Collaborative research projects in the technology-enhanced language classroom: Pre-service and in-service teachers exchange knowledge about technology

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Abstract

This paper presents research findings of a longitudinal empirical case study that investigated an innovative Computer Assisted Language Learning (CALL) professional development program for pre-service English as Foreign Language (EFL) teachers. The conceptualization of the program was based on the assumption that pre-service language teachers learn better in situated contexts (Egbert, 2006). Therefore, a key component of the program was the development of school-based research projects, in which the student teachers needed to design, implement, and evaluate technology-enhanced EFL lessons in collaboration with in-service teachers. Data were collected via field notes, video recordings of lessons, academic research reports produced by the pre-service teachers, and in-depth interviews with the pre-service and in-service teachers. Our findings indicate that the field experiences provided professional learning opportunities that supported the student teachers' development as CALL practitioners. The participating pre-service teachers especially emphasized the important role played by school-based experiences in allowing them to use technology in authentic language teaching scenarios and to evaluate the impact of technology on language teaching and learning. The paper concludes with a discussion of important principles and guidelines that should underlie and inform such collaborative efforts and a summary of the implications of the findings for the design of CALL pre-service teacher education programs.

Keywords: teacher education, reflective practice, situated learning, teacher cognition

1 Introduction

Several researchers (e.g., Egbert, 2006; Dooly, 2009) point out that CALL coursework alone, without opportunities to practise, apply, and see evidence of learner improvement in situated contexts may lead to technology learning, but not necessarily to its use in the

classroom. Studies on computer-assisted language learning (CALL) coursework transfer have also shown that peer mentoring and site-based application are more likely to lead to transfer of new knowledge to classroom activities (e.g., Fuchs, Hauck & Mueller-Hartmann, 2012; Comas-Quinn, 2011; Egbert, Paulus & Nakamichi, 2002). Therefore, there appears to be a need for bridging the gap between the knowledge and skills pre-service teachers can acquire in formal CALL courses and the knowledge and skills they actually need in everyday language teaching.

This paper discusses research findings of a longitudinal empirical case study (2008–2013) that investigates the impact of an innovative CALL professional development program for pre-service EFL teachers. The conceptualization of this program follows the design proposed by several authors (e.g., Fuchs, Hauck & Mueller-Hartmann, 2012; Meskill, Anthony, Hilliker, Tseng, & You, 2006; Debski, 2006; Egbert, 2006), and is based on the idea that pre-service teachers learn better in situated contexts and technology courses should thus prepare them for the realities of their future classrooms. The CALL program was implemented at a German university that specializes in teacher education for primary and secondary education. As part of their degree requirements, the students must complete at least one introductory CALL course, which provides a general overview of computer assisted language learning and involves them in using and discussing existing applications of computer technology in the language classroom.

The motivation for the design of the innovative CALL program derives from the results of questionnaires administered to the 2006 student cohort, which showed that most students found their CALL courses to be disconnected from the real world of school. Therefore, from 2007 onwards the program incorporated a novel approach to bridging the gap for pre-service teachers in CALL via (a) workshops provided by in-service EFL teachers, who demonstrate technology-enhanced language lessons they have implemented, and (b) research projects carried out by the students in collaboration with in-service teachers. By focusing on the contextualization of technology use the program aimed at facilitating pre-service teachers' deep understanding of the potential of CALL applications for enhancing language teaching and learning and fostering positive attitudes towards the use of technology in the English classroom.

In order to evaluate the impact of the collaborative projects on teachers' learning processes and their attitudes towards technology, we employed in-depth interviews, video-stimulated reflection (VSR) and research reports produced by the pre-service teachers to collect extensive research data on pre-service teachers' and in-service teachers' views on (a) the impact of the school-based collaborative projects on their development as CALL practitioners, (b) their learning processes during the design, implementation and evaluation of technology-enhanced lessons and (c) principles and guidelines that should inform such collaborative efforts.

This paper focuses specifically on the views of the pre-service teachers regarding the impact of the training program on the acquisition of new CALL-related teaching competencies (Hubbard & Levy, 2006). We start by synthesizing the findings of previous research on pre-service teacher education in CALL and laying out the theoretical framework that guides the data analysis. Section 3 contextualizes the research by providing information on its motivation, setting, design and aims. In section 4 the main findings will be presented and discussed before the final section draws the article to a conclusion with a brief consideration of the implications of our findings for the design of CALL pre-service teacher education programs.

2 Literature review

2.1 Pre-service teacher training in CALL

The important role played by CALL pre-service teacher education in assisting L2 teachers in gaining confidence and developing a positive attitude toward integrating technology into their teaching has been widely discussed in the literature (e.g., Guichon & Hauck, 2011; Hong, 2010; Hegelheimer, 2006). In recent years special focus has been given to establishing a distinction between the formats and approaches to CALL pre-service teacher education that are more likely to achieve the above-mentioned results and the ones that fail to take the pre-service teachers' needs into consideration (e.g., Fuchs *et al*., 2012, Brown & Warschauer, 2006; Meskill *et al*. 2006; Legutke, Mueller-Hartmann & Schocker v.Ditfurth, 2007).

Research findings from studies investigating the transfer of CALL coursework to the classroom have shown that most formats of pre-service technology courses and programs have a limited impact on how teachers think about and implement technology-supported teaching. Egbert *et al*. (2002), for instance, examined how language teachers apply practical experiences from CALL coursework to their teaching and how they continue their CALL professional development. Their findings showed that technology courses at university level do not have much direct immediate impact on teachers' classroom uses of computers. Other factors, such as peer collaboration in situated learning contexts and gathering sufficient evidence of the positive effects of technology-enhanced teaching, play a much more important role. Their findings point to the need for more contextualized CALL instruction that is directly related to the teaching environments in which pre-service language teachers will be practising later on (see also Debski, 2006).

Similar issues were discussed by Brown and Warschauer (2006) and Legutke *et al*., (2007). Brown and Warschauer examined pre-service teachers in their teacher-preparation programs and later on in their practice teaching in order to investigate technological knowledge transfer within the real world context of the field placement sites. Their research findings showed that students who were paired with technologically proficient mentor teachers were much more likely to implement technology-enriched instruction during their placement. These findings point towards the importance of moving teacher preparation courses into authentic venues and the need for training university faculty as well as school mentors to provide adequate models for pre-service teachers.

Drawing from research conducted in German universities, Legutke *et al*. (2007) state that most CALL programs, in their current format, have failed to provide the relevant knowledge base that enables student teachers to cope with the complex demands of the school system after graduation. As a result, pre-service teachers tend to feel insufficiently prepared for implementing technology-based teaching, which might lead to qualitatively inferior use of technology in their future classrooms. They attribute the gap between university and school training as one of the main reasons for the apparent inefficacy of current pre-service CALL programs, and highlight the importance of establishing productive collaboration between these two areas in order to provide pre-service teachers with opportunities for authentic technology-rich field experiences in schools.

Research has also shown that technology use by novice teachers in their first years of work is considerably constrained by overwhelming demands placed on them

(Egbert *et al.*, 2002, Brown & Warschauer, 2006; Dooly 2009). As Dooly's (2009) findings have shown, novice teachers typically focus on mastering the routines and rituals of the new context first, and "even when they are willing and keen to experiment with novel approaches, everyday pressures and anxiety concerning issues such as class management in unfamiliar circumstances can be daunting" (*op. cit.*: 365). The author concludes by proposing an approach to CALL pre-service teacher education that focuses on identifying, acknowledging and dealing with these fears while the trainees are still within a supportive environment and before they must face such situations alone.

Remarks regarding the gap between the content delivered by language teacher education programs and the real needs of novice teachers have also been made in the general literature on language teacher education (e.g., Tarone & Allwright, 2005; Farrell, 2009). However, this concern seems to be especially pertinent for the CALL classroom since the "technological infrastructure and support, access and general resources available may vary widely between a university and a classroom in a school" (Egbert, 2006 *op. cit.*: 166).

In order to tackle the above-mentioned challenges, several approaches to pre-service technology training have been proposed in the literature. Meskill *et al.* (2006), for instance, reported on an innovative approach to CALL pre-service training, which used field experiences and guided reflection as complements to university coursework. They examined the effectiveness of expert-novice mentoring that involved experienced in-service teachers, pre-service teachers and doctoral students with expertise in instructional technology longitudinally as part of a three-year-long project. Their findings have shown that linking pre- to in-service education facilitated the important linking of theoretical knowledge with procedural knowledge.

Fuchs, Hauck and Mueller-Hartmann (2012) reported on two empirical case studies following a task-based telecollaborative learning format, in which they investigated the competencies (future) language teachers require in order to develop first their own and then their learners' autonomy in online and blended settings. In their paper, they discuss the benefits of two specific approaches in CALL teacher education – experiential modeling (Hoven, 2006) and exploratory practice (Allwright & Hanks, 2009) – in supporting the development of such competencies.

This literature review indicates that there is a need to bridge the gap between the knowledge and skills pre-service teachers seem to be able to acquire in formal CALL courses and the knowledge and skills they actually need in everyday teaching in the classroom. Research findings have pointed towards the importance of enabling pre-service teachers to develop important CALL-related competencies and to reach a sustained and deeply rooted motivation unfazed by difficult circumstances. Research has also shown that in order to develop that level of motivation, student teachers need to experience sufficient evidence of the positive effects of technology-enhanced teaching (Hubbard & Levy, 2006).

Although the CALL literature has been replete with references to such innovative approaches, there has so far been relatively little focus on the analysis of classroom-based language teaching and the specific competencies developed by pre-service teachers participating in such situated CALL teacher education programs. In Meskill *et al.* (2006), for instance, the pre-service teachers' reflections were mainly addressed in terms of the general benefits they gained from such collaborations, without a detailed consideration of their language teaching practices in the framework of the programs and their perceived CALL-related competence development.

In the language teaching literature, the impact of language teacher education programs on the structure of teachers' cognition (Borg, 2006)[1] and the likely changes such pre-service courses bring about in teachers' performance have been investigated from different angles, for example, on teachers' conception of teaching (e.g., Freeman, 1993) and more recently on the production of pedagogical thoughts (Akbari & Dadvand, 2011) and on teachers' self-efficacy beliefs (e.g., Mills, 2011). By placing special emphasis on language teachers' cognition, these studies have been able to identify key aspects of their learning processes and competence development that can inform the design and implementation of innovative language teacher education programs. This paper presents research findings drawn from a CALL professional development program that aimed at achieving such results.

The following section lays out the theoretical framework that was used for the conceptualization and description of CALL-related teaching competencies.[2]

2.2 CALL-related teaching competencies

Hubbard and Levy (2006) introduced a framework for distinguishing elements of CALL expertise, in which expertise is described in terms of roles played by the individual within the field. They distinguish between institutional and functional roles. While the former refers to job titles and descriptions (e.g., teacher, CALL specialist), the latter refers explicitly to what one does (e.g., practitioner, developer or trainer). Drawing on Schulman's (1986) concept of "pedagogical content knowledge", the authors highlight an important distinction between "technological knowledge and skills that are necessary for the competent operation of the computer technology and the pedagogical knowledge and skills that are necessary for the appropriate and effective integration of the technology into the teaching and learning process" (*op. cit.:* 10). In their attempt to describe the different roles performed by CALL practitioners, the authors outline a framework for the analysis of CALL expertise. As they point out, in order to be able to implement CALL appropriately and effectively teachers need to develop the following key competencies (See Table 1).

For the conceptualization of the CALL professional development program described herein we have drawn on the "types of language teacher knowledge bases" proposed by Roberts (1998)[3] and Hubbard and Levy's framework to define the main competencies to be developed by the pre-service teachers.

This study has therefore drawn on the CALL recommendations discussed in the previous section and on the CALL-related competencies proposed by Hubbard and Levy (2006) to address the following research questions:

1. What was the perceived impact of the situated CALL teacher education program on the pre-service teachers' acquisition of CALL-related teaching competencies?

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[1] The concept of teacher cognition has been defined by Borg (2006:272) as "the complex, practically-oriented, personalized and context-sensitive networks of knowledge, thoughts and beliefs that language teachers draw on in their work".

[2] In this paper, we adopt Gillen's (2006:77) definition of competencies as "categories of the individual, which can only be developed by the individual himself/herself and which include skills, knowledge, qualifications as well as values and attitudes".

[3] Roberts (1998) proposes that the six basic elements in language education are: content knowledge, pedagogical content knowledge, general pedagogic knowledge, curricular knowledge, contextual knowledge and process knowledge.

Table 1 *CALL-related teaching competencies*

Competence	Description
C1	Having a sufficient technical foundation – i.e. systematic and incidental understanding of the computer system in terms of hardware, software and networking and being able to use this technical knowledge efficiently
C2	Using pedagogical approaches that are intentional and well-considered (e.g. in accordance to current theories of teaching methodology)
C3	Understanding frameworks for the evaluation of CALL in all its forms (e.g. the frameworks developed by Chapelle (2001), and Doughty & Long (2003))
C4	Making informal judgments on the suitability of the tool for the task (e.g. what kinds of language learning goals may appropriately include the use of chats?)
C5	Appreciating the strengths and limitations of the technological options at hand (e.g. in which phases of a lesson an interactive whiteboard should be used)
C6	Being able to identify and understand the impact of authentic technological constraints and to be able to work creatively between them (e.g. how to implement a WebQuest project without internet connectivity)
C7	Having the capacity for research and development in CALL (e.g. designing CALL activities and materials)
C8	Being able to act to build CALL knowledge in others (e.g. CALL learner training)
C9	Having a positive attitude towards using electronic technology for language teaching

(adapted from Hubbard & Levy, 2006)

2. Which elements of the professional development program were especially beneficial in facilitating and supporting the pre-service teachers' pedagogical learning?

For reasons of space, this paper concentrates primarily on the first research question. The following section contextualizes the research by providing information on its motivation, setting, and design.

3 Research context and research methodology

The CALL professional development program described herein was implemented at a higher education institution in Germany that specializes in teacher education for primary and secondary education. The university program covers all school subjects, including English as a Foreign Language (EFL). The curriculum is strongly geared towards developing teaching competencies through the intensive integration of theory and practice. Student teachers (aged between 19 and 25 on average) study for a period of six to eight semesters, which includes up to six periods of teaching practice in different schools, where they observe lessons taught by school teachers, but also teach and evaluate their own lessons under the supervision of school mentors and university teacher trainers. The duration of each teaching practice varies between 45 hours per semester (for the subject-specific placement) to three weeks (full time) for the intensive teacher training. The curriculum of the TEFL program has a strong focus on task-based language learning (TBLL) and places special emphasis on reflective practice (Wallace, 1991). As part of their academic evaluation for the "practicum", for instance, the students are required to submit reflective journals of all EFL lessons they observe and teach.

In order to earn their TEFL degree enabling students to teach K-12 English as a Foreign Language, the students must complete at least one introductory CALL course, which they can attend after completing the first two modules of their degree (i.e., after two semesters of an 8-semester degree program). The main aim of this course is to give participants a broad general overview of computer assisted language learning, by involving them in using and discussing existing applications of computer technology in the language classroom. The students are required to prepare tasks that simulate real world teaching challenges in order to use and test knowledge gained through reading, discussion and hands-on experience. The overall goal is for students to be prepared to implement media-assisted activities that are informed by current language teaching theory and research (e.g., task based and project based language learning). Since 2008, however, the objectives of this course have been expanded in order to include a component of school practice. This change was motivated by the results of questionnaires administered to the 2006 student cohort, which showed that most students found their CALL courses to be disconnected from the real world of school. The participants' attitudes are succinctly captured by the following student comment:

> We, CALL students, do not have the opportunity to practice our knowledge about "media in the classroom" in a real class situation. We know all about it, but we are not able to experience it in class and how media is accepted by the students and which problems may appear!   (Pre-service teacher - online discussion)

In order to take the students' needs and feedback into consideration, a new format of the professional development program was implemented. We followed the design proposed by Meskill *et al.* (2002 and 2006) in which pre-service teachers learn to use technology via mentoring by experienced educators in their classrooms, and the principle of research-oriented teacher education (Legutke *et al.*, 2007). The student teachers thus developed projects for a particular class and researched an aspect of the language learning potential that technology offered for that particular class.

Therefore, as part of their credit evaluation for this course, the students are required to carry out a small-scale research project, for which they need to design, implement and evaluate at least four technology-enhanced lessons and write a research report on their findings. In the first three semesters of the implementation of the program, the students who carried out research projects received extra academic support by means of workshops on "research methodology", which were carried out twice a month during the semester. Currently, the students are given the option of either receiving individual support or attending "classroom research" courses, which are offered as part of the university curriculum.

Thus far, a total of 21 student teachers and eight in-service teachers have agreed to take part in the research by allowing the use of their reports as research data, and by agreeing to be interviewed at least once by the investigators. For their school projects the student teachers could choose between a variety of computer applications, namely language learning software, web-based resources, social media (blogs, wikis and podcasts) and interactive whiteboards (IWBs). For reasons of space, the following table only describes the lesson/projects that were developed by the participating student teachers who have been cited in this article (See Table 2).

The eight participating in-service teachers are state school English teachers who use a variety of language teaching approaches (from project-based to more traditional Presentation Practice Production (PPP) approaches). Considerable effort was made to finding school mentors with some knowledge of CALL so that they could provide adequate

Table 2 *Lessons / projects developed by pre-service teachers*[4]

Name	Lesson/Project	School/Grade	Main CALL Element	Year
Helen	Airport project – interviewing native speakers and reporting on the results	Secondary/7th	Interactive Whiteboard	2008
Frederick	Practicing simple present forms around the topic hobbies and sports	Secondary/6th	Interactive Whiteboard	2009
Johanna	4 EFL lessons focusing on various topics/skills	Secondary/6th	Interactive Whiteboard	2009
Nadine	Project work on the topic Australia	Secondary/8th	WebQuest	2008
Helga	CLIL project – teaching geography in English	Secondary/5th	Interactive Whiteboard	2011
Krista	Practicing the will-future around the topic "houses of the future"	Secondary/6th	Interactive Whiteboard	2008
Raise	6 EFL lessons focusing on various topics/skills	Secondary/6th	Interactive Whiteboard	2009
Anita	4 EFL lessons focusing on storytelling	Primary/3rd	Interactive Whiteboard	2012

models for the pre-service teachers (Brown & Warschauer, 2006). Their participation in the project was voluntary and motivated by a personal interest in advancing their own skills with respect to CALL. Findings from the initial in-service teacher interviews have shown that their levels of new media literacy vary, ranging from basic to advanced.

Each mini research project followed the same structure and development. The first stage involved the investigation of the in-service teachers' pedagogical practices. Data were collected through in-depth interviews (conducted mainly by the main researcher) and classroom observations (conducted by the students) for a period of one to three months. The students wrote down chronological descriptive field notes as the lessons unfolded. In the second stage, the students collaborated with the in-service teacher for the design, implementation and evaluation of at least four technology enhanced lessons, which were video-recorded and later described in detail for further analysis (following the research-oriented teacher education approach proposed by (Legutke *et al*. 2007).

In-depth individual interviews with in-service teachers and pre-service teachers and video-stimulated reflective sessions with some pre-service teachers were conducted at the end of each mini research project. The pre-service teachers produced 5000-word research reports in which they described and analyzed their data in detail. The main researcher conducted video stimulated reflections (VSRs) with five of the pre-service teachers, in which they watched the videotape of one of their lessons together with the investigator and took the initiative in identifying the aspects of their teaching they wanted to comment on. Our initial intention to conduct VSR sessions with all participating pre-service teachers could not be fulfilled because most participants found it difficult to juggle their normal workload and could not find time to take part.

Therefore, research data were collected via a variety of qualitative research instruments in order to attempt to maximize reliability through triangulation. The qualitative analysis

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[4] All names have been changed in order to protect teachers' anonymity.
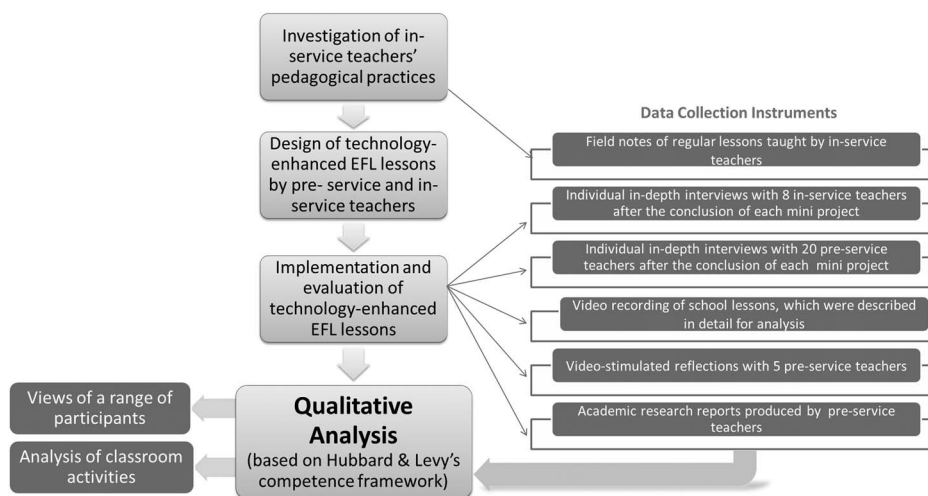
Fig. 1. Research process.

software tool MaxQDA supported the process of coding and categorization of the prominent themes, based on Levy and Hubbard's (2006) suggested competencies, that emerged from the various sources of data in response to the research questions. In order to ensure greater internal validity in our research, we used the technique of 'respondent validation' (Burns, 2001), which involved taking the data analysis and interpretation back to the actual research participants (mainly pre-service teachers) to ascertain whether they recognized and supported the findings. Figure 1 summarizes the research process.

In order to better prepare the participating students for their research endeavors, a "young scientists research group" was set up by the main researcher. This group met once a month for a two-hour session. During these meetings the students received academic support on research methodology, exchanged ideas about their projects, and supported each other in research tasks such as narrowing down their research questions, designing questionnaires, coding research data, and so on.

In the next section we summarize our main findings on the pre-service teachers' perceptions regarding the impact of the training program on their development as CALL practitioners. Although all the other sources of data contributed to the findings, due to space limitations the data discussed in this article are mainly drawn from interviews with pre-service teachers.

4 Data analysis

4.1 Impact on the development of CALL-related teaching competencies

4.1.1 Developing a technical foundation and being able to use this technical knowledge efficiently. The fact that most German primary and secondary schools are not well-equipped with current technology, nor with technological support and professional training, adds some extra difficulty to the task of motivating pre-service teachers to learn about CALL. The literature has shown that this situation is very similar in many European

countries and in other parts of the world (Hubbard & Levy, 2006). In our context, even when they recognized the potential benefits of technology for their own learning, the student teachers often emphasized the difference between the "perfect environment" of the technologically well-supported university context and the "real life" of poorly equipped schools. As a result, many of them questioned whether CALL projects such as LanguageQuests, Collaborative Writing with Wikis and Telecollaboration, which are successfully implemented at higher education level, could also be developed in schools.

The participants in the CALL seminar often referred to the unpredictability and risks involved in technology use as major reasons for them not planning to use computers for teaching, at least in their first years of work. Most students feared to have their plans derailed by technical problems and many of them stated they would rather master the basic requirements of their jobs first before taking up more "risky" challenges.

The students who developed school-based projects, however, seemed to have strengthened their self-confidence in dealing with technical problems and other challenges related to technology integration, thus allowing them to further develop their technical foundation. Krista, for instance, developed and implemented four IWB-based lessons for a 6th grade classroom. Since the school was not well-equipped with hardware, software and technological support, she was confronted with unexpected operational challenges that led her to perform a great variety of technology tasks, including purchasing new cables for the IWB, upgrading the IWB software and setting up the whole equipment for each lesson. When asked whether she would be willing to use computer technology in her future career, the student teacher replied:

> So I have to say if I had only been in the CALL seminar …. I wouldn't do it, I think, because you see how it could work, but you don't see how it really works. So I think the project is really good because you do it on your own and see the problems for the first time, and now if I do it again I know the problems and I know the challenges that will wait for me and I'm… and I feel better prepared now with the project.
>
> (Krista - interview)

In this excerpt, the student acknowledged that the input and practice she obtained in the university seminar were not adequate in providing her with sufficient technical foundation in her ability to implement CALL at school level. She also pointed out that the school-based experience required her to experience and respond to a variety of real-life problems, which helped her to feel better prepared for the challenges that "would wait for her" in her future profession. This student was thus able to deal with her fears while still within a supportive environment, as proposed by Dooly (2009).

4.1.2 Developing a positive attitude towards using technology for teaching languages. As pointed out earlier in this paper, an important aim of the CALL professional development program was to foster positive attitudes towards using electronic technology for language teaching, mainly among the pre-service teachers. In fact, most students interviewed for the project pointed out that their school-based experiences strengthened their motivation to employ electronic technology in their future classrooms because they were able to make use of it in ways that enhanced pupils´ motivation and/or language learning.

In the following excerpt the student referred to a Webquest project on the theme "Australia", which was implemented for an 8th grade in a secondary school. When asked

whether she would be willing to use electronic technology in her future teaching, the student provided the following response:

> And I would definitely do it again, I mean to use computers, since you significantly notice… well, how… the students were really excited, since they did not know anything like that, neither from the language teachers they already had, nor from other teachers or subjects. Well, the motivation was really there and they were all so excited, which gave us all, those who were in charge of the project, well, reassurance that it is important to work with computers and that it can be an advantage.
>
> (Nadine - interview)

The student pointed out that the excitement and involvement shown by the pupils during the project confirmed her expectations that the use of computer technology could have a favorable influence on pupils' motivation. This student, however, did not go more deeply to pinpoint the connections between the motivational aspects of the medium and how they supported the processes of pupils' learning. In fact, this was a recurrent pattern in the pre-service teachers' responses. In this sense, our findings are similar to the ones obtained by Meskill *et al*. (2002), which have shown that when novice teachers "praised the medium for its motivational aspect, their reports tended to be superficial, with the locus of motivation lying solely with the machine" (*op. cit*.: 53). One of the students explained how a positive experience with the IWB refueled her motivation to use this technology in her future teaching career:

> But what I also mean is for a fifth grade they really understood a lot. And they also said, most of them said. We asked: "How much did you understand during the lessons?" And then most of them said "most of it". And now in the Praktikum I was teaching in a fifth and a sixth grade and my, the biggest problem I had was that I was talking too much English and too difficult for them. And the teacher told me after that that they didn't understand me. And now that I compare it to them, maybe it was even, yeah the IWB that helped them.
>
> (Helga - interview)

In this excerpt, the student referred to a CLIL (content and language integrated learning) project that she implemented in a 5th grade at a secondary school. In that context, the IWB was used to facilitate the process of teaching geography in English. The pre- and in-service teachers drew on a great variety of resources (e.g., pictures, videos, graphs, animations and audio and interactive flash files) to help make the input comprehensible to learners with limited proficiency in the language of instruction. In lines 1–3 the student made reference to questionnaire results on pupils' perceptions, which indicate that they seemed to have understood most of the content. She then compared these findings to another context in which she was not equally successful in making herself understood by her pupils.

In comparison to Nadine, this student goes a step further in the analysis of the language teaching potential of electronic technologies. While Nadine simply referred to students' increased motivation without making direct connections to enhanced learning, this student was able to identify a specific language teaching goal that the IWB can help to achieve, i.e., to facilitate the understanding of linguistic input through the use of multiple media. In other parts of the interview, the student also pointed out that, although she had been intrinsically motivated to use new technologies prior to the project, this motivation was

certainly strengthened after having been able to experience the positive gains of technology use in her own teaching.

However, in her discourse, the student still reveals the "misconception of machine agency" (Meskill *et al.* 2002), which is a common notion held by novice teachers, who (more often than expert teachers) tend to view computers as agents in the instructional process. In line 6, the student concluded that it "might have been the IWB that helped them" to make sense of the input. In spite of being actively involved in the design of electronic materials and classroom teaching, in that phase of the CALL program the student still placed too much focus on the medium and its potential. She thus failed to reflect on her own mediating role and on the specific features of the electronic materials and implementation strategies which had contributed to the positive impact of technology use on pupils' learning in her context.

The data presented in this section indicate that the student teachers' motivation to use technology in their future careers was reinforced by their positive technology-enhanced teaching experiences during their placements. The section also discusses some misconceptions, which reveal that the student teachers' increased motivation for using CALL was not always directly connected to pupils' enhanced language learning.

However, as the data presented in the next sections will show, some student teachers were able to gain a more solid understanding of the potential affordances of specific technological tools and how they could be harnessed to improve language education.

4.1.3 Using CALL approaches that are intentional and well-considered. When asked about the benefits they gained by developing school-based technology projects, most students pointed out that they gained a deeper understanding of the learning and teaching potential of electronic technology because they were required to design and implement technology-based activities which had clear language learning goals and were aimed at a specific audience. In contrast to the lessons they designed for peer teaching in the framework of the CALL seminar, the school-based lessons offered a much more genuine experience because the student teachers were confronted with "real" learners in an authentic language teaching scenario. As one of the pre-service teachers pointed out:

> Yeah, I think in the CALL seminar you just saw what you can do with the electronic whiteboard but it's a difference because here you have pupils and you have…you want them to learn something, so you have to implement the whiteboard lesson in a way that they learn something from it. So you don't have to show just pictures or…. I don't know…. films… but films that they can learn and pictures that they can profit from. Do you know what I mean? I can't explain it better […] there has to be some learning background behind it.
>
> (Helen - interview)

This student developed a project-based learning unit in which learners were given the opportunity to come into contact with native speakers at a large German airport and use the target language to interview them. The student then used computer technology in the lessons that aimed at motivating and preparing learners for this task, for instance, by using the IWB as a digital hub to integrate a variety of ICT tools (digital videos, pictures and audio files) into her lesson. In this excerpt the student teacher had been asked about the potential benefits of implementing technology-based school lessons for her development as a CALL practitioner. In her response, she emphasized the important role played by her field

experience in allowing her to gain a better understanding of the potential of one specific technology (the interactive whiteboard) for enhancing language learning. As she pointed out in lines 4–6, having set specific learning goals required her to employ technology-based materials that would not merely add an element of fun and entertainment to her lessons, but which would in fact facilitate pupils' language learning.

As several students pointed out, the same goal could not be achieved in the lessons implemented at university level. In spite of being required to design technology-based activities with clear language learning aims and a specific learner audience in mind, the pre-service teachers did not respond to the university-level peer teaching opportunities with the same degree of motivation and engagement as to the ones offered to them at school level, as stated by one of the student teachers:

> Although we should try to, in the CALL seminar, we should try to design the lessons like… for children… but they are much… it's not as serious… like with children. So it's another… it's a subjective feeling that you see your fellow course mates and you don't take it so seriously, whereas when you see the children, you know you are teaching them something.
>
> (Frederick - interview)

The student teacher stated in lines 4–5 that having to teach something to a real class added an extra element of seriousness to his teaching endeavor.

Our findings have also shown that the student teachers' efforts in accomplishing an authentic teaching task often seemed to help them to redirect the focus from themselves and their performance as technology users to the pupils and their language learning needs. For instance, when asked about possible challenges that she had faced during the implementation of the school-based project, one of the students responded:

> Teaching in a more learner-centered way….that was kind of a bit difficult for me. Because I thought "Okay, that whiteboard is so cool and as a technology learner I have to try out all the features the interactive whiteboard has." And then I thought "Okay, I mustn't forget about the pupils because they might fall asleep while I try out myself!"
>
> (Johanna - interview)

In this excerpt the student teacher refers to a tension she experienced between two different roles. On one hand, as a university student and "technology learner" she was expected to exploit and understand the full potential of a specific technology. In her role as a teacher, however, the focus needed to be redirected to enhancing pupil learning with the use of the technology. As she pointed out, during her lessons she sometimes behaved more as a "technology learner", who "tries out as many features of the technology as possible", than as a teacher, who responds to her learners' needs.

Therefore, the field experiences seem to have created authentic professional learning opportunities that helped the student teachers to redirect their focus from their own performances as technology users to the potential of the technology for facilitating language learning processes.

Another important point made by most students was the fact that the school-based experiences enabled them to evaluate their use of the technology on the basis of specific language learning outcomes that could be measured during or after their lessons.

4.1.4 Evaluating the effectiveness of CALL activities.   Some students emphasized the benefits of having the opportunity to assess pupils' learning and the effectiveness of their CALL initiatives. In the initial conceptualization of the program the students were not required to design lessons that were integrated into the school's regular curricular schedule. As a result, some student teachers tended to avoid certain 'dull' topics, such as grammar teaching, and designed lessons that focused on more general topics, very often without specific language learning goals in mind. This approach made it more difficult for them to undertake an appropriate assessment of pupils' learning and of their own development as CALL practitioners. As one of the student teachers pointed out:

> Yes. Maybe afterwards, that's what… something I am interested in…I would like to observe what effect my teaching had. If it was effective, if the use of the interactive whiteboard was effective to teach the children something…Yeah, or if it was just a nice thing to have, they were amused and everything was fine and next lesson they don't remember anything.
>
> (Johanna - interview)

As part of her project for her "Wissenschaftliche Hausarbeit"[5], this student teacher designed and implemented four IWB-based lessons for a 6th grade. Her aim was to exploit the potential of IWB technology for teaching four different skills: grammar, vocabulary, speaking and listening. Although her lessons were integrated into regular curricular activities, they were spread over a one-month period and were not connected to each other. Since the individual lessons did not build upon previous ones, it became more difficult for her to evaluate the effectiveness of her teaching.

These findings motivated the development of new guidelines for the collaborative projects. Therefore, from the second year of the CALL program onwards the student teachers were required to develop lessons that covered the objectives of an entire teaching unit from school textbooks, thus avoiding the implementation of isolated, decontextualized lessons in a random sequence. This way the student teachers were "forced" to move outside their comfort zones and exploit the potential of the technology to achieve a greater variety of pedagogical goals. This change proved to be especially beneficial for the techno-savvy student teachers, who are proficient in exploiting technological tools for designing catchy, motivating and fun activities, but often lack the ability to integrate technology in a contextualized learning environment.

The opportunity to assess pupils' learning was especially relevant for some student teachers who demonstrated considerable skepticism towards the potential of specific technological tools introduced in the CALL seminar. In the following excerpt, one of the students refers to the important role played by the assessment of learning outcomes in enabling her to overcome such skepticism:

> I think I learnt a lot. I was in the CALL seminar and it seemed hard for me to be able to do something like this in an elementary school, especially in a foreign language […] So it was difficult for me to imagine children achieving something (with this technology).

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[5] A Wissenschaftliche Hausarbeit is a mini-thesis (60–80 pages) which the student teachers have to submit as part of their final academic evaluation.

Or that the whiteboard could be beneficial in supporting their language learning. And so it was very nice to see that it did work, that they did benefit from it.

(Anita, interview)

In her project, the student teacher investigated the integration of IWB technology in the different stages of storytelling in a 3rd grade. In lines 1–4 the student expressed her initial skepticism towards the potential of this technology for supporting language learning in the primary school context. Since she was able to implement and evaluate four consecutive lessons, she could assess pupils' learning through classroom activities and homework as well as their perceptions/reactions through questionnaires. As she pointed out, in lines 4–5, only after gathering sufficient evidence of the positive effects of IWB-enhanced teaching, could she finally trust the potential of the technology, and (hopefully) consequently be more open to integrating the technology in her future teaching.

This section has discussed the perceived impact of the situated CALL teacher education program on pre-service teachers' acquisition of CALL-related teaching competencies. Our findings have thus shown that the school-based projects seem to have provided student teachers with opportunities for reaching mastery experiences[6] that had a positive impact on their development as future CALL practitioners.

5 Conclusion and further work

The results suggest that the field experiences, in conjunction with systematic guided reflection, have provided professional learning opportunities that supported the student teachers' development as CALL practitioners. The student teachers especially emphasized the important role of these school-based experiences in allowing them to use technology in authentic language teaching scenarios, to evaluate the impact of technology on language teaching and learning, and to reach genuine mastery experiences.

It is important to highlight, however, that in order to be able to bring sufficient focus to pedagogy in the analysis of CALL activities the student teachers needed to receive adequate guidance and support in the process of self-analysis and self-assessment. In the context of the program described herein this assistance was mainly provided by the university instructors (through lectures and supervision), and by their fellow students during the "young scientists" research group meetings. Most student teachers highlighted the benefits they gained from participating in the various research training initiatives that were implemented in the framework of the program. Therefore, incorporating a component of action research training into the program was another key element for its effective implementation.

Our focus on the pre-service teachers' cognition allowed us to identify key aspects of their learning processes and patterns of competence development which can inform the design and implementation of CALL language teacher education programs. Some findings reveal common notions held by novice teachers which have already been discussed in the literature (e.g., Meskill *et al.*, 2002), as for instance the "misconception of machine agency" (*op. cit.*: 51) and "technology seen as in primary relationship with teachers and their plans" (*op. cit.*: 50). Our findings also point towards important elements that seem to facilitate pre-service

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[6] Mastery experiences are defined as using perception of successful teaching to raise confidence of teaching (Bandura, 1997).

teachers' learning about technology. For instance, the findings reveal their need to evaluate their own use of the technology on the basis of specific language learning outcomes that could be measured after their lessons and their perceived cognitive gains after facing and overcoming technology-related challenges in authentic work environments.

The findings presented and discussed in this article also confirm the advantages of an approach that has been strongly advocated in the literature on general language teacher education (e.g., Legutke & Schocker-von Ditfurth, 2009) and CALL (e.g., Meskill *et al.*, 2006; Egbert, 2006), which is the establishment of partnerships and collaboration between language teacher education institutions and schools. As our findings have shown, the student teachers perceived these technology-rich field experiences as having supported the development of important CALL-related competencies. These findings thus reiterate the importance of such partnerships for the future of CALL language teacher education.

As pointed out earlier, research has shown that non-site-based technology courses have very little direct impact on teachers' classroom uses of computers. Our findings indicate that the student teachers' involvement in the design, implementation and evaluation of school-based projects seems to have enabled them to achieve a deeper understanding of CALL processes and outcomes. However, the scope of our study did not allow us to examine the impact of the CALL development program on pre-service teachers' use of technology in their own classrooms. Therefore, we are currently designing a follow-up study to investigate the impact of the CALL professional development program on in-service language teaching practice.

Another fruitful topic for further research could be the development of strategies for promoting the continuity of this type of teacher collaboration once the students have completed their university degrees. Several authors (e.g., Hanson-Smith, 2006; Hubbard & Levy, 2006) have pointed out that an important challenge faced by pre-service teachers is that most of their knowledge and skills in CALL is likely to become obsolete shortly after leaving their formal educational setting. Therefore, there seems to be a need for developing models for creating and maintaining communities of practice as extensions of pre-service CALL programs in order to create opportunities for the novice teachers to continue developing their knowledge and skills. A strategy we are currently exploring is to invite novice in-service teachers who took part in the CALL professional program in the past to serve as school mentors for new generations of pre-service teachers.

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