and the better such representations will be. For example, the experiential knowledge gained from constructing and evaluating communicative oriented lessons for elementary school students in Australia and 10th graders in Bangkok will be more useful for this situation than the experiential knowledge derived from discussing studies and theories of CLT
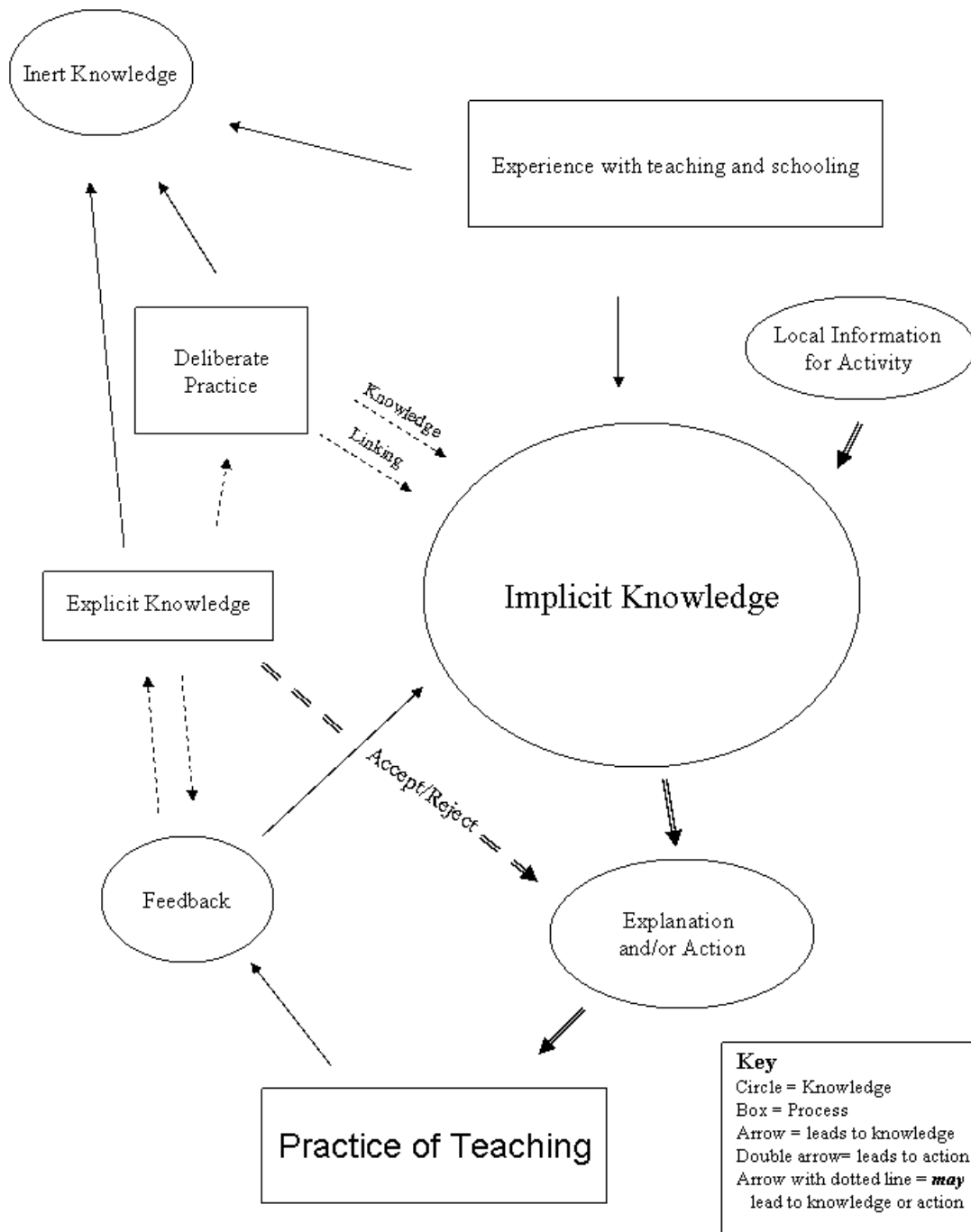
Figure 9.1: Model of L2 Teacher Cognition

because there would still be significant similarity between the present task and the knowledge the teacher has.

If an explanation for a situation but no course of action is generated by implicit cognition, the teacher will not be able to function well in the classroom and will be forced to resort to routines and activities which do not fit the situation but which can be recalled with ease. For example, this is what happens when teachers want to change the
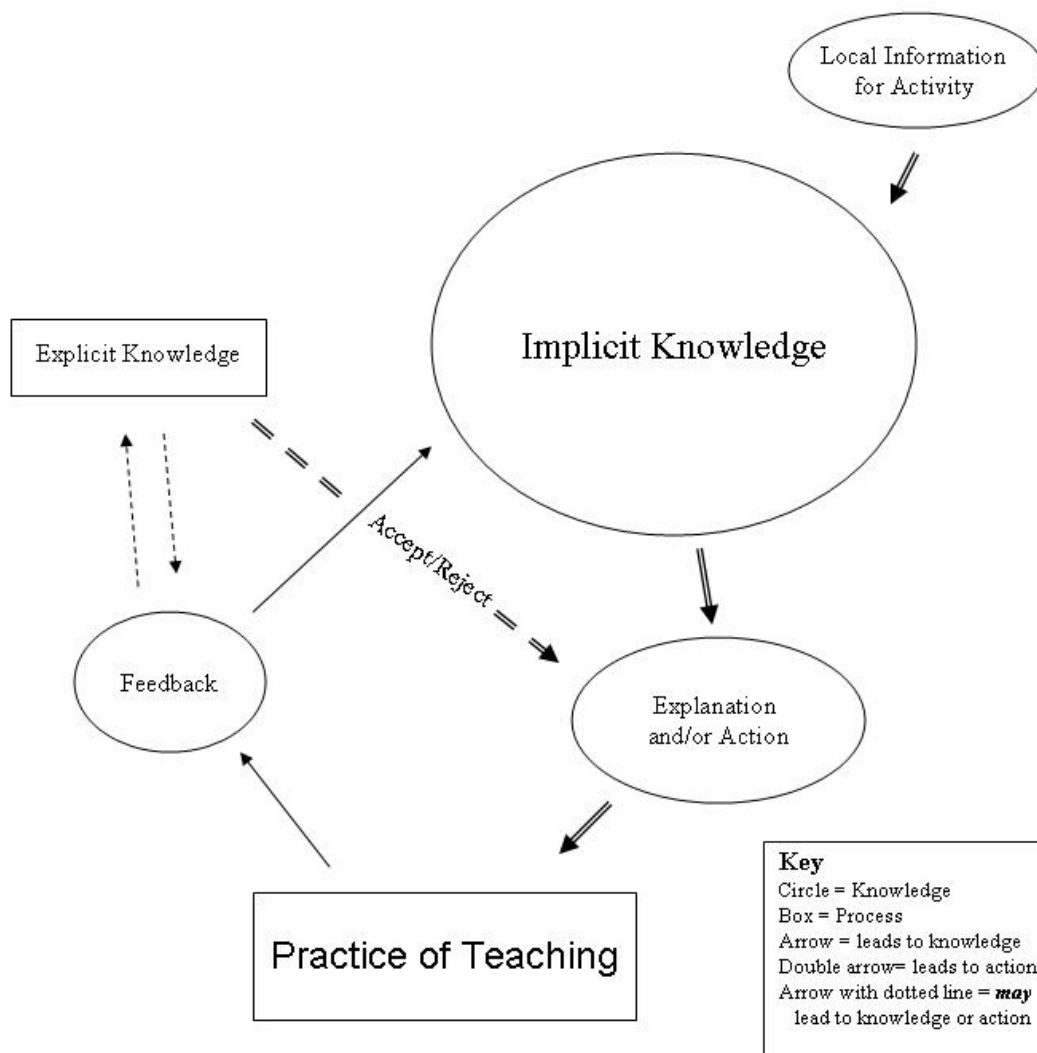
Figure 9.2: Model of Teacher Action

way they teach but lack the practice-specific schemata and procedural knowledge to accomplish this (i.e., Johnson, 1994; Foss, 1997; Spaulding, 1997; Wideen, Boote, & Mayer-Smith, 2000). However, when this process provides only recommendations for action, the teacher can still function well in her practice, as long as the procedures she uses work in that context, even if she does not understand why. According to this model, if the teacher is able to generate both a rich representation of the situation and a clear series of actions, she will be able to tailor her instruction to interactive developments in

class much more easily than if only actions but not explanations are generated. The extent to which a teacher will be able to construct rich representations in the classroom depends on how well her knowledge is linked and on her skill in creating such on-the-spot representations of practice.

9.3.2 Cognition and learning

The teacher learning part of this model is shown in figure 9.3. This mainly concerns how teachers can acquire implicit, organized, practice-specific knowledge for teaching. The bubbles represent aspects of cognition and the arrows point to possible relations between these. These relations can be from very good to very poor quality, so, in this model, the quality of processes are just as important as the quality of the different kinds of knowledge involved in cognition.

9.3.2.1 Teaching experiences
The main source of implicit knowledge for teaching is some sort of participation in instruction, whether this is as a student, an observer or as a teacher. This includes the whole range of experiences with teaching: classroom teaching, lesson preparation, lesson evaluation, responding to student work, assessment activities, classroom management, working with other teachers, administrators, and parents (if the students are school age), and other typical teacher work. By participating in such activities, people acquire implicit knowledge about (a) teaching activities, techniques, materials, and routines, (b) subject matter representations, and explanations, (c) school curriculum and teachers' agendas for specific classes, and (d) experiences with the social context of schooling, from relationships between students and the teacher or between students to interactions with administrators, parents and other teachers. What knowledge is acquired depends on the role of the learner. Students acquire different implicit knowledge than teachers from the same experience. For example, students may acquire knowledge of materials, procedures and the ease with which they can complete (or avoid completing) the class activities. Teachers may acquire knowledge about how well their expectations for student work matched what actually happened. Observers, lacking the insider knowledge of the teacher and the participation of the students, will also learn something different.

There are several reasons to conclude that knowledge gained from participation in instruction makes up the bulk of teachers' implicit knowledge for teaching. First, teachers have a lot of experience in classrooms. It has been estimated that before they reach university students have spend 13,000 hours in classrooms (Lortie, 1975). Add to this thousands more hours of doing homework, studying, participating in school activities, and talking to friends and parents about school and school work, and you have an incredibly large amount of experience. The same is true once teachers are finished with SLTE; the bulk of their time will be spent engaging in teacher activities in and out of the classroom. Given the extensive amount of time that teachers, regardless of whether they are novice or experienced teachers, have engaged in practices related to teaching, it is difficult to imagine a SLTE program which could help teachers acquire more than a fraction of the implicit knowledge that they acquire in classrooms.

Another reason knowledge gained from being a student or a teacher makes up the vast bulk of knowledge for teaching is that it produces knowledge that is very similar to what is needed for teaching. Similarity makes near transfer possible, so such knowledge would be much more likely to be useful for teaching than knowledge acquired through
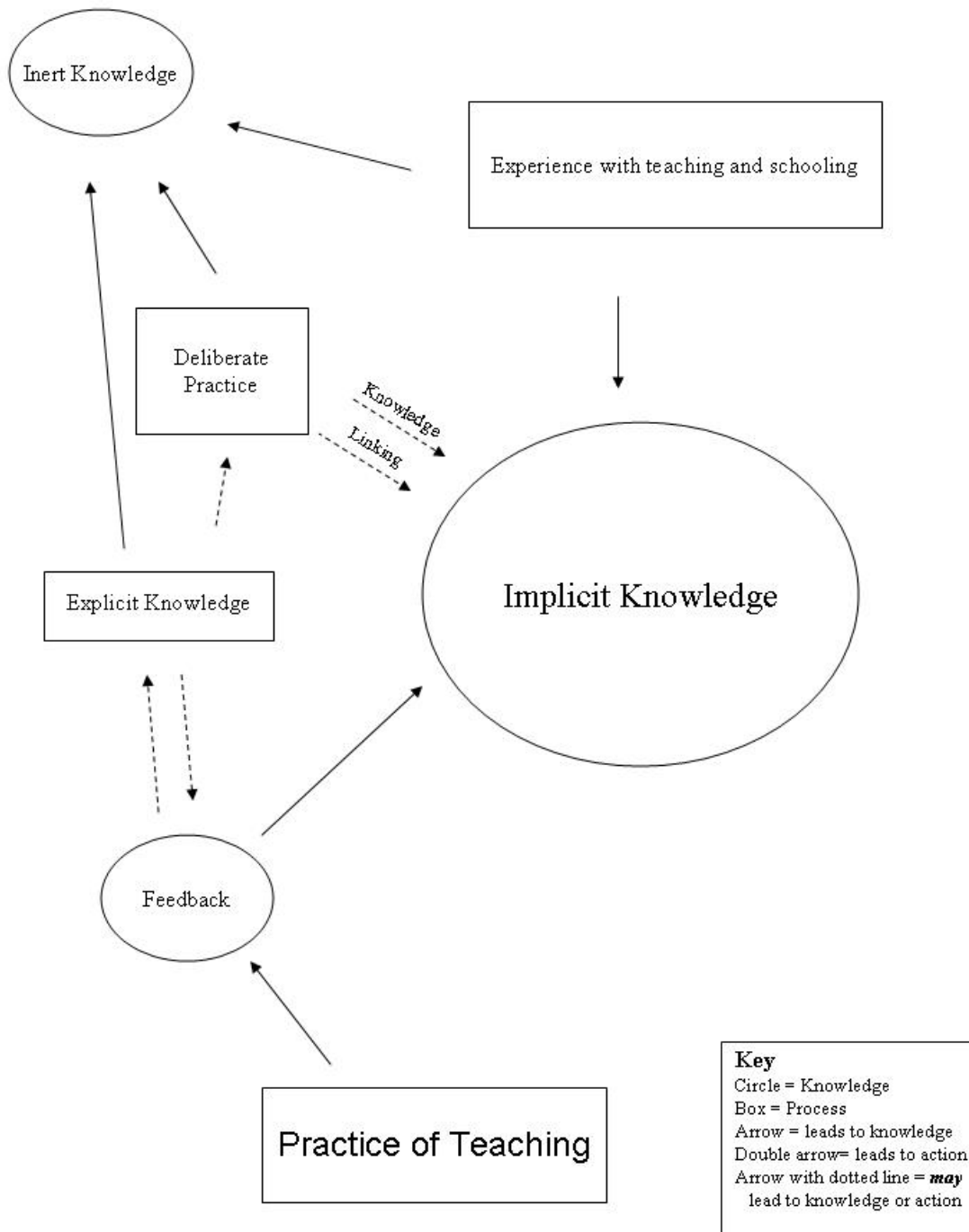
Figure 9.3: Model of Teacher Learning

experiences, like writing academic papers, that are not as similar to teaching. It should also be noted, however, that not all knowledge gained from such experiences is useful for teaching. As a teacher or student you may acquire knowledge such as the favorite soup of one of your students or the middle name of the girl who sat behind you in math class in 7th grade, but this probably will remain inert rather than be used for teaching.

9.3.2.2 Feedback
Feedback refers to any kind of information teachers acquire about actions in the classroom. When participating in teaching or teaching-related activities, teacher students, teachers and observers received feedback on what happens in the classroom. For example, teachers notice the extent to which their expectations about how students would understand and participate in activities were matched; students notice the teacher's reactions to their language production and other behaviors; and observers notice the developing dynamics between students in classroom activities. Feedback can range from specific, explicit information about how well students performed a task to more subtle information such as students' expressions, pauses in student work, or vague feelings that the activity is or is not going well. Even in solitary activities such as lesson preparation or responding to student work, there is feedback for teachers. For instance, I may think that a Venn diagram would be useful for a lesson on understanding differences between types of math problems in an ESL math class, but when I try to categorize the problems myself I find that the differences are too complex and subtle for such an activity.

Feedback is part of the experience of participating in teaching activities and so contributes to implicit knowledge. Over time such experiences can produce a rich implicit knowledge base about activities, students, language learning, etc. Furthermore, if feedback is compared and linked to feedback from other experiences, experienced-based abstractions can be formed. For example, if a teacher (a) notices in a lesson that open-ended questions tend to elicit more communication (and more language production) with advanced students but less with beginning language students and (b) links this information to similar experiences, then (c) an abstract but practice-specific notion of "communicative questions" can form over time. The flip side of this process is that biases can also be formed through this process. If a teacher attempts to engage EFL students in project work several times but break off the attempts early each time because of the noise level in class, she may form the implicit conception that project work "doesn't work" with such students. This could, however, be a misinterpretation of the situation since it is also possible that project work would work with that group of students, but only if they are taught how to engage in project work.

9.3.2.3 Deliberate practice
Deliberate practice refers to activities in which teachers engage in order to learn more themselves, both in terms of conceptual knowledge (i.e., knowledge of specific activities, student cues or teaching routines) and procedural knowledge (i.e. developing skill in using specific activities, student cues or teaching routines). This may be part of their teaching or a separate activity; they can be organized by others or by the teacher herself. Teacher education experiences can be considered a type of deliberate practice. In this model, deliberate practice is important because there are many things teachers will not learn through their experiences in the classroom. For example, a teacher may want her instruction to focus on communication only interrupted briefly for compact input on aspects of language, but not possess representations for such aspects of language which can be communicated to students clearly in very limited time. She could then engage in deliberate practice by developing such representations (e.g., explanations, examples and/or graphics) with the help of reference materials, try these in class, see how long they take, checking students comprehension and ability to learn from such representations, and then further modifying the representations. Deliberate practice does not always occur, however, which is why in the figure 9.3 the arrow linking it with implicit knowledge contains gaps. Note that in the model presented here, deliberate

practice does not necessarily result in useful implicit knowledge. In addition, deliberate practice may result in inert knowledge if it is not done well or if its goal is not realistic given the constraints of practice.

As well as developing implicit knowledge, deliberate practice may also have the goal of linking and organizing knowledge. A teacher may want not only to develop a repertoire of representations of article usage, supersegmentals in questions, or turn-taking rules, but also to develop understandings of which representations work better with beginning students or more advanced students, what student cues (e.g., target language production) suggest that such representations are either helpful (because students are ready to learn that aspect of language) or not (because that aspect of language has already been learned or the students are not ready to learn about it). Some representations may work better if used one after another, while it may be better for students if other representations are used alone (e.g., if they are fairly complex or difficult to grasp).

The effectiveness of deliberate practice depends on several factors. First, it depends on how well cognitive load is managed. If a teacher has to monitor too many factors, she will find it difficult to learn from such experiences. Second, the quality of feedback the teacher gets determines how effective the deliberate practice is. If a teacher is not able to keep track of how much time it takes to use a representation of negation in English or monitor the extent that L2 students understand the representation, then it will be difficult for her to construct and refine a quick and understandable representation. Third, the usefulness of such activities depends on the extent to which it helps the teacher acquire practice-specific, implicit knowledge. Reading an article on the acquisition of past tense forms may be the first step (of many) in deliberate practice, but alone it is unlikely to produce knowledge useful for teaching. Fourth, effectiveness of deliberate practice is determined by the extent to which it helps teachers to organize their knowledge better, to generate abstractions from examples in practice, and to make connections between what they already know and any new knowledge acquired. It is important to note, however, that deliberate practice will also result in inert knowledge, for example knowledge of representations that students don't understand or insights that the teacher lacks procedures to achieve in the classroom. The final factor is the extent to which the teacher has been trained to develop and carry out deliberate practice. The evidence presented in the previous chapter suggests that teachers do not necessarily engage in deliberate practice after they have achieved a minimal level of proficiency in teaching.

9.3.2.4 Explicit knowledge
In the second chapter a good deal of evidence was presented that explicit knowledge, if used inefficiently, simply produces a great deal of inert knowledge. The reason for this is that explicit knowledge does not directly guide the formation of implicit knowledge or practice. However, in this model of teacher cognition there are several important ways in which explicit knowledge can be used to enrich teachers' implicit knowledge bases although, unfortunately, explicit knowledge is often not used for these purposes. The first use of explicit knowledge, as mentioned above, is to monitor the explanations and actions suggested by implicit cognition. This influences learning in that it may produce better explanations and actions which, when experienced, reinforce implicit knowledge in this area.

A second use for explicit knowledge is to monitor and evaluate feedback from teaching activities. For example, if L2 students are having the same problems with articles despite

repeated focus on this area, the teacher might use her explicit knowledge to evaluate feedback from lessons to see if this is due to (a) their not understanding the teacher's representations of articles, (b) they are not developmentally ready to learn this, or (c) the students are playing a joke on the teacher. This is what Schön (1983) referred to as *reflection-on-action*. The process of evaluating classroom feedback results in implicit knowledge of that feedback. The extent to which teachers are able to do this, however, is contingent on how well cognitive load is managed. Monitoring activities to make sure students really communicate is feasible; monitoring activities to make sure all factors of CLT mentioned by Canale and Swain (1981) are present is probably not.

The last, but most important role for explicit knowledge is in contributing to deliberate practice. Explicit knowledge can provide ideas for deliberate practice, materials and information to be modified, and can help monitor the process. Several studies suggest that explicit knowledge is important for these processes (Schwartz & Bransford, 1998; Strasser & Gruber, 2004; Tsui, 2003). Thus, while explicit knowledge may not be used directly to create implicit knowledge or to direct teachers' practice, it plays a key role in developing teachers' implicit knowledge base if used in deliberate practice. For example, if teachers have learned how to analyze a novel's narrative structure in a literature class, they may be able to use that knowledge for deliberate practice. They could experiment with having their L2 students analyze the narrative structure of young adult novels in order to understand how structuring novels in different ways adds or subtracts to the quality of the book. If teachers do this with the goal of working out how to get their students to connect these insights into their own reading or writing skills, then such experimenting with activities could help develop schemata on using analysis of literature to increase L2 students' reading and writing skills. However, the research data in chapter eight indicates that it is difficult for teachers to use explicit, academic knowledge for deliberate practice. Therefore, it may be necessary for teachers to be apprenticed into using explicit knowledge to develop, carry out and evaluate their deliberate practice for teaching. For instance, learning about narrative structure in a traditional literature course on late 19th century British literature might not lead to deliberate practice. However, a literature class which includes the analysis of novels commonly taught in schools and discussions of how certain aspects of narrative structure improve writing may be more successful in sparking deliberate practice in teachers.

In many ways the role of explicit knowledge in teacher learning is similar to the role of explicit knowledge in second language learning. In L2 learning the goal is not to acquire explicit knowledge of question formation or intonation patterns, but to acquire the implicit knowledge which enables you to form questions and intonation patterns similar to the speech community you would like to be a part of. Learning explicit KAL may not result in any language learning and one can learn a language without any explicit KAL. However, when used in a way that (a) supports the acquisition of implicit KAL and (b) does not cause cognitive overload (for example by focusing only on one aspect of grammar and not all grammar problems), KAL can be a very useful tool in language learning. In the same way, explicit knowledge does not necessarily result in knowledge for teaching. People can learn to teach well without academic knowledge, but explicit, academic knowledge can be a useful tool for developing teacher knowledge. However, for it to be useful in this process, teachers need to (a) be provided with experiences which help them use explicit knowledge to develop implicit, practice-specific knowledge and (b) learn how to use explicit knowledge to develop implicit, practice oriented knowledge.

9.3.3 Research questions

The model presented here is a working model which is speculative in nature. It is suggested by present research but there are still many questions that need to be researched before a model which is more firmly rooted in empirical data can be developed. For example, many of the studies supporting this model focused on the knowledge or learning of non-teachers or non-L2 teachers, so studies are needed to confirm that language teacher cognition is not radically different from cognition in other human activities. For example, studies show that teachers' advanced work in math or science does not result in more math or science learning in their students, suggesting that math or science teachers need to be experts in the math or science knowledge being taught, not in the whole field of mathematics or science. It would be helpful if similar studies would investigate if the students of L2 teachers who have done advanced academic work in linguistics, applied linguistics, literature and culture acquire more proficiency in the target language compared with the students of teachers who have not engaged in such academic work.

Furthermore, the field of teacher cognition is relatively new and sparsely researched, so every aspect of the model could use further investigation. Below is a list of questions relating to this model which need investigation. This by no means represents a full and complete list of questions that need to be researched, but rather represents some of the more central questions in relation to the model of teacher cognition presented here.

- To what extent is it true that only implicit knowledge is used for action? To what extent does this depend on the activity and the situation? (For example, is more explicit knowledge used in lesson preparation than classroom teaching because the former has less time pressure than the latter?)

- How similar does knowledge need to be to teaching in order for it to be useful for teachers? To what extent are some people better at knowledge transfer and need less similarity? How practice-specific does explicit, academic knowledge need to be in order to be used for deliberate practice?

- In what ways and to what extent do teachers distribute cognition during teaching activities (e.g. classroom instruction, planning, constructing assessment instruments, etc.)? How can teachers increase their use of the physical and social contexts of teaching to increase distribution of cognition or to make it more effective?

- It would also be helpful to develop and research practice-specific knowledge (for example, what student cues are really helpful? What representations good and which have problems?).

- It has been shown that knowledge is more useful if it is linked and organized. However, how linked does it need to be? Does there need to be a critical mass of linkage before such knowledge is useful? Does this depend on the kind of knowledge or the activity it is used for?

- To what extent does deliberate practice need to be learned? How much does the use of deliberate practice depend on personality factors of the teacher? What kinds of knowledge is deliberate practice in the classroom good for? What kinds of deliberate practice can be done outside the classroom?

- What contributes to cognitive load in SLTE? How much cognitive load can teacher students take on before this reduces learning? What kinds of factors can help scaffold teacher learning?

9.3.4 Using the model to evaluate proposals for SLTE

This model can be used to evaluate proposals and innovations for SLTE programs. For example, Schocker-von Ditfurth has argued for the importance of making school-based experiences an integral and central part of SLTE programs. She proposes that school-based experiences need to be linked to SLTE courses by having teacher students (a) make predictions about the experience based on their personal interpretations of academic knowledge they have learned, (b) investigate these interpretations by collecting data during teacher observation or practicum experiences, and (c) use the data and experiential knowledge gained in this process to examine and confront contradictions in teacher students' conceptions of language and language teaching (Schocker-von Ditfurth, 2002; Schocker-von Ditfurth & Legutke, 2002, 2005). Such activities fit well with the model presented in this chapter. They involve abstracting more general ideas from specific examples of practice with the help of explicit knowledge, so this can be seen as a form of deliberate practice. However, the model also suggests that such deliberate practice activities should not only focus on abstracting general conceptions for L2 teaching. They also need to work on (a) developing related procedural knowledge for teaching (i.e., teaching activities, routines, materials, knowledge of student cues, etc.) which fit with those conceptions and (b) creating links between conceptual knowledge and procedural knowledge (e.g., understanding how each teaching activity fits into the general conception) and links between procedural knowledge (e.g., which cues should trigger which activities or routines, which activities should follow each other, etc.).

Another proposal is to organize the SLTE curriculum into modules. Modules are a series of courses (making up one module) which focus on specific competencies teachers have to develop. The core curriculum could then consist of a number of modules. Modules are touted as a way to force those teaching in SLTE programs to be more teaching oriented (Bausch, 2003; Krumm, 2003) and to increase coherence of the program by relating the course content and activities to other courses in the module (Königs, 2003). According to the model of human cognition, modules have the potential to take advantage of deliberate practice by using a wide range of explicit knowledge to focus on understanding and by organizing knowledge of important issues and activities in L2 teaching. The effectiveness of modules, however, depends on *how* they are actually done in specific programs. If modules are really focused on activities and issues central to L2 teaching they will be much more effective than modules where the focus is on activities and issues central to academic practice. For example, a module which combines several courses in applied linguistics and literature which all focus on how to get high school students to engage in genre analysis of different texts in order to better understand how to write for different audiences would probably be similar enough to make transfer to teaching relatively easy. On the other hand, a module which simply combines an existing lecture class on genre analysis and an existing seminar on 20th century British literature without significant changes in the focus and teaching methods (Funk, 2003) would likely not result in much usable knowledge for L2 teachers.

Currently one of the most popular goals of SLTE programs is to prepare teachers for reflective teaching. The question, though, is whether reflection is enough to develop
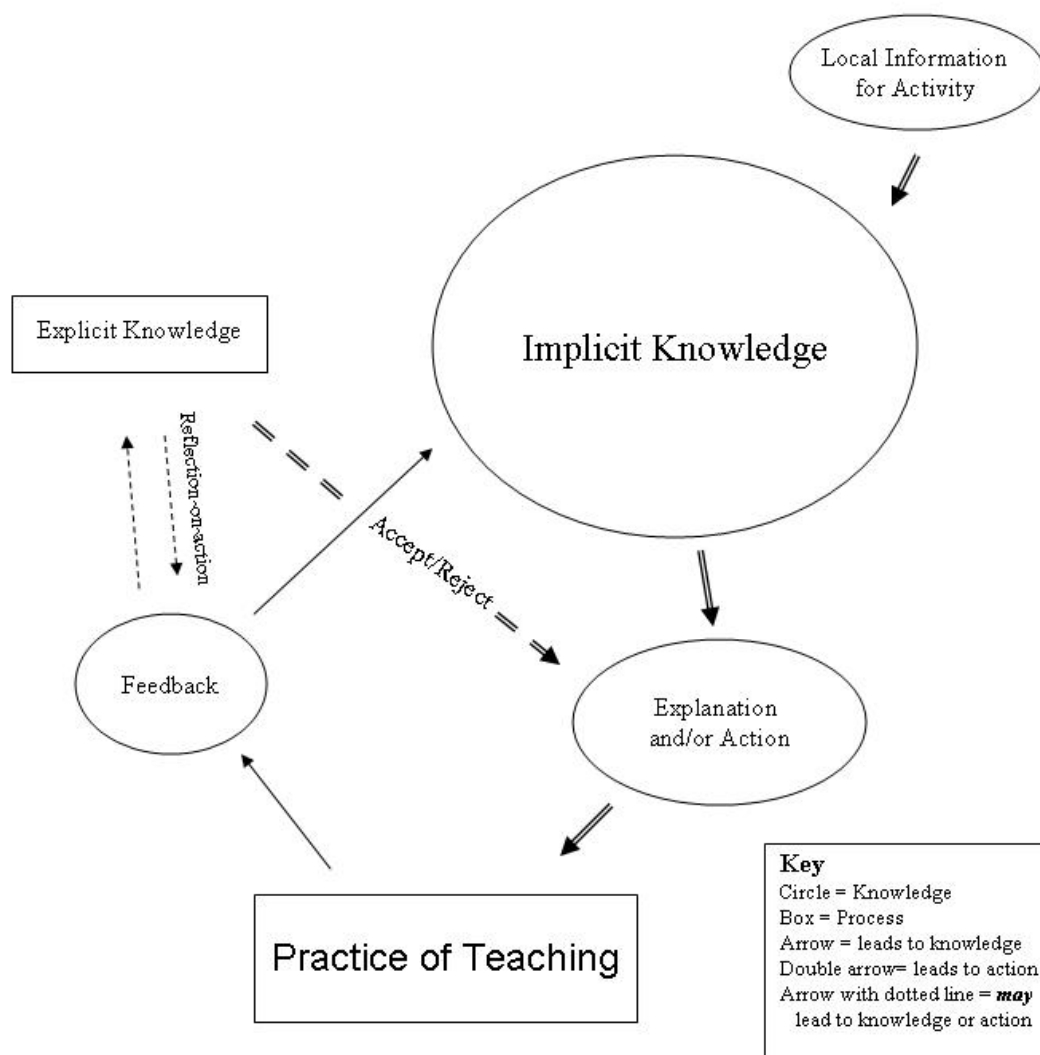
Figure 9.4: Model of Reflection-in-action

expertise in L2 teaching. Reflection-in-action (figure 9.4), which Schön saw as
responsible for practitioner knowledge, includes many more cognitive processes and
contributes directly to implicit knowledge. However, it does not include deliberate
practice and, thus, is inadequate in accounting for the acquisition of expertise in a
practice such as teaching. Reflection-on-action, which Wallace (1991) and others argue
is central to teacher learning, makes up only a small portion of teacher cognition
according to this model and does not directly contribute to teachers' implicit knowledge

(see figure 9.4). Therefore, reflection-on-action alone is not likely to produce a significant change in teachers' knowledge.

9.3.5 Summary

In this model, implicit knowledge guides action. Stimulated by information on the context and immediate situation a teacher's implicit knowledge creates on-the-spot explanations and/or courses of action which then guide practice. Implicit knowledge is gained through (a) experience with teaching and schooling (including school-based experiences as part of SLTE programs), (b) feedback from engaging in teaching, and (c) deliberate practice. Most SLTE activities can be considered a type of deliberate practice and their effectiveness will depend on the extent to which they allow teacher students to acquire and organize practice-specific, implicit knowledge. Explicit knowledge is not central to any of these processes, but can still be very influential by (a) checking the products of implicit cognition before action, (b) helping to process feedback, and (c) by helping design deliberate practice activities. According to this model, knowledge gained from experience with teaching, knowledge from deliberate practice, and explicit knowledge can all end up as inert knowledge. The key challenge in SLTE is to minimize the amount of knowledge which ends up inert and to increase the amount and quality of teachers' implicit knowledge.

9.3.6 Human cognition and SLTE

The last remaining issue that I want to deal with in this volume is what this model of teacher cognition means for SLTE programs. The following suggestions can be taken as working hypotheses that need further research.

1) The focus of SLTE programs should be primarily on learning to teach the target language. Superficial, abstract knowledge is not enough; SLTE programs need to help teacher students acquire detailed and sophisticated knowledge about teaching the target language. This does not mean that teachers should not acquire explicit, academic knowledge in SLTE programs, but rather that such background knowledge should only take up a portion of the SLTE program relative to its importance to teacher learning. This also means that learning to teach should not be put off until student teaching or other kinds of school-based experiences, but should be the central focus of SLTE programs.

2) SLTE teachers (i.e. those who teach in SLTE programs) need to develop a research attitude towards their work. Choices made to change present practice (or to not change present practice) should be seen as hypotheses about teacher cognition that need to be empirically investigated. Furthermore, SLTE teachers should develop (a) their own deliberate practice and (b) tools (physical and intellectual) for SLTE teaching. To this end, SLTE teachers should be provided with professional preparation for SLTE teaching and SLTE programs should demand such professional preparation from its teachers.

3) In developing SLTE programs the main goal should be to develop teachers' dynamically organized, practice-specific, implicit knowledge, not in favoring one academic discipline over another. Some academic disciplines, such as *Applied Linguistics* in Anglo-American regions and *Fachdidatkik* in Germany, see themselves as more relevant to SLTE than others and argue that their disciplines

should play a larger role in teacher education (e.g., Bausch, 2003; Grucza, 1993; Hu, 2003). However, *Applied Linguistics* or *Fachdidaktik* classes can be just as academically oriented as *Linguistics* or *Literature* classes (Königs, 2002). What is important is how the SLTE classes are organized and run, not which discipline is represented by that class. This has led some to suggest that teachers of academic disciplines (e.g., linguistics, literature, cultural studies) should also be held accountable for the learning (or lack thereof) of the teacher students in their classrooms (Stotsky, 2006).

4) The model presented here is different from previous models of SLTE. Nevertheless, I would recommend that SLTE programs change slowly and incrementally. Research on PBL, for example, has shown that program changes based on theoretical ideas often only change the surface form but not the underlying structural form of instruction.

5) When designing SLTE programs or classes, the focus should be on the kinds of learning experiences teachers are exposed to and how and what they can actually learn from such experiences. All learning is experiential; reading about and discussing theoretical ideas about language learning is a context-specific experience which results in knowledge about reading and discussing such issues. SLTE courses should provide experiences which (a) are similar to language teaching, (b) give teachers significant opportunities to link and abstract from concrete examples from teaching, and (c) help teachers learn how to develop and carry out deliberate practice for L2 teaching.

6) The fact that, for economic reasons, some SLTE classes are a variety of students (for example, linguistics, journalism or translation majors in addition to teacher students) is not a valid reason for avoiding a focus on teaching. Such courses are not neutral sources of information, but typically prepare students for the situated practice of being an academic (e.g., writing papers, reading research, conducting research, reporting on research). If such courses are truly to be for students of different practices, then they have to focus on these practices. For example, a class on language analysis where the major focal points were how to analyze language for L2 teaching, for linguistics research, for editing newspaper or magazine articles, and for translating technical texts would truly be a class for a variety of students (polyvalent). In addition, if SLTE programs do not help teacher students learn to teach because they consist mainly of traditional academic courses, they need to either change the kinds of courses in their program or cease to offer such degrees in teaching if they cannot offer the kinds of courses which allow students to learn to teach.

7) Just because a piece of information could be useful for language teaching does not justify its inclusion in SLTE. Given the limited time available for learning experiences in such programs (and limited cognitive load of SLTE students), SLTE programs need to be careful to distinguish between what is *central* to the practice of L2 teaching (such as learning to notice and understand student cues) and what is *peripheral* (such as APA formatting of citations), and concentrate on the former.

8) SLTE teachers should help manage the cognitive load of their students by carefully regulating the cognitive demands of SLTE activities and using a wide variety of means to scaffold teachers' learning.

9) If teaching is based on teachers' implicit knowledge base, SLTE programs should not assess teacher students' learning based on their performance in tasks which focus on explicit knowledge and their skill in academic tasks (e.g., writing academic papers, giving academic reports, etc.). Instead, SLTE programs should assess primarily the dynamically organized, practice specific, implicit knowledge teachers have developed and their ability to use such knowledge in tasks typical of teaching, such as lesson planning, material evaluation for specific uses, assessing student cues for further action, etc.

9.3.7 Conclusion

This dissertation contributes to the field of SLTE in three ways. To begin with, it evaluates the construct of cognition inherent in traditional models of SLTE using a wide range of research. In addition, it introduces a new construct of cognition which can be used to develop, explore and research SLTE programs and issues. The final contribution of this volume is to help integrate SLTE into the wider research community researching relevant issues of human cognition. There are two main conclusions from the work presented here. First, SLTE programs need to apprentice people to be teachers, not academics. SLTE needs to focus on the acquisition of knowledge about L2 teaching by specific teachers in specific contexts for specific reasons, not the acquisition of general academic knowledge and skills in academic practices. Second, SLTE research needs to become part of a community researching human cognition, not just focused on folk theories or research on L2 teachers alone.

The major problem in the development of SLTE programs and SLTE theory, however, is that SLTE teachers face the same cognitive constraints as L2 teachers. Like language teachers, they will resist or misinterpret new information (like that presented here) to fit existing conceptions and knowledge. Like language teachers, they will see their existing knowledge as central for issues where it is not relevant (due to the *Curse of Knowledge*). Like language teachers, they will rely on their implicit knowledge base gained from participating in university instruction to guide their teaching in university contexts. (Of course, this also means that I faced the same problems in writing this volume and, thus, much of what is presented here has been to some extent misinterpreted to fit my previous knowledge and the selection of what to include or not has doubtlessly been influenced by my knowledge base. This does not mean that the information presented here can be dismissed as all academic writing suffers from the same problem.)

A further problem SLTE teachers face is that they are generally not provided with any professional preparation for teaching in SLTE programs (Bartels, 2002; Gorsuch & Beglar, 2004; Murray, 2005; Korthagen, Loughran, & Luneberg, 2005; Smith, 2005) and that developing their knowledge for teaching is not regarded as a central part of their professional responsibilities (Bartels, 2002; Smith 2003). Ironically, some academics have suggested that what SLTE teachers need is simply experience as L2 teachers rather than explicit knowledge about teacher knowledge and learning (e.g., Long, 1998; Mendelsohn, 2001; Rhodes, 1993). However, there is no guarantee that knowledge gained from L2 teaching experience will prove useful for SLTE teaching (Bartels, 2005a; Richards, 1990) if SLTE teachers have not had professional training in developing their own deliberate practice. It is likely that real change in SLTE teaching will not come until tools for SLTE teacher learning are created (cases, materials, textbooks structured like L2 teaching, etc.) and SLTE teachers consider researching the hypotheses inherent in

their own instruction (Bartels, 2002; Burns, 2005; Luneberg & Willemse, 2006). It is hoped that this volume can provide a starting point for reflection, action research and, eventually, deliberate practice for SLTE teachers.

Index of Abbreviations

BALLI: Beliefs about Language Learning Inventory

CBI: Content Based Instruction

CLT: Communicative Language Teaching

EAP: English for Academic Purposes

KAL: Knowledge about Language

MA TESOL: Masters degree in Teaching English to Speakers of Other Languages

NCRTL: National Center for Research on Teacher Learning

PBL: Problem Based Learning

PCK: Pedagogical Content Knowledge

SAT: Scholastic Aptitude Test

SFL: Systemic Functional Linguistics

SLTE: Second Language Teacher Education

TA: Teaching Assistant

TBL: Task Based Learning

TOC: Target-Oriented Curriculum

UCLES/RSA: University of Cambridge Local Examinations Syndicate/Royal Society of Arts

ZPD: Zone of Proximal Development

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Erklärung zur Dissertation

Ich erkläre hiermit, dass ich die Dissertation selbstständig verfasst und keine anderen als die angegebene Hilfsmittel benutzt habe. Die Stellen der Arbeit, die anderen Werken im Wortlaut oder dem Sinn nach entnommen sind, sind durch Angaben und Quellen kenntlich gemacht. Dies gilt auch für Zeichnungen, Skizzen, bildliche Darstellungen und dergleichen.

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