Weaving technology in the design of learning experiences in world language teacher education: The development of a cognitive tool, an instructional device and an exploration

by

Julio César Rodríguez

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Program of Study Committee:
Carol A. Chapelle, Co-major Professor
Ann Thompson, Co-major Professor
Dale Niederhauser
Marcia H. Rosenbusch
Denise Schmidt

Iowa State University
Ames, Iowa
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UMI Number: 3243835

ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

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CHAPTER 1. GENERAL INTRODUCTION

Background

Research in Computer Assisted Language Learning (CALL) has undoubtedly influenced our understanding of how computer technology can best serve language teaching and learning. In recent years, World Language Teacher Education (WLTE)[1] has emerged in the CALL literature as a key component to achieve the effective integration of computer technology into language learning. However, research on computer technology integration into WLTE is still in its infancy.

Typically, very few studies in major journals published in English focus on the specific aspects of WLTE in either second or foreign language settings. In 1998, Freeman reported that only 9% of the articles featured in the cumulative indexes of the TESOL Quarterly fall under the topic of teacher preparation (pp. 397-398). Similarly, Bernhardt and Hammadou (1987) reviewed ten years of contributions published in the Modern Language Journal (MLJ) that focus on WLTE and revealed the scarcity of research in this area: only 75 articles on teacher education, and merely eight out of those reported research. The paucity of research on WLTE was once again highlighted in a turn-of-the-century report that appeared in the MLJ, which stated that "many of the problems discussed more than 80 years ago still remain unsolved" (Schulz, 2000, p. 495). One such problem has been the definition of a knowledge base for language teacher education. In both foreign and second language teacher education there have been efforts to define a WLTE knowledge-base (e.g., see Freeman & Johnson, 1998; Schulz, 2000).

The body of research that focuses on WLTE can be broadly classified into three main domains according to the purpose and focus of inquiry: a) the epistemological domain, which includes basic research that is primarily geared toward the definition of WLTE (e.g. Freeman & Johnson, 1988; Richards, 1985; Richards & Nunan, 1990); b) the conceptual domain, which includes contributions that are anchored to assumptions in the epistemological domain, such as research on models for teacher training and development in institutional, program, or course contexts (e.g., Grosse, 1993; e.g., Wilhem, 1997; Woodward, 1991), methodologies for language teaching (e.g., Kumaravadivelu, 1992, 2003); and c) the implementational domain, which comprises research that focuses on

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1 The term World Language Teacher Education (WLTE) refers to both second and foreign language teacher education in either pre- or inservice contexts.

Table 1. Literature domains in WLTE

Domain	Purpose	Focus	Sample Contributions
Epistemological (philosophical assumptions about language learning and teaching)	Define the knowledge-base for WLTE (What teachers need to know about language teaching & learning)	Profession as a whole	Freeman (1998); Brumfit (2000); Guntermann (1993); Kumaravadivelu (2006); Richards (1998)
Conceptual (specification of a conceptualization)	Identify & describe training and development models	WLTE curriculum development, Instructional models at institutional, program or course levels	Woodward, (1991); Wilhem, (1997); Horwitz et al. (1997); Kumaravadivelu, (1992 & 2003); Ellis, (1990)
Implementational (operationalization of conceptual level contributions)	Describe and/or analyze the context of WLTE	Pre- and inservice professional development; instructional practice and participants	Woodward (1991); Kumaradadivelu (1992 & 2003); Nyikos & Hashimoto (1997);Woods (1996 & 2006); Senior (2006)

the operationalization of the guidelines for effective practice that are formulated in the conceptual domain. The implentational domain includes research into tasks in WLTE settings and their impact on language teaching and learning (e.g., Ellis, 1990; Horwitz *et al.*, 1997; Kumaravadivelu, 1992, 2003; Nyikos & Hashimoto, 1997; Woodward, 1991) (see Table 1).

Although the contributions outlined in Table 1 do not focus on technology, they constitute a valuable source of information to guide technology integration into WLTE since they address issues and concerns that have implications for WLTE and that could directly affect technology integration into the design of language learning experiences. For example, this body of literature offers varied rationales for WLTE task configurations (e.g., Ellis, 1990 and Woodward, 1991), addresses specific interactional features in WLTE tasks (Nyikos & Hashimoto, 1997) and recommends specific content to inform WLTE tasks (Kumaravadivelu, 1992).

In recent years, technology integration has become an integral part of the discussion at the epistemological domain inquiry, which yields research that often constitutes a key factor in informing curricular change in WLTE. Issues that affect technology integration at this level that have been discussed in this area include: the importance of faculty modeling technology use in teacher preparation programs (Garret, 1991); the definition of the role of the teacher in the integration efforts (Amiri, 2000; Hubbard, 2004; Hubbard & Levy, 2006) and consequent redefinition of the knowledge base for language teachers (Chapelle & Hegelheimer, 2003; Hubbard & Levy, 2006); and the formulation of constructs that may help us ground technology use in teacher education on relevant content and pedagogies (van Olphen, in press).

The implementational domain of inquiry in WLTE has recently received more attention. Although there is still a small number of contributions in this domain, there is some work that now directly focuses on strategies for technology integration that are specifically geared toward WLTE. This area of research has investigated topics such as the value of principled approaches to integration (Hegelheimer *et al.*, 2004), approaches that facilitate contextualized integration, such as project-based learning (Levy, 1997a, 1999).

CALL research has conventionally focused on the language learner. However, effective CALL integration often depends on factors that originate in a context that is larger than the settings usually described in the CALL literature and that overlap with the context of WLTE. Arguably, the integration of CALL into World language instruction originates in the design of CALL activities. Claims in the literature go as far as to assert that CALL already is at an "integrative stage"(Warschauer & Healey, 1998, p. 57), that is, a stage of technology use which goes beyond behaviorist or communicative paradigms and which is characterized by the interplay of language learning skills (e.g., listening, reading, speaking, etc.) and different technologies. Yet, very little is known about the processes through which future teachers learn and teacher educators teach how to design language learning experiences in WLTE.

The assumption that integration has been achieved with disregard of an adequate understanding of how this process starts and evolves in WLTE and materializes through language learning instruction does not appear to have a solid foundation. The contributions listed at the implementational domain in Table 2 make up almost all the available research in this area, including both second and foreign language contexts. These studies have investigated teachers' perceptions of instructional approaches used to

integrate technology in WLTE (Debski & Gruba, 1999); discursive differences between expert and novice teachers when referring to technology integration (Meskill *et al.*, 2002); and the impact of a preservice CALL course on inservice practice (Egbert *et al.*, 2002).

In a recent article on the history of CALL, Bax (2003) argued for the distinction between three historical approaches in the integration of CALL: a) a restricted approach that mainly focused on basic tutorial usage of the technology; b) an open approach defined by a more flexible application of computer technology into language learning (although within this approach the computer is still viewed more as a supplementary "toy" rather than a powerful tool); and c) an integrated approach characterized by the ubiquitousness of the technology, which makes it invisible, and by the primary use of the computer as a flexible tool. Contrary to Warschauer and Healey's (1998) argument that CALL has moved beyond a stage characterized by simple addition of computer technology to language teaching to what they call an "integrative stage" (p. 57) of CALL, Bax (2003) contends that much of the field is still operating in what he described as the second approach, namely open CALL. He states that "[t]he key point about Integrated CALL … is that it does not yet exist to any significant degree, but represents instead an aim towards which we should be working" (p. 22).

Language teachers grow accustomed to managing a multiplicity of tasks and pedagogical goals that are typical of even the simplest language learning setting (Senior, 2006; Woods, 1996, 2006; Woodward, 1991). Instructional approaches that naturally embrace flexibility for implementation across the WLTE curriculum and diversity in tasks and goals may be valuable in WLTE contexts. In a survey study of impact of a CALL course on inservice teachers' use of technology, Egbert et al. (2002) conclude that their findings "support a shift away from isolated coursework in CALL to the development of a sequence of situated technology experiences for teachers" (p. 123). One approach that may help address the multiplicity of tasks and pedagogical goals and implement sequences of experiences of the kind Egbert et al. (2002) have mentioned is Project-Based Learning (PBL).

PBL is here defined as a task or series of tasks that converge in a common goal and which, in combination, result in an enquiry-driven learning experience that is central to the learning process, authentic and that promotes learner autonomy. As an instructional device, PBL appears to offer multiple qualities that may help improve how preservice

Table 2. Sample contributions in technology in WLTE

Domain	Purpose	Focus	Sample Contributions
Epistemological (philosophical assumptions about language learning and teaching)	Define the knowledge-base for technology integration into WLTE (What teachers need to know about teaching & learning with technology)	Profession as a whole	Amiri (2000); Bax (2003); Chapelle & Hegelheimer (2003); Garret (1991); Hubbard (2004); Hubbard & Levy (1997b); van Olphen (in press)
Conceptual (specification of a conceptualization)	Identify & describe training and development models to integrate technology into WLTE	WLTE curriculum development, Instructional models at institutional, program or course levels	Hegelheimer et al. (2004); Levy (1997a; Levy, 1999)
Implementational (operationalization of conceptual level contributions)	Describe and/or analyze the context of technology integration into WLTE	Pre- and inservice professional development; instructional practice and participants	Debski & Gruba (1999); Doering & Beach (2002); Egbert (2002); Meskill et al. (2002); Nunan (1999)

teachers learn about technology and incorporate technology into their teaching. The first part of this dissertation focuses on PBL qualities that could be of particular importance in WLTE. This first paper is based on the notion that one of the best ways for preservice teachers to integrate technology is through the design of language learning experiences.

Understanding teacher thinking during the design of language learning experiences may help us better understand how technology is integrated. In the last few years, researchers have started to investigate teacher cognition at different stages of the instructional process, such as the planning, execution and evaluation of learning tasks. Probably the most extensive example of work on language teachers' cognition to date is Woods' (1996) ethnographic work, which presents a deep analysis of ESL teachers' cognitive processing, starting at the instructional design (planning) stage of teaching and

ending with the teachers' reflections on recalled experiences. However, studies on teacher cognition have so far remained concerned with traditional language instruction and have not yet considered how technology may help support and possibly enhance the complex cognitive processes that are triggered through the design of learning experiences.

The centrality of the teachers' cognition in the design of language learning experiences and in any serious attempt to integrate technology in a principled and meaningful way into language learning is unquestionable. The teachers' ability to design articulated language learning experiences constitutes a fascinating field of inquiry that, surprisingly, has not yet drawn much attention. This is unfortunate because achieving a better understanding the complexity of the processes involved may not only help us improve how technology is used in WLTE contexts, but ultimately how technology is integrated into language learning.

One way to forward our understanding of how technology can be used to improve WLTE is through the exploration of how technology tools interface with cognition. Creating graphical representations of intangible pedagogical concepts may aid the process that preservice teachers need to go through to learn how to orchestrate the host of factors that come into play in the design of language learning experiences. In a powerful analysis of discourse, Goodwin (1994) made reference to the relevance of graphic representations in relation to human cognition.

> "… the ability of human beings to modify the world around them, to structure settings for the activities that habitually occur within them, and to build tools, maps, slide rules and other representational artifacts, is as central to human cognition as processes hidden inside the brain. The ability to build structures in the world that organize knowledge, shape perception and structure future action, is one way that human cognition is shaped through ongoing historical practices. Graphic representations constitute a prototypical example of how human beings build external cognitive artifacts for the organization and persuasive display of relevant knowledge" (Goodwin, 1994, p. 628).

A software tool that enables the creation of graphical representations of language learning experiences constitutes a starting point for the research reported in this dissertation. The design and construction of such tool, named the Activity Design Studio, was a central aspect of this work.

This dissertation addresses two major needs in WLTE: a) the need for a deeper

exploration of the potential benefits that PBL can offer to facilitate the integration of technology into WLTE; and b) the need for a better understanding of how technology tools designed to support the cognitive processes involved in the conceptualization and design of language learning experiences. The former need becomes the focus of the first paper in this dissertation. This first paper would be placed within the conceptual domain of inquiry described in Table 2. The latter need is addressed by this dissertation through two combined endeavors: the design and development of a prototype of the Activity Design Studio, and an exploration of how this tool supports the users' cognitive processes while they design a language learning experience. This second paper would fall into the implementational domain of inquiry listed in Table 2. The prototype and both papers pursue a common goal: to further our still limited understanding of technology integration into WLTE.

Dissertation Organization

This dissertation contains two publishable papers and the documentation that explains the development and basic operations of a software prototype that was built as part of this dissertation project. The first paper proposes PBL as a promising approach to integrate technology into WLTE and to support the design of effective, contextualized CALL activities. This paper draws from the relevant literature to construct a rationale for the application of PBL in WLTE. It closes with a taxonomy of tasks that can be used to operationalize PBL in WLTE.

The second paper reports an exploration of the Activity Design Studio, a software prototype designed and developed as part of this dissertation. The exploration of this tool is grounded on a design-based research approach. The purpose of this study is to gain insights into the cognitive processes that are triggered through the use of the software. The participants in this study are knowledgeable of the context of WLTE and relevant technology tools and software applications. Findings will be used to improve and inform further development of the software.

Finally, the software documentation, which is available online[2], consists of a hypertext user's manual that contains: a) an overview of the project containing information on the conceptualization of a learning management system (LMS) named Designs for Language Learning and the evolution of both the concept and interface of

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2 Available at http://www.language.iastate.edu/dsn/ or contact rodriguez.julioc@gmail.com

the prototype that was developed, the Activity Design Studio; and b) a user's guide that illustrates basic software functions and operations of the Activity Design Studio. This manual includes diagrams and charts describing the components of the LMS and their function, and a blueprint of the relational database used to store user data generated by the assessment tool. References are included at the end of each paper.

References

Amiri, F. (2000). It-literacy for language teachers: Should it include computer programming? *System, 28*, 77-84.

Bernhardt, E. B., & Hammadou, J. (1987). A decade of research in foreign language teacher education. *Modern Language Journal, 71*, 289-299.

Brumfit, C. (2000). Modern languages within a policy for language education. In S. Green (Ed.), *New perspectives on teaching and learning modern languages* (pp. 94-104). Clevendon, England: Multilingual Matters, Ltd.

Chapelle, C. A., & Hegelheimer, V. (2003). The language teacher in the 21st century. In S. Fotos & C. Browne (Eds.), *New perspectives on CALL for second language classrooms* (pp. 299-316). Mahwah, NJ: Lawrence Erlabaum Associates.

Debski, R., & Gruba, P. (1999). A qualitative survey of tertiary instructor attitudes towards project-based CALL. *Computer Assisted Language Learning, 12*(3), 219-239.

Doering, A., & Beach, R. (2002). Preservice english teachers acquiring literacy practices through technology tools. *Language Learning & Technology, 6*(3), 127-146.

Egbert, J., Paulus, T. M., & Nakamichi, Y. (2002). The impact of CALL instruction on classroom computer use: A foundation for rethinking technology in teacher education. *Language Learning & Technology, 6*(3), 108-126.

Ellis, R. (1990). Activities and procedures for teacher preparation. In J. C. Richards & D. Nunan (Eds.), *Second language teacher education* (pp. 26-36). Cambridge, England: Cambridge Unviersity Press.

Freeman, D., & Johnson, K. (1998). Reconceptualizing the knowledge-base of language teacher education. *TESOL Quarterly, 32*(3), 397-417.

Garret, N. (1991). Technology in the service of language learning: Trends and issues. *The Modern Language Journal, 75*(i), 74-101.

Goodwin, C. (1994). Professional vision. *American Anthropologist, 96*(3), 606-633.

Grosse, C. U. (1993). The foreign language methods course. *The Modern Language Journal, 77*(iii).

Guntermann, G. (1993). *Developing language teachers for a changing world*. Lincolnwood, IL: National Textbook Company.

Hegelheimer, V., Reppert, K., Broberg, M., Daisy, B., Grgurovic, M., Middlebrooks, K., et al. (2004). Preparing the new generation of CALL researchers and practivioners: What nine months in an ma program can (or cannot) do. *ReCALL, 16*(2), 432-447.

Horwitz, E. K., Mclendon, M. E., Bresslau, B., Yu, J., & Dryden, M. (1997). A graduate course focusing on the second language learner. *The Modern Language Journal, 81*(iv).

Hubbard, P. (2004). Guest editorial. *Computer Assisted Language Learning, 17*(1), 1-6.

Hubbard, P., & Levy, M. (2006). The scope of CALL in education. In P. Hubbard & M. Levy (Eds.), *Teacher education in CALL*.

Kumaravadivelu, B. (1992). Macrostrategies for the second/foreign language teacher. *The Modern Language Journal, 76*(1), 41-49.

Kumaravadivelu, B. (2003). *Beyond methods: Macrostrategies for language teaching*. New Haven: Yale University Press.

Kumaravadivelu, B. (2006). *Understanding language teaching: From method to post-method*. Mahwah, N.J.: Lawrence Erlbaum Associates.

Levy, M. (1997a). Project-based learning for languag teachers: Reflecting on the process. In R. Debski, J. Gassin & M. Smith (Eds.), *Language learning through social computing* (Vol. 16). Melbourne, Australia: Applied Lingusitics Association of Australia & The Horwood Language Centre.

Levy, M. (1997b). A rationale for teacher education and CALL: The holistic view and its implications. *Computers and the Humanities, 30*, 293-302.

Levy, M. (1999). Design processes in CALL: Integrating theory, research and evaluation. In K. Cameron (Ed.), *Assisted language learning (CALL): Media, design, and applications* (pp. 83-107). Exton, PA: Swets & Zeitlinger.

Meskill, C., Mossop, J., DiAngelo, S., & Pasquale, R. K. (2002). Expert and novice teachers talking technology: Precepts, concepts, and misconcepts. *Language Learning & Technology, 6*(3), 46-57.

Nunan, D. (1999). A foot in the world of ideas: Graduate study through the internet. *Language Learning & Technology, 3*(1), 52-74.

Nyikos, M., & Hashimoto, R. (1997). Constructivist theory applied to collaborative learning in teacher education: In search of zpd. *The Modern Language Journal, 81*(iv).

Richards, J. C. (1998). *Beyond training*. Cambridge, England: Cambridge University Press.

Schulz, R. A. (2000). Foreign language teacher development: Mlj perspectives - 1916-1999. *The Modern Language Journal, 84*(iv).

Senior, R. M. (2006). *The experience of language teaching* (1st ed.). Cambridge; New York: Cambridge University Press.

van Olphen, M. (in press). Technological pedagogical content knowledge: An integrated framework for educating foreign language teachers. In M. J. Koehler & P. Mishra (Eds.), *Tpck book*.

Warschauer, M., & Healey, D. (1998). Computers and language learning: An overview. *Language Teaching, 31*, 57-71.

Wilhem, K. H. (1997). Sometimes kicking and screaming: Language teachers-in-training react to a collaborative learning model. *The Modern Language Journal, 81*(iv).

Woods, D. (1996). *Teacher cognition in language teaching: Beliefs, decision-making, and classroom practice*. Cambridge [England]; New York: Cambridge University Press.

Woods, D. (2006). Who does what in the ‘management of language learning’? Planning and the social construction of the ‘motivation to notice’. In S. Gieve & I. K. Miller

(Eds.), *Understanding the language classroom* (pp. 88-114). New York: NY: Palgrave Macmillan.

Woodward, T. (1991). *Models and metaphors in language teacher training*. Cambridge: Cambridge University Press.

CHAPTER 2. PROJECT-BASED LEARNING: A PROMISING PATHWAY TO TECHNOLOGY INTEGRATION IN WORLD LANGUAGE TEACHER EDUCATION

Abstract

This article presents project-based learning (PBL) as a promising conduit to aid preservice teachers' acquisition of the complex types of knowledge that result from the combination of content, pedagogy and technology. The process through which language teachers integrate subject-matter, technical, pedagogical, second-language acquisition and instructional design knowledge constitutes an important aspect of computer technology integration into world language teacher education (WLTE) and ultimately, of the effective integration of computer-assisted language learning (CALL) in language learning curricula. This article begins by defining PBL and describing the unit of a project: the WLTE task. A taxonomy of WLTE tasks serves as the basis to consider the potential of PBL for the contextualized integration of technology in WLTE. The implementation of PBL for technology integration into WLTE tasks is then considered from two distinctive perspectives: a) as a pedagogical process experienced by preservice teachers; and b) as part of the content of WLTE. Advantages of implementing PBL from both perspectives are discussed.

Introduction

Research in Computer-Assisted Language Learning (CALL) has been instrumental in shaping and expanding our understanding of how computer technology can best serve language learning. In recent years, World Language Teacher Education (WLTE) has been acknowledged in the CALL literature as one of the key components to the integration of computer technology into language learning. One aspect of computer technology integration into WLTE that needs attention is the process through which the technical, pedagogical, second-language acquisition, and instructional design knowledge that teachers develop in WLTE programs is constructed. The design and management of WLTE tasks appears to have an important impact on these processes. A WLTE study highlighted this need by concluding:

> This study underscores a great need for 'studies of how teachers gain subject-matter and pedagogical content knowledge; studies of how teachers learn ambitious forms of teaching on their own and in the company of other teachers; studies of teachers' practical knowledge and how it develops (Feiman-Nemser & Remillard, 1996, p. 2, cited in Egbert *et al.*, 2002).

Recent work in teacher education has built on the concept of pedagogical-content knowledge (PCK) originally described by Shulman (1986) and has proposed that in the same way PCK constitutes a specific type of knowledge that becomes the foundation of a teachers' expertise, the adequate use of technology to improve learning results from the application of a similar type of knowledge that blends both PCK with knowledge of technology. Koehler and Mishra (2005) have described this type of knowledge as technological-pedagogical content knowledge (TPCK). They have argued that preservice teachers best develop this type of knowledge through hands-on design of learning experiences for their students which incorporate technology.

This article shows that PBL has the potential to help in the construction of TPCK. Based on the premise that the development of preservice teachers' TPCK is a desirable outcome in WLTE, I present a rationale for the implementation of PBL in WLTE in two complementary modes: as part of the modeled pedagogies in WLTE (preservice teachers experience PBL), and as part of the content of WLTE (preservice teachers design PBL experiences for their students). Wooldward's (1991) loop-input model, which makes the distinction between these two modes, informs the content of this paper.

Defining Project-Based Learning (PBL)

Project-based learning (PBL) embodies the pedagogical concepts of learning through action, experience and perceptions that was advocated by prominent educational figures such as Jan Amos Comenius (17th century Prague), Johann Pestalozzi (Switzerland), Maria Montesori (Italy), and Jean Piaget (France), to name a few (van Lier, 2006). In the U.S., the philosopher John Dewey was a keen supporter of the concept of learning by doing (Dewey, 1938), which is central to PBL. In fact, PBL has often been referred to as one of the instructional tools available to realize this type of learning.

In the general literature, both terms *project*- and *problem*-based learning have often been used to refer to the same concept: open-ended, inquiry-based instructional activities focused on an issue or question and resulting in a realistic product (Barron *et al.*, 1998). Although there is no precise definition for PBL, a few characteristics of PBL emerge from the general literature. In his extensive review of the research on project-based learning, Thomas (2000) proposes the following five qualities to define PBL: centrality, inquiry driven, goal-directed, autonomous and realistic. These qualities or criteria are used in this article to help define the concept of PBL and are further explained in relation to WLTE below.

Centrality is an important aspect of PBL. Centrality refers to the idea that the project constitutes a central component in the curriculum. Research in project-based CALL (PBCALL) supports this tenet. In a study on instructors' attitudes toward PBCALL, Debski and Gruba (1999) found that "situating motivating project work peripherally is problematic" (p. 236). The authors warn that peripheral integration may be perceived as unfair by students who are motivated by the project and desire to achieve high standards.

Inquiry driven projects have long been part of both language learning and WLTE contexts. In WLTE contexts, content-based instruction projects such as the creation of thematic units for language teaching (Bigelow & Ranney, 2005) provide a good example of the inquiry-driven nature of project work. Preservice teachers are presented with the challenge of designing activities anchored to an overarching goal, i.e. the development of the learners' communicative competence in the target language. How to best reach the goal becomes the focus of inquiry for the project. Providing a concrete answer to this type of question prompts preservice teachers to activate and deploy their arsenal of technology, pedagogy and content knowledge.

In language learning contexts, the inquiry nature of a project is probably more subtle than in other content areas but still constitutes an important criterion for PBL. This is the aspect of the project that ultimately drives and sustains the learners' motivation to work on a series of complex tasks. The inquiry-driven aspect of the project is often realized through a central question or problem (Blumenfeld *et al.*, 1991). A problem-solving perspective to PBL works well in WLTE contexts, where the acquisition of the additional language (L2) may be framed as a problem, but should not be readily transferred to language learning settings. In language learning contexts, there may not be a clearly defined central question or problem that drives a project but rather a set of guidelines that define a specific outcome, which may be the creation of a product. Even though there will be problem-solving, decision-making and negotiation activities in pursuit of the outcome, the project itself may not necessarily be framed from a problem-solving perspective. Hence the subtlety of the inquiry driven quality of PBL in WLTE.

The goal-directed quality of a project is also a defining aspect of PBL. Whether the goal is framed as the answer to a question or the creation of a product, it needs to be specific and negotiated for the project to succeed. Lack of specificity in the goals may result in outcomes that are not readily measured. Similarly, non-negotiating project goals may result in the absence of two qualities that may help ensure the project's success: participant ownership and motivation. Both of these qualities have been linked to the

success of PBL (Chuang & Rosenbusch, 2005).

In the context of WLTE, project goals may vary significantly but would always be geared toward the development of the preservice teachers' knowledge of content in the subject area and of related pedagogy. Shulman (1986) contends that the blending of those types of knowledge results in a different and unique type of knowledge, which he calls pedagogical-content knowledge (PCK). In recent work in the field of technology in teacher education, Shulman's seminal work has been expanded to include knowledge of technology (Koehler & Mishra, 2005; Koehler *et al.*, 2004). The resulting construct is referred to as technological pedagogical content knowledge (TPCK). Koehler and Mishra (2005) have argued that meaningful integration of technology takes place when teachers develop this kind of knowledge and that one effective way to develop TPCK is through direct experience in the design of technology-enhanced learning.

The TPCK construct is a powerful metaphor to think about ways in which principled technology integration could be achieved in WLTE. It helps us frame WLTE goals not only in terms of content and pedagogy, but also in relation to how technology intersects these areas. To achieve contextualized technology integration in WLTE then, WLTE projects need to be directed towards the development of the preservice teachers' TPCK.

The consideration of autonomy as a criterion for PBL has implications for both WLTE and language learning contexts. Autonomy is associated with the notion of self-directed learning, which is a desirable quality in adult learning contexts. Autonomy is also associated with the redefinition of roles in an instructional context. Increased preservice teachers' autonomy may result in an enriched pedagogical experience. As preservice teachers work on their projects, they may learn more about technology and content aspects of their projects than the teacher educator. The resulting redefinition of roles, which is actively sought in constructivist contexts, may contribute to the creation of an environment that enriches both the preservice teacher and the teacher educator. In this redefined role, the teacher educator becomes an informed participant with expertise in language learning pedagogy and technology.

Finally, the realistic quality of a project is related to the degree of likelihood that the tasks that are necessary for the completion of the project correspond to tasks that the participants would encounter in real life. This concept has long been discussed in the literature in applied linguistics under the label "authenticity" (e.g. Kramsch, 2003). In WLTE contexts, project authenticity should probably be measured against the degree of correspondence between the cognitive processes that preservice teachers experience and

the cognitive processes an exemplary technology-using teacher would engage in when designing language learning experiences for their learners. Findings from a study that researched language teacher attitudes toward a project-based approached for computer-assisted language learning (CALL), named PBCALL, highlighted the importance of this criterion (Debski & Gruba, 1999). The study gave an overview of the challenges participants faced when implementing the projects, as well as the concerns they expressed. A central concern for these teachers lay on the authenticity of the tasks. The authors reported that instructors most believed that computer-mediated communication "should be used only in situations that truly demand them" (p. 233). Referring to methodologies for this approach, participants pointed out that it is important to situate PBCALL in relation to "authentic goals and situation" (p. 235).

The five qualities discussed above (centrality, inquiry driven, goal-directed, autonomous and realistic) are all necessary properties of a WLTE project. PBL is then here defined as a task or series of tasks which converge in a common goal and which, in combination, result in an enquiry-driven learning experience that is central to the learning process, that is authentic and that promotes learner autonomy. Since a task or series of tasks constitute a necessary component of project, and since tasks in WLTE tasks may incorporate a number of features that may make them quite complex, I first focus on a description of WLTE tasks and provide a basic taxonomy of WLTE tasks based on the description. Then I extend the task-level taxonomy to the project level to focus on the potential of project-based learning in WLTE.

Characterizing WLTE Tasks

There is very little research to date that specifically focuses on WLTE tasks. Ellis' (1990) research was one of the first attempts to try to characterize some of the important features of WLTE tasks. Ellis (1990) proposed subdividing WLTE tasks into two categories: a) experiential practices, through which the preservice teacher is involved in actual teaching, including classroom teaching or any other simulated practice such as microteaching or peer teaching; and b) awareness-raising practices, whose main goal is to make the preservice teacher aware of the principles underlying world language teaching and of teaching strategies that can be used in different situations. Ellis argued that experiential and awareness-raising practices can, and probably should, be combined in both pre- and inservice settings. He contends that by doing so, it would be possible to better support the claim that awareness-raising practices lead to better teaching. As he explains, "[i]t is all too easy to assume that a better-informed teacher will become a better

teacher" (Ellis, 1990, p. 27).

Ellis (1990) further explains that awareness-raising practices involve *activities* and *procedures*. Activities are made up of a set of tasks which the preservice teachers are requested to perform. Such tasks are based on data (e.g., video clips of actual language learning situations, transcripts of lessons or a combination of video and transcripts, textbook materials, case studies, lesson plans, etc.) and they involve one or more operations (e.g., preservice teachers are asked to read a transcript). Operations can be combined in different ways. A particular combination of operations results in a task type. For example, a "rearranging" task would consist of the following operations: a) watch the video of a language teacher organizing group work; b) make a list of the steps the teacher follows in this process; c) recommend changes to the order of steps based on the guidelines for classroom management you read (Ellis, 1990, p. 30). Procedures, on the other hand, refer to the teacher educator's methodology applied to those activities in WLTE sessions (p. 27).

Ellis' (1990) work provides an excellent starting-point for the description and analysis of WLTE tasks, because, although not explicitly, it points to the inherent duality present in WLTE tasks: operations (what the preservice teachers do) and procedures (what teacher educators do). However, the complexity of WLTE tasks goes beyond the distinction between operations and procedures. Even though this distinction is useful to describe the context of WLTE, what Ellis (1990) calls operations appear to constrain the types of WLTE tasks to models that require the use of language teaching data, such as case-based learning. Although case-based learning is a very useful approach, WLTE tasks present more variation.

Awareness-raising tasks in WLTE are usually compounded by other factors which are not accounted for in Ellis' (1990) description. For example, the language used by the teacher educator (a "second language" in a world language methods class may be virtually any language other than English) and the target language of the preservice teachers, which may or may not be the same as their native language; the content that informs the WLTE sessions (besides what Ellis calls the data of the activities, there is also the specific content of the WLTE program, which may not necessarily be used as data for a WLTE task). Finally, the distinction between operations and procedures does not readily reflect the dual goals in WLTE. Both procedures (e.g., lectures, group/pair discussions, demonstrations, elicitation, etc.) and operations have embedded pedagogical processes. Thinking of them in terms of duality rather than different entities may help us better

describe and understand WLTE.

Besides these important factors, WLTE tasks may embody duality in the processes that preservice language teachers experience. In WLTE, it is common for teacher educators to embed language learning tasks as part of a WLTE task. These embedded language learning tasks often serve the purpose of modeling complex pedagogical processes or concepts that may be difficult to understand without having experienced them. Embedded language learning tasks are particularly common in the methods classes.

Although there are distinctive contextual differences between WLTE tasks and embedded language learning tasks (see Table 1), the underlying processes of a particular WLTE task (what Ellis, 1990, calls procedures) could be manipulated to match the processes in the embedded language learning task. In the loop-input model (Woodward, 1991) for example, the distinction between procedures and operations (Ellis, 1990) is blurred, possibly resulting in an improved awareness-raising experience for preservice teachers because they actually experience the same pedagogical process their learners would.

Several reasons justify a type of pedagogical experience such as the loop-input model. For example, Hall (1999) states the problem of this mismatch between expected competences of preservice teachers and current pedagogical practices of language teacher educators: "…what teachers of elementary, middle, and high schools learn to do in a foreign language and what they learn about 'learning' in their university language classes departs, sometimes radically, from what they learn about communication and teaching for communicative development in their teacher preparation programs" (p. 49). This type of inconsistency creates a paradox in teacher education. As Gebhard et al. (1990) point out, the "role of the student teacher [i.e., preservice teacher] is to listen, accept, occasionally give an opinion, but ultimately to follow a prescription, or at least give this impression" (p. 16). Making a strong connection between the processes that are intended to raise the preservice teachers' awareness about language teaching and learning with those present in a language learning experience, as Woodward (1991) has suggested, may help address those inconsistencies.

As Table 1 indicates, the contextual differences between WLTE and embedded language learning (L2) tasks are numerous. The participants and their roles change radically; the goals of the embedded task compound the WLTE task; process and content may be quite different; and the purpose of technology use is quite distinct for each of them. An additional feature that is not reflected well on a table is the notion of

Table 1. A comparison of WLTE and embedded tasks features

Features	**WLTE Task**	**Embedded Task**
Participants	teacher educator and preservice teachers	Teacher educator and preservice teachers
Participants' Roles	instructor (played by teacher educator) student (played by preservice teacher)	inservice teacher (played by teacher educator or preservice teachers) language learner (played by preservice teachers)
Goal	Development of TPCK	Development of communicative competence
Topical content (Data in Ellis' framework)	Field-specific; cognitively complex; not personal	May or may not be field-specific, cognitively complex, or personal
Process	Focused on knowledge acquisition (e.g., lectures, workshops, assignments, [Ellis, 1990]) – May involve L2 acquisition	Focused on language acquisition
Content	WTLE Content (KAL, language learning methods, approaches and pedagogy)	Varied according to targeted L1 use. (e.g., French for business)
Location	WLTE setting	Dependent on WLTE setting
Duration	Time constraint dependent on available WLTE time block	Dependent on the duration of a specific WLTE task
Language	L1	L1 or L2
Use of language	Motivated by need for knowledge acquisition (e.g., development of preservice teachers' knowledge on an instructional strategy) Register: Academic	Motivated by need for language acquisition Register: Varied
General purpose of technology use	Improve the acquisition of TPCK	Improve learners' communicative competence

subordination (rather than separation) of the embedded task to the WLTE task. Time and location are probably the features that best reflect this trait. However, in all Embedded task features there is the implicit notion of subordination to the WLTE task. So even though the Embedded task has a goal defined in terms of language learning, its goal is still linked to WLTE features.

A Basic Taxonomy of Compounded WLTE Tasks

Tasks can be considered the unit of a project. From a task perspective, an instructional project could be defined as a set of tasks that are cohesively directed toward a common goal. In WLTE, the intrinsic duality of tasks and goals warrants closer attention. This section provides a basic taxonomy of WLTE tasks that is used to organize the discussion of the potential of PBL in WLTE.

WLTE tasks can be affected by the dual goals and pedagogical processes that characterize WLTE. As stated previously, WLTE tasks may contain an embedded language learning task, during which preservice teachers assume the role of language learners. Role-switching characterizes WLTE tasks and, interestingly, is also very common in language teaching contexts. Senior (2006) observes that as early as 1980, researchers "drew attention to the fact that some of the best language teachers he had known readily switched roles in their classrooms, alternating between behaving conventionally as teachers and functioning as what he termed 'Fellow Human Beings'" (p. 85). Alternatively, WLTE tasks may not include an embedded task but feature a compounded goal, which is usually manifested in the dual purpose of the WLTE pedagogical process. This dual purpose entails: a) modeling a pedagogical process that preservice teachers may also implement in their practice; and b) assisting in the construction of the preservice teachers content knowledge. For example, a WLTE task may focus on the subject-matter content "L2 writing strategies" and engage participants in pedagogical processes that are the same as those dealt with in the content, such as brainstorming, freewriting, outlining information, etc. WLTE tasks that contain an embedded task are referred to as compounded tasks in this paper.

The numerous contextual changes that take place when this compounded experience occurs make it possible to differentiate among a few basic WLTE task types. Table 2 shows a basic taxonomy of compounded tasks based on some of their most salient contextual differences, namely the participants' role, the language used during the tasks, the underlying pedagogical process and the content. Woodward (1991) identified five

Table 2. A taxonomy of compounded WLTE task types

Type	Task	Role of preservice teacher	Lang.	Pedagogical Process	Content
A	WLTE	Self	L1	WLTE specific (e.g., discussion of process experienced through embedded task)	WLTE specific (e.g., negotiation of meaning)
	Embedded	Self	L1	Language learning specific (e.g., information-gap activity)	Language learning specific (e.g., deciding where to study abroad)
B	WLTE	Self	L1	WLTE specific (e.g., guided discussion on teaching advanced composition)	WLTE specific (e.g. teaching advanced composition)
	Embedded	Self	L1	Language learning specific (e.g., prewriting activities on the topic "teaching advanced composition")	WLTE specific (e.g. teaching advanced composition)
C	WLTE	Self	L1	WLTE specific (e.g., reflection of process experienced through embedded task)	WLTE specific (e.g. task-based instruction)
	Embedded	L2 learner or teacher	L2	Language learning specific; choice of processes is highly constrained by the content of the task (e.g., identify numbers in a dialog)	Language learning specific; choice of content is highly constrained by the language proficiency of the participants (e.g., numbers in Chinese)
D	WLTE	Self	L1	WLTE specific (e.g., preservice teachers adapt a text for L2 learners)	WLTE specific (e.g. simplified input)
	Embedded	L2 learner	L1 or L2	Language learning specific; modeled by teacher educator; process highlights may be verbalized by teacher educator during the development of the task	Language learning specific (e.g., reading a news report)

variations that feature different combinations of process and content in non-compounded WLTE tasks.

The task types presented below are based on Woodward's (1991) work. It should be noted that these types do not exhaust all possibilities. Rather, they are intended to give readers a sense of the diversity and inherent complexity of compounded WLTE tasks. Features of compounded tasks that are not mentioned here may have an impact on their effectiveness and still remain to be researched. For example, the positioning of the embedded task relative to the whole instructional experience (at the beginning, half-way through or toward the end of the WLTE task) may have an impact on the effectiveness of the WLTE task. Similarly, preservice teachers may play the role of the teacher educator in any of the compounded WLTE tasks considered below. An in-depth discussion of these factors is beyond the scope of this paper.

Type A: Simulating L2 learning environments using L1

The preservice teachers' role is the same role during both the WLTE and embedded tasks. Preservice teachers may be asked to perform a particular WLTE task using the language of instruction (L1) and afterwards reflect on the task. WLTE content (e.g., language features and pedagogical process involved in the language learning task) may be elicited by the teacher educator through a discussion of the participant's experiences during the WLTE task or through lecture or presentation. Preservice teachers experience the pedagogical process first-hand, but with their own needs and language proficiency in mind rather than their learners'. The content of the WLTE task does not match the content of the embedded task. For example, content of the WLTE task may focus on the concept of negotiation of meaning, and the content of the embedded task may focus on a particular discourse domain of the additional language (L2), such as planning a trip with a travel agent.

Type B: Blending content and process

The preservice teachers remain in the same role during both tasks. The WLTE task content and process are closely related to the content and process of the embedded task. For example, the content of the WLTE task may focus on the concept of negotiation of meaning, so the embedded task may be an information gap activity which is likely to elicit negotiation of meaning. The content in this information gap activity is also related to negotiation of meaning. For example, a reading on negotiation of meaning

from a professional publication is used as content to create the information gap activity. Woodward (1991) graphically represented the compounded goals of this type of task with a mobius strip. When the task content and process are put in motion, the teacher educator moves the focus of the preservice teachers' attention from content to process and vice versa.

Type C: Experiencing authentic L2 learning

The preservice teachers participate in two roles: in order to experience the process first hand, they are asked to switch to the role of learners in a language classroom. The WLTE tasks that illustrate the process may be conducted in the L2, which may not necessarily be the same as the preservice teachers' L2 (e.g., the preservice teachers' in a given methods class are majoring in Chinese, French, German and Spanish, while the embedded task is carried out in Japanese). As in Type A, the content of such activities is different from the specific content of the WLTE task. The content of the WLTE task may be delivered through processes aimed at the acquisition of content knowledge, such as lectures, workshops, group-work or assignments (Ellis, 1990), while the content of the embedded task will be informed by pedagogical processes that specifically pertain to language learning and are hopefully informed by SLA.

Type D: Modeling practice

The preservice teachers are asked to switch to the role of L2 learners. The teacher educator models a particular process. The language of the embedded task may or may not be the same as the language of the WLTE task (L1) depending on the complexity of the content and process of the embedded task and on the L2 of the preservice teachers. Preservice teachers experience the process first-hand through both the embedded and the WLTE tasks (e.g., teacher educator/s may give preservice teachers options and explain to them the rationale for giving those options, thus illustrating a process and making preservice teachers aware of it). The content of the WLTE task is different from the content of the embedded task.

The loop input model for WLTE (Woodward, 1991) is summarized in taxonomy type b. This model merges the content of both the WLTE and the embedded task. Despite the advantages it may present (e.g., the use of the same content may result in a more efficient use of time), it is also clear that the use of this task type alone presents limitations. One of the limitations is that this task type blurs the distinction between the goals of

WLTE and embedded tasks (see Table 2). Because of this, preservice teachers may not be able to clearly distinguish between the pedagogical adequacy of the process they are experiencing for the context in which it is used as opposed to language learning. The apparent lack of authenticity of this type of task also presents a limitation that preservice teachers probably need to be made aware of. For example, the field-specific content of the WLTE task will probably not elicit the types of interactional language features that an authentic L2 task would (Chapelle, 1999). Besides interactional features, a further note of caution needs to be given to preservice teachers regarding the authenticity of the materials. The types of materials appropriate for WLTE tasks will not adequately reflect the types of interaction that would arise in tasks designed for low language proficiency levels. Finally, the process will be affected by the task participants (their roles, age, gender, learning styles, etc.). These task features will have an impact on the quantity and quality of language, which may not correspond with an authentic language learning task.

As Table 2 shows, other features that interplay in the execution of compounded tasks also raise issues of authenticity. For example, WLTE task types that prompt the use of an L2 (as in Type C) will always have to be carried out at very low levels of language proficiency. This will have an impact on the content of the embedded task, which needs to be simplified, and subsequently the processes, which need to be adapted to the level of proficiency of the participants.

Models of instruction in WLTE, like methods for teaching an L2, provide descriptive or sometimes prescriptive sets of well-intended principles to assist in the design of WLTE tasks. However, the application of those models should be sensitive to the context of their use. For example, some WLTE models may result in specific task types which may only work in specific contexts. Woodward (1991) has been critical of WLTE tasks that assume universal characteristics in the roles of language learners and instructor. For example, particular tasks may not be suitable or appropriate in a specific context, e.g. the process or content of the task may be incompatible with the cultural background of the participants (Tedick et al., 1993). Similarly, they may endorse SLA theories which have been so far tested using very limited data (e.g., only one or two Indoeuropean languages) and rather homogeneous contexts (Schleppegrell, 2001).

As the taxonomy in Table 2 indicates, compounded WLTE tasks present a wide spectrum of possibilities. Although there is no research to date that compares these different types of tasks, it appears that every type offers particular advantages, such as the higher level of authenticity in type c or the possibility to experience first-hand

pedagogical processes appropriate for higher proficiency levels. Experiencing all task types would probably enrich the preservice teachers' experiences in WLTE.

The different possibilities for configurations at the task level can be extended to the project level. The section below considers the potential of PBL in WLTE first as a process (preservice teachers experience PBL) and then as content (preservice teachers design PBL). As in the taxonomy presented above, PBL as an instructional approach may be a process of either WLTE or the embedded language learning experience (in this case not a task but a project). The sections below present the potential of PBL from each of these perspectives.

PBL as a Process in WLTE

The literature in WLTE offers abundant discussions and guidelines regarding what language teachers need to know (e.g., Bigelow & Walker, 2003; Freeman & Johnson, 1998; e.g., Hubbard, 2004; Hubbard & Levy, in press; Levy, 1997; Richards & Nunan, 1990). Recent accounts in the WLTE literature have started to address *how* teacher educators are supposed to face the challenge of preparing teachers who are proficient in the design of effective language learning experiences (e.g., Ellis, 2005; e.g., Kumaravadivelu, 2006), including experiences that effectively integrate technology (e.g., C. A. Chapelle & Hegelheimer, 2003; Hegelheimer *et al.*, 2004). Simpson et al. (2004) have noted that "teacher educators often find themselves with little preparation for their roles, and with little chance to discuss the special issues of teacher education. Few have been 'educated as educators'. A common assumption is that if you are an effective teacher, you will be an effective teacher educator" (p. 5).

PBL may help teacher educators enhance their learning environment through the possibilities it offers to expose preservice teachers to a wide variety of learning experiences. The following are some the potential advantages offered by PBL as a process in WLTE. These advantages are based on the taxonomy of tasks presented earlier.

Projects that simulate L2 learning environments using L1

Ironically, language, which is the foundation of subject-matter expertise in WLTE, sometimes becomes an impediment for cross-curricular activities in WLTE programs. The methods classes are unique in that they often do not cluster students according to languages as most of the other classes in language programs. However, they are also unique in that usually majors from different languages converge in this class. Methods

classes could exploit the advantages of implementing projects that simulate L2 learning environments using a common language.

Doering & Beach (2002) provide an example of a project of this type which was carried out in English and involved extensive use of technology. Preservice teachers who were simultaneously enrolled in a methods and technology course were grouped with middle school students to create multimedia projects. The communication with the students was mediated through technology. The authors report that the preservice teachers tended to dominate the discussions and that female preservice teachers achieved higher participation from their students than their male counterparts. Clearly, projects such as this could enrich WTLE enormously by giving preservice teachers the opportunity to experience issues related to the management of language learning experiences first-hand. Through projects such as this, discussions of WLTE content can be situated in a shared context, anchored to personal experiences and supported by real data.

This type of project can also be extended beyond the methods classes to the entire WLTE curriculum. As Furstenberg has stated: "[t]en years ago, it would have been difficult to connect the words *technology* and *culture* or *technology* and *literature* [emphasis in original] or to find synergy between those fields. Interestingly enough, technology may end up being the medium that binds together the different areas of our departments, namely language, literature, culture, and film" (Furstenberg, 1997, p.24). Furstenberg identified the content that technology could possibly mediate in WLTE. PBL processes can be used to synergize the connections between these classes. Garret (1991) provides numerous ideas to establish connections between language and culture classes in the WLTE curriculum on which technology-based projects can be based.

Projects that blend content and process

One of the challenges of WLTE that teacher educators face is finding effective ways to help preservice teachers understand complex pedagogical processes. As noted in the taxonomy presented earlier, the variety of languages represented in methods classes imposes many limitations, such as the need to keep examples of practice at a low level of language proficiency, which has an effect on both the content and process options that can be illustrated.

Teacher educators can use PBL as a way to experience complex pedagogical processes first-hand and simultaneously learn content related to those processes. This is the type of learning experience in WLTE that Woodward (1991) describes as loop

input. By interweaving content and pedagogical processes it is possible to create an environment that fosters reflection. Technology integration in this type of projects can make the experience even richer, since technology could become both part of the content and mediator of the process.

Examples of this kind are not common in the literature. The following illustrates a possible loop-input PBL experience in WLTE: preservice teachers create a series of 3 five-minute scripted podcast episodes that explore the potential that podcast technology offers to language learning. In order to create such podcasts, teachers would need to go through some of the pedagogical processes that language learners would experience: gathering data on the topic, drafting and revising a script, recording and editing audio (possibly adding sound effects or music) and publishing it. Going through the stages of production of a few podcast episodes would provide experiences that are highly contextualized and that have the potential to elicit rich reflections. Reflecting on the interplay between content, pedagogy and technology fostered by this type of project may help preservice teachers become more aware of the complexity involved in their combination. Sharing those reflections in podcast format would further enrich the experience, since it would give preservice teachers the opportunity to approach the podcast medium from a different perspective: as an audio journal rather than a scripted show.

Projects to experience authentic L2 learning

Projects that would allow preservice teachers to experience authentic L2 learning correspond to the compounded task type described above as "type c." The distinctive feature of this type of compounded task is the use of L2 in the embedded task. By exploiting this feature, teacher educators can expose preservice teachers to sustained immersion experiences in the L2. Unlike the embedded task described in Type C tasks, a project that uses L2 would extend through a series of contact hours or even throughout a whole semester. No projects of this kind appear to be described in the literature.

This type of project presents obvious challenges, such as articulating the process of the embedded L2 project with relevant WLTE content so that preservice teachers can relate what they learn about the content to the processes they experience in the project as L2 learners. On the other hand, this type of format opens up possibilities that are not easily implemented with the other types described in the taxonomy, such as establishing collaborations with inservice language teachers in the community. Inservice teachers

could lead preservice teachers in the role of L2 learners through a project. Rather than observing practice, preservice teachers would have the opportunity to experience processes directly from the perspective of the L2 learner. The role of the teacher educator in this type of configuration is to guide teachers in the learning of WLTE content and to debrief to prompt reflection after the preservice teachers have gone through the L2 experience.

As in the corresponding task described above (Type C), this type of projects present some limitations, such as the types of process and content that can be considered, which are constrained by the language proficiency of the preservice teachers in the L2 and also the linguistic features of the L2. For example, the writing proficiency that could be illustrated through a project that uses languages (L1 and L2) with similar writing system (e.g., English as the L1 and French as the L2) would be different than the writing proficiency that could be illustrated if two languages with different writing systems are used (e.g., English as the L1 and Japanese as the L2). These constraints additionally have an impact on the types of technology that could be integrated into the project. For example, communication tools that rely on written language such as chat or email would probably present serious difficulties considering the L2 proficiency level of the participants. Despite these limitations, the authenticity of the L2 experience offered by this type of project may justify their implementation.

Projects that model practice

Perhaps the ultimate challenge that teacher educators face is helping preservice teachers make real-life applications of the theory they learn in language teacher-education specific courses. Preservice teachers often refer to the difficulties they face when confronted with situations in which they need or would like to apply the theoretical concepts they have learned about in teacher-education specific courses, particularly the methods and technology courses (Bigelow & Ranney, 2005). In the WLTE literature, the concept of applying theory to concrete teaching and learning situations is referred to as *knowledge-in-practice* (Bigelow & Walker, 2003). PBL may be helpful for preservice teachers to establish meaningful connections between theory and practice, thereby developing knowledge-in-practice.

Projects that model practice may help preservice teachers make meaningful connections between theory and practice. For example, a common paradox that preservice teachers encounter in WLTE is learning about constructivist approaches

through pedagogical processes that contradict the foundational principles of constructivist practice (e.g., learning about constructivism through lectures). If preservice teachers are given the opportunity not just to learn about these approaches but also experience them, they may not only be better prepared to critically evaluate them but also more inclined to try them in their practice. Additionally, if they are given an opportunity to reflect on their experiences, they may more readily make meaningful connections. As Howard (2002) states, a "good PBL teacher will provide opportunities to reflect on the learning that has taken place in the PBL experience and arrange for transfer opportunities by engaging students in more than one experience where similar knowledge and skills can be used" (p. 350).

A recent report presents a good example of the changed role of a teacher and sheds some light on the impact of the redefinition of the role of a teacher educator on the quality of preservice teachers' experiences (Chuang & Rosenbusch, 2005). The authors analyzed a digital video project implemented in WLTE, specifically an elementary foreign language methods class. As part of this project, students watched video clips of a language class and reflected on pedagogical concepts using guiding questions prepared by the teacher educator. The preservice teachers then reported on their observation. The authors report that the digital project contributed to the increase in authenticity, quality of interaction, and to the preservice teachers' sense of ownership of the final product. Besides the qualities identified by the authors, the experience recounted in this article exemplifies the added value of implementing PBL in WLTE contexts: preservice teachers did not only read about, but also had the opportunity to experience a learner-centered, technology-enhanced pedagogical process that may help develop their TPCK and that they may themselves try to replicate with their language learners.

PBL as Content in WLTE

This section focuses on PBL as part of the content in WLTE programs. From this perspective, the emphasis is on preservice teachers designing L2 projects rather than experiencing them. Recent work in teacher education has underscored the importance of involving preservice teachers in the design of learning experiences as a conduit to develop composite forms of knowledge that combine knowledge of content, pedagogy and technology. Drawing from Shulman's (1986) work, Koehler and Mishra (2005) have argued that a special kind of knowledge, named technological pedagogical content knowledge (TPCK), constitutes the foundation for effective technology integration.

The idea that preservice teachers should design language learning experiences is not

new. In fact, most methods courses include a design component (lesson plan, thematic unit, project, etc.). However, the advantages of designing PBL in WLTE have not been explored in depth. The inclusion of a PBL design component in WLTE may foster the development of the preservice teachers' TPCK by: a) giving them opportunities to engage in micro and macro-level thinking about language tasks and technology; and b) motivating authentic and principled integration of technology. These two ideas are further explored below.

Engagement in micro- and macro-levels of thinking

In his seminal work, Richards (1985) identified two perspectives to describe language teaching: a micro- and a macro-approach. The micro-approach focuses on discrete contextual features of a language learning context (e.g., instructor's use of time, turn-taking, etc.). On the other hand, the macro approach is based on a core of knowledge that teachers have constructed through experience (e.g., strategies to raise cultural consciousness). Kumaravadivelu (2003, 2006) has provided an excellent synthesis of this latter type of knowledge drawing from years of work in language methods and approaches. According to Richards, neither perspective presents an accurate view of language teaching by itself, but in combination, they provide valuable insights to inform WLTE.

The knowledge gained from both perspectives is valuable in a WLTE context. Through the implementation of a PBL approach, it would be possible for preservice teachers to integrate information from these two perspectives and focus on either of them at different points in the development of their projects. The need for macro-approaches that encompass a wide spectrum of information originated by both research and practice has been made clear in the literature (e.g., see McDonough, 2002). Developing one lesson plan or a series of lesson plans that are not articulated does not give preservice teachers opportunities to engage in macro-levels of thinking about tasks or the use of technology. Similarly, developing one technology-enhanced lesson or a series of technology-enhanced lessons does not confront preservice teachers with the need to think which technologies to use, when to use them and what justifies their use. Having to design lessons that prescribe the use of technology does not give preservice teachers opportunities to engage in this type of thinking about language learning and technology. If properly implemented, PBL can support the two perspectives mentioned by Richards and thereby prompt preservice teachers to think about language learning and the use of relevant technologies at a

macrolevel of language learning activity design.

Authentic and principled technology integration

Ideally, preservice language teachers will not use technology in the design of language learning experiences because the assignment for the methods or technology course so requires, but rather because using technology makes sense in the context of instruction the preservice teacher is planning to use it. Principled integration of technology is not likely to occur in WLTE contexts where the design of language learning experiences does not extend beyond a task, or focuses on or prescribes a particular technology. The design of sustained language learning experiences (i.e., experiences that go beyond a single task) that does not include the requirement to integrate technology in every single task is more likely to prompt principled integration, that is, integration motivated by the context of use rather than availability of the technology.

A PBL-enhanced methods class has the potential to create opportunities for preservice teachers to design language learning experiences that extend beyond a lesson plan. Designing discrete activities that focus on a particular technology or pedagogical concept, does not expose preservice teachers to authentic design experiences, which usually require the consideration of tasks that precede and follow a technology-enhanced task. A PBL approach in WLTE would give preservice teachers opportunities to design series of tasks that illustrate how tasks would be scaffolded, how content and processes would be articulated at the task and project level, what technologies would be used to support them, and what aspects of theory (e.g., second language acquisition) inform decisions at the task or project level. PBL can synergize these connections by providing design experiences that bear resemblance to the ones inservice teachers would encounter. The need to manage multiple levels of instructional planning (task and project) through sophisticated pedagogical processes (e.g., scaffolding tasks within a project) exposes preservice teachers to authentic instructional challenges.

Conclusion

This article has explored the value of implementing PBL in WLTE. It proposed a distinction between WLTE tasks and embedded language task through relevant features and provided a taxonomy based on those features. This task taxonomy was extended to the project level to consider the advantages of implementing PBL in WLTE. PBL implementation was approached from two distinctive perspectives: through the

application of PBL as a process in WLTE and through the inclusion of PBL as content in WLTE.

As this article shows, approaches to integrate PBL in WLTE and PBL configurations, like tasks types in the taxonomy presented, offer distinctive advantages. However, each type also appears to present particular limitations, such as the constraints introduced by the use of a L2, which has an impact on the possible choices for pedagogical processes and content. This suggests that exposure to and participation in a variety of PBL configurations would enrich the preservice teachers' experiences in WLTE.

Research in applied linguistics has produced useful frameworks that can guide and support the design and implementation of PBL experiences in WLTE. For example, Bachman and Palmer (1996) have contributed a detailed and practical classification of language features that can inform project rubrics for preservice teachers. This classification can also be used to reference what types of linguistic knowledge is being targeted by a specific project task. Similarly, Kumaravadivelu's (2003; 2006) macrostrategy framework provides guidelines to identify pedagogical processes that years of research in applied linguistics have found to have an impact on language learning. The macrostrategy framework provides preservice teachers with some structure to integrate their knowledge of theory into the design of language learning experience. Finally, Chapelle (2001) has contributed a useful framework to design and evaluate CALL activities based on sound second-language acquisition principles. These contributions synthesize years of research on language learning and constitute an essential reference for the design, implementation and reflection on language learning experiences in WLTE. PBL gives preservice teachers a unique opportunity to instantiate these guidelines in a series of activities and gain a deeper understanding of how the concepts expressed by these guidelines interact. This type of design experience is more authentic than the creation of isolated lesson plans.

Research that focused on examining the impact of technology courses on inservice language teachers' practice concludes that isolated technology experiences do not result in technology integration and recommends "a shift away from isolated coursework in CALL to the development of a sequence of situated technology experiences for teachers" (Egbert et al., 2002, p. 122). PBL has the potential to support such shift. However, more research on PBL as an instructional device to support the improvement of technology integration in WLTE is needed. This article has described some of the complexity of the WLTE context, where PBL could aid by becoming part of the process and content of

WLTE. The need for empirical research that would help us understand how PBL could be used as a conduit to enhance the preservice teachers' experiences and the integration of technology is evident.

Finally, PBL appears to be a promising instructional device to foster authentic experiences for preservice language teachers and to motivate the principled integration of technology into language learning. The design of language learning experiences that require scaffolding within and between tasks and integration of technology would give preservice language teachers an excellent opportunity to apply, and possibly develop, their TPCK. Designing projects that include a CALL activity probably constitutes a bigger challenge than designing a single CALL task. The design of a project would probably prompt the designer to think where and how CALL should be integrated in a project. This type of macrolevel thinking about the design of language learning experiences and principled integration should be integral to the experiences of preservice teachers in WLTE.

References

Bachman, L. F., & Palmer, A. S. (1996). *Language testing in practice: Designing and developing useful language tests*. Oxford; New York: Oxford University Press.

Barron, B. J. S., Schwatz, D. L., Vye, N. J., Moore, A., Petrosino, A., Zech, L., et al. (1998). Doing with understanding: Lessons from reserach on problem- and project based learning. *The Journal of the Learning Sciences, 7*(3&4), 271-311.

Bigelow, H. M., & Ranney, S. E. (2005). Pre-service esl teachers' knowldge about language and its transfer to lesson planning. In N. Bartels (Ed.), *Applied linguistics and language teacher education*. New York: Springer.

Bigelow, H. M., & Walker, C. L. (2003). *Creating teacher community: Research and practice in language teacher education.* Paper presented at the Third International Conference on Language Teacher Education, Minneapolis, MN.

Blumenfeld, P. C., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., & Palincsar, A. (1991). Motivating porject-based learning: Sustaining the doing, supporting the learning. *Educational Psychologis, 26*, 369-398.

Chapelle, C. (2001). *Computer applications in second language acquisition: Foundations for teaching, testing and research*. Cambridge: Cambridge University Press.

Chapelle, C. A., & Hegelheimer, V. (2003). The language teacher in the 21st century. In S. Fotos & C. Browne (Eds.), *New perspectives on call for second language classrooms* (pp. 299-316). Mahwah, NJ: Lawrence Erlabaum Associates.

Chuang, H., & Rosenbusch, M. H. (2005). Use of digital video technology in an elementary school foreign language methods course. *British Journal of Educational Technology, 36*(5), 869-880.

Debski, R., & Gruba, P. (1999). A qualitative survey of tertiary instructor attitudes towards project-based call. *Computer Assisted Language Learning, 12*(3), 219-239.

Dewey, J. (1938). *Experience and education*. New York: The Macmillan company.

Doering, A., & Beach, R. (2002). Preservice english teachers acquiring literacy practices through technology tools. *Language Learning & Technology, 6*(3), 127-146.

Egbert, J., Paulus, T. M., & Nakamichi, Y. (2002). The impact of call instruction on classroom computer use: A foundation for rethinking technology in teacher education. *Language Learning & Technology, 6*(3), 108-126.

Ellis, R. (2005). Principles of instructed language learning. *System, 33*, 209-224.

Freeman, D., & Johnson, K. (1998). Reconceptualizing the knowledge-base of language teacher education. *TESOL Quarterly, 32*(3), 397-417.

Furstenberg, G. (1997). Teaching with technology: What is at stake? *ADFL Bulletin, 28*(3), 23-25.

Garret, N. (1991). Technology in the service of language learning: Trends and issues. *The Modern Language Journal, 75*(i), 74-101.

Hegelheimer, V., Reppert, K., Broberg, M., Daisy, B., Grgurovic, M., Middlebrooks, K., et al. (2004). Preparing the new generation of call researchers and practivioners: What nine months in an ma program can (or cannot) do. *ReCALL, 16*(2), 432-447.

Howard, J. (2002). Technology-enhanced project-based learning in teacher education: Addressing the goals of transfer. *Journal of Technology and Teacher Education, 10*(3), 343-364.

Hubbard, P. (2004). Guest editorial. *Computer Assisted Language Learning, 17*(1), 1-6.

Hubbard, P., & Levy, M. (in press). The scope of call in education. In P. Hubbard & M. Levy (Eds.), *Teacher education in call*.

Koehler, M. J., & Mishra, P. (2005). Teachers learning technology by design. *Journal of Computing in Teacher Education, 21*(3), 94-102.

Koehler, M. J., Mishra, P., Hershey, K., & Peruski, L. (2004). With a little help from your students: A new model for faculty development and online course design. *Journal of Technology and Teacher Education, 12*(1), 25-55.

Kumaravadivelu, B. (2006). *Understanding language teaching: From method to post-method*. Mahwah, N.J.: Lawrence Erlbaum Associates.

Levy, M. (1997). A rationale for teacher education and call: The holistic view and its implications. *Computers and the Humanities, 30*, 293-302.

McDonough, S. H. (2002). *Applied linguistics in language education*. London

New York, N.Y.: Arnold;

Distributed in the U.S.A. by Oxford University Press.

Richards, J. C. (1985). *The context of language teaching*. Cambridge, England: Cambridge University Press.

Richards, J. C., & Nunan, D. (1990). *Second language teacher education*. Cambridge [England]; New York: Cambridge University Press.

Senior, R. M. (2006). *The experience of language teaching* (1st ed.). Cambridge; New York: Cambridge University Press.

Shulman, L. (1986). Those who understand: Knowlege growth in teaching. *Educational Researcher, 15*(2), 4-14.

Simpson, C., Popovic, R., & Stojanovic, S. (2004). Modifying tasks in teacher education sessions to meet learners' needs better. *The Teacher Trainer, 18*(1), 5-11.

Thomas, J. W. (2000). A review of the reserach on project-based learning. Retrieved June 20, 2005, from: http://www.autodesk.com/foundation.

van Lier, L. (2006). Foreword. In G. H. Beckett & P. C. Miller (Eds.), *Project-based*

second and foreign language education: Past, present and future. Greenwich, CT: Information Age Publishing.

Woodward, T. (1991). *Models and metaphors in language teacher training*. Cambridge: Cambridge University Press.

CHAPTER 3. POSTCARDS FROM THE MIND: DESIGNING LANGUAGE LEARNING EXPERIENCES WITH TECHNOLOGY

Abstract

This exploratory study investigates the potential of a cognitive tool designed for the context of world language teacher education (WLTE). This tool, the Activity Design Studio (ADS), is intended to assist in the conceptualization and design of language learning projects and in the communication of underlying pedagogical concepts. The purpose of this research is to better understand how the tool supports the cognitive processes in which the participants engage while interacting with it. The participants constituted a purposive sample of four individuals experienced with technology and knowledgeable of language teaching methodologies and the context of WLTE. The data collected consisted of concurrent think-aloud protocol transcripts, artifacts constructed with the software, the researcher's notes and an exit interview. The analysis of the data is approached from two complementary perspectives: representational and presentational (Freeman, 1996). The representational analysis of the data indicates that the ADS triggers and supports a variety of cognitive processes pertaining to the design of language learning experiences, including the activation of complex and forms of knowledge, the elicitation of specific macrostrategies for language teaching and the application of sophisticated mental models. This analysis also reveals the potential this tool offers to support and enhance the development of the designers' knowledge of technology, pedagogy and content in WLTE. The presentational analysis identifies interesting commonalities among participants, such as attention to learner interaction, as well as differences in the participants' approach to the design of their projects. Recommendations for the improvement of the tool at the conceptual and interactual level of interface organization are included.

Introduction

The contruction of language learning activities is a complex and challenging intellectual process. Designing and developing engaging, meaningful, and effective computer-assisted language learning (CALL) experiences requires a set of skills and knowledge that researchers in World Language Teacher Education (WLTE) have only recently started to explore and understand. For world language teachers, the context of WLTE is where these complex skills and knowledge are cultivated, nurtured and grown.

This research explores a prototype of a cognitive tool specifically designed to function

in the dynamic context of WLTE which supports the creation of graphical representations of the design of language learning experiences. To create those graphical representations, the designer manipulate a small set of icons and their properties. The overall purpose of this research is to gain a better understanding of how this tool may support the cognitive processes of its users, and what cognitive processes it triggers while it is used.

Theoretical Perspective

This study is framed within an interpretivist epistemology (Kamberelis & Dimitriadis, 2005). Improving our understanding of the design and development of context-sensitive and context-relevant technology tools is an important part of interpretivist research (Willis, 2003).Consistent with the interpretivist tradition, this research seeks to gain a deep and situated understanding of the participants' cognitions while they interact with a software tool.

In order to gain such understanding, this research is based on theoretical foundations of constructivist cognitive science (Bednar, Cunningham, Duffy, & Perry, 1992), which advocates the notions that a) learning constitutes an active process in which "the learner is building an internal representation of knowledge, a personal interpretation of experience" (Bednar et al., 1992, p. 21); b) cognition is a highly contextualized and situated activity (Brown, Collins, & Duguid, 1989); and that c) cognitive processes that result in the acquisition of knowledge are informed by cognitive structures or schemas (Ausubel, 1968) constructed by the individual in interaction with the world. Since these schemas are constructed through interactions within specific environments, they are shaped by the context of the culture that define such environments.

The notion of situated cognition has profound implications for teaching and learning, regardless of the subject-matter or developmental stage of the individual. These implications can be summarized as follows: learning is a process of constructing contextualized knowledge; the process of learning entails activating and enriching prior knowledge and experiences; and teaching is the activity of guiding and assisting individuals in their process of knowledge creation.

Review of the Relevant Literature

> "It is clear that knowledge domains are not readily separated in the world; information from many sources bears on the analysis of any issue." (Bednar et al., 1992, p. 23)

This study is contextualized in three major areas of research, namely cognition,

WLTE and technology. The term cognition is used in this study to refer to teachers' knowledge, beliefs and thinking with regard to language teaching and learning. Figure 1 shows the three major areas of research (WLTE, cognition and technology) and their corresponding overlaps. The literature is most relevant for this study falls within WLTE and the overlaps labeled a, b and c. The section below discusses the literature in these areas. I start first with a brief review of the literature pertinent to WLTE, the context in which the tool explored in this study is intended to operate, and then focus on work associated with the overlapping areas. Finally, I present and describe a construct, technological pedagogical content knowledge (TPCK), which I use to organize the findings of this study. As shown in this study, the TPCK construct has potential to organize and guide future research in technology integration into WLTE.

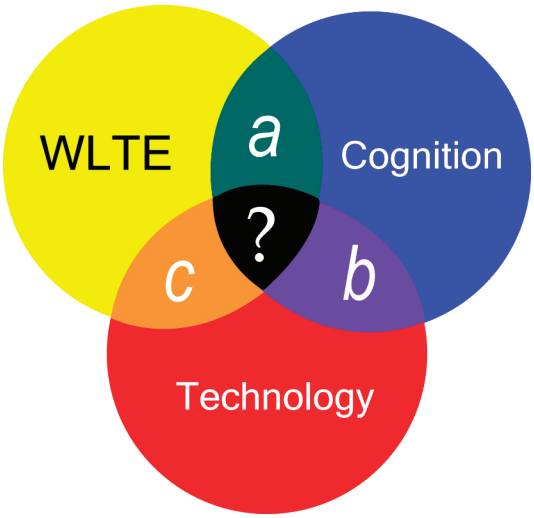

Figure 1. The relevant literature: WLTE, Cognition and Technology

World language teacher education

Attempting an accurate description of the context of WLTE can be a daunting task. However, some literature in the field has explored aspects of WLTE in relative depth. We know, for example, that the environments where language teachers acquire information and construct their knowledge about language learning and teaching are characterized by frequent contextual changes involving the participants, the content, and sometimes even the target language.

Systemic-Functional Linguistics (SFL), a theory of language that focuses on the text

as the unit of analysis (Halliday & Hasan, 1976), offers a useful framework to describe the contextual changes that typically arise in WLTE. Through the lens of SFL, language is seen as a stratal system embedded in a socio-cultural context. SFL distinguishes between two broad contexts: the context of culture and the context of the situation. The system operates within the constraints of these contexts, that is, the linguistic choices available to the participants are determined by the specific culture (context of culture) and the specific situation (context of situation) in which language is realized (Halliday & Hasan, 1976). The use of language in a given context of situation is in turn influenced by three factors: the field (the topic), the tenor (the participants), and the mode (the role of language).

Figure 2 illustrates some of the variables involved in the study of WLTE from a systemic-functional perspective. Activities carried out in the context of WLTE in a first language (L1) often contain an embedded language learning activity in a language different from the language of instruction (L2). For example, during a methods class, the teacher educator may focus on the concept of integrating language skills. After a brief class discussion of the assigned reading on this topic, the teacher educator assumes the role of the L2 teacher and using her L2 (e.g., French) she demonstrates the concept by immersing the preserive teachers in a L2 activity that involves listening, writing and reading. Even though the participants in both activities (i.e., the WLTE activity and the L2 activity) are the same individuals, their roles, the topic, the role of language, and the context of culture and situation may differ greatly. As in other teacher education contexts, the dual goals of teacher development activities in WLTE make for interesting grounds for exploration. The pedagogical goals that guide the development of WLTE activities will focus on teacher development, while the goals that guide the development of the embedded TL activities will be framed within the overall goal of language learning. Dynamic contextual changes such as these are a natural component of WLTE.

The array of activities described in the literature makes implicit reference to contextual changes in WLTE (e.g., see Guntermann, 1993; Rea-Dickins & Germaine, 1998; Woodward, 1991). Some of those changes include switching the focus from a WLTE task to a language learning task, using a target language (L2) that may or may not be the L2 most participants share, assuming a new participant role (e.g., the methods professor models an instructional strategy so preservice teachers play the role of the language learner), switching the focus of the instructional content from WLTE (e.g., second language acquisition concepts) to language learning (e.g., giving directions in French), and others.

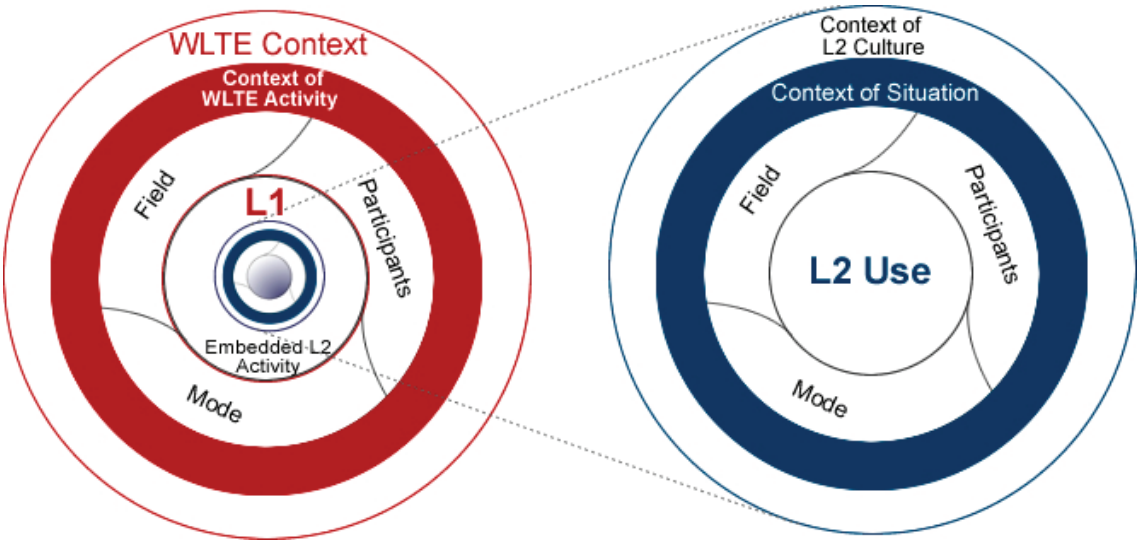

Figure 2. The context of WLTE from an SFL perspective

We also know that contextual changes are typically triggered by the particular configuration of WLTE tasks. As stated above, WLTE tasks may be compounded with an embedded language learning task. These compounded tasks have dual goals: besides their primary goal of language learning, they are intended to also address WLTE goals. For example, a WLTE goal may be to raise preservice teachers' awareness of a particular instructional issue (e.g., how to apply a methodological principle to the design of a language learning activity), illustrate a theoretical concept (e.g., a language acquisition process), model a particular instructional mode (e.g., an immersion experience), prompt language teachers to explore their own language learning strategies, etc.

The identification of different features in WLTE activities motivated researchers to attempt a classification according to their purpose. Early conceptual work in this area proposed a distinction between experiential and awareness-raising WLTE activities (Ellis, 1990). In his proposed framework, Ellis (1990) further subclassified awareness-raising practices into activities and procedures. Activities are made up of a set of tasks which the preservice teachers are requested to perform. Such tasks are based on data, e.g., video clips of exemplary instructional practices, transcripts of lessons or a combination of video and transcripts, textbook materials, case studies, lesson plans, etc. and they involve one or more operations, e.g., preservice teachers are asked to read a transcript. Operations can be combined in different ways. A particular combination of operations results in a task configuration. For example, a task described in the literature as a rearranging task, would

consist of the following operations: a) watch the video of a language teacher organizing group work; b) make a list of the steps the teacher follows in this process; c) recommend changes to the order of steps based on the guidelines for classroom management you read. The tasks or group of operations which the preservice teachers are requested to perform with the raw data can then be defined as WLTE tasks (Ellis, 1990, p. 30). Procedures, on the other hand, refer to the teacher educator's methodology applied to those tasks in WLTE sessions (p. 27).

WLTE tasks are worthy of attention by CALL practitioners and researchers alike because of their potential to improve technology integration into both language teaching and learning. Even though many of us who have gone through WLTE programs are familiar with WLTE task configurations of this kind, there is surprisingly very little literature that delves into WLTE task features (e.g., Ellis, 1990; Woodward, 1991; Kumaradadivelu, 1992; Horwitz, 1997; Nyikos & Hashimoto, 1997) and very limited research that directly addresses the integration of technology into these WLTE tasks (Arnold & Ducate, 2006; Levy, 1997a; Nunan, 1999). Aspects of WLTE tasks, such as contextual features and changes, warrant our attention because they affect basic features of communication, such as the participants' roles and, subsequently, their relationships, the thematic content, the use of language, and sometimes even the target language: a rapid switch to a language different than the language used for instruction is can be common in WLTE environments (see Figure 2)

In brief, we currently know very little about WLTE tasks, and have very little information on the cognitive processes that take place when language teachers combine and apply what they learn about technology integration, methodology, language learning pedagogy, and instructional design in WLTE contexts. Likewise, we currently have a very limited understanding of the technologies that may assist in the conceptualization and design of language learning activities. There has been work on world-language teacher cognition (Woods, 1996), the advantages of project-based CALL to integrate SLA and learner-centered methodologies (Skehan, 2003), and there has been promising research on the use of cognitive tools. However, much of the work on WLTE does not address technology integration (e.g., Allwright, 2006; Freeman & Richards, 1996; Nunan, 1991; J. C. Richards & Lockhart, 1994; J. C. Richards & Nunan, 1990; Tsui, 2003) research on CALL acknowledges the important role of the teacher in designing successful CALL activities but there's very limited literature linking CALL and WLTE (e.g., Egbert, Paulus, & Nakamichi, 2002; Levy, 1998, 1999; Meskill, Mossop, DiAngelo, & Pasquale,

2002); and the potential of cognitive tools (Jonassen, 1996; Jonassen, Carr, & Yueh, 1998; Jonassen, Peck, & Wilson, 1999) for WLTE has not yet been explored. So, until now, there hasn't been software nor studies that explore the potential of technology cognitive tools within the context of WLTE.

Cognition and WLTE

The area of cognition in WLTE (labeled "a" in Figure 1) has steadily grown since the early 1990's and has become a major focus of inquiry within the last decade. Three reviews of research in WLTE provide, in combination, a comprehensive account of the development of this area of expertise: a) work that focuses on the broader field of WLTE (Velez-Rendon, 2002); b) a contribution draws from general education research to interpret and describe the study of world language teacher thinking (Freeman, 1996); and c) a review that capitalize's on Freeman's (1996) groundwork to expand our understanding of the main issues of WLTE (Borg, 2003). The section below briefly reviews these three contributions in the order presented here.

In her review of the literature in language teacher education, Velez-Rendón (2002) identified five topical areas that have received attention from research in WLTE: the impact of teacher education programs, the role of collaboration in WLTE, the role of reflection, the role of teacher's previous experiences, and finally, teachers' beliefs and instructional decision making. These last two areas include studies that deal with WLTE and cognition. Velez-Rendón (2002) identifies the teachers' previous learning experience as one important theme across studies. She points to the pervasiveness of Lortie's (1975) concept of *apprenticeship of observation* in much of the literature that focuses on previous experiences. An example not included in Velez-Rendón (2002) is Sato and Kleinsasser's (1999) study, which investigated the conceptions that teachers of Japanese in Australia have regarding communicative language teaching. In a rather detailed account of the literature published in the 90's, they analyze the complexity of the issue of the distinction and interplay between beliefs, knowledge, and practice. They conclude that personal L2 learning and teaching experience has a primary role in shaping teachers' understanding of L2 teaching and learning. Much of the research in this area was driven by the process-product approach that was criticized by Freeman (1996).

A key concept mentioned in Velez-Rendon (2002), which is of particular relevance to this research, is pedagogical reasoning, defined as the "ability of translating subject matter into instruction that is appropriate to the various levels of ability and backgrounds

brought by students" (p. 462). This ability is part of a teachers' pedagogical-content knowledge, a concept that was originally discussed by Shulman (1986), and that is discussed in depth later on in this study.

The nature of the knowledge of novice and expert language teachers has attracted the attention of scholars in the field of WLTE (e.g. Tsui, 2003; Woods, 1996). Much of the research in this area is motivated by the assumption that knowing how expert and novice teachers operate at different stages of language instruction (designing, managing a language learning activity, embedding technology, etc.) may help identify the knowledge required to achieve expertise in language teaching, which could be in turn used to improve WLTE. One of the recurrent topics in the literature in this area is lesson planning (e.g., see J. C. Richards & Lockhart, 1994; Tsui, 2003; Woods, 1996). Within this area, a recurrent concept is that the process of conceptualizing and designing language learning activities is informed by a variety of factors, including the teachers' beliefs and knowledge about language teaching and learning (Woods, 1996), the materials, and the teachers' previous experiences (Meskill *et al.*, 2002; Tsui, 2003).

Complementing studies on expertise there is also work on how knowledge is acquired. For example, Cabaroglu & Roberts (2000) investigated the impact of a language teacher certification program on 20 participants from an interpretivist perspective. The authors challenged the notion that student teachers' beliefs remain unchanged after participation in formal teacher development interventions (e.g., Kagan, 1992). Using a pre-, post-interview design, they identified 11 distinctive processes that the teachers underwent during a period of professional development.

Besides categorizing the types of knowledge involved in the design of language learning activities and processes involved, the literature in cognition and WLTE has shed some light on the nature of the knowledge of expert language teachers. A collection of case studies in this area asserts that experienced language teachers tend to conceptualize and design language learning activities thinking of the materials that will be used and their student's interests (Tsui, 2003). According to Tsui, expert language teachers have a rich past experience in the role of the instructor and they can rely on these experiences and draw from a sophisticated repertoire of "routines." On the other hand, novice language teachers tend to approach the design of language learning activities relying more on curricular tools such as aims and objectives and detailed lesson plans (p. 187).

The first account of the research on teacher cognition was provided by Freeman (1996). In this insightful piece, Freeman (1996) informs that the most comprehensive

reviews of the literature in teacher thinking (Clark & Peterson, 1986 & Stern, 1981) give credit to the National Institute of Education (NIE) and the British Social Science Research Council (SSRC) for articulating the area of focus that in the mid-70's became to be known as teacher knowledge and cognition. Freeman (1996) identifies two generations of research. The first one, from 1975 to 1985, was grounded on the decision-making construct that was originally developed and made popular in the research of physicians' diagnostic decisions. This type of research relied on methodological procedures such as interviews, stimulated recall, and simulated tasks (Clark & Peterson, 1986, p. 260 in Freeman, 1996), all of which appeared to fit the process-product paradigm of the time. The second generation of research, which started in 1985, replaced the process-product views that resulted in the identification of dichotomized aspects of teacher thinking (e.g. thought vs. action) with more holistic views that blurred the edges of such dichotomies. The increasing use of methods such as narrative and biography reflected this shift.

Freeman's (1996) historical account of how the field of inquiry into teacher thinking developed provides a lively depiction of the predominant methodologies. He questions the single-handed approach to research that he describes as representational. According to Freeman, the study of teacher thinking needs to include both a presentational and a representational perspective. The latter constitutes the approach commonly used in research in this field. This approach is based on the assumption that language is data that directly reflects teacher thinking. What is said becomes the focus of inquiry. On the other hand, a presentational approach to the study of teacher thinking would not just consider what is said, but *how* it is said. Freeman (1996) argues that this linguistic dimension "preserves the cognitive and sociopolitical foundations" of the research in this field (ibid, p. 734). He further states that this does not constitute an alternative but rather a complementary perspective.

The representational view of language is built on the property of language to establish reference: words represent thinking. The presentational view, on the other hand, is based on the social function of language. In the former view, language is a tool that allows the individual to communicate. It can be dissected into parts that can be grouped into categories. In the latter view, language is an integral part of a community. It allows the individual to form and sustain social relationships within and across communities. An example of this latter view is Warford and Reeves' (2003) study, which instantiated the presentational perspective proposed by Freeman in the methodology of a study of novice TESOL teachers. In the present study, both perspectives are included.

After a long period of latent interest in teacher cognition that started in 1975 (Freeman, 1996), the literature in this area increased exponentially in the late 90's. In a comprehensive review of 64 studies in the area of teacher cognition that appeared between 1976 and 2002, Borg (2003) notes that 47 of them appeared after 1996. In this exhaustive review, Borg could trace three major themes: cognition in relation to a) prior language learning experience; b) classroom practice; and c) teacher education (referred to as WLTE in this study). Cognition in WLTE is the most relevant area for this study. Within this specific area, Borg's (2003) review singles out two distinctive themes: a) the distinction between cognition and behavior; and b) the notion that simple aggregation is not the processes of knowledge acquisition observed in WLTE contexts. Work on the former theme often hinges upon Pajares' (1992) discussion on the definition of the teachers' beliefs construct and continues to attract the interest of researchers. In a study focusing on ESL teachers' behaviors, Basturkmen, Loewen, and Ellis (2004) highlighted the discrepancies between the teachers' stated beliefs and their observed actions. Consistent with Pajares' (1992) recommendation, the authors conclude that research into teachers' beliefs in situations that include incidental elements need to consider both the teachers' stated beliefs and their observed behaviors.

Bruning et al. (1999) also examined the beliefs of foreign language teachers. They focused on a group of Nebraska teachers who participated in a grant-funded project to support the development of foreign language standards. The researchers investigated how these teachers' participation in the project impacted their beliefs about language learning and teaching in relation to two focal areas: a) perceptions of self-efficacy with respect to their foreign language teaching and advocacy; and b) conceptions of teaching. They found that teachers who participated in a greater number of project related activities reported significantly higher degrees of self-efficacy, advocacy, and more readiness to incorporate the standards into their practice.

Technology and cognition

The area of technology and cognition has long been of interest in disciplines related to human learning. At the crossroads of technology and cognition ("b" in Figure 1), the notion that cognition is situated has steadily gained support among researchers in instructional design (e.g., Bednar et al., 1992; e.g., Dabbagh, 2001; Jonassen, 2003a; Koehler & Mishra, 2005). As mentioned above, the idea that cognition is situated has lead to the exploration of technology tools that are rooted in constructivist pedagogies.

Jonassen's work in this area has broadened our understanding of how the design of instruction can benefit from such tools using a problem-solving approach (Jonassen, 2000, 2003b, 2004). This approach is worth considering in the context of WLTE, where much of the content can be dealt with from a problem-solving perspective.

The concept of situated cognition has then implications for the use of technology, such as the idea that an effective use of computer technology is fostered by the use of applications that individuals can "learn with, not from [emphasis in original]"(Jonassen et al., 1998, p. 24). The generic term "mindtool" has been used to refer to the notion of using computer applications to assist in the construction, rather than transmission, or knowledge (e.g., see Dabbagh, 2001; e.g., see Jonassen, 1996; Jonassen, 2000; Jonassen et al., 1998). Specific applications such as concept mapping and simulation software are examples of mindtools. The tool explored in this study can be considered a mindtool.

Jonassen et al. (1998) have distinguished between two overarching categories of computer applications that have been designed or can be repurposed to be used as mindtools, namely semantic organization tools and dynamic modeling tools. Semantic organization tools can be used to create and organize information structures and express semantic relationships in the data. Tools such as spreadsheets or concept mapping applications fall under this category. Dynamic modeling tools also can be used to express semantic relationships in the data, but additionally allow learners to easily manipulate those relationships. Subcategories of dynamic modeling tools include spreadsheets, expert systems, microworlds, and system modeling tools.

The tool explored in this study falls under the category that described as dynamic modeling tools and the subcategory that Jonassen et al. (1998) describe as system modeling tool. Jonassen (2003) defines a system's model as a "conceptual, conjectural representation of the dynamic relations among factors in a system, resulting in a simulation that imitates the conditions and actions of it" (Jonassen, 2003b, p. 375). The ADS version tested for this study did not reach the stage of simulation due to the complexities of the systems the tool is intended to represent. A much more substantial amount of time would be necessary develop a tool that can accurately simulate the system. However, the ADS does create a representation of the relationships among the objects in the system which can be used to think about and discuss aspects of the design of language learning experiences, including possible learning outcomes.

Finally, an area of the literature in technology and cognition that needs attention in this study is comprised by work that has investigated the design of interfaces. A

major concept relevant to this study is interaction design. Leading work in the design of interaction for software interfaces has proposed three levels of interface organization that contribute to the optimization of users' experiences with the system: conceptual, interactive, and graphical (Cooper, 2003). This study is mainly concerned with the first two levels of interaction organization, namely the conceptual and interactive levels, in relation to how they interplay with the users' cognitive processing of knowledge related to pedagogy and technology. Conceptual level guidelines or principles help define the essence of a product and how it fits into its context of use. Similarly, interaction level principles help define how the tool should behave. In this study, these two levels of organization serve as a frame of reference for the design of collection procedures and analysis of the data.

WLTE and technology

In the area of technology and WLTE ("c" in Figure 1), teaching has been mainly described and understood through the lens of student learning and achievement in a much similar fashion as teacher thinking was first described and understood in the field of teacher cognition (see Freeman, 1996). Accounts in the WLTE literature sometimes try to stretch implications far enough to include the impact of WLTE interventions in on the language learners (e.g., Doering & Beach, 2002; Egbert et al., 2002).

Interpreting technology integration in WLTE through the lens of the language learner is probably not the optimal way to approach enquiry in this area, but this perspective should not be discarded when considering the competencies that world language teachers need to acquire, and that WLTE contexts need to address. Using this process-product perspective, Chapelle and Hegelheimer (2004) place communicative competence, a construct set forth by Canale & Swain (1890) and refined by subsequent research in applied linguistics, as the product of language teaching. The authors identify some of the components of world language teachers' knowledge, such as the understanding of the diversity of research methods used in CALL, teaching learners how to use technology to learn a language, designing language learning tasks, and evaluating tasks for language learning. Chapelle and Hegelheimer (2004) argue that communicative competence is at the core of language teaching and thereby constitutes "what" (p.302) language teachers teach. The construct of communicative competence appears to be appropriate to shape a technology-rich curriculum in WLTE that is not driven by the available (and ever-increasing) technology tools; but rather, by the potential those tools offer to create

opportunities for effective language learning.

Technology in WLTE constitutes a rapidly growing area of interest. Teacher education has surfaced in the last few years in publications that focus on CALL. Levy (2000), for example, identified teacher education as one of the four salient themes in a comprehensive overview of CALL research. Probably one of the earliest explorations of technology in WLTE was Levy's (1997b) contribution, which argues for a holistic approach to develop preservice teacher's expertise in CALL. Drawing from the results of a survey conducted by the author in 1991, he asserts that "expertise in CALL derives from knowledge and experience in other fields such as language pedagogy, SLA theory, linguistics and instructional design" (p. 297). The role of the language teacher in the integration of technology clearly becomes one of the author's concerns in this publication, which has recently been developed into a full-length book on the topic (Hubbard & Levy, in press). This work is reviewed in more depth later in this paper.

Another important exploration of this emerging field of research was the 2005 theme issue of the journal of Language Learning and Technology, which focused on technology and WLTE. In this issue, the contribution by Meskill and Athony's (2005) is probably the most relevant to this study. The authors examined the language produced by the teacher of a first-year Russian class in a computer-mediated communication (CMC) activity by focusing on the interactional strategies used by the teacher in exchanges that had a deliberate instructional purpose. They analyzed the transcripts of the CMC interactions and identified six instructional moves. Meskill and Anthony's (2005) study constitutes one of the first systematic evaluations of teacher behavior in an electronic environment. This information is invaluable for preservice teachers, who most probably do not experience CMC in the role of instructors until the moment they are already teaching. Research in this field is important because it helps understand the use of technology from a broader perspective.

Meskill and Anthony's (2005) study is of particular importance because it focuses on a contextual factor that is often not accounted for in CALL research: the instructor's intervention and the possible impact of such intervention on language acquisition. This study helps make the point that research that is of interest to teacher educators can also be made relevant for CALL.

The role of the teacher in the integration of technology has been the object of much discussion in WLTE. Two positions are usually emerge from this discussion: the teacher as developer (e.g., Amiri, 2000), which implies an emphasis on technical skills; and the

teacher as designer (e.g., Levy, 1999; e.g., C. Richards, 2005), which implies an emphasis on instructional design. This latter view has found support in the general field of teacher education (Koehler & Mishra, 2005; Koehler, Mishra, Hershey, & Peruski, 2004).

Hubbard and M. Levy (in press) have recently undertaken the first in-depth exploration of the concept of roles to define technology integration into WLTE. Their work, which is intended to define the knowledge and skills needed for technology integration into WLTE, has produced a useful framework as well as the first book-length treatment of technology integration into WLTE. Drawing from a branch of psychology known as role theory, the authors define the expertise needed in order to effectively integrate CALL. The authors define roles according to a matrix composed of two categories: institutional (pre- or inservice teacher, CALL specialist, or CALL professional) and functional (practitioner, developer, researcher, or trainer). The knowledge needed for CALL integration is defined by the intersection of both categories. At each of these intersections, knowledge definitions are further specified by distinguishing between two domains: technical and pedagogical. The pedagogical domain is considered equivalent to what Shulman (1986) defined as "pedagogical content knowledge" (PCK).

This framework has the advantage of offering fine granularity in the description of levels of expertise expected for each role. For example, it can be used to define both the knowledge of preservice teachers, developers, or teacher educators from a technical or pedagogical perspective. However, the application of this framework in WLTE presents some conceptual challenges, such as: a) it places WLTE within CALL (teacher education is considered a "branch" of CALL, as stated in Hubbard, 2004), which presents the problem of expanding CALL to include content and pedagogical knowledge which is specific of WLTE and not directly related to computer technology; and b) it links the knowledge of the teacher to the role of the teacher, which compounds the problem of defining a role for the teacher with the problem of establishing a knowledge-base for technology integration in WLTE.

Since roles are usually defined by social status and behavior, the definition of roles has been one of the long-standing criticisms of role theory (Gross, Mason, & McEachern, 1958). In the case of foreign language teaching, this can be problematic. The long-standing divisions between language and philology faculty coupled with a technocratic view of technology integration may intensify perceptions that technology integration in WLTE is the sole responsibility of the language and WLTE-specific courses (Garret,

1991). A technocratic view of technology integration into WLTE can be practical for the purpose of defining technology competencies as a starting point, but difficult to extend beyond this practical purpose (e.g., for research into the integration of technology into WLTE).

For the most part, published contributions on technology and WLTE cover a wide range of topics and interests. The scattershot nature of these publications in both time and scope prevents us from forming a cogent view of how technology should be articulated and researched in WLTE. As a result, we find manuscripts that propose frameworks for technology training for preservice language teachers that disregard years of research in CALL (Spodark, 2002, p.431), and include uses of technology that are not directly relevant to language learning (e.g. the use of spreadsheets for grading) while they ignore applications that are particularly relevant to language learning, such as concordancers.

Very few studies have dealt with cognition and WLTE. Among those, none has explored the intersection of teacher cognition, teacher education, and technology integration. In a recent contribution that examined three cases of preservice teachers learning to design technology-enriched activities, Richards (2005) concludes that

> ...the discussion about the challenge of ICT integration in terms of teacher designs for learning has largely remained at macro levels of theory as well as policy and rhetoric. The many good ideas and useful concepts associated with these general approaches might be even more relevant if related to a more bottom-up perspective on how effective practice presumes some kind of design strategy grounded in performance or dialogue" (p. 73).

This study is intended to start an exploration at the micro-level of technology integration, where the teacher's cognition, knowledge of technology and pedagogy blend to create language learning experiences. There appears to be no literature that specifically addresses this area (signaled with a question mark in Figure 1). The section below presents a construct that has been proposed in the literature to organize and further our understanding of how teachers learn to integrate technology in the design of learning experiences.

The Technological Pedagogical Content Knowledge (TPCK) Construct

Elaborating from the work of Schulman (1986), Koehler and Mishra (2005) have proposed a construct to define the knowledge teachers need to acquire in order to

effectively integrate technology into learning. The authors argue that a unique form of knowledge, defined as technological pedagogical content knowledge (TPCK), is constructed by establishing nuanced and meaningful connections between the subject matter (content), the ways of teaching and learning it (pedagogy), and the technologies that can assist in this process. The TPCK construct is used in this study to organize and inform the analysis of the data and to define a mental model that is here referred to as proto-task. The next section briefly presents the construct in relation to WLTE. For a more detailed discussion of TPCK development in WLTE (see Van Olphen, in press).

In one of the earliest accounts of the theory of pedagogical content knowledge (PCK), Shulman (1986) defined PCK as "the ways of representing and formulating the subject that make it comprehensible to others" (p. 9). His description of PCK implies that the dialogic interaction between pedagogy and discipline-specific content results in a new type of knowledge: PCK. Koehler and Mishra (2005) further define and extend Shulman's original theory by proposing a framework composed of three main bodies of knowledge: content knowledge (CK), pedagogical knowledge (PK), and knowledge of technology (TK). As Shulman did in his original work, they also rely on the concept of knowledge amalgamation. They contend that the interaction between each of the three "core" bodies of knowledge with one another gives rise to blended types of knowledge, namely technology pedagogy knowledge (TPK), pedagogy content knowledge (PCK) and technology content knowledge (TCK). They posit the claim that the amalgamation between these three blended types results in a unique, highly contextualized type of knowledge (TPCK) that is a prerequisite for effective technology integration (Koehler & Mishra, 2005; Koehler *et al.*, 2004). Koehler and Mishra (2005) have argued that due to the highly complex, situated, and transactional nature of TPCK, the best way to develop it is through direct experience in situations that require its application. TPCK is best developed under conditions that favor the interaction between TPK, PCK and TCK. One of the situations that favor such interaction is the design of language learning experiences.

The duality of content knowledge in WLTE

The discussion about what constitutes the content knowledge that should be part of WLTE is far from settled (e.g., see Egbert et al., 2002; Freeman & Johnson, 1998; Levy, 1997a, 1997b; Nunan, 1991; J. C. Richards & Nunan, 1990; Wilhem, 1997). As Koehler and Mishra (in press) have noted, CK is an ill-structured domain at best in all disciplines and usually the subject of much controversy. As such, it is expected to be in a state of

permanent fluctuation, affected by redefinition and reinterpretation as our understanding of the subject matter evolves. The content domain of WLTE bares no exception. Throughout the years, the knowledge base for WLTE has been revised and redefined. The rich discussions that inform revisions and redefinitions of WLTE often stir controversy (e.g., see Freeman & Johnson, 2005; e.g., see Seidlhofer, 1999).

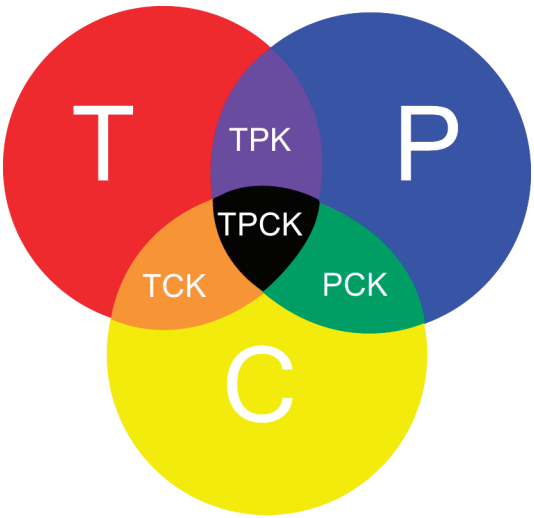

Figure 3. Graphic representation of the TPCK construct

Despite the natural disagreements regarding what constitutes the content knowledge of WLTE, a bird's eye view of the literature reveals two distinct components of CK: knowledge of the target language (TL) and knowledge about language (KAL) (see Figure 4). For practical purposes, in this study the knowledge of the TL refers to the teacher's degree of proficiency in the language he or she teaches, usually expected to be at or close to the level of an educated native speaker (Leaver & Shekhtman, 2002). TL knowledge then comprises a high level of both fluency in the target language and understanding of the target culture. A discussion of how this knowledge is acquired and how technology can assist is obviously relevant to WLTE (e.g. see Garret, 1991for a discussion of technology issues in WLTE that is still current) but is the specific focus of the field of CALL.

The knowledge about language (KAL) refers to the explicit understanding of the linguistic system. In WLTE, this understanding is inextricably connected with theories of language, second language acquisition and the metaphors and constructs that are derived from those theories in order to organize, describe or research KAL (e.g., different types of

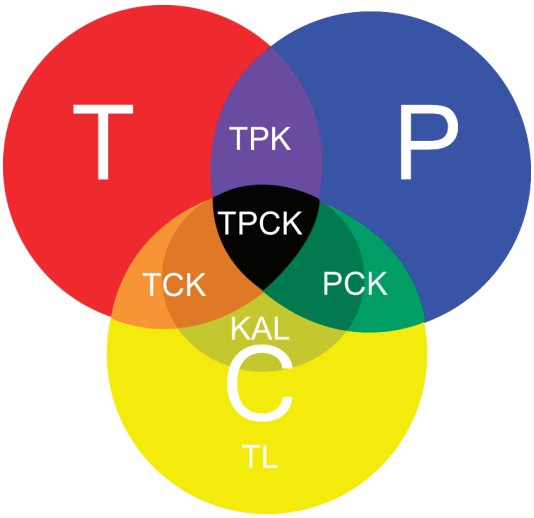

Figure 4. Defining the spectrum: The dual nature of content knowledge (KAL + TL) in WLTE

grammars, descriptive or prescriptive, systemic-functional, communicative, pedagogical, etc. have been crafted from those theories). The enactment of those theories and constructs within the context of language learning falls within the broad realm of Applied Linguistics, which is considered part of the CK of a language teacher in this study .

The duality of CK poses important challenges in developing TPCK in WLTE and deserves better attention in the literature. For example, preservice teachers' opportunities to design language learning experiences could be constrained by the teacher educator's knowledge of the TL, which is a fundamental component of the CK which a preservice language teacher would be expected to acquire. This is one of the warrants that supports the claim that the preservice teachers' construction of PCK in WLTE programs should not be the sole responsibility of the methods class and practicum experience (van Olphen, in press), as the development of TPCK should not be the sole responsibility of the single CALL course or the general technology integration classes.

TPCK in WLTE

The knowledge of technology (TK) is an important component of the TPCK framework. In fact, the effective integration of technology is what motivated its creation. The development of TK presents a particular challenge: TK is a moving target. New technologies emerge and become popular in a matter of days. They then may become obsolete almost as fast. Koehler & Mishra (in press) indicate that TK includes a basic understanding of the wide range of available digital technologies. In WLTE, technology

integration is usually associated with CALL (Computer-Assisted Language Learning). Much of what constitutes the TK domain in WLTD and its amalgamations (TPK and TCK) is dealt with in the CALL literature. One thing to note about the field of CALL is that while it acknowledges the duality of CK in its literature, it has nonetheless kept a strong focus that has blurred artificial boundaries between second and foreign language teaching and learning. Despite the limitation of focusing on computer technologies, CALL constitutes much of the growing body of knowledge that the "T" circle represents in the TPCK construct (see Figure 4).

If we consider the impact that digital technologies have had in the ways we use language in the last few years (e.g., e-mail, blogging, podcasting, instant messaging, etc.), it becomes clear that to consider the interaction between technology and content in WLTE can easily become overwhelming if language becomes part of the content definition. It is difficult to think of technologies that do not have an impact on the use of language. Virtually all technologies that have an impact on communication, and on language learning by extension, have some relevance to WLTE. In this respect, the CALL literature constitutes and invaluable source of information and knowledge to organize and prioritize the principled use of computer technology and to understand the interaction between technology and the dual content of WLTE. CALL offers an extensive body of research on generic technology tools that TL users would use (e.g., chat, instant messaging, speech recognition, word processing, etc.) as well as language-specific tools designed for language learning (e.g., learner dictionaries and grammars, multimedia glossaries, etc.) or linguistic analysis (e.g., concordancers). This rich repository of information can be used to develop language teachers' TCK. Part of this type of knowledge is the teachers' understanding of how specific technologies can be adapted to work in their specific TL domain (e.g., how to set up a browser to display Japanese characters or how to do instant messaging in Russian).

Technological pedagogical knowledge (TPK) is defined as how teaching and learning change when specific technologies are integrated (Koehler & Mishra, in press). As with TCK, the literature in CALL has offered insights into how generic technology tools can have a pedagogical effect on language learning activities (e.g. increased learner participation in synchronous and asynchronous online environments), and therefore constitutes a primary resource to build the language teachers' TPK.

Pedagogical knowledge (PK) implies a general understanding of "cognitive, social and developmental theories of learning and how they apply to students in

their classroom" (Koehler & Mishra, in press). This type of knowledge encompasses techniques for general classroom management, lesson planning, evaluation, etc. Since theories of language and SLA are often grounded on general theories of human learning, it is important for language teachers to develop a sense of the main concepts arising from these theories and their impact on language learning.

The overlap between pedagogy and content yields the amalgamated variety of knowledge that Shulman (1986) labeled *pedagogical content knowledge* (PCK). In WLTE, this type of knowledge encompasses language pedagogy constructs such as approaches, methods and techniques (Antony, 1963). In an extensive discussion of these concepts, Kumaravadivelu (2006) broadly distinguishes between three overarching categories of language teaching methods: language-centered, learner-centered, and learning-centered. He posits the idea of moving beyond this type of constructs and proposes what he calls a macrostrategy framework. In a similar endeavor to link second language acquisition research and language learning pedagogy, Doughty & Long (2003) proposed general principles for effective technology integration into distance language learning. A working understanding of concepts such as these would constitute part of a language teacher's PCK.

Research Questions

The purpose of this exploratory study is to gain insights into the mental processes in which the participants engaged while using a cognitive tool designed specifically for the context of WLTE. Those insights will be used to inform subsequent development of the tool. Since this tool is intended to assist world language teachers in the conceptualization and design of language learning projects for their students (reference to Paper 1), the insights gained from this study will also foster our understanding of the cognitive processes that inform the design of language learning experiences.

The use of the tool in WLTE contexts is hypothesized to support cognitive processes associated with the design of language learning experiences. The following questions guide this exploration:

1. In what ways did the tool support the four world language teachers' cognitive processes during the design of language learning projects?
2. How did the tool support the participants' cognitive activity at the conceptual and interactual level of interface organization (Cooper, 2003)?
3. What barriers and constraints did the language teachers encounter when they used the tool?

Method

In this section I present the methodological approach used in this exploratory research, briefly describe the activity design studio, the cognitive tool that is explored in this research, provide information on the participants and criteria for their selection, and explain the data collection procedures. I include a brief rationale for each data collection procedure anchored to the pertinent literature.

This study is grounded on principles of Design-based Research (DBR), an approach that emerged in response to the need for context-sensitive methodologies for inquiry that primarily focuses on the design and development of pedagogical innovations (The Design-Based Research Collective, 2003). DBR is characterized by: a) dual goals manifested in the design of learning environments and the formulation of "prototheories" of learning; b) the inclusion of iteration in the research and design process; c) the requirement to account for authentic settings; and d) the use of methods suitable to document and relate "processes of enactment" to "outcomes of interest" (The Design-Based Research Collective, 2003, p. 5). Even though DBR is still being defined, scholars that actively participate in this community of inquiry appear to agree on two foundational precepts: the development of learning environments and theories is inextricably intertwined; and that researchers must employ methods that make possible the connection between processes of enactment and outcomes of interest, so that our understanding of pedagogical innovations and learning can go beyond the dictum of success or failure of an innovation (Dede, Nelson, Ketelhut, Clarke, & Bowman, 2004).

The present study was designed to align with these two characteristics through the selection of participants that are knowledgeable of issues of technology integration into

Table 1. Data collection events and corresponding data sources

Events (in chronological order)	**Data Sources**
Participants design a language learning project using the Activity Design Studio (see Appendix A)	Concurrent think aloud transcripts Researcher's notes (participant observation) Artifact (saved project)
Exit interview (see Appendix B)	Interview transcript

the target environment (Gilchrist, 1999), the use of data collection procedures that allow for a participatory approach to this formative evaluation (Pawson & Tilley, 1997), and the collection of different types of data that will enable a rich description of the participants' experience with the software (Lincoln & Guba, 2002). Table 1 presents a summary of the data-gathering events and corresponding data sources utilized for this study. Events are presented in chronological order.

The Activity Design Studio

This section presents a brief overview of the Activity Design Studio (ADS)[1], a cognitive tool designed specifically for use in WLTE. The ADS is one of the components of a learning management system (LMS) optimized for language teaching and learning. The ADS was conceived as an authoring tool within the LMS that would make possible the graphical representation of the design of language learning experiences. While most current LMS's replicate a desktop metaphor to add and organize content within the system (e.g., files are stored within folders), the ADS relies on symbols that are not connected in relation to the location where they are stored in the system but rather in relation to their pedagogical function within a language learning experience.

In the literature of educational technology and instructional design, tools like the ADS are usually referred to as cognitive tools. Jonassen & Reeves define cognitive tools as computer applications that "enhance the cognitive powers of human beings during thinking, problem solving, and learning" (p. 693). According to their purpose and use, cognitive tools can fall into several different categories. Different types of cognitive tools are considered appropriate for the development of particular types of knowledge. For example, semantic networks can be used to develop conceptual knowledge, while expert systems can better assist in the acquisition of procedural knowledge (Jonassen, 2003b). The ADS was designed as the type of cognitive tool described by Jonassen, Carr, and Yueh (1998) as a *systems modeling tool* (p. 6). System modeling tools are hypothesized to assist in the development of complex knowledge structures, such as mental models.

Systems modeling tools can be used to express mental representations of ill-structured and highly complex concepts, in this particular case, the design of a language learning experience that entails a series of tasks and subtasks. Through use of the ADS, it was hoped that some of the designer's tacit knowledge about language teaching and learning

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1 A detailed explanation or the tool is available in an online manual at www.language.iastate.edu/dsn/index.html and can be provided by author: rodriguez.julioc@gmail.com

as well as the abstract pedagogical and linguistic concepts that abound in WLTE can be expressed through concrete graphical representations. A finite number of elements or symbols available in the ADS are used to create these representations. One of the attributes of systems modeling tools is, in fact, the availability of such symbols, also called building blocks, which stand for concepts and operations that are pertinent to system that the tool is intended to model. Within the context of use of the ADS, one of the main functions foreseen for these building blocks was to enable the conceptualization, creation and communication of pedagogical representations (see Figure 5).

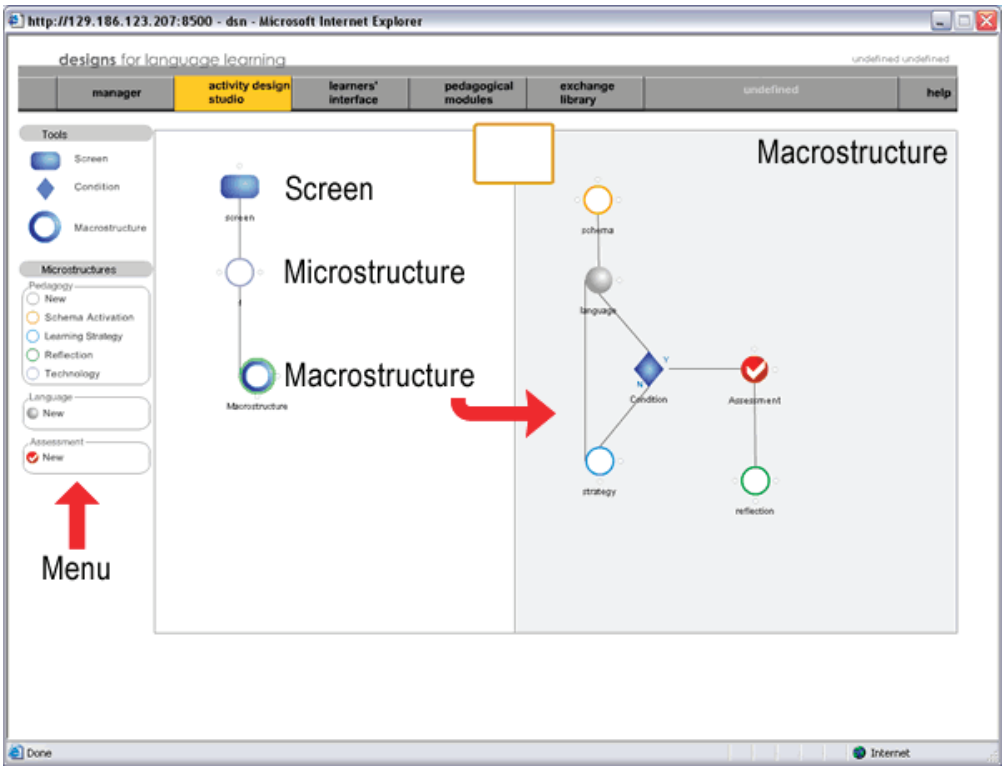

Figure 5. Screenshot of the ADS interface

Note. The first column to the left lists the available menu items, which are divided into 2 categories: tools and microstructures. The three subcategories in the microstructure portion of the menu are encased in boxes. The white screen shows a sample project. The contents of the macrostructure are displayed on the gray screen to the right.

The building blocks available in the ADS are divided into two categories: microstructures and tools. The microstructures category is in turn divided into three

subcategories: pedagogy, language, and assessment. Each of these subcategories is represented by a distinct graphical icon and all subcategories include a button that allows users to define microstructures associated with them. The pedagogy subcategory additionally contains four microstructures whose function was predefined: schema activation, learning strategy, reflection, and technology. Microstructures within this subcategory have a primarily pedagogical role and can therefore be associated with either a first language (L1) or a target language (TL). On the other hand, language and assessment microstructures are expected to be in the target language (TL).

The tools category features three icons with distinctive functions: a) a screen, which functions as a container for all the processes and graphical elements associated with a screen in the learner's interface; b) a conditional connector, which allows for the branching of microstructure sequences according to different types of variables (e.g., a sequence of microstructures may loop until a condition is met, or a certain microstructure is deployed or skipped if learners have (or have not) met a certain logical condition, etc.); and c) a macrostructure tool that can cluster a group of microstructures that lead up to a common overarching language learning goal. In the software, all these building blocks can be dragged and dropped on a main screen and defined using their respective properties menus.

Participants

The four participants in this study can be considered key informants as defined by Gilchrist (1999), since they have extensive experience and expertise using technology in teacher education and knowledge of pedagogy. Participants with this type of knowledge and expertise were necessary to generate data corresponding to highly demanding usage of the tool. This type of purposive sampling resulted in a small group of informants who "provide representative pictures of aspects of information or knowledge distributed within the study population" (p. 361). All participants received and signed an informed consent document before initiating the data collection procedures. In order to keep the identity of the participants confidential, their real names are not used in this report.

Participants shared similar backgrounds because all had experience teaching and integrating technology in teacher education contexts. However, each of them brought a very different perspective to this research: Cheryl has expertise in foreign language (FL) teaching (Spanish), WLTE, and technology integration into WLTE. She teaches FL methods courses and has led a number of professional development activities focusing on

language pedagogy and technology integration. Celia also has expertise in FL teaching (Spanish) and technology integration into WLTE. She has led multiple professional development projects for language teachers, some of which have focused on technology integration for practicing teachers. Klaus' expertise is in teaching English as a Second Language (ESL/EFL), applied linguistics, and computer-assisted language learning (CALL). He holds a Ph.D. in education and teaches M.A.-level courses in applied linguistics, including advanced applications for CALL, language testing, and computer methods for language study. He has published in professional journals in this area. Hong has WLTE experience in Asia and expertise in technology in teacher education. She has been involved in a faculty mentoring program for technology integration and in research involving the integration of technology into WLTE.

Participants' experience with the tool

Research on cognition has made a distinction between fast, automatic processing and slow, attended processing (Winn, 2004). As users become more experienced with a task, processes that used to be attended to become automatic. Ericsson & Simon's (1984) model of protocol analysis assumes that "*only information in focal attention* can be verbalized" (p. 90) (emphasis in original). Novice users verbalizations are typically more complete and thorough than those of experts (Ericsson & Simon, 1984). Therefore, automaticity is not desirable because it could preclude information from reaching focal attention and its consequent verbalization. None of the four participants in this study had ever used the software before so they can be considered "novice users." Their verbalizations were thus expected to be detailed.

Language proficiency and verbalizations

Two of the participants, Klaus and Hong, were speakers of languages other than English who had near-native proficiency in English. This does not pose a validity concern regarding the protocol data. Ericsson and Simon (1984) noted that non-native speakers of the language in which they report may take longer to think aloud in the foreign language depending on their second language proficiency but, "there is nearly a one-to-one mapping between structures in the oral code of the first language and the code of the second language that is used for vocalization" (p. 250).

Data collection procedures

The raw data consisted of transcripts of the participants' concurrent verbalizations

during their work on tasks with the software, transcripts of retrospective verbalizations elicited using a rubric, transcripts of the participants' interview, the researcher's notes, and screenshots of the graphical representations created by the participants with the tool (see Table 1). The following describes the two procedures used to obtain the data and discusses related methodological considerations.

Concurrent think-aloud protocol.

Think-aloud protocol has been used to investigate cognitive and meta-cognitive processes related to language learning, e.g. (Chun, 2001), human-computer interaction (Carroll, 1997), and teaching (e.g., Hong, 1998). In the context of language learning, think-aloud protocol analysis has been used extensively to collect data on cognitive processes triggered by reading and writing using computers. Examples include examining how language learners make use of various types of word look-up tools, such as multimedia glosses or annotations (Lomicka, 1998), or electronic dictionaries (Hulstijn, 2000).

The use of this technique to gather data has raised questions regarding the validity and reliability of these reports. However, a comprehensive review of dozens of studies by (Ericsson & Simon, 1984) suggests that this data collection method, if properly applied, may be very effective to further our understanding of human cognition. Ericsson & Simon (1992) describe an information-processing model that makes a distinction between three levels of verbalization according to the amount and type of intermediate processing required prior to the articulation of a thought. Level 1 verbalizations comprise direct vocalization, that is, no intermediate processes are engaged. Level 2 verbalizations involve the description of the thought content, that is, some recoding of information in short term memory is necessary but the participant's focus of attention does not switch to new information (i.e., the participant is not asked to interrupt her thought process in order to consider a new piece of information that was not part of the process). Finally, Level 3 verbalizations are complemented by interpretative processes, that is, the participant is requested to explain his or her thought processes. Ericsson & Simon (1984) found evidence in think-aloud research that producing this kind of verbalization prompts intermediate processing that changes the course and structure of the original thought process (p. 106). They contended that Level 1 and 2 verbalizations yield more reliable data if the purpose is to keep the thought process intact and describe it as it occurs. In addition to this distinction, verbalizations can also be classified into two distinct categories according to whether the researcher specifies the type of verbalizations

expected or not: mediated and non-mediated (Johnson, 2005).

This study was designed to elicit mediated, level 2 verbalizations, since the intent was to find out what kind of information was brought to short-term memory through interaction with the software. After a brief introduction to the tool's basic operations, think-aloud procedures were explained to participants using Perkins' (1981, cited in Wong, 2005) recommendations. A list of these recommendations was placed behind the keyboard as a reminder (Appendix A). Participants were then requested to read the instructions to execute a task using the software and to start developing the task. The main goal of this task was to conceptualize a language learning project. The participants' verbalizations while working on this task were recorded and transcribed.

Semi-structured interview

The technique used in this research to construct interview questions is aligned with the underlying concept of theory-building of design-based research (Collective, 2003). The exit interview was designed following the guidelines specified in Wengraf's (2001) pyramid model (Appendix B). This model recommends starting with the definition of central research questions (CRQ's), in this case, the guiding questions stated above. Theory Questions (TQ's) are derived from CRQ's and are used to guide the generation of interview questions (IQ's).

Wengraf (2001) makes a distinction between lightly and heavily structured depth interviews. The degree of structure, which is indicated by the degree to which questions are pre-prepared by the researcher, depends on the purpose of the interview. Unstructured to lightly structured interviews would appear to be more suitable for model or theory building, whereas heavily to fully structured interviews are better suited for model or theory testing. However, (Pawson & Tilley, 1997) criticize this distinction on the grounds that these interview types (e.g., structured, semi-structured, etc.) are formulated from a data rather than theory-driven approach. They propose a theory-driven interview approach for heavily structured interviews, thereby challenging the idea that lightly structured interviews are more suitable for theory building. Pawson & Tilley's (1997) approach was preferred for this research due to the exploratory nature of this study and the participants' rich knowledge on the topics of technology integration in WLTE. In this approach, interviewees assume a highly participatory role. They are not considered data-providing entities, but rather active co-constructors of the theory in question.

The interview questions were framed to address two concerns from two distinctive

situational perspectives: a) how the tool supported the design of language learning experiences at the conceptual and interactual level of interface organization (participants situated themselves as preservice language teachers using the technology); and b) what affordances the tool appeared to offer to support learning in WLTE contexts (participants situated themselves as teacher developers). During the interview, participants were encouraged to rephrase and reformulate their ideas in order to increase the descriptive power of the data. Although the order of topics varied, all topics were addressed by all participants.

Data Analysis

The data collected for this study were derived from two main events: the participants' creation of a language learning project using the software and an exit interview (see Table 1). The participants' verbalizations during both events were recorded and carefully transcribed by the researcher. The researcher's handwritten notes taken during these events were inserted as comments in the transcripts at the time of transcription. Additional notes reflecting the researcher's initial associations or commonalities within and across participants' verbalizations were also included as comments in the transcriptions. The transcriptions for each data-gathering event and for each participant were saved in individual files which were printed and imported into qualitative software ("Qualrus 2.1.0.0", 2002) for the analysis.

As stated in the review of the literature, Freeman (1996) presents a compelling argument for the analysis of language data from two complementary perspectives: presentational and representational. Following Freeman's integrated model for the analysis of teacher thinking, commonalities in the data were identified from two perspectives: representational and presentational (see Table 2). The instantiation of both perspectives in this study is further explained below.

Representational analysis

The representational perspective approaches language as data (words express thought), while the presentational perspective approaches language data as language (words connect individuals within social systems; "[t]he word in language is half someone else's" (Bahktin, p. 294, cited in Freeman, 1996). Freeman (1996) proposes the integration of both perspectives. He argues that by adding a presentational perspective the analysis of language would "reveal not only *what* is being learned or is changing, but also *how* it is being learned or is changing" (p. 735). Freeman additionally argues that

Table 2. Perspectives for the analysis of the data

Representational Perspective	**Presentational Perspective**
Language as data	Language data as language
Analysis grounded on What the participants do and say they do	Analysis grounded on How the participants say what they do
Locus of analysis: patterns in the data	Locus of analysis: relationships in the data
Scope of analysis: Participants as individuals and as a group	Scope of analysis: Participants as members of a community of practice

approaching the analysis of language data from these two perspectives can serve as a form of triangulation.

In this study, the representational analysis entailed two complementary processes. The first process included the identification of themes within and across the participants' think-aloud verbalizations and the formulation of claims based on those themes and the relevant literature. The second process entailed the identification of commonalities in the transcripts of the semi-structured interviews. Those commonalities are also grounded both in the data and the relevant literature.

Although subtle, there is a difference between the two end products, which in this study are referred to as themes and categories respectively. Themes were identified in the participants' verbalizations elicited through interaction with the ADS. Those verbalizations were constrained by the task given to the participants (Appendix B) and the ADS itself. The process of identifying themes was inherently inductive. On the other hand, categories were identified in the participants' verbalizations elicited through interview questions constructed by the researcher prior to the participant's experience with the ADS. These verbalizations were constrained by the researcher's predetermined questions. The use of the terms theme and category in this study is further explained below.

Themes

In this study, the word theme is used to denote patterns that emerged in the think-

aloud protocol data. The transcripts of the protocols of each participant were first read separately to identify internal themes in relation to each participant. The researcher created a tentative list of those themes and their codes. For example, the think-aloud transcript of one of the participants indicated that the participant frequently thought about scaffolding. Scaffolding then became a tentative theme and the code "scaffolding" was applied to corresponding segments. Using the software, all segments that referred to scaffolding were grouped and then subgroups were marked using more specific codes that reflected the types of knowledge that appeared to be tapped into while building the scaffolds (e.g. pedagogy, technology, etc.).

The identification of themes was guided by the research questions. For each research question, the researcher looked for evidence in the protocol data that could be used to generate a claim. For example, in relation to the first research question, "In what ways did the tool support the participants' cognitive processes during the design of language learning projects?," the researcher initially identified in one of the participants' data careful consideration to how learner interaction was to be set up and managed. When comparing these processes across participants, the similarities in the ways the participants appeared to approach the management of interaction appeared to suggest that the participants were systematically applying general guidelines. Consultation with the related literature was used to formulate a claim based on the evidence provided by this particular theme (i.e., setting up interaction). In the particular case of managing negotiation, the themes suggested that rather than specific methodologies, the participants may be applying what Kumaravadivelu (2003) calls macrostrategies, broad guidelines derived from "historical, theoretical, empirical, and experiential insights related to L2 learning and teaching" (Kumaravadivelu, 2003, p. 38). The researcher then looked for evidence in the data from a representational perspective; first in each participant and then across participants. Segments in the data that appeared to support the claims were coded using qualitative analysis software.

Categories

In this study, categories are defined as commonalities arising from the participants' answers to questions pre-defined by the researcher using the relevant literature (Appendix C). For example, how the tool supported the design of a language learning experience at the conceptual level of interface organization was a broad question created through consultation with the literature in CALL (Chapelle, 2001) and interface design (Cooper, 2003). Interview questions were derived from this main question using Wengraf's (2001)

pyramid model to design interviews. Commonalities in the verbalizations elicited through these questions are here referred to as categories.

Presentational analysis

The presentational analysis entailed identifying semantic relationships that revealed the participants' thought processes while working with the software (see Table 3). This latter type of analysis appears to be particularly useful to identify problems or constraints in the software at early stages of development which could have an impact on the adoption of the tool. Language data can give an indication of the degree of use of the metalanguage used in the software and improve our understanding of how participants use the metalanguage associated with the interface. In this particular case, words such as "microstructure" and "macrostructure" are part of the metalanguage used in the software interface.

One way to identify semantic relationships in the data is to analyze the frequency of occurrence of particular terms. The following steps were followed to carry out the word frequency analysis: 1) original data in protocol transcripts were kept intact[2]; 2) before running the protocols through the frequency indexer, they were prepared using the protocol described below; 3) the think-aloud protocols transcriptions were then entered into a word frequency indexer[3].

Presentational analysis protocol

To ensure the semantic consistency of the terms, the researcher designed and implemented the following analysis protocol: a) determiners (pronouns, substitute words, etc.), modal and auxiliary verbs and prepositions, punctuation and researcher's comments embedded in the transcript (e.g., participant watches a video; typing while mumbling, etc.) were deleted; b) lexemes (words with different morphological features, e.g., produce, producing, product, production) were identified and grouped; c) all words were checked using a concordancer in order to make sure that all occurrences of the term

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2 Cheryl's transcript included the transcription of a few minutes during which the participant drew on a piece of paper and did not use the software. Since the motivation for this presentational analysis was to better understand the participants' cognitive processes while they were using the software, that portion of Cheryl's transcript was not included in the analysis.

3 Catherine N. Ball's word frequency indexer was used, which is available at http://www.georgetown.edu/cball/webtools/web_freqs.html

Table 3. Alignment of data sources and analysis

Data Sources	Data Group	Data Analysis
Concurrent think aloud transcripts Researcher's notes	Group 1	Focus on identification of themes. Representational & Presentational Approach. Used data Group 2 to support findings.
Interview transcript Artifact (saved project)	Group 2	Focus on information categories derived from research questions. Representational Approach. Used data Group 1 to support findings.

corresponded to the same semantic unit (i.e. occurrences of the acronym CALL were not counted as the verb "to call"); c) a manual disambiguation of meaning was carried out on concordance data for each content word (for example, "sentence" in Hong's TA, which originally had 25 occurrences, was compounded with "topic"; the whole semantic unit was considered to be "topic sentence" rather than just the word sentence alone); e) the first 60 content words representing a semantic unit were ranked in decreasing order of frequency (semantic units that had the same rank order were sorted alphabetically); and f) a rank-order scale with specific font sizes was used to create frequency graphics (see Table 4).

Results and Discussion

Consistent with the analysis described above, this section is divided into two parts. The first part focuses on a representational approach to analyze and discuss the data based on the identification of themes and categories. The second is based on a presentational approach grounded on a word-frequency analysis and concordances generated using transcripts of the protocol data which were prepared as specified in the methods section.

Representational analysis

> Those who can, do. Those who understand,[additionally] teach. (Shulman, 1986, p. 14)

The first section of this representational analysis focuses on the themes that emerged in the protocol data. Themes are organized under claims that were drawn from the relevant literature. The second section of this analysis focuses on categories identified in

the interview data.

The following three main claims are supported by the themes in the data: 1) scaffolding learning activates sophisticated forms of knowledge; 2) the design of language learning experiences is informed by the iterative consideration of general guidelines rather than subscription to specific methodologies; 3) designers use a mental model (named here proto-task) as referent during design. The section presents the major findings first organized according to the claims introduced above and then in relation to components of the TPCK construct.

The construct of TPCK has been proposed to organize and further develop our understanding of how technology can be integrated into teacher education with the

Table 4. Rank order scale for frequencies with corresponding font sizes

Rank	Font Size
1	60
2	55
3	50
4	45
5	40
6	38
7	36
8	34
9	32
10	30
11	28
12	26
13	24
14	22
15	20
16	18
17	16
18	14
19	12
20	10

ultimate aim of improving teaching and learning. In this study, TPCK is used to frame and inform the findings. By doing so, it is expected the TPCK framework will gain definition as a construct to guide future work in technology integration for WLTE.

Claim 1: Scaffolding learning activates sophisticated forms of knowledge

How teachers scaffold activities gives us insights into the types of knowledge that is necessary to design effective language learning experiences. The data supports the claim that the use of the tool in scaffolding processes activates composite forms of knowledge, such as knowledge about language (KAL), pedagogical-content knowledge (PCK) and technological-pedagogical content knowledge (TPCK). This section begins by taking a closer look at the notion of scaffolding and its relevance to WLTE and presents support for the claim stated above with data that illustrate the activation of KAL, PCK and TPCK.

The role of the teacher in the learning process has been extensively discussed in the WLTE and also recently in the CALL literature (e.g., see Amiri, 2000; Hubbard, 2004; Hubbard & Levy, in press; Levy, 1998). Clearly, the discussion of what should be the knowledge-base in WLTE often rests on assumptions as to what the role of the teacher should be. In a discussion of theory and implications for practice and research, Levy (1998) broadly described the role of the language teacher from a Vygotskian and a Piagetian perspective. Levy argued that these two perspectives have profound implications to second language learning. The Piagetian perspective is driven by the notion that learning is a highly individualized activity. Consequently, the teacher's primary role in the learning process is to design environments that foster learning. On the other hand, the Vygotskian perspective, informed by the concept of the *zone of proximal development*, highlights the centrality of social interaction in the process of learning. The teacher's role is to help learners bridge the gap between what they can do and what they can't yet do alone. From this perspective, the teacher's primary role is to assist learners in the process by devising and implementing the support needed for a learner to become autonomous. The notion of structuring learning so that learners progressively achieve autonomy has been referred to as scaffolding (Donato, 1994).

The concept of scaffolding is central to the design of effective constructivist language learning experiences. A cognitive tool intended to assist in the design of such experiences would be expected to support the designer's cognitive processes that are associated with scaffolding and also raise awareness of scaffolding needs within a given design. This is explored in this section in terms of how the software a) activates; b) supports and

sustains; and c) fosters the building of composite forms of knowledge (TPC, PCK, and TCK).

The notion of scaffolding has been explored in the CALL literature. In recent work that analyzes how experienced language teachers implement scaffolds using technology, Meskill (2005) defines the construct of *triadic scaffolds*: "three dimensions of an utterance that at once aims to teach language, is fashioned to be instructional, and references the computer in a sociolinguistically and instructional way" (p.50). Meskill further defines the construct by distinguishing different purposes that scaffolding appears to serve in a technology-assisted language learning situation:

> In second language and literacy instruction, scaffolding has a three-fold purpose. Language teachers not only scaffold learning in the traditional sense of cueing, supporting, and sustaining thought, but employ the added dimension of tailoring learner attention to both the forms of talk and accompanying visual referents to which that language corresponds in the immediate physical and social environment (Meskill, 2005, p. 54).

Meskill's construct was used to initially identify instances of the participants' thinking about scaffolding while designing. In agreement with Meskill's premise, a preliminary analysis of the data indicated that the implementation of scaffolding in the design of language learning activities appeared to serve a number of purposes. The concept of purpose, however, is problematic because it implies intentionality on the part of the designer. Since the intention of the participants cannot always be accounted for or was not always clear in the protocol data, coding for scaffolding was defined in terms of the type of knowledge that the participants activated while working on their designs of language learning experiences.

In this study, scaffolding is defined as the process of providing and planning for withdrawal of support. The following section further explores and illustrates how the tool activated the participant's knowledge. The section starts by further defining KAL and exemplifying its activation, and builds up by considering related composite forms of knowledge, namely PCK and TPCK.

Activating KAL (knowledge about language) to scaffold language learning

The process of scaffolding content for language learners offers unique opportunities to look into the types of knowledge the participants or designers activate. Scaffolding for the acquisition of targeted language features is probably the most complex forms

of scaffolding a language teacher would engage in, since it entails scaffolding for the learner's acquisition of multiple and varied types of linguistic knowledge, which needs to be explicit in the designer's mind but not necessarily in the design. Recent work in applied linguistics has referred to this knowledge using the umbrella term Knowledge About Language (KAL) (e.g., see Bartels, 2005). The construct of KAL is difficult to define. The very notion of separating language knowledge from ability has been the object of much discussion in the literature. Kumaravadivelu (2006), for example, compounds both concepts and refers to the construct as "knowledge/ability" (p. 21).

The construct specifications for language knowledge that Bachman & Palmer (1996) proposed for the context of language testing are used in this study to define KAL. Bachman & Palmer propose two broad categories to describe language knowledge: organizational knowledge and pragmatic knowledge. These categories are in turn subdivided into subcategories (see Figure 6).

The following examples illustrate how the participants activate their KAL in order to build scaffolds for different areas of language knowledge that were targeted for acquisition. A word of caution is in order, as Bachman & Palmer (1996) note, the categories in the KAL construct are not mutually exclusive. The segments below were selected to illustrate the activation of KAL in relation to categories that appeared to be salient.

Grammatical knowledge

> …I would definitely want them to have the present perfect and the impersonal se - and so they need to see those in context before they have to produce them… (Cheryl, think-aloud)

> they are going to need adjectives, they're going to need verbs, they're going to need past tense, usually that's all decided - and I know that that's WHY we're doing this so that's part of what's making this hard, I think - hmm - adjectives, verbs, past tense, I would definitely want them to have the present perfect and the impersonal se - and so they need to see those in context before they have to produce them… (Cheryl, think-aloud)

Knowledge of cohesion

She is using her knowledge of cohesion to define the task that will lead to the creation of a caption. She is also anticipating how that task will contribute to the project goal,

Figure 6. KAL construct (from Bachman & Palmer, 1996, p. 68)

Organizational Knowledge
(how utterances or sentences and texts are organized)

Grammatical Knowledge
(how individual utterances or sentences are organized)

- Knowledge of vocabulary
- Knowledge of syntax
- Knowledge of phonology/graphology

Textual Knowledge
(how texts are organized)

- Knowledge of cohesion
- Knowledge of rhetorical or conversational organization

Pragmatic Knowledge
(how utterances or sentences and texts are related to the communicative goals of the language user and to the features of the language use setting)

Functional Knowledge

(how utterances or sentences and texts are related to the communicative goals of the language users)

- Knowledge of ideational functions
- Knowledge of manipulative functions
- Knowledge of heuristic functions
- Knowledge of imaginative functions

Sociolinguistic Knowledge
(how utterances or sentences and texts are related to features of the language use setting)

- Knowledge of dialects/varieties
- Knowledge of registers
- Knowledge of natural or idiomatic expressions
- Knowledge of cultural references and figures of speech

which is to create the front page of a newspaper (the caption will be expanded into a topic sentence of one of the paragraphs of the a news story).

I want them to write a caption first - and the caption is going to need to say

> firefighters- so it's going to need a noun - a verb : burnt - and usually a place and then they could use that to expand into their topic sentence and for that scaffolding we would - and then they'll add their details to that paragraph - okay this is going much better - and the scaffolding they'll need for that one - and where's this guy - scaffolding they're going to need for that one is the sentence expansion (Cheryl, think-aloud)

Knowledge of rhetorical organization:

> okay I am writing a description about - I have to tell them what is write a topic sentence - because the story is composed of two or three paragraphs - uh - you have to have a topic sentence in order to write a - in order to … following supporting sentence in each paragraph, so the story will have a theme (Hong, think-aloud)

Sociolinguistic knowledge (knowledge of registers)

> …okay so first kids need to know what the sections in a newspaper are - secondly they need to look at the organization - third thing they need to think about is what the - functions - so actually this is going to be - actually I made that hard to see - hmm the function of organization - this is the general organization - general organization - the functions of each section then I want them to do some comparing and contrasting - each between the sections and to see if there's any difference between target language- how they're used and the English… (Cheryl, think-aloud)

The scaffolding functional knowledge possibly requires a level of specificity that the participants in this study were not requested to reach in their designs. There are, however, segments in the data that suggest that consideration was given to functions. In the segment below, for example, Cheryl thinks about engaging learners in ideational and heuristic functions.

> … so I have the pictures and then I want to model for them how we read the two articles and what are some things that would be the same and different about - that might be too hard - about what they're going to work at - so in the English article - so actually a Venn [diagram] is probably not the best choice - instead we're going to want them to have - to do a concept map - so model a concept map on the projector and that way I can predefine the categories… (Cheryl, think-aloud)

Activating PCK

Designers of language learning experiences should be able to scaffold content.

However, attention to how processes are scaffolded within activities and sequences of activities is also important. At the level of language learning project design, scaffolding can be structured in two different ways: a) by providing support to enable the acquisition of targeted language features (e.g., keywords to expand into a sentence) or b) by providing pedagogical structures that regulate language learning (e.g., jigsaw activity followed by a writing task). The former focuses on content, the latter on pedagogy. Both have an impact on language learning.

The process of scaffolding micro and macrostructures is here referred to as project articulation and minimally requires the activation of PCK. In the context of designing language learning experiences, we should probably not assume that a sequence of activities will necessarily result in optimal project articulation. A certain amount of scaffolding along a sequence of project tasks may be necessary for a project to succeed.

In the excerpt below, Cheryl is mentally reproducing samples of the register (language of the press) and she is doing an analysis *on the fly* of the discursive features (e.g., preterit and imperfect tenses, lexicon, etc.) that the learners will need to use in order to complete the task (write a caption for a picture that will appear in a news report). She is also thinking of the pedagogical structure she will use to facilitate the elicitation of those discursive features. The structure she uses is a teaching strategy that language teachers commonly use to assist writing processes (information that describes the who, what, why, how and where ("*a place*") of the story).

> … fifty-five people were killed in a blast – they [the people] had had numerous problems with this before and - they're [the learners] going to need at least the preterit - preterit and imperfect is probably going to be better - but I could really scaffold that - so that's okay - I can give them - okay so what they're going to need here is who- what - okay what happened - five firefighters were killed today after they - so they are going to say the who - that one for a different story - fifteen middle school students - okay so who did it - what did they do - so this is their verb - this is going to be their noun - plus an adjective or two - fifteen middle school students marched down main street hmm - and why - how - then that would be structured - details - kind of nice if this would let you print a worksheet from here - so this is going to be - so actually I want them to write a caption first - and the caption is going to need to say firefighters- so it's going to need a noun - a verb : burnt - and usually a place and then they could use that to expand into their topic sentence and for that scaffolding we would - and then they'll add their details to that paragraph – (Cheryl, think-aloud)

The following example also illustrates the dynamic interaction between content and pedagogy as well as the designer's activation of PCK. She has constructed a type of activity that is likely to result in the elicitation of language features that may be conducive to acquisition (e.g., see Pica, Kanagy, & Falodun, 1993) and is now considering the outcome of that activity (we have our headline, the caption), the task that follows up (they have to write a paragraph.), and a potential classroom management problem.

> … so I want to spend sometime one layout and how we make one and they're going to need to spend some time on group work once - so there's going to be two separate groups - so this is a jigsaw - so we have our headline, the caption, they have to write a paragraph - I wonder if all those pictures are different - probably not - oh actually maybe I wouldn't want them to be because then they could say she got a better picture than I do - each group receives a picture - each member writes the headline and the paragraph – (Cheryl, think-aloud)

Scaffolding at the project level (between micro and macrostructures) is important for preservice teachers to experience since it may lead to the design of more effective language learning experiences and thus have a direct impact on language acquisition. For example, in a study framed within the task-based curriculum design approach[4], Robinson (2001) reported that even though the sequencing of tasks (from simple to complex and vice versa) has no effect on the amount of interaction, a simple-to-complex sequencing does have a positive effect on the accuracy and fluency of speaker production (p. 45).

The literature in applied linguistics has identified task characteristics that may have an impact on the complexity, fluency and accuracy of the language produced (Skehan, in Bygates). Task characteristics effects on performance are important because they may have a direct impact on language acquisition. For example, Robinson's (2001) study provides evidence that task complexity has an effect on measures of negotiation of meaning. Complex tasks elicit more negotiation of meaning. However, complex tasks do not appear to favor fluency (Skehan –in Bygates-, in fact, uses the term "dysfluency" (p. 174) to refer to discursive indicators of negotiation of meaning such as reformulation and

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4 Kumaravadivelu's (2006) does not give task-based language teaching (TBLT) the status of a method. I agree with Kumaravadivelu's idea that task is a curricular, not a methodological construct. As Kumaravadivelu has noted, a task can be learner-, learning-, or language-centered independently from the methodological context within which it is instanciated.

repetition), which is a desirable goal for most language learning undertakings.

Therefore, it is important for preservice teachers' to develop the ability to design language learning experiences that require articulation, i.e. language experiences that incorporate tasks that not only rely on topical content to build cohesion, but also on the characteristics of the tasks (PCK) and underlying acquisition processes that the learners would engage in. Designing learning experiences that are sophisticated enough to require articulation is probably one way for preservice language teachers to develop their PCK.

Thinking about project articulation appeared to be best supported by two features: a) at the conceptual level of interface organization, icons for micro- and macrostructures provided a graphical representation for a hierarchy and sequence of activities; and b) at the interactual level of interface organization, the interface layout allowed to quickly identify activities and reposition them within a sequence by simple drag-and-drop actions. Cheryl, for example, quickly repositioned a series of microstructures to represent a sequence she considered more suitable:

> … we were thinking about those captions so I need to go get a headline - so they're going to write their headline - and I want them to learn to expand the headline - and then I want them to expand the paragraph and then they'll actually be ready for the real activity so this is all pre, pre, pre, pre - okay so they're in groups… (Cheryl, think-aloud)

Three aspects of the software design appeared not to adequately sustain thinking about project articulation. Two were related to the conceptual level of interface organization: a) no curricular information was readily available in the interface, which made it difficult for the participants to estimate the learners' prior knowledge based on curricular cues (see first protocol below); and b) even though microstructures could be rearranged within a macrostructure, the software did not allow users to turn a series of microstructures into a macrostructure, or to repurpose a microstructure so that it could become a macrostructure. This latter issue is explored in depth below. The second protocol elucidates this user experience.

> …so they need some adjectives - and they're going to need question marks - I wonder how - where are we in the year for this? we don't really know - so I'm going to assume they all know this stuff so I don't have more activities in here – (Cheryl, think-aloud)

> … now I'm thinking of turning those into macros because I have subtasks underneath those that I want to have them actually do - so can I just magically turn them into macros? (Celia, think-aloud)

Finally, a design feature at the interactual level of interface organization also seemed not to sustain thinking about project articulation: the icons that signaled micro- and macrostructures did not indicate whether content within them had been specified. In other words, there were no visual cues to distinguish between those micro- and macrostructures that had been fully specified (e.g., participants, input, etc.) and those which had not.

> … there's nothing that tells me that I entered information here - about the goals -- so I could see this helping me plan flowchart wise - how things might have to flow - how things might have to break down - but when it comes to some of the more details - unless I get them when I'm mouseover or some other indicators there - then I don't think it would help me as much - and if it's something really complicated that there were unique processes going on between the four groups my headline - opinion - world and local - if there were unique processes for each one of those groups, then it's nice to have the gray area to be able to lay out the unique processes - but since they are the same - then I'd just as soon clone it (Celia, think-aloud).

Activating TPCK

Anticipating scaffolds for technology integration during the design of a language learning experience entails making educated guesses that require the activation of TPCK. The designer minimally needs to: a) anticipate the learners' level of knowledge of the technologies required to successfully complete a task; b) assess whether the learner would have reached that level by the time the task is executed; and, if not, c) providing the necessary guidance or support to reach that level of knowledge. Of all participants, Hong was the one that appeared to manifest the most concern regarding this type of scaffolding. At all times, she was mindful of whether the learners' knowledge of technology was sufficient to complete the project successfully. As the design of her project became more specific, so did her expectations regarding her learners' use of technology. She progressively decreased the complexity of technology used from creating a website to uploading a file, and scaffolded the latter activity by supplying a tutorial to her language learners.

> … so the goal would be they would successfully upload the newsletter into a certain sever so they would be able to have - they would be able to read the newspaper

> online, the input - would be the publisher page and the process would be first - here I wish I could find a website that could explain how to convert the publisher page into HTML page or file and then they can upload a file into a server - but that's going to be very difficult - to find a website to do all of this - then I need to come up with my own tutorial things - wherever you put - using this design studio? (Hong, think-aloud)

The software appeared to support the consideration of this issue. Indeed, one of the preset microstructures was conceived for this purpose and was deliberately labeled "technology" in the interface. Even though the label did not make its purpose immediately clear to all participants (interactual feature flaw), the fact that the icon was readily available on the interface appeared to prompt its use. This is a good example of how an interactual feature of the interface (e.g., availability of a function on screen) may amplify a concept.

> … and I need one to be a model, which means we are going to need technology before they do this - let's save and close that - did a little technology - and this one is going to be model [typing] English article… (Cheryl, think-aloud)

Hong, however, was confused as to how the software would help her create the type of scaffolds for the use of technology that she considered appropriate:

> … using this software, how can I make the tutorial? I have no idea - I mean for me - if I'm using my computer I would just use some screen shots with some text and then point to the tutorial - here how could I do it? or maybe kind of create my own Word document and just kind of upload it… (Hong, think-aloud)

In some cases, participants appeared to be very mindful of project articulation. The example below reveals Cheryl's TPCK while working with the software. At one point during the design of the project, she stopped to review the tasks that she had designed and seemed to monitor several aspects of project articulation, such as a) use of technology (…I'm going to have them view the video - then I'm going to have stills out of the video or representative pictures); b) whether the tasks were providing the necessary amount of input (…maybe we'll show two videos; … and I would do lots of modeling of better or worse out of the videos); c) how the tasks were balancing cognitive load (…because then that will lighten things up because they've done all these readings…; …. I might need to support that with pictures that are really funny); and d) whether they increased the expected language output (…I'm going to ask yes no questions; … and once they use the

either-or questions with the comparatives - then they'll be ready ; …that would prepare them to do some writing about their opinions of things).

> …so, I'm going to have them view the video - then I'm going to have stills out of the video or representative pictures and I'm going to ask yes no questions and then the kids based on the yes or no questions *es mejor que* - or *es mejor o peor* - which one is better or worse - maybe we'll show two videos - two videos - and I'll try to find… [mumbling while typing] - and then they're going to have to pick - because then that will lighten things up because they've done all these readings - and they're going to have to pick what do they like - and then look at some stuff to talk about - and I would do lots of modeling of *better* or *worse* out of the videos - these aren't really yes or no questions - these are either-or questions using the comparatives - and once they use the either-or questions with the comparatives - then they'll be ready - I might need to support that with pictures that are really funny and I'll have them compare and contrast those - like maybe famous people - and especially that would work really nicely because they're going to have lots of famous people in the news and that would prepare them to do some writing about their opinions of things - so they're going to need a lot of language to do all of these things - so they're going to have that little lesson and then they'll be ready to practice with flyswatters - (Cheryl, think-aloud)

The way the participants think about implementing scaffolds reveals the underlying knowledge they need. In a similar fashion, the participants' consideration of methodological strategies unveils the types of knowledge needed for the design of language learning experiences. The following section takes a closer look at the designers' cognitive processes while thinking about methodological options and how the software supported those processes.

Claim 2: The design of language learning experiences is informed by the iterative consideration of general pedagogical guidelines

> "...even as the methodological band played on, practicing teachers have been marching to a different drum" Kumaravadivelu, 2003, p. 29.

The data support the claim that the design of language learning experiences was informed by the iterative consideration of general pedagogical guidelines rather than subscription to specific language methodologies. This section describes how participants considered those guidelines while working with the software from a conceptual and

process perspective. First, I present a methodological framework recently described in the WLTE literature and use it to conceptually organize and discuss the themes that support this claim. Then, I draw from the literature on instructional design to explore the process of iteration used by the participants. Explanations of how the software supported the participants' cognitive processes are given in both sections.

The literature related to language learning activity design has often favored prescriptive guidelines derived for methods that were claimed to be "effective." The underlying assumption is that there is one *better* way to design learning activities. In a thought-provoking synthesis of promising directions in applied linguistics, Allwright (2006) makes reference to a shift in language learning experiences design from a precision to a broadcasting approach. The former supports the idea that precision in the design of a task makes possible the specification of what will be learnt from the prescription of a particular task or task sequence. The literature in task-based language teaching (TBLT) sometimes produces examples that support this idea (e.g., see Bygate, Skehan, & Swain, 2001; Nunan, 2004; e.g., see Robinson, 2001; Skehan, 2003). A task-based design approach implicitly puts the instructor in command, since task design is considered a highly controlled activity that is completed before learning starts. On the other hand, the broadcasting approach supports the notion that the design of learning experiences should offer a wide range of learning opportunities. This alternative design approach does not imply completion of the design before the learning experience starts, but rather a series of initially open-ended learning experiences, some of which are chosen by the participants and defined or redefined as they progress toward a common goal.

Clearly, these design approaches support radically different ways of thinking about language learning. The literature has recently produced a line of thinking about the design of language learning experiences in terms of models that attempt to cogently blend theory, research and practice. For example, Kumaravadivelu (2003) has proposed moving beyond prescriptive methods by considering conceptual frameworks that support holistic, research-informed, pedagogical thinking about language learning in WLTE. Recent trends in the field of WLTE indicate that his perspective would probably gain the support of other researchers. For example, from a constructivist perspective, Woods (2006) asserts:

> When we examine the interactions that take place in the management of language learning, we can see that the most that a method can do is provide a starting point. The moment that the teacher and learners step beyond this starting point, they engage in a reality which is not predictable from the method, nor from a set of abstract

> categories of instructional actions. It is a deeper situated reflective 'understanding' of the interactivity that plays the crucial role in decision-making (Woods, 2006, pp. 110-111).

Similarly, in the context of distance language learning, Doughty and Long's (2003) methodological principles (MPs) for task-based language teaching (TBLT), defined by the authors as "universally desirable instructional design features," also attest to this line of thought. The authors also make clear their disbelief in prescriptive methodologies by stating that "[g]iven the checkered history of prescriptions for language teaching, the likelihood that all 10 TBLT MPs will turn out to have been well founded is minimal" (Doughty & Long, 2003, p. 68).

From the data in this study, it appears that different participants favored different styles of designing language learning activities, and all of those styles shared some commonalities, such as recursion in the consideration of factors that pertain to task design (e.g., attention to the sequencing of tasks, the logistic difficulty of the task in terms of classroom management demands, the complexity of the linguistic input, etc.). This appears to support the idea that the participants operated within what Kumaravadivelu's (2003) calls a postmethod pedagogy. Instead of a defined set of steps to design activities, participants appeared to work on their designs applying some of the general principles that Kumaravadivelu named macrostrategies, and defined as "guiding principles derived from historical, theoretical, empirical, and experiential insights related to L2 learning and teaching" (Kumaravadivelu, 2003).

Table 5 summarizes the number of instances in the data in which the participants were considering distinct macrostrategies. Participants were not given a time limit to design their project. Interestingly, the amount of macrostrategies by each participant matches the proportion of time they spent designing their project, Hong being the one who finished her design in the shortest amount of time (approximately 45 minutes), and Cheryl being the one who spent the most time on the task (almost 1 hour and 40 minutes). It is important to note that the numbers associated with the macrostrategies correspond to the order in which they appear in Kumaravadivelu's work (2003). Macrostrategies are not to be interpreted in a ranked order but rather as a set of guidelines intended to be operationalized as a whole.

The data indicates that all participants considered two key macrostrategies: a) maximizing learning opportunities and b) facilitating negotiated interaction. It should be noted that even though this latter macrostrategy occurred as often as the macrostrategy

Table 5. Trends in the use of macrostrategies

Macrostrategy	Participants				
	Hong	**Celia**	**Cheryl**	**Klaus**	**Total**
1. Maximizing learning opportunities	2	2	6	3	13
2. Minimize perceptual mismatches		2	4	3	9
3. Facilitate negotiated interaction	2	**6**	9	**5**	21
4. Promote learner autonomy (e.g., use of learning strategy microstructures	3		1	1	5
5. Foster language awareness	3		**16**	1	20
6. Activate intuitive heuristics		1	6		7
7. Contextualize linguistic input			9	1	9
8. Integrate language skills			4		4
9. Ensure social relevance		1	1		2
10. Raise cultural awareness			7		7
Total	10	12	63	14	

"fostering language awareness," one participant, Cheryl, was responsible for most of its occurrences. The following section briefly explains these two macrostrategies and provides examples of their occurrence in the protocol data.

Maximizing learning opportunities

Kumaravadivelu (2003) defines this strategy as the "process in which teachers strike a balance between their role as managers of teaching acts and their role as mediators of learning acts," p. 39. The successful application of this macrostrategy implies achieving a balance between learner involvement and teacher guidance. From the perspective of language learning activity design, applying this macrostrategy would involve thinking of the connections students may make while working on the materials and adapting the

materials accordingly, anticipating different types of knowledge that can be activated and developed (cultural, grammatical, etc.), and considering possibilities for language acquisition through the involvement with communities that extend beyond the classroom (e.g., local or global). The following examples from the protocol data illustrate how this macrostrategy was applied:

> …definitely I want to know what countries are they noticing that are covered - let's see intermediate so what of the topics is representing - and they want to think about and do we want these to be checkboxes or how are they going to report this - oh I want them to definitely look at the photos - uhm - the subject of the photo - so this would be a really good place for them to use their adjectives - so as they compare and contrast I'm going to…(Cheryl, think-aloud)

> …first thing they do is get into their groups - each group gets a newspaper and maybe we'll do that online - they're going to look at the different sections and the first thing I want them to do before we ever do any analysis is just compare and contrast U.S. versus this - jot down what we notice there - so that'll get them acclimated - so that's good - okay- and they'll do that in small groups which will make it lots more manageable – (Cheryl, think-aloud)

Cheryl is applying this macrostrategy by anticipating the connections her students may make while working on the materials. She is considering the different types of knowledge that can be activated and developed (cultural information, vocabulary, visual literacy, etc.) and the type of learner interaction (small groups) and type of linguistic features (comparing and contrasting) that will be most suitable for this activity.

Facilitate negotiated interaction

This macrostrategy was also applied by all participants. It entails strategizing for meaningful interaction during language learning activities. This is probably one of the most abstract and difficult macrostrategies to apply, since its successful implementation (success in terms of the dual achievement of the expected type of interaction and quality of language output) does not only depend on the materials being used, but also on the multiple traits that define the specific group of participants (e.g., their age, cultural background, level of language abilibity, their beliefs about language learning, etc.). Applying this type of macrostrategy entails considering the myriad of factors involved in the instanciation of a language learning experience, anticipating how these factors will interplay, and strategizing to achieve the best possible interaction outcomes. Having

access to the mental processes in which the designers engage would help preservice teachers become aware of the interplay of the many different factors that guide expert designers' decisions. The following excerpts from the think-aloud protocol data illustrate some of the factors the participants considered and how the software triggered cognitive processes in relation to the consideration of those factors.

> … this would be a whole group [pointing to a macrostructure icon on the screen]- doing headline is whole class - and then we set small groups - and those are four small groups that would do their work - but then they come back to do one final publish for the whole class… (Celia, think-aloud)

> …and the way I was going to have them do that is that they look at the different sections - so would I want the group to do that? to do a different section? I think I'd want them to all do it - which is going get really messy unless I give them four little -- restrict it to a couple of sections - so maybe I'll restrict it to the sections they have to do it - so they're going to look at world, at local, at editorial, at opinion, and at the comics - sports, I'm sure the boys would like to - well the girls too - business, sports, education… (Cheryl, think-aloud)

> … I'm going to do as a whole class - some of this they're going to do on their own - so they might want to do the comparing and contrasting - really want them to have the papers in their hands but I guess they could - I don't want to have some people look at papers online. (Cheryl, think-aloud)

> …Adriana, Adriana, we are tyring to have Fabian[5] - and we can also have gender balance here. (Klaus, think-aloud)

The macrostrategy framework is not only useful to organize the cognitive processes involved in the design of language learning experiences, but also to identify trends and patterns in the style of the designers. This implies that we could think of designing language learning experiences not as a series of calculated activities that can be precisely defined and prescribed to preservice teachers, but rather as a craft that involves considering specific macrostrategies for the specific contexts for which the language learning activities are designed. The protocol data provides evidence that while the

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5 These names were entered in the software by the researcher.

instructors were working on designing a sequence of tasks, they were thinking about the project in different ways and emphasizing different aspects of language learning activity design (e.g., the participants, the input, the interaction, etc.). As a result, some designs appeared to be grounded mainly on linguistic concepts (e.g. the contrast of registers: how the language of the press differs from other registers), while others were anchored to multiple pedagogical and linguistic concepts (identification and production of topic sentences, gender considerations for interaction or classroom management, use of cultural referents to contextualize the tasks, etc.).

The software appeared to amplify these design features, making it possible to elucidate distinct design styles. This was probably more obvious from the observer than the participants' perspective, but one of the participants, Cheryl, commented on this quality of the software during the interview:

> I like the fact that it makes the pedagogy explicit – because as a practicing teacher I definitely think through those things but as you can see – I'm sure – or sick of seeing – I'm very back and forth in my thinking process about – and so I tend to approach it from the activity level and kind of see what I got and then I will pull all of that together using backward design in this assessment. (Cheryl, Interview)

> I think it was really interesting for me to see my own tacit knowledge - I mean - or lack thereof- exposed - for example to realize that I really prefer to plan starting with the activities even though I know ultimately I have to plan from the assessment backwards and it made me realize that I'm a recursive planner - I do it in stages - and that's something that I never realized so it would be very hard to make it explicit to my students that you might want to brainstorm first and then you might want to go back and think about how those would be clustered into the structures - and then you might want to go back and think about okay now that I sort of have some idea of what I think the pieces are how am I going to –(CH Int)

As the trends in Table 5 show, Cheryl was the only participant that considered the full spectrum of macrostrategies. She also spent the most time working on the task. In order to better understand her use of the software to apply macrostrategies, the occurrences of macrostrategies in her data were chartered on two axes. Figure 7 shows the patterns that emerged in these data.

The macrostrategy framework is a useful tool for language teachers to develop their PCK. It offers a coherent set of guidelines informed by theory, research and practice

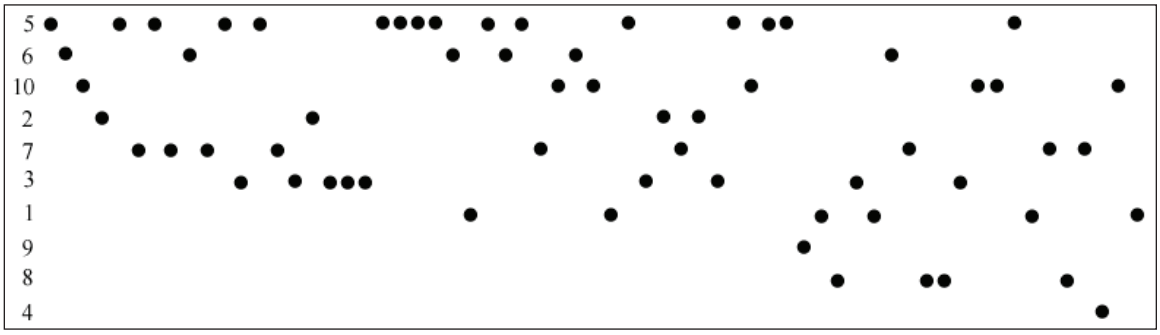

Figure 7. Cheryl's application of macrostrategies during design

Note. The vertical axis represents an ordinal scale with the macrostrategies presented in the order they appeared in Cheryl's protocol data. The numbers associated with the macrostrategies match the sequence of numbers used in Table 5: 1) Maximize learning opportunities; 2) Minimize perceptual mismatches; 3) Facilitate negotiated interaction; 4) Promote learner autonomy; 5) Foster language awareness; 6) Activate intuitive heuristics; 7) Contextualize linguistic input; 8) Integrate language skills; 9) Ensure social relevance; and 10) Raise cultural awareness.

to think and learn about what to take into account in the design of language learning experiences. The guidelines that such framework provides are undoubtedly helpful for language teachers to inform their practice without the limitation of looking at language learning through the lens of a particular method. However, the macrostrategy framework is not intended to account for specific instructional design (ID) processes that language instructors use and that preservice teachers would benefit from knowing about and trying to incorporate into their own designs of language learning experiences. In other words, the framework is not intended to specify the ID processes that assist in the implementation of macrostrategies. The data for this study give us some insights into these processes.

The patterns in the data revealed three distinct ID processes related to the way participants applied their PCK: a) the hierarchical consideration of macrostrategies; b) the iterative consideration of macrostrategies (Figure 7); and c) the repurposing of content or pedagogical process. Variations in the intensity of the application of these design characteristics appear to account for particular design styles.

A hierarchy in the consideration of macrostrategies emerged due to the fact that participants would apply some macrostrategies more readily than others. Four of the macrostrategies that were applied less frequently were: integrating language skills (MS 8), contextualizing linguistic input (MS 7), promoting learner autonomy (MS 4)

and raising cultural awareness (MS 10), suggesting that there could be a hierarchy of macrostrategies, possibly determined by the sophistication of PCK required to instantiate them. One possible explanation for the absence of these important macrostrategies in some designs could be the notion that the operationalization of certain macrostrategies requires more sophisticated pedagogical thinking. However, there is also the possibility that operationalizing these macrostrategies requires thinking that extends beyond the task level and that considers not just the specific linguistic features targeted for acquisition (KAL), but also the broader context in which the language learning activities will unfold (PCK). In other words, implementing these macrostrategies could quite possibly require a level of definition and contextualization in the design of the experience that most participants did not reach.

A further possibility is that the four macrostrategies listed above were not activated because of the limitations of the software. Cheryl, for example, who did apply all the macrostrategies, identified this weakness during the interview stating:

> … I don't think for example there's anything here [in the software] that forced me to think about culture at all - so if I weren't already oriented in that direction -and in fact if I were to really finish developing this I'd have to go back and really do that more - there's nothing here that forces me to think about - am I representing Central America versus South America versus you know - Europe - there's nothing here that forces me to say am I having students approach this task from say - for example - the perspective of an editor versus the perspective of a person who can't read very well versus the perspective of someone from a different country… (Cheryl, Interview)

Even though the software did not appear to trigger the activation of these macrostrategies, it did seem to prompt discussion that was deeply contextualized in the realm of language teaching. Cheryl attested to this idea by stating:

> …[the software] forces you a) to make your mental model explicit - b) it would allow you to assemble - to analyze, deconstruct, and assemble or reassemble that model in multiple different - I mean multiple times if you want to - as I did - and the third thing is it aids in the translation between the representations in the sense that I can think about it structurally, pedagogically, language-wise, I can think about it with words, or I can think about it with pictures, I can think about it with colors… (Cheryl, Interview)

The field of instructional design has produced a wealth of insights into the process

of design that could be used to guide and better understand the processes of design of language learning experiences. One such process is iteration. An important piece of the ID literature which draws from principles of social constructivism identified iteration as one of the qualities present in constructivist design processes (Willis, 2000). Similarly, in a recent contribution that examined what teachers learned about ID while designing technology-enhanced learning experiences, Koehler and Mishra (2005) mentioned iteration as one of the salient features of design processes. Using an approach described as learning by design, the teachers who participated in this study had the opportunity to experience the iterative nature of ID and its benefits first-hand.

The iteration of macrostrategies during the design seemed to be a constant among the participants. The first macrostrategy applied usually reoccurred after other strategies had been considered. Iteration patterns clearly emerged when the consideration of each macrostrategy by each participant was charted in the particular order the participants followed (see Figure 8).

Koehler and Mishra (2005) suggest that one of the causes of iteration is realizing that design decisions have a ripple effect throughout the design. A change in a particular aspects of a design generates the need to reconsider earlier design decisions. This may be one of the reasons that motivated iteration in the consideration of macrostrategies.

Another distinct ID process related to the way participants applied their PCK was the repurposing of content and pedagogical process. Participants sometimes extracted pieces of activities they had designed, and repurposed and reused them in a new context. While doing this, sometimes participants stripped off the content from the pedagogical processes and "recycled" those processes using different thematic context, as illustrated by the two excerpts below.

> …now the other reason I want to clone is then - so if I have that same process for the editorial I'm doing the same process with those groups for the other groups - so I would just like to copy all that for the other macrostructures related to my opinion page - world and local news… (Celia, think-aloud)

> …so opinion [one of the microstructures] would be the same [meaning the same as the editorial microstructure] - [pause]…it would be the same process, just different topic… (Celia, think-aloud)

A variation of repurposing was using the same thematic content with a different

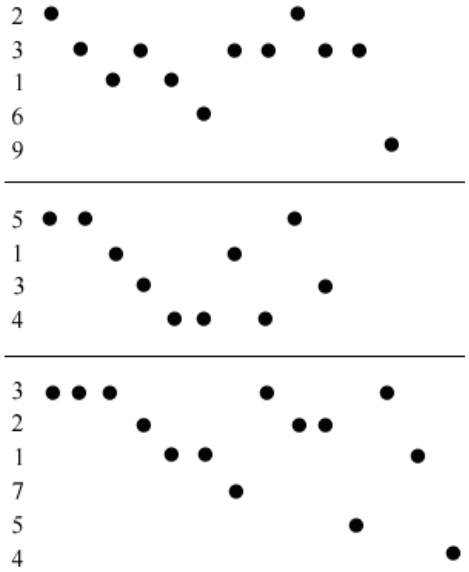

Figure 8. Participants' consideration of macrostrategies

Note. Y axis lists macrostrategy identifiers in order of consideration (note differences in order for each participant). Macrostrategies are identified with the same numbers as in Table 5.

pedagogical intent, as one of the participants explained below:

> …would still use though this type of format [referring to the pedagogical process] when we do the whole class activity - because this would model it for the whole class, and then when they will go to the four groups, they will be following the same format that we used for the whole class [with the same content]… (Celia, think-aloud)

ID processes such as these have not been thoroughly researched in WLTE and are therefore not yet adequately understood. Processes such as these are likely to surface when several microstructures combine into a macrostructure or a "project," or when the attributes of either of those structures change (i.e., changes in task features, such as the number of participants). Even though experienced language teachers would probably apply these ID processes intuitively, they may not be immediately obvious to novice teachers. The following section further explores how the tool supported ID processes.

ADS support for instructional design processes

One way to look at how the tool supported the concept of iteration is to assess how browsing, repurposing and duplication of elements was supported at the interactual level of interface organization. The ability to quickly browse back and forth through the micro- and microstructures specified would support iteration. When a "ripple" effect requires making quick adjustments in micro- and macrostructure properties, easy browsing should be possible. Participants referred to two visual enhancements that could improve the tool at the interactual level of interface organization: a) addition of icon status indicators; and b) fast access to hidden information. The former enhancement can be implemented in different ways. One option mentioned by the participants is making the icon reflect the status of completion of a given element (e.g., a microstructure icon would be half-full if some of the attributes of the microstructure it represents have been specified). The latter enhancement could be implemented by displaying on rollover some of the information contained in the icon. As one participant suggested:

> … when it comes to some of the more details - unless I get them when I'm mouseover or some other indicators there - then I don't think it would help me as much. (Celia, think-aloud)

Implementing these visual cues would probably improve support for iteration.

The repurposing of elements in the software was mainly supported by changes in the properties of the macro- and microstructures or by changing their order or function in a given cluster of micro- or macrostructures. However, the repurposing of elements was not supported across hierarchies. For example, a microstructure could not be turned into a macrostructure. The protocol below illustrates an instance of that situation:

> … now I'm thinking of turning those into macros because I have subtasks underneath those that I want to have them actually do - so can I just magically turn them into macros? (Celia, think-aloud)

> … I could go about it - I think- in a different way - is it possible to uh - produce - is it possible to produce structures and then call them - unify them under one macrostructure - or is it better to have the macrostructure first … (Klaus, think-aloud)

Interestingly, there were no instances in the data where the participants tried to implement the opposite process, i.e., turn a macrostructure into a microstructure.

The duplication function in the software was limited to the copy/paste function

from text fields, i.e., text copied to the clipboard could be pasted in a text field in the software. However, specific interface elements such as micro- or macrostructures could not be cloned and consequently had to be redone to be duplicated, which was a source of frustration for some of the participants. The protocols below illustrate instances when the participants thought about using copying functions to replicate a micro- or macrostructure. They also illustrate the interruption caused in the participants' thought process due to the lack of this function in the software.

> I'd almost like to be able to clone these tasks because if they know they're going to be doing some individual writing and they might publish those little individual pieces before they do a final publish, would almost be the same task - so to be able to clone them would be kind of nice – (Celia, think-aloud)

> this is going to be world news - local news - editorial - so now that I know - now that I can see what they're doing I can start in this other macrostructure - oh man, I wish I could copy this - there's no way to copy this and? cause if I could copy then I could manipulate - add my other pieces in here but that's all right - okay so schema - so divide into groups - I'm not sure how I want to do that... (Cheryl, think-aloud)

> … so I'm going to have to go through this four times I think - can I move this ? […] okay so group four - so in essence what we want here - oh okay - okay - can you copy these? [tries copy/paste] okay so I'm going to have to do this four times… (Klaus, think-aloud)

This section expanded on the applications of macrostrategies as part of the instructional design processes that the participants engaged in. The section closed with some observations on the limitations of the macrostrategy framework to look at the ID processes involved in the application of macrostrategies. It described some of those processes and how the software supported them. The next section further explores the dynamic interaction of different types of knowledge and processes involved in the design of language learning experiences.

Claim 3: Designers of language learning experiences base their design on proto-tasks

This section describes a mental model, named proto-task, which participants used to inform their designs. This mental model is relevant to the integration of technology into WLTE. The relevance lies on the assumption that if teachers use proto-tasks to inform the design of language learning experiences, the integration of technology into language

learning experiences should reach that depth of conceptualization in the designer's mind. In other words, technology should be part of the proto-tasks used by the designer if it is to be optimally integrated.

The analysis of the think-aloud data revealed the participants use of rather specific mental models, named here proto-tasks, that were used as reference for the instantiation of the specific project tasks that the participants were requested to design for this study. As the literature in the field has repeatedly suggested, designing sophisticated language learning experiences requires the consideration and critical evaluation of an extraordinary amount of information (e.g., Meskill et al., 2002; Tsui, 2003; e.g., Woods, 1996). Strategizing for the effective integration of technology to enhance language learning compounds this task. It makes sense then that participants would work on the design of their task as if following known guidelines (macro- and microstrategies) as well as a proto-task.

Defining proto-tasks

A proto-task is defined here as a mental model that is informed by the designers' knowledge of design of language learning activities. The TPCK model described previously represents the types of knowledge contained in these metal models or proto-tasks. The notion of mental model is used in this study to describe the interaction and organization of those types of knowledge. Mayer (1992, in Winn) identified two properties of mental models: 1) representations of objects (objects in the software are micro- and macrostructures; each object has a number of properties, e.g., a microstructure contains properties such as input, participants, procedure, etc.); and 2) descriptions of how a change in one object affects other objects.

The first protocol illustrates the representation of objects. Klaus uses "level of production" as a variable to define one of the objects of the proto-task (microstructure or task). He makes explicit aspects of his TPCK by assessing the output ("mostly written language") and giving an indication that the expected output would be reasonable considering the type of electronic environment the learners are working on ("that's okay…given the online environment"). The second protocol gives an example of the dynamic interplay between objects in the designer's proto-task. A task based on the notion of comparing and contrasting information (object) prompts the creation of a Venn diagram to scaffold the activity (object), and the creation of a Venn diagram prompts in turn the use of technology to do comparing and contrasting.

> I would call it a microstructure - umm - depending - I guess it depends on their level of production - how much they produce - but in essence they produce mostly written language - uh - and that's okay - you know given the online environment anyhow - (Klaus, think-aloud)

> so they're going to look at this - so I'm going to need some little Venn's [diagrams] - and I need one to be a model, which means we are going to need technology before they do this - let's save and close that - did a little technology… (Cheryl, think-aloud)

In conceptual modeling theory, an object is "the basic modeling construct around which all other modeling constructs are defined" (Boman et al, 1997, p. 49). Drawing from conceptual modeling theory, we can think of the microstructures in the software as objects. These objects were designed to contain a set of properties that minimally define a language learning activity, namely the goal/s of the activity, the participant/s involved, the input and the process that the language learners were expected to engage in using the input. Figure 9 shows how this concept was graphically represented in the software.

Support for proto-tasks

Much of what is done in WLTE is related to learning and applying concepts (e.g. designing a language learning activity that incorporates a focus on form and a communicative component). In an analysis of the applications of concept theory to instructional design issues, Jonassen (2006) argues for a "concept-in-use" approach to learning and assessing concepts. From this perspective, concepts need to be learned in "the context of conceptual organizations fostered by the development of personal theories of the world and the conceptual change that facilitates those processes" (p. 179).Jonassen further contends that technology-based system modeling tools are well suited for this type of approach to concept learning since they "require learners to represent the integration of concepts into meaningful propositions, rather than focusing on concepts as discrete entities"(Jonassen, 2006, p. 191).

Jonassen's point bears relevance to this discussion because the WLTE curriculum is often built around discrete categories of information (e.g., second language acquisition, methodology, phonology, CALL, etc.) that language teachers are expected to apply to the design and execution of language learning experiences. Technology tools that support and foster the application of a concept-in-use approach in WLTE may help to more readily integrate the preservice teachers' TPCK and develop proto-tasks that are informed by that

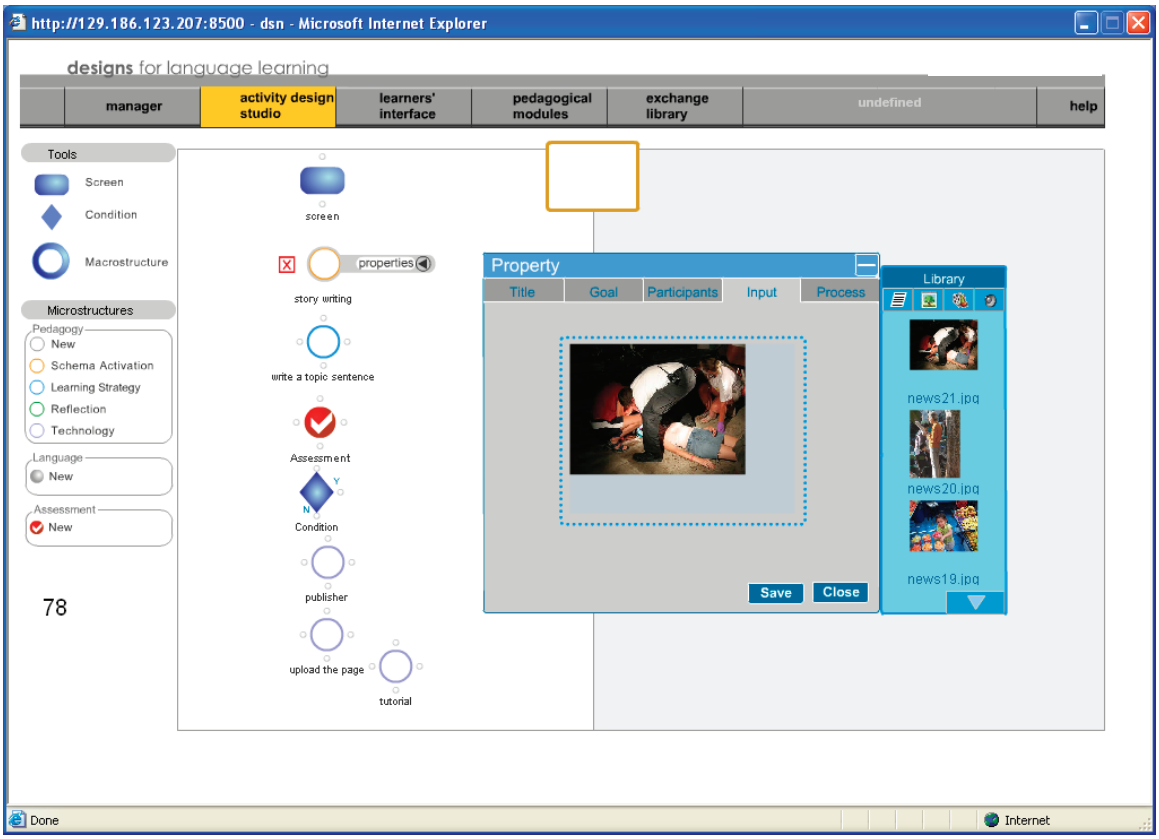

Figure 9. Property dialog box.

Note. The content corresponds to a microstructure named "written language," which was created by Hong. The input property is associated with a multimedia library that contains texts, pictures, sounds and videos. Items from this library can be specified as input for a particular microstructure, as was the picture that appears in the input box.

deep understanding of technology integration.

As previously stated, a system's modeling tool is intended to represent the dynamic relations among factors in a system (Jonassen, 2003b). To do so, building-block icons that represent processes are used to define the system model. In the case of the Activity Design Studio, the tools (i.e., screen, condition, and macrostructure) and microstructure icons constitute the main building blocks[6]. A good match between the concepts represented by the building blocks available in the software and the designer's proto-task

6 A detailed explanation of each of these tools is available at www.language.iastate.edu/dsn/index.html

is necessary for the tool to reach its maximum potential for knowledge representation. Four software features at the conceptual and interactual levels of interface organization (Cooper, 2003) appeared to have an impact on the adequacy of the interface to represent complex concepts: a) the metalanguage used in the interface; b) the representation of interaction; c) the availability of pedagogical constructs on the interface; and d) the availability of a graphical synthesis during the creation of the project. The first feature is related to the conceptual level while the other three have a closer connection with interactual aspects of interface organization. The following section expands on these three features.

a) Metalanguage used in the interface

The software is intended to assist in the graphical representation of complex language learning activity design concepts, which, to a certain extent, reflect the designer's mental models that guided their construction. For the software to be efficient, the metalanguage used in the interface to refer to the building blocks used to create graphical representations should be easy to learn and should support the designer's thinking. The data indicate that the concepts of micro- and macrostructure were easily adopted. The protocol segment below illustrates coherence in the use of the terms "microstructure" and "macrostructure," despite Klaus' perception that he is not using them in the intended way:

> … if I think this through - in essence I'm sort of replicating my own model - but I'm replicating it not exactly understanding how - what everything is - so I'm having a hard time assigning - sort of telling what a macrostructure is - but according to the definition a series of macrostructures are needed - macrostructures and microstructures are needed to produce a project - so the entire thing I see is a project with different macrostructures or the different groups could be macrostructures or activities that occur in those groups - macrostructures - and then there would be individual little activities of students looking at an image and writing a little thing - that would be - I would call it a microstructure - umm - depending - I guess it depends on their level of production - how much they produce - but in essence they produce mostly written language – (Klaus, think-aloud)

There were instances, however, when the participants did not find the metalanguage used to describe the tools easy to apply. Klaus, for example, expressed his frustration with the ambiguity of the concept represented by the tool named "screen:"

> "I'm having a hard time assigning these tools to my own terminology - cause we

> use here the screen as sort of an input - but what they're producing is an online newspaper - which I think can also be looked at as a screen - so that's how I would organize this - now my problem is - how do I - so this is the overall architecture of this task. (Klaus, think-aloud)

b) The representation of interaction

The way learners were supposed to interact during the project was another software feature that had an impact on the representation of concepts using the interface. Interaction among participants is a key component of a communicative language learning activity. Adequately representing participant interaction is important because of the impact it may have on language learning. The ability to represent different types of interaction among participants is a necessary component in a software tool such as this one.

In the prototype tested for this study, activity participants were specified at the microstructure level. The designers overcame the constraints of such limited functionality by using creative ways to graphically represent interaction. Klaus, for example, used a macrostructure icon to represent a group of participants:

> ...apparently we cannot assign multiple pictures unless we have an image with four - so I think what I need to do - I need to - okay - I'm looking for something that would be most similar to a group but a macrostructure is - a product - a set of processes - it's not a group - so pedagogy - assessment - I think the only thing that I can do here is really macrostructure. (Klaus, think-aloud)

Similarly, Celia used pedagogy microstructure icons to specify interaction.

> I'm going to use it as just a pedagogical "set my groups" so it's a marker of where I'm going to do that in this whole thing (Celia, think-aloud)

Cheryl's design in Figure 10 below shows the pedagogy icons marking interaction with the labels: *divide into groups, distribute pictures, 4 new groups* and *vote.*

Klaus, who tried to implement quite a sophisticated array of interactions, took advantage of information available in the software that may have an impact in the resulting interaction:

> Adriana, Adriana, we are trying to have Fabian - and we can also have gender balance here - they get a picture - the process: description (Klaus, think-aloud)

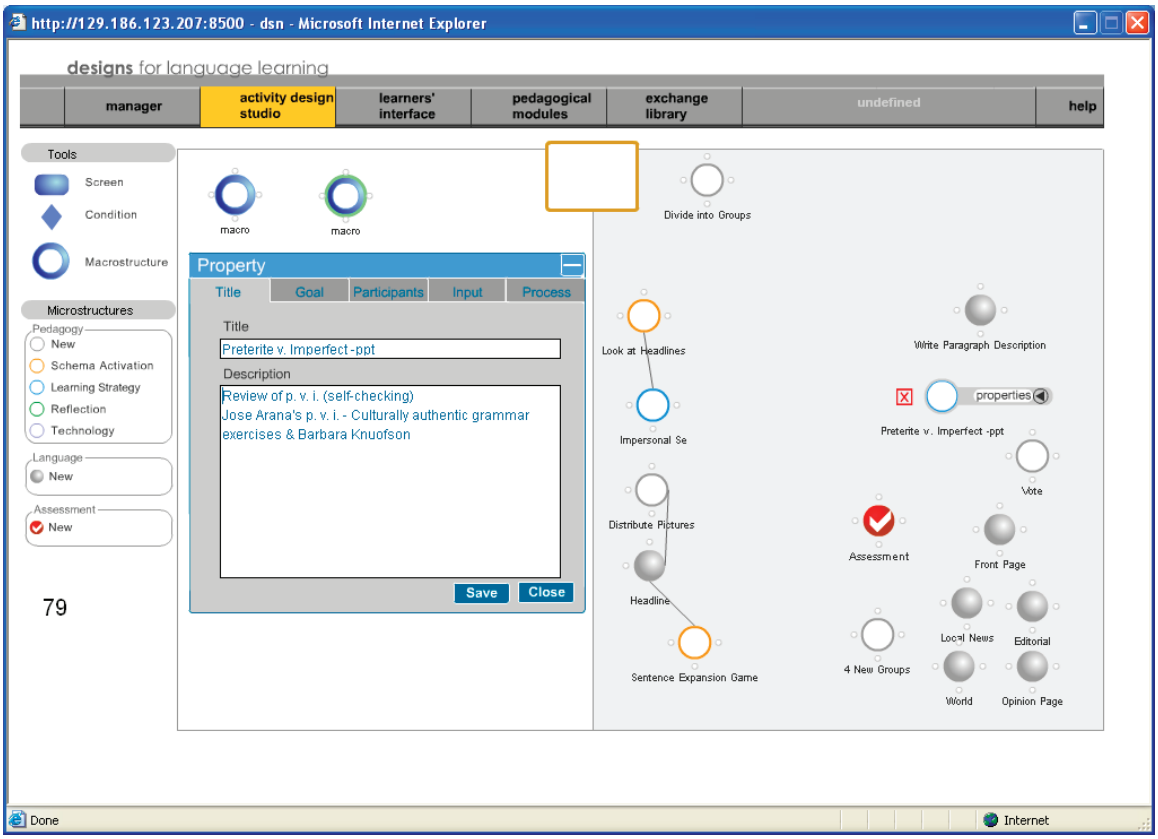

Figure 10. Capture of Cheryl's design on the ADS interface

c) The availability of pedagogical constructs

The main menu of the ADS included pedagogical constructs such as learning strategy, schema activation, etc. The availability of these constructs on the interface appeared to have an impact on the design of activities. Particular icons were used because they were available, which suggests that if the building blocks in the software menu could be modified, the menu could be use to make specific pedagogical concepts salient.

The following protocol segments illustrate instances where the availability of the tool appeared to prompt the designers' use. The first protocol refers to the association of activities with standards. Different types of standards were available in the same section where the designer was supposed to specify an activity goal.

> …okay that's the final product - a goal - a description - produce a newspaper - it's just the front page - [while typing] front page of the online newspaper in the L2 - activity standards? - how do I add standards? (Klaus, think-aloud)

> …now my macrostructure is going to *be schema activation* - learning strategy - there's going to be some *reflection* within that group - but I want to complete one - we're going to put the *reflection* here - schema - I need something in the middle that says production. (Klaus, think-aloud)

> …one component that I haven't included here that I think is important - we have to include assessment - there has to some assessment - now based on this task or the description of the task - assessment is not even included - the assessment occurs at the local level - or assessment. (Klaus, think-aloud)

The use of pedagogical tools prompted by their presence was also mentioned during the interviews. In the following excerpt, Cheryl explains how the interface influenced her pedagogical thinking:

> ...well normally I would have just had them share stuff - and actually this is when I think it'd come down so you don't see it here - then I went to get a technology button because I saw it over there and I thought oh what a great way they could each e-mail those to me and we could dump them in a powerpoint or whatever and they could be flashing up and you know with a digital photo the kids could have made headlines about themselves with a picture and wouldn't that be fun and meaningful and - in a different - I mean to where they certainly have a reason to want to pay attention while they were presented in a way that without the technology if you just have them stand up and read them - they wouldn't care - so having that button [the technology icon] made me think of the option - and I wouldn't have otherwise. (Cheryl, Interview).

d) Availability of a graphical synthesis

As the participants worked on the development of their projects, a graphical synthesis of their project took shape on the canvas. Easy access to this graphical representation appeared to be a valuable feature of the software. Having this type of graphical representation gave participants more flexibility to think about different aspects of the design of their projects from different perspectives. Because adjusting aspects of the project (e.g., activity sequencing, participants, activity input, etc.) is relatively easy to do, it was relatively easy for participants to consider different scenarios. The following excerpt from Cheryl's interview illustrates the advantages of this software feature:

> ...and this software allows the user to look at each facet or each of those components of the project and the way that it represents those visually not only allows me to

> look at it individually but to look at the relationships among them - and so because the software allows me to see the relationships it allows me to be more cognitively flexible as I'm planning than if I were trying to plan it just out of my head or in a linear way on paper - not that the relationships aren't still present - not that the three layers still wouldn't be present but because I can visualize the relationships it allows me to manipulate them and to change them in ways that are more flexible than I think I could if I couldn't - if I were planning linearly - it allows more translations between those sort of representations if that makes sense. (Cheryl, Interview)

The previous section explored the participants cognitive processes while they worked on the software. This section of the representational analysis reports three categories identified in the answers to the interview questions. All categories refer to the participants' perceived usefulness of the ADS in WLTE contexts. The following three categories were identified: a) making tacit knowledge explicit to users (e.g., using the tool to model or talk about the design of language learning experiences with preservice teachers); b) making designers aware of their own design processes thus promoting opportunities for reflective practice; and c) creating "*zones of engagement*" that foster dialog about and facilitate the communication of complex pedagogical concepts among language activity designers.

After her experience using the ADS, Cheryl described the potential of this kind of tool in a WLTE context by stating the following:

> ... it would be helpful for me as a methods professor to sit down with one of my preservice teachers and be able to say okay - so - especially if I had a few more options in terms of colors over here - so that I could say at a glance you have no pre-reading activity -you know – pre-activity here - you're doing no scaffolding here - where are your management pieces here - there's no technology here – (...) I can see very quickly what they're doing and the other thing I like about them is that I can see - especially if they are consistent in their coding – I can see what it is they think they're doing so for example here they might think the discussion or flyswatters or whatever is the learning strategy - and it helps - I'm not expressing this very well - but I think it would help me to see quickly (...) it would be a concrete way for me to say if you moved this here and if you inserted one of these here and I could literally point and they would be able to see what I'm talking about … what am I trying to say here - I like the fact that it makes the pedagogy explicit - because as a practicing teacher I definitely think through those things. (Cheryl, Interview)

Klaus and Hong also pointed to the potential of this tool after their experiences with it:

> …. when they [preservice teachers] develop this I could see the design- the process and it would be easy to point out what things would work and what things would not work. (Hong, Interview)

> …what I really liked about it - in a way I think it worked okay for me was understanding the task and printing sort of a schema of the task and then being able to implement this relatively easy onto the screen - so what I sort of have in mind - my tacit knowledge as you call of what needs to happen or shouldn't happen - I think you can do this with the student. (Klaus, Interview)

The tool's potential to raise awareness of one's own design processes also appears to be a valuable characteristic. Cheryl experienced this first-hand and made the following comment:

> This is interesting because I'm not sure I voiced it while those thoughts were happening – I was focused more on the process but it made me rethink – and realize I'm not – I don't backward design in the way that I thought – it made my thinking more explicit to me – I guess- and it made me realize that when kids [language learners] have to manipulate objects – that's why I think my lessons where I'm asking them to DO stuff – in conjunction with the words - or the lessons where I ask them to draw something based on the words or to interpret a drawing and make words out of it are so effective, because it's forcing them to make explicit a lot of mental – it gives them the tools to make explicit the mental models that they have in their head. (Cheryl, Interview)

In a description of environments that foster constructivist learning, McMahon and O'Neill (1993) put forward the term "zones of engagement" to describe the zones of interactions between tools and users. Such zones include the topics, the tools that mediate communication, the participants and their thinking processes, and the concepts that trigger their interactions. The concept of "zones of engagement" is useful to think about the potential that tools like the ADS may provide in the context of WLTE. As the previous analysis shows, complex amalgamations of knowledge are often created and summoned during the designers of language learning experiences. The creation of zones of engagement that support the discussion of these highly sophisticated concepts with preservice language teachers would create opportunities for higher-level thinking and discussion in WLTE contexts. One particular byproduct of interactions within a zone of engagement that is relevant to this discussion is the creation of "cognitive shortcuts."

The idea of having a tool that can help build "cognitive shortcuts" is a powerful

concept for the context of WLTE, where, as discussed in this study, the amalgamation of complex forms of knowledge is commonplace. In the literature of acquisition of medical expertise, the process of creating hybrid forms of knowledge that draw from a person's expertise in a variety of areas is referred to as knowledge encapsulation. Knowledge encapsulation theory posits the hypothesis that medical knowledge is composed of interlinked biomedical and clinical knowledge (Verkoeijen, Rikers, Schmidt, Wiel, & Kooman, 2004). As Boshuizen et al. have asserted, "[knowledge] encapsulations function as a sort of shorthand in clinical reasoning processes" (Boshuizen, Schmidt, Custers, & Wiel, 1995, p. 273). As this study has discussed, it appears that knowledge encapsulation processes naturally emerge and may become "visible" when working with a tool that motivates its use. We know from experience that "learning to design sometimes takes the form of making explicit what one already knows how to do" (Schön, 1987, p. 87). The ADS appeared to assist in making knowledge explicit through its graphical interface.

This part focused on a representational analysis of the data. As mentioned before, the basis of this representational analysis was the identification of themes and categories within the protocol and interview data respectively. The next part supplements this analysis with a complementary perspective, namely a presentational view of the data.

Presentational analysis

This section focuses on a presentational analysis of the data grounded mainly on a word frequency analysis and concordances of the protocol data. The purpose of the frequency analysis was to identify recurrent semantic units referred to by the participants in order to better understand how the participants' thinking was supported by both interactual and conceptual aspects of interface organization. The participants' use of the words displayed in the interface gives us some insights into the interactual level of interface organization. For example, frequencies reveal whether they adopted the interface "metalanguage," which are the building blocks of the tool. Likewise, a closer examination of high-frequency terms using concordances gives us some insights into the conceptual level of interface organization.

The four figures below show a rank order depiction of the words that participants used most frequently during their think-aloud sessions. The font size of each word corresponds to a rank in a rank-order scale (see detailed protocol in methodology section above). For example, in Figure 11 (Cheryl's frequencies), the word "look" appeared most frequently in the protocol data so it is represented with the highest font size in the

figure. Variations in frequencies across participants are not reflected in these figures. Therefore, the highest font size always corresponds to the highest frequency rank, but the highest frequency rank for each participant does not necessarily correspond to the same number of occurrences. So the semantic unit "think" in Cheryl's sample corresponds to 49 occurrences and placed in rank 2, while the same semantic unit in Celia's sample corresponds to 21 occurrences and also placed in rank 2.

As the figures indicate, interesting commonalities emerged among all participants. For example, terms that denote mental activity and learner interaction appeared very frequently in the think-aloud protocols. Some examples are the terms: group, section, whole, activity and numbers (e.g., from Klaus' think-aloud data: the term *four* appeared in segments such as "divided in *four* groups*";* "I'm going to have two groups of *four* and two groups of three"; or "can I group this with group *four*?"). This seems to indicate that the software did prompt thinking about this important aspect of language learning activity design. Participants often also thought about specific features of the interaction, such as the type of thinking participants in the activity would be engaged in ("compare and contrast while in their *groups,*" Cheryl's think-aloud); and how the interaction would be set up ("those *groups* I assume they're going to be formed electronically," Klaus, think-aloud).

Also common to all participants was a sense of active engagement with the design of the learning experience. The semantic units *see*, *think*, *produce*, *want* and *publish* illustrate this point. Interestingly, these terms were used in two distinctive ways according to the agent that performs the action, i.e. the instructor or the learners. Concordances in Cheryl's protocol, for example, make it clear that in many instances the learner is the agent performing the thinking. The concordances from Cheryl's and Klaus' protocol segments (Figure 15) illustrate instances of the terms referring to the learners.

As the frequency data figures indicate, the participants' work with the tool elicited terms that refer to the visual representation of their designs and to the iconic representations on the interface. Those terms include: *picture*, *look*, *see*, *piece*, *headline, write*, as well as the labels on the interface such as *micro-, macrostructure, condition,* respectively. It is interesting to note that even though participants worked at the microstructure level defining the individual activities that would make up the project, the word macrostructure and variations (e.g., *macro*) occurred much more frequently than *microstructure*. This indicates that even though the participants' focus shifted from the design of a project component to another one, they kept in mind the macrostructure

Figure 11. Cheryl's word frequency (Word count: 7,817)

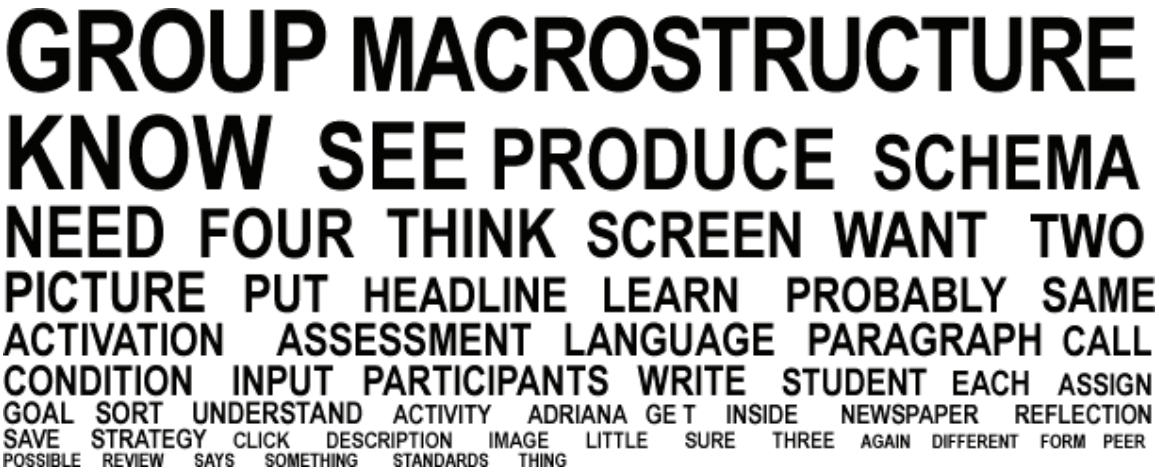

Figure 12. Klaus' word frequency (Word count: 3,565)

aspects of their designs while they did so.

The protocol and frequency data also indicate that the participants who had the most difficulty using a limited number of "building blocks" to realize the complexity of their mental models (i.e., Celia and Klaus) were also the participants who appeared to use the interface metalanguage (e.g., micro-, macrostructure, screen, etc.) most in their verbalizations. High-frequency use of interface terms in this case appeared to signal difficulties understanding the conceptual organization of the interface. The concept of

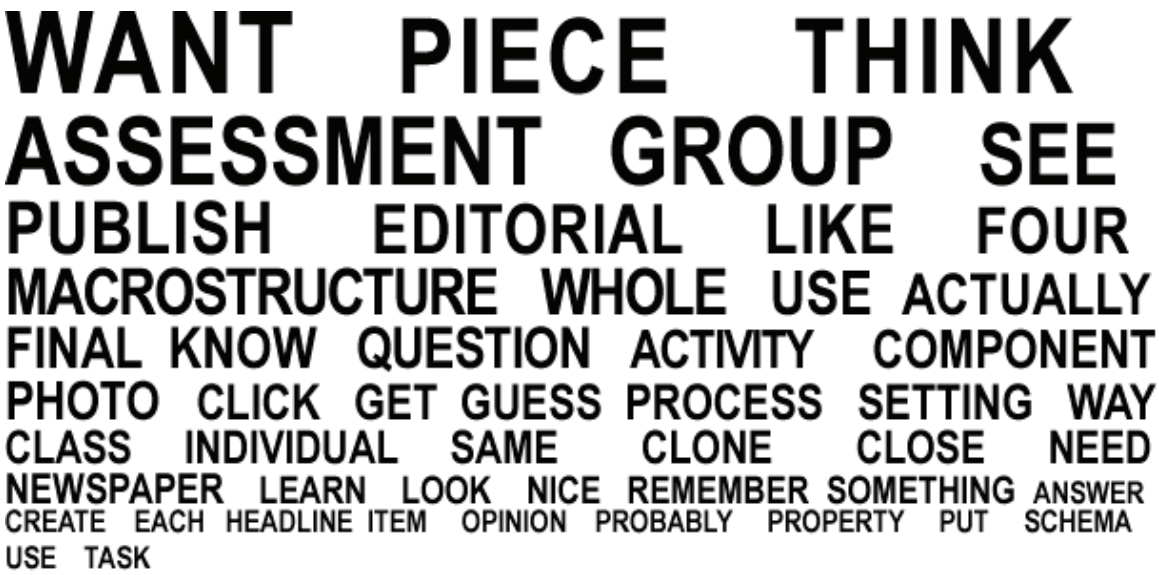

Figure 13. Celia's word frequency (Word count: 2,854)

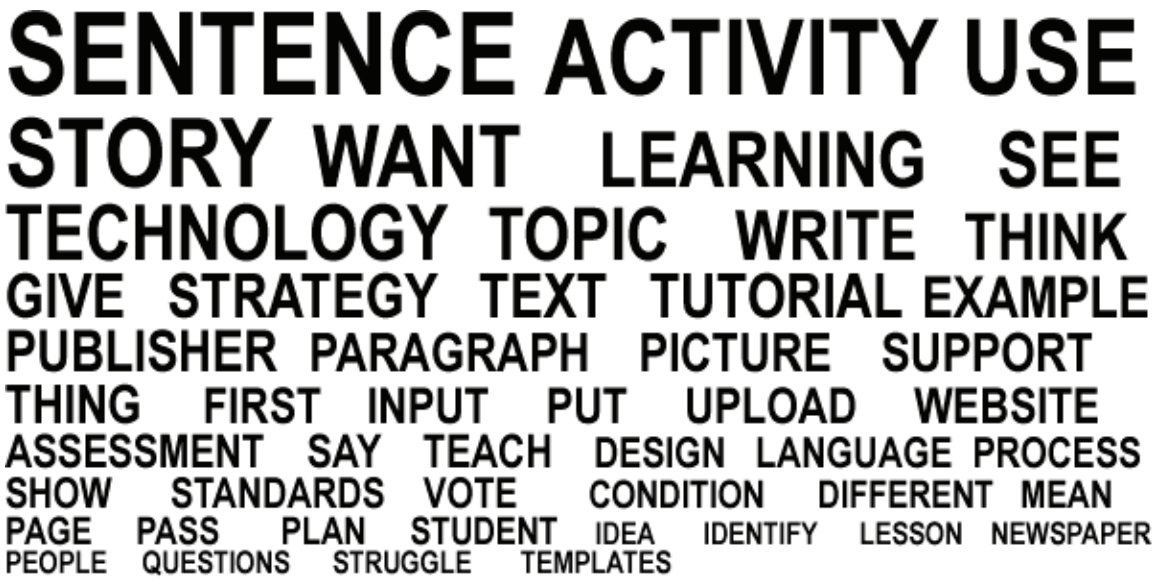

Figure 14. Hong's word frequency (Word count: 3,139)

cognitive overload may help explain this seemingly contradictory finding. Participants were asked to design a fairly complex project after a brief demonstration of how the interface operates. Learning the software at the same time they were designing a language learning activity from specifications given by the researcher gave participants too much

and they want to **THINK** *about* and do we want these to be
so they have a chance to **THINK** *about* it and I
then I want them to **THINK** *about* words in terms of the content
they are ready to **THINK** *about* what is in the article so they
so once they **THINK** *about* the stuff that's in the newspaper
so I want them to **THINK** *about* what they're going to need to do
(Cheryl, think-aloud)

I **WANT** *them* to prepare oh that would be an easy way
I **WANT** *them* to link to a newspaper okay so if I
I'd **WANT** *them* to all do it which is going to get
I **WANT** *them* to look for cognates or do I
I **WANT** *them* to compare and contrast those words so I
so I **WANT** *them* to think about what they're going to need
the first thing I **WANT** *them* to do before we ever do any analysis
I **WANT** *them* to see the relationship between form and
(Cheryl, think-aloud)

so I want them to **SEE** *the* relationship between form and function
they are going to have to **SEE** *the* venn underneath we'll put that
that they're going to **SEE** *the* similarities between *the* target
we'll just say oh let's **SEE** *the* pictures right here oh that's cute
they need to **SEE** *the* concept map before they do *the* article
want them to **SEE** *the* cognates what they think stories are
(Cheryl, think-aloud)

where they **PRODUCE** *a* headline and the paragraph and then
they have to **PRODUCE** *and* then there's a reflection *and* then
how much they **PRODUCE** *but* in essence they
but in essence they **PRODUCE** *mostly* written language uh and that's
and THEY **PRODUCE** *the* way I understand this is that *the*
they moved on to **PRODUCE** *this* next one now screen I'm not quite
the four best stories **PRODUCED** *by* the group are then combined to
four groups where each one **PRODUCES** *a* headline and *a* paragraph out of but what
they're **PRODUCING** *is* an online newspaper which I think can
(Klaus, think-aloud)

Figure 15. Cheryl's and Klaus' protocol concordances

information to process. Reading the terms featured on the interface probably helped cope with the overwhelming amount of information. In some instances, reading the terms was a way to stall development and think about a particular aspect of the design.

Finally, frequencies in think-aloud protocols appear to point to differences in the participants' approach to the design of the project. For example, Cheryl's most commonly used terms appear to reveal a highly visual thinker. This is an aspect of design that has not yet received proper attention in the literature related to WLTE or instructional

design. Specifically, the instructional design literature often emphasizes discreet design processes and has not dealt with the designers' thinking in relation to their design style. The following excerpt from Cheryl's interview further illustrates her natural inclination to focus on visual aspects of the interface organization:

> I liked that each of these is a completely different shape - those have associations for me - even down here - I mean the design of it definitely does support the concept of activity structures - also the fact that these are containers [the macrostructures] and that these things are individual so you could actually even start with one of these containers as your overall and start working backwards that way or you could start with the smaller pieces and building up to the assessment - but it gives me the flexibility to do it either way - I like that - uh - I do wish that I could sort of - kind of like in a drawing uh - on a drawing screen like in a paint program you can have these three things - or even in Word where I can go get the little arrow like this and draw around them and that would suddenly become a group - I kind of like for it to work a little more like that - or like I said if I could drag things in and out of the groups - I would like that - but I think the color coding, the shapes and the fact that you built in multiple levels and that I can see instantly the linkages in the purposes from the color coding and from the shapes - and that might be another interesting way to approach it: if you have learning strategy be always blue - but then if you have a sub-layer - maybe they're blue diamonds or blue squares - depending on - you know what I mean? (Cheryl, Interview)

The presentational analysis of the data unveils two aspects of the tool that deserve further investigation. At the conceptual level of interface organization, it appears that the tool's functions may serve as a catalyst to engage participants into deep thinking about the design of language learning experiences. The occurrences of semantic units across participants that correspond to a semantic domain that could be labeled "interaction" supports this claim. At the interactual level of interface organization, it appears that the interface terms did not give participants the flexibility of overlaying their own terminology to the functions of the tools. Participants who could get past the need to comprehend the exact function of the interface tools more easily appropriated the tools. On the other hand, the interface metalanguage seemed to get in the way in the case of participants who struggled to make the tools' terminology fit their own.

Conclusion

This study provides valuable information on a cognitive tool that could potentially foster our understanding of the blending of technology, pedagogy and WLTE for the

improvement of language learning and teaching. As this study has shown, the ADS can contribute to the construction and enrichment of language teachers' knowledge of design of language learning experiences. Below I synthesize the features of the ADS that were found in need of improvement and briefly summarize the features of the ADS that manifest potential for the improvement of WLTE and related research. The research questions that motivated this study serve as a guide to organize this section.

The ADS appeared to provide support for the cognitive processes of the participants in three main ways: 1) it activated complex knowledge structures; 2) it triggered thinking about essential components in the design of language learning experiences, such as planning for learners' interaction; and 3) it provided a means to visualize a) the articulation between activities and assessment at both a micro- and a project level and b) a synthesis of the whole language learning experience. The possibilities the tool opens for visualization appeared to be exiting for participants:

> ...the ability to visualize what I'm doing on paper makes it easier to almost imagine my students' doing these things - and to identify where the breakdowns are going to occur in a way I can't do when I'm designing this with words only. (Cheryl, Interview)

As this study has shown, conceptual and interactual aspects of the interface organization had an impact on how the tool supported the participants' cognitive activity. At the conceptual level, the interface appeared to successfully provide *cognitive shortcuts* to think about and communicate pedagogical concepts, even in the cases where interactual aspects of the interface organization interfered with the participants' intent. An example of such shortcut is the macrostructure icon. Even though participants referred to this icon in different ways (e.g., group, container, macro, macrostructure), the understanding of its basic functionality (i.e., serving as a container for a group of microstructures) was shared across participants.

Also at the conceptual level of interface organization, the availability of pedagogical constructs on the interface appeared to make them salient, which in turn motivated their use. The following excerpts from two interviews illustrate this point:

> "I think by having reflection listed there under pedagogy - it certainly implies that it's an important component - what it looks like, how it's done, how it all connects within one project and across projects, depends on the implementation. (Celia, Interview)

> "I would find myself inserting things that maybe I hadn't thought of before because they're sitting over here blink… I mean not blinking but kind blinking at me as options - they are ever-present … (Cheryl, Interview)

This finding has direct implications for interface revisions. Having the flexibility to manipulate the constructs that are available in the microstructure menu would open up many possibilities in WLTE contexts. Specific pedagogical concepts could be made salient to preservice teachers by placing them on this menu. Revisions to the interface should then consider the addition of a menu customization tool that would allow the principled manipulation of the microstructure menu.

At the interactual level of interface organization, the absence of two main functions had an impact on the cognitive processes of the participants, namely a) the lack of a copy/paste function; and b) the lack of a repurposing function (e.g., turn a microstructure into a macrostructure or viceversa); and c) the availability of only two levels of depth in the design of projects (macro- and microstructure) appeared to present a critical limitation. It is important to revise these aspects of the interface because not having these functions readily available often interrupted the participants' thinking, sometimes replacing higher-order thinking related to aspects of activity design with busy-work intended to duplicate or repurpose and element. The lack of a function to repurpose elements also presented a significant limitation. Even though participants sometimes took the trouble to recreate an element with all its properties, having the flexibility of repurposing elements would allow participants to take more risks revising and redesigning portions of their designs. Finally, the availability of only two levels of depth in the design (macro- and microstructure) appeared to unnecessarily constrain the design and, in some cases, was a source of frustration for participants. The following excerpt from Celia's interview illustrates this point:

> "[expert teachers] will tend in their thinking to go deeper and to create more layers, whereas a novice user probably two layers would be great - but someone like me I'm ready to think four layers deep as to what that's going to look like - so if they have to create this final product and they're going to do this in small groups, well when they are in their small groups they have to go here and before they go here they have to go to this other place - so I'm already two three - I'm already four layers deep - and the tool only allows me to go two. (Celia, Interview)

As Celia's comment indicates, the level of expertise may correlate with the amount of depth that a designer would find suitable for the creation of a project like the one

participants designed for this study. Having only two levels of depth, however, offers the advantage of keeping the complexity of the design relatively under control. Therefore, the ability to manipulate the number of layers available for a project seems to be the optimal solution at this point in the development. Having this type of flexibility would allow language teacher educators to scaffold design projects in WLTE contexts.

An aspect of the tool that appeared to foster constructivist pedagogies was its ability to trigger metacognition. Bednar et al. (1992) affirm that, "[r]eflective awareness of one's own thinking implies monitoring both the development of the structure of knowledge being studied and the process of constructing that knowledge representation" (p. 30). The data provided evidence for these two complementary processes:

> ... this is interesting because I'm not sure I voiced it while those thoughts were happening - I was focused more on the process but it made me rethink - and realize I'm not - I don't backward design in the way that I thought - it made my thinking more explicit to me - I guess- and it made me realize that when kids have to manipulate objects - that's why I think my lessons where I'm asking them to *do* stuff - in conjunction with the words - or the lessons where I ask them to draw something based on the words or to interpret a drawing and make words out of it are so effective because it's forcing them to make explicit a lot of mental - it gives them the tools to make explicit the mental models that they have in their head - and so this helped me to see - I mean all that stuff kind of flies around up there but this gave me the tools to really start to work with those mental models and I think eventually if I got - I'm thinking more comfortable with the software. (Cheryl, Interview)

As the interview segment above shows, Cheryl reflected on her use of the tool at the same time she was using it. Her verbalization of the experience implies she was monitoring the development of new knowledge as she was drawing parallels between her learning experience using the tool and her experiences observing language learners learn. The elicitation of this type of profound reflection is precisely what the use of the ADS is intended to produce in WLTE contexts.

Further exploring and exploiting the possibilities that a cognitive tool like the ADS opens is one of the many challenges to come in WLTE research. Although this research is not intended to define a new area of enquiry, it hopefully demonstrates that research into WLTE needs to go beyond CALL for any meaningful integration of technology to take place in WLTE contexts. Contextualizing enquiry within WLTE will help us consider issues that are essential for the improvement of WLTE.

References

Allwright, D. (2006). Six promising directions in applied linguistics. In S. Gieve & I. K. Miller (Eds.), Understanding the language classroom (pp. 11-17). New York: NY: Palgrave Macmillan.

Amiri, F. (2000). It-literacy for language teachers: Should it include computer programming? System, 28, 77-84.

Antony, E. M. (1963). Aproach, method, technique. English Language Teaching, 17, 63-67.

Arnold, N., & Ducate, L. (2006). Future foreign language teacher's social and cognitive collaboration in an online environment. Language Learning & Technology, 10(1), 42-66.

Ausubel, D. P. (1968). Educational psychology: A cognitive view. New York, NY: Holt, Rinehart and Winston.

Bachman, L. F., & Palmer, A. S. (1996). Language testing in practice: Designing and developing useful language tests. Oxford; New York: Oxford University Press.

Bartels, N. (2005). Applied linguistics and language teacher education. New York: Springer.

Basturkmen, H., Loewen, S., & Ellis, R. (2004). Teachers' stated beliefs about incidental focus on form and ther classroom practices. Applied Linguistics, 25(2), 243-272.

Bednar, A. K., Cunningham, D., Duffy, T. M., & Perry, J. D. (1992). Theory into practice: How do we link? In T. M. Duffy & D. H. Jonassen (Eds.), Constructivist and the technology of instruction (pp. 17-34). Hillsdale, NJ: Erlbaum.

Borg, S. (2003). Teacher cognition in language teaching: A review of research on what language teachers think, know, believe, and do. Language Teaching, 36(2), 81-109.

Boshuizen, H. P. A., Schmidt, H. G., Custers, E. J. F. M., & Wiel, M. W. v. d. (1995). Knowledge development and restructuring in the domain of medicine: The role of theory and practice. Learning and Instruction, 5, 269-289.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. Educational Researcher, 18(1), 32-42.

Bygate, M., Skehan, P., & Swain, M. (2001). Researching pedagogic tasks: Second language learning, teaching, and testing. Harlow, England; New York: Longman.

Cabaroglu, N., & Roberts, J. (2000). Development in student teachers' pre-existing beliefs during a 1-year pgce programme. System, 28, 387-402.

Carroll, J. M. (1997). Human-computer interaction: Psychology as a science of design. International Journal of Human-Computer Studies, 46, 501-522.

Chapelle, C. (2001). Computer applications in second language acquisition: Foundations for teaching, testing and research. Cambridge: Cambridge University Press.

Chun, D. M. (2001). L2 reading on the web: Strategies for accessing information in hypermedia. System, 14(5), 367-403.

Collective, T. D.-B. R. (2003). Design-based research: An emerging paradigm for educational inquiry. Educational Researcher, 32(1), 5-8.

Cooper, A. (2003). About face 2.0: The essentials of interaction design. New York; Chichester: Wiley.

Dabbagh, N. (2001). Concept mapping as a mindtool for critical thinking. Journal of Computing in Teacher Education, 17(2), 16-24.

Dede, C., Nelson, B., Ketelhut, D., Clarke, J., & Bowman, C. (2004). Design-based research strategies for studying situated learning in a multi-user virtual environment. Paper presented at the Sixth International Conference on Learning Sciences.

Doering, A., & Beach, R. (2002). Preservice english teachers acquiring literacy practices through technology tools. Language Learning & Technology, 6(3), 127-146.

Donato, R. (1994). Collective scaffolding in second language learning. In J. P. Lantolf & G. Appel (Eds.), Vygotskian approaches to second language research. Norwood, NJ: Ablex Publishing Corporation.

Doughty, C. J., & Long, M. H. (2003). Optimal psycholinguistic environments for distance foreign language learning. Language Learning & Technology, 7(3), 50-80.

Egbert, J., Paulus, T. M., & Nakamichi, Y. (2002). The impact of call instruction on classroom computer use: A foundation for rethinking technology in teacher education. Language Learning & Technology, 6(3), 108-126.

Ericsson, K. A., & Simon, H. A. (1984). Protocol analysis: Verbal reports as data. Cambridge, Mass.: MIT Press.

Ericsson, K. A., & Simon, H. A. (1992). Protocol analysis: Verbal reports as data (Rev. ed.). Cambridge, Mass.: MIT Press.

Freeman, D. (1996). “to take them at their word”: Language data in the study of teachers’ knowledge. Harvard Educational Review, 66(4).

Freeman, D., & Johnson, K. (1998). Reconceptualizing the knowledge-base of language teacher education. TESOL Quarterly, 32(3), 397-417.

Freeman, D., & Johnson, K. (2005). A response to tarone and allwright. In D. J. Tedick (Ed.), Second language teacher education: International perspectives (pp. 25-32). Mahwah, NJ: Lawrence Earlbaum Associates.

Freeman, D., & Richards, J. C. (1996). Teacher learning in language teaching. Cambridge [Eng.]; New York: Cambridge University Press.

Garret, N. (1991). Technology in the service of language learning: Trends and issues. The Modern Language Journal, 75(i), 74-101.

Gilchrist, V. J. (1999). Key informant interviews. In A. Bryman & R. G. Burgess (Eds.), Qualitative research (Vol. 1, pp. 354-371). Thousand Oaks, CA: SAGE Publications.

Gross, N., Mason, W. S., & McEachern, A. W. (1958). Explorations in role analysis: Studies of the school superintendency role. School Review, 66(3), 367-371.

Guntermann, G. (1993). Developing language teachers for a changing world. Lincolnwood, IL: National Textbook Company.

Halliday, M. A. K., & Hasan, R. (1976). Cohesion in english. London: Longman.

Hong, E. (1998). Korean and us preservice elementary teachers' conceptions about teaching word problem solving. Journal of Education for Teaching, 24(2), 165-175.

Hubbard, P. (2004). Guest editorial. Computer Assisted Language Learning, 17(1), 1-6.

Hubbard, P., & Levy, M. (in press). The scope of call in education. In P. Hubbard & M. Levy (Eds.), Teacher education in call.

Hulstijn, J. H. (2000). The use of computer techynology in experimental studieds of second language acquisition: A survey of some techniques and some ongoing studies. Language Learning & Technology, 3(2), 32-43.

Johnson, K. (2005). The 'general' study of expertise. In K. Johnson (Ed.), Expertise in second language learning and teaching (pp. 11-33). New York: N.Y.: Palgrave Macmillan.

Jonassen, D. H. (1996). Computers in the classroom: Mindtools for critical thinking. Englewood Cliffs, N.J.: Merrill.

Jonassen, D. H. (2000). Computers as mindtools for schools: Engaging critical thinking (2nd ed.). Upper Saddle River, N.J.: Merrill.

Jonassen, D. H. (2003a). Learning to solve problems with technology: A constructivist perspective (2nd ed.). Upper Saddle River, N.J.: Merrill.

Jonassen, D. H. (2003b). Using cognitive tools to represent problems. JRTE, 35(3), 362-381.

Jonassen, D. H. (2004). Learning to solve problems: An instructional design guide. San Francisco, CA: Pfeiffer.

Jonassen, D. H. (2006). On the role of concepts in learning and instructional design. ETR&D, 54(2), 177-196.

Jonassen, D. H., Carr, C., & Yueh, H. (1998). Computers as mindtools for engaging learners in critical thinking. TechTrends, 43(2), 24-32.

Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). Learning with technology: A constructivist perspective. Upper Saddle River, N.J.: Merrill.

Kagan, D. (1992). Professional growth among preservice and beginning teachers. Review of Educational Research, 62(2), 129-169.

Kamberelis, G., & Dimitriadis, G. (2005). On qualitative inquiry. New York: Teachers College Press.

Koehler, M. J., & Mishra, P. (2005). Teachers learning technology by design. Journal of Computing in Teacher Education, 21(3), 94-102.

Koehler, M. J., Mishra, P., Hershey, K., & Peruski, L. (2004). With a little help from your students: A new model for faculty development and online course design. Journal of Technology and Teacher Education, 12(1), 25-55.

Kumaravadivelu, B. (2003). Beyond methods: Macrostrategies for language teaching. New Haven: Yale University Press.

Kumaravadivelu, B. (2006). Understanding language teaching: From method to post-method. Mahwah, N.J.: Lawrence Erlbaum Associates.

Leaver, B. L., & Shekhtman, B. (2002). Principles and practices in teaching superior-level

language skills: No just more of the same. In B. L. Leaver & B. Shekhtman (Eds.), Developing professional-level language proficiency (pp. 3-33). Cambridge; New York, NY: Cambridge University Press.

Levy, M. (1997a). Project-based learning for languag teachers: Reflecting on the process. In R. Debski, J. Gassin & M. Smith (Eds.), Language learning through social computing (Vol. 16). Melbourne, Australia: Applied Lingusitics Association of Australia & The Horwood Language Centre.

Levy, M. (1997b). A rationale for teacher education and call: The holistic view and its implications. Computers and the Humanities, 30, 293-302.

Levy, M. (1998). Two conceptions of learning and their implications for call at the tertiary level. ReCALL, 10(1), 86-94.

Levy, M. (1999). Design processes in call: Integrating theory, research and evaluation. In K. Cameron (Ed.), Assisted language learning (call): Media, design, and applications (pp. 83-107). Exton, PA: Swets & Zeitlinger.

Levy, M. (2000). Scope, goals and methods in call research: Questions of coherence and autonomy. ReCALL, 12(2), 170-195.

Lincoln, Y. S., & Guba, E. G. (2002). Judging the quality of case study reports. In A. M. Huberman & M. B. Miles (Eds.), The qualitative researcher's companion (pp. 205-215). Thousand Oaks: SAGE Publications.

Lomicka, L. (1998). To gloss or not to gloss: An investigation of reading comprehension online. Language Learning & Technology, 1(2), 41-50.

McMahon, H., & O"Neill, W. (1993). Computer-mediated zones of engagement in learning. In T. M. Duffy, J. Lowyck & D. H. Jonassen (Eds.), Designing environments for constructive learning (Vol. F105, pp. 37-57). Berlin; New York: Springer-Verlag.

Meskill, C. (2005). Triadic scaffolds: Tools for teaching english language learners with computers. Language Learning & Technology, 9(1), 46-59.

Meskill, C., & Anthony, N. (2005). Foreign language learning with cmc: Forms of online instructional discourse in a hybrid russian class. System, 33(1), 89-105.

Meskill, C., Mossop, J., DiAngelo, S., & Pasquale, R. K. (2002). Expert and novice teachers talking technology: Precepts, concepts, and misconcepts. Language Learning & Technology, 6(3), 46-57.

Nunan, D. (1991). Language teaching methodology: A textbook for teachers. New York: Prentice Hall.

Nunan, D. (1999). A foot in the world of ideas: Graduate study through the internet. Language Learning & Technology, 3(1), 52-74.

Nunan, D. (2004). Task-based language teaching. Cambridge, UK; New York, NY, USA: Cambridge University Press.

Pajares, M. F. (1992). Teachers' beliefs and educational research: Clearing up a messy construct. Review of Educational Research, 62(4), 307-331.

Pawson, R., & Tilley, N. (1997). Realistic evaluation. London; Thousand Oaks, Calif.: Sage.

Pica, T., Kanagy, R., & Falodun, J. (1993). Choosing and using communication tasks for second language instruction. In G. Crookes & S. Gass (Eds.), Tasks and language learning: Integrating theory & practice. Clevedon, England: Multilingual Matters, Ltd.

Qualrus 2.1.0.0. (2002). Idea Works, Inc.

Rea-Dickins, P., & Germaine, K. P. (1998). Managing evaluation and innovation in language teaching: Building bridges. Essex, England: Addison Wesley Longman Ltd.

Richards, C. (2005). The design of effective ict-supported learning activities: Exemplary models, changing requirements, and new possibilities. Language Learning & Technology, 9(1), 60-79.

Richards, J. C., & Lockhart, C. (1994). Reflective teaching in second language classrooms. Cambridge [England]; New York, NY, USA: Cambridge University Press.

Richards, J. C., & Nunan, D. (1990). Second language teacher education. Cambridge [England]; New York: Cambridge University Press.

Robinson, P. (2001). Task complexity, taskdifficulty, and task production: Exploring interactions in a componential framework. Applied Linguistics, 22(1), 27-57.

Sato, K., & Kleinsasser, R. (1999). Communicative language teaching: Practical understanding. Modern Language Journal, 83(4), 494-517.

Schön, D. A. (1987). Educating the reflective practitioner: Toward a new design for teaching and learning in the professions (1st ed.). San Francisco: Jossey-Bass.

Seidlhofer, G. (1999). Double standards: Teachere education in the expanding circle. World Englishes, 18(2), 233-245.

Shulman, L. (1986). Those who understand: Knowlege growth in teaching. Educational Researcher, 15(2), 4-14.

Skehan, P. (2003). Focus on form, tasks, and technology. Computer Assisted Language Learning, 16(5), 391-411.

Spodark, E. (2002). The tek. Xam as a framework for preservice foreign language teacher technology training. Foreign Language Annals, 35(4), 426-436.

Tsui, A. (2003). Understanding expertise in teaching: Case studies of second language teachers. Cambridge; New York: Cambridge University Press.

van Olphen, M. (in press). Technological pedagogical content knowledge: An integrated framework for educating foreign language teachers. In M. J. Koehler & P. Mishra (Eds.), Tpck book.

Velez-Rendon, G. (2002). Second language teacher education: A review of the literature. Language Annals, 35(4), 457-467.

Verkoeijen, P. P. J. L., Rikers, R. M. J. P., Schmidt, H. G., Wiel, M. W. J. v. d., & Kooman, J. P. (2004). Case representation by medical experts, intermediates and novices for laboratory data presented with or without a clinical context. Medical Education, 38(6), 617.

Warford, M. K., & Reeves, J. (2003). Falling into it: Novice tesol teacher thinking. Teachers and Teaching: theory and practice, 9(1), 47-65.

Wengraf, T. (2001). Qualitative research interviewing: Biographic narrative and semi-structured methods. London; Thousand Oaks, Calif.: SAGE.

Wilhem, K. H. (1997). Sometimes kicking and screaming: Language teachers-in-training react to a collaborative learning model. The Modern Language Journal, 81(iv).

Willis, J. (2000). The maturing of constructivist instructional design: Some basic principles that can guide practice. Educational Technology, 40(1), 5-16.

Willis, J. (2003). Lecture notes.

Winn, W. (2004). Cognitive perspectives in psychology. In D. H. Jonassen (Ed.), Handbook of research on educational communications and technology (2nd ed., pp. 79-112). Mahwah, NJ: Lawrence Erlbaum Associates.

Wong, A. T. Y. (2005). Writers' mental representations of the intended audience and of the rhetorical purpose for writing and the strategies that they employed when they composed. System, 33(1), 29-47.

Woods, D. (1996). Teacher cognition in language teaching: Beliefs, decision-making, and classroom practice. Cambridge [England]; New York: Cambridge University Press.

Woods, D. (2006). Who does what in the 'management of language learning'? Planning and the social construction of the 'motivation to notice'. In S. Gieve & I. K. Miller (Eds.), Understanding the language classroom (pp. 88-114). New York: NY: Palgrave Macmillan.

Woodward, T. (1991). Models and metaphors in language teacher training. Cambridge: Cambridge University Press.

CHAPTER 4. GENERAL CONCLUSION

Understanding how language teachers design language learning experiences for their learners is a key component of technology integration into language learning. Improving our understanding of what is involved in the design of such experiences and what instructional and technology tools may help improve their design will possibly result in the improvement of technology use for language learning.

This dissertation constitutes a first step toward improving our understanding of how technology and instructional tools can help us achieve better and more sophisticated uses of technology in the context of world language teacher education (WLTE). This work includes a) the design and development of a prototype of a cognitive tool intended to support the design of language learning experiences, b) a rationalization that advocates project-based learning (PBL) as a powerful instructional device to support sophisticated learning experiences in WLTE; and c) the exploration of conceptual and interactual aspects of said cognitive tool.

Chapter 2, "Project-based learning: A promising pathway to technology integration in world language teacher education" put forward a taxonomy of complex WLTE tasks. Building from this taxonomy, the potential of PBL was explored as a possible pedagogical process in WLTE and as part of the content of WLTE. As this paper suggests, PBL appears to be suitable to take full advantage of the complexity of WLTE and to immerse preservice teachers in rich design experiences that integrate technology. Additionally, PBL may prompt the creation of forms of knowledge that are hypothesized to lead to better technology integration (Koehler, 2005).

Implementing PBL in WLTE as either a process or content poses challenges. Technology tools that facilitate the conceptualization, creation and management of projects and that are specifically designed for the context of WLTE may help in the implementation of PBL in WLTE. Chapter 3, "Postcards from the Mind: Designing language learning experiences with technology," explored a prototype of such tool. This study gives us some insights into the cognitive processes involved in the design of language learning experiences. Interactual and conceptual aspects of the tool that did or did not support the users' cognitive processes are discussed and recommendations for the tool's improvement are made.

Key Findings

Chapter 2 discusses the complexity of WLTE tasks. Embedded language learning tasks, i.e. compounded tasks, were considered to create a simple taxonomy of WLTE tasks, which is based on task features such as the role of the participants, the language, content and process of the WLTE task. Possibilities to exploit the potential of PBL are explained in relation to pedagogical processes and content. Although the context of WLTE has been explored, there is very little research on WLTE tasks (e.g., Simpson, 2004) and even less on the use of technology on WLTE tasks (e.g., Chuang & Rosenbusch, 2005). This article discusses how some of the possibilities that PBL offers to WLTE can be operationalized and argues that providing preservice teachers experiences with and exposure to sophisticated pedagogical interventions such as the ones supported by PBL can improve the integration of technology into the design of language learning activities.

Chapter 2 attests to the formidable complexity of the knowledge and cognitive processes involved in the design of language learning experiences. The cognitive tool investigated in this design-based research engaged users in complex thinking about the design of language learning experiences. This study sheds light into some of the knowledge and processes that emerge during the design of such experiences. The cognitive processes identified included the activation of composite forms of knowledge (e.g., pedagogical-content knowledge and technological pedagogical content knowledge) which are hypothesized to be a prerequisite for the effective integration of technology into learning experiences (Koehler & Mishra, 2005), the iterative consideration of general pedagogical guidelines and the application of a mental model to the design of language learning experiences.

Findings from this study such as the types of cognitive processes supported and activated by the tool have implications for the development of similar tools whose conceptualization and design are also grounded on a very specific context of use. Similarly, findings related to the interactual aspects of the tool, such as the influence of the interface on users' choices, have implications for interface design.

Recommendations for Future Research

This dissertation focused on the construction and exploration of a prototype of a cognitive tool designed to support cognitive processes triggered by the design of language learning experiences. Findings from this dissertation suggest that more research

is needed which is grounded on what we already know about world language teacher education, rather than what we know about technology and language learning. Seminal work in technology integration in language teacher education is probably more likely to be rooted in the issues and complexities of WLTE, than general technology integration into language learning.

This dissertation also highlights the need for research on the experiences that language teacher educators design for preservice teachers and how related pedagogies (e.g., adult learning theory appears to be more appropriate than general learning theories to ground research in this area) and technologies inform those experiences.

Finally, more development and research are needed to explore how cognitive tools such as the one investigated in this dissertation can aid preservice language teachers in the acquisition of complex forms of knowledge.

References

Chuang, H., & Rosenbusch, M. H. (2005). Use of digital video technology in an elementary school foreign language methods course. *British Journal of Educational Technology, 36*(5), 869-880.

Koehler, M. J., & Mishra, P. (2005). Teachers learning technology by design. *Journal of Computing in Teacher Education, 21*(3), 94-102.

Simpson, C., Popovic, R., & Stojanovic, S. (2004). Modifying tasks in teacher education sessions to meet learners' needs better. *The Teacher Trainer, 18*(1), 5-11.

APPENDIX A: THINK-ALOUD INSTRUCTIONS GIVEN TO PARTICIPANTS

(Adapted from Wong, 2005)

Say whatever is on your mind. Don't hold back hunches, guesses, wild ideas, images or intentions.

Speak as continuously as possible. Say something at least once every five seconds.

Speak as telegraphically as you please. Don't worry about complete sentences and eloquence.

Don't over explain or justify. Analyze no more than you would normally do.

Don't elaborate past events. Get into the pattern of saying what you are thinking now.

APPENDIX B: TASK INSTRUCTIONS GIVEN TO PARTICIPANTS

Task

Using the activity design studio, design a CALL project whose final product is an online newspaper in the target language.

Description

Learners collaboratively design, produce and publish the front page (homepage) of an online newspaper. To complete this activity, the class is divided into four groups. Each group of learners receives a picture. Each member of the group writes a possible headline and a paragraph describing the piece of news the picture is intended to illustrate. All members of a group vote for the best story. Then, the four best stories produced by the groups are combined to create the class newspaper's front page. Learners form four new groups to create the rest of the newspaper sections: editorial, opinion page, world, and local news.

Learner's language proficiency level:	intermediate
Learner's age:	adult learners (20-45)
Gender:	7 females and 7 males
Location:	learners work on these activities using computers in class

APPENDIX C: INTERVIEW QUESTIONS

Central Research Question	Theory-questions	IQ formulation
In what ways does the software support the conceptualization and design of language learning experiences?	Does the software support the design of language learning experiences at the conceptual level of organization? (Cooper, 2003)	Is the concept of activity structures presented in the handout useful to conceptualize a CALL project? Why/not? What aspects of the software support the integration of pedagogical knowledge (knowledge of language teaching and learning)? What aspects of the software support the integration of theoretical knowledge (for example, knowledge of second language acquisition theory)? What aspects of the software may support the sharing of tacit knowledge (for example, knowledge of how to group participants for a particular activity to achieve the desired language output)?
	Does the software support the design of language learning experiences at the interactual level of organization? (Cooper, 2003)	Does the interface support the concept of activity structures? (If yes) How? (If not) Why not? What aspects of the interface support this concept best? Why? What additional features would you recommend to better support the concept of activity structures? How (if at all) did the software change your thinking about project-based learning? What features of the software interface best supported your thinking about the design of CALL projects while you were designing the project? Were there any aspects of the software that negatively interfered with your thinking about CALL project design?

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