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RESEARCH ARTICLE

Developing in-service teachers' pedagogical knowledge of CALL through project-oriented tasks: The case of an online professional development course

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Abstract

The growing popularity of online CALL professional development (PD) courses and programs has necessitated a more in-depth look into their design. For so doing, a qualitative case study was carried out to explore how project-based learning (PBL) contributes to six in-service teachers' CALL PD. Drawing on data obtained from technology-review projects and follow-up discussions, it was observed that the experience of review, reflection, and discussion enhanced participants' technological knowledge, along with their attention to the affordances and constraints of different tools, their application for materials development or selection, and CALL evaluation. The potential contribution of this study to PD research lies in the account of how inquiry-oriented projects can be defined into the design of a CALL PD. The integration strategies are applicable for online PD attempts across various contexts.

Keywords: teacher education; project-based learning; online professional development; computer-assisted language learning

1. Introduction

Computer-assisted language learning (CALL) courses were introduced into master's and doctoral curriculums of English language teaching (ELT) programs by the Iranian Ministry of Sciences, Research and Technology in 2014. Since then, more universities across the country have clamored for effective CALL teacher education, and a plethora of workshops and courses have risen to professionally prepare language teachers for technology-enhanced instruction. This growing demand for effective CALL professional development (PD), which addresses the inflexible and busy work schedules of in-service language teachers – many of whom are located in geographically dispersed areas – has widely stimulated the design and development of fully/partially online CALL PD courses.

The potential of online learning environments for teacher education beyond the temporal/spatial confines of the physical classrooms (Reeves & Pedulla, 2011) has presented online classrooms as a practical solution for making CALL PD available for all teachers across the country (Nami, Marandi & Sotoudehnama, 2018). Online PD is suggested as a strategy to overcome what Yurkofsky, Blum-Smith and Brennan (2019: 1) call "*insufficiently responsive*" teacher education attempts, particularly for working teachers.

Although shifting the medium of education from face to face to online can address the accessibility problem, it may not be adequate for effective teacher preparation (Powell & Bodur, 2019). This might be attributed to the fact that these preparation attempts usually draw on design features and instructional strategies that are more apt for face-to-face contexts. It appears crucial

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to re/define the design features and instructional strategies of online courses that work for teacher education. As Moon, Passmore, Reiser and Michaels (2014: 172) acknowledge, "a corollary to the challenge of access is the challenge of developing research-based design principles to guide the ongoing development, implementation, and evaluation efforts in online PD." Hence, the main challenge is the identification of the strategies that work well in online teacher education courses to effectively prepare teachers for technology-enhanced education (Tondeur *et al*., 2019).

In practice, however, online PDs have largely replicated conventional face-to-face PD practices (Yurkofsky *et al*., 2019). A careful review of related research reveals a scarcity of studies that empirically explore the design of online PD in general (Reeves & Pedulla, 2011) and online CALL PD in particular (e.g. Wang, Chen & Levy, 2010). There is also a dearth of research into what teachers value in online PD (Powell & Bodur, 2019; Yurkofsky *et al*., 2019). To achieve a comprehensive understanding of the potential of "any approach for teachers' professional growth, it is also essential to explore the issue from the perspective of teachers" (Nami, Marandi & Sotoudehnama, 2016: 659). Effective preparation plays a determining role in teachers' future teaching experience. This, coupled with the novelty of online CALL PD and the expenditures made for its design, renders the essence for conducting more studies that empirically explore *which preparation designs/strategies work for* and *are valued* by teachers (Dede, Ketelhut, Whitehouse, Breit & McCloskey, 2009; Moon *et al*., 2014).

In response to this demand, the present qualitative study reports the design of an online CALL PD and endeavors to explore the contribution of project-based learning (PBL) to the development of teachers' technological and pedagogical knowledge of CALL. The experiences of six in-service English as a foreign language (EFL) teachers who completed a seven-week, 13-session online synchronous course were investigated. The findings reported and discussed in this study can be productive for the design and implementation of an online CALL PD course.

1.1 Teacher PD for CALL

PD plays a defining role in developing teachers' pedagogical practice for teaching with digital technologies (Tondeur *et al*., 2019). PD has been conceptualized differently in teacher education research. According to Little (1987), it encompasses the activities that aim at preparing in-service staff for better performance in schools. The growing popularity of situated and social theories of learning, decades later, expanded the scope of PD beyond mere workshops to include a wider range of formal and informal individual/collective preparation attempts for pre- and in-service teachers across different contexts. For Desimone (2009), an effective PD develops teachers' *knowledge*, which, in effect, transforms their *instructional practice*. This, in turn, promotes *student learning*.

The growing proliferation of educational technologies for language learning/teaching over the past decade has "not only cast new lights on language education, but also ushered in new practices in teaching and learning English as a second language" (Lin, 2015: 527). This has increased demands from language teachers as they are tasked with effective selection and integration of these technologies into their instruction. Considering the determining role of teachers in CALL, catering for their pedagogical knowledge of technology-enhanced instruction is of prime importance (Kim & Hannafin, 2011). In the absence of such a knowledge base, technology selection and integration into teaching/learning practices might be done arbitrarily or inappropriately, which, in effect, would restrict the effectiveness of CALL (Guichon & Hauck, 2011).

In response to this need, CALL PD courses and programs are gradually growing in number in higher education institutions. Despite this growth, however, PD still occupies a small part of CALL research, and even fewer are the studies that focus on online CALL PD. Additionally, "training for academics so that they learn how to effectively redesign learning opportunities ..., in particular through the incorporation of ICT ..., is not straightforward" (Rienties, Brouwer & Lygo-Baker, 2013: 123).

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Directly modelled after guidelines and frameworks designed for other educational enterprises (Hubbard & Levy, 2006), CALL PD has mostly been decontextualized and teacher-centered, with a focus on technology per se. Such preparation is not only *fragmented* (Dede *et al.*, 2009) but also insufficient. The problem worsens as these courses and programs are also often logistically and spatially constrained. Although such endeavors may develop teachers' technological knowledge, they are seldom translated into language classroom practice (see Tondeur *et al.*, 2019; Wikan & Molster, 2011). Having to dedicate a great deal of their precious and limited time without gaining much, many teachers find these attempts sparse (Teräs, 2016). Jeong (2017) argues that the main concern in CALL PD is the lack of adequate opportunities for relevant modeling for the use of educational technologies. In his study of formal and informal CALL preparation, Kessler (2007) observed that 79% of teachers related the ineffectiveness of the course they were participating in to the absence of opportunities to use technology for instruction.

These problems have necessitated a transformation in current CALL PD to apply relevant design mechanisms to develop the pedagogical knowledge required for effective technology-enhanced language instruction (Baran, Canbazoglu Bilici, Albayrak Sari & Tondeur, 2019; see also Prestridge, 2010). Hubbard and Levy (2006) define the pedagogical knowledge of CALL as an understanding of how computers can be applied in language instruction and the ability to use that understanding for materials, content, and task development and student assessment. CALL can be more effective when teachers understand the interplay between digital technologies, pedagogy, and language content and apply that understanding in practice (i.e. real classroom instruction). As Powell and Bodur (2019) note, the knowledge that is translated into practice is of value. Inspired by Ertmer and Ottenbreit-Leftwich (2010) and Hubbard and Levy (2006), CALL pedagogical knowledge, in the present study, encompasses the knowledge of (a) digital technology use, (b) its particular affordances/constraints when applied to language teaching/learning, (c) technology-enhanced materials selection/development, and (d) technology-enhanced language learning assessment.

1.2 Online PD

Advances in educational technologies and online learning platforms, along with educational paradigms shifting toward online education, have increased the popularity of online PD (Jeong, 2017; Parsons *et al.*, 2019; Reeves & Pedulla, 2011). Online PD promotes more sustained interaction, which is crucial for knowledge construction (Lee & Brett, 2015). It also supports personalized learning as teachers are given a voice and an opportunity to align learning experience with their needs (Dede *et al.*, 2009; Yurkofsky *et al.*, 2019).

The design of online PD must be well articulated as the structure and pedagogical approaches are affected by the mode of delivery (Lin, 2015). Although research is abundant on what constitutes effective teacher education, how preparation strategies can be best implemented into online PD design is not carefully explored (Teräs, 2016). Similarly, research on the design of effective online CALL PD remains largely scant (Lin, 2015; Wang *et al.*, 2010). Hence, parallel with the growing needs for high-quality teacher education and in line with the surge in the use of online platforms for CALL PD, there is a call for more detailed accounts of teacher experiences in these platforms (Parsons *et al.*, 2019).

1.3 CALL PD: Theoretical groundings

Grounded in situated and social constructivist views of learning, it is suggested that for teacher knowledge to be professionally constructed, in addition to receiving instruction, teacher learning should be *situated* in meaningful practice (Rienties *et al.*, 2013; Weber, Gold, Prilop & Kleinknecht, 2018). The underlying reason is that knowledge is not developed solitarily and in isolation from the external world (Vygotsky, 1978). Such practice helps teachers develop

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experiential knowledge parallel with the knowledge transmitted via direct instruction. Although practice through the course of preparation may not replicate real classroom practice, it can "effectively prepare student teachers for the complexities and demands of … teaching" (Grudnoff, 2011: 223).

To be meaningful, practice should promote teacher reflection and interaction with content, technology, and/or peers. Such "*authentic technology experiences*," in Tondeur *et al.*'s (2019: 1189) terms, have the potential to develop teachers' pedagogical understanding of different technologies for teaching/learning purposes (see also Powell & Bodur, 2019). This happens by enabling teachers to turn their abstract or received knowledge (Wang *et al.*, 2010), known as *hypothetical competency*, into *actual competency*. Actual competency refers to an understanding of how to apply the abstract knowledge into a particular situation and deal with unknown conditions (Guichon, 2009).

Hence, effective PD should provide opportunities for reflection and interaction with the content – that is, practice or enaction in Lin's (2015) terms – in a learner-centered context by engaging teachers in inquiry-oriented tasks. These authentic tasks or projects, which build upon instructional content, teachers' background knowledge (Jeong, 2017; Parsons *et al.*, 2019), and problem-solving and active learning (Moon *et al.*, 2014), reflect an approach toward teaching/learning, commonly referred to as PBL. As a variation of inquiry-based learning, PBL "begins with a preconceived idea of an end product, which can be achieved through student mastery of specific knowledge and skills" (Gubacs, 2004: 33–34). Focusing on a driving problem, learners try to devise plans, pose questions, interact, explore, and debate in an attempt to come up with practical solutions (Choi, Lee & Kim, 2019) and present these solutions in the form of a descriptive and/or instructional artifact or product.

These qualities turn PBL into a productive preparation strategy for CALL PD in which the development of technological pedagogical content knowledge and its transfer to a real classroom context has always been a challenge (Tseng & Yeh, 2019; see also Howard, 2002). Technology-related projects, according to Tseng and Yeh (2019), promote deep and active learning in teachers by placing them in a situated learning context that encourages problem-posing, reflection, interaction with peers and/or instructional content, social presence, and critical thinking to solve real classroom problems (see also Powell & Bodur, 2019; Teräs, 2016). Drawing on their subject matter content knowledge, teachers use and evaluate digital tools, platforms, and technologies in meaningful tasks to critically explore their application for learning/teaching different language skills. This way, teachers are expected to apply the knowledge they have acquired through the course of preparation in a contextual manner (Herro, Hirsch & Quigley, 2019). They can also draw on technology to present the outcome of their technology use and review projects.

Multimedia technologies, in other words, can be both the focus of CALL projects and the means to present their outputs. As noted by Biasutti and EL-Deghaidy (2015), digital and multimedia technologies can facilitate and support PBL (see also Thomas, 2017) by providing a stimulating context for knowledge construction (Howard, 2002). Screencasts are good examples of technology use in PBL. Creating these instructional and descriptive videos calls for not only the knowledge of how to use media-generator technologies but also higher-order thinking skills (Howard, 2002). In using and evaluating different tools, debating their application for language teaching/learning or content design, and explaining this in instructional videos to others, teachers are expected to develop their pedagogical and content knowledge. In line with Shepard (1989), it is suggested that "a person who is able to successfully explain a body of knowledge to others may be considered to have mastered this knowledge" (Gubacs, 2004: 37).

A careful review of research, however, reveals that inquiry-oriented projects have just recently captured attention in CALL PD courses (e.g. Tseng & Yeh, 2019) and studies that explore their integration into the design of online teacher education courses remain scant (Dana, Pape, Griffin & Prosser, 2017; Teräs, 2016). These studies (e.g. Antoniadou, 2011; Magidin de Kramer, Masters, O'Dwyer, Dash & Russell, 2012; Jeong, 2017), by and large, have reported a positive relation

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between PBL and teachers' technological knowledge. How PBL should be defined into the design of PD courses to contribute to the development of teachers' pedagogical knowledge is yet to be explored.

The present study features an attempt to move beyond stand-alone technology courses by providing opportunities for teachers to get engaged in technology-review project development and sharing, followed by in-class discussions. The following research question is addressed in this study: How did PBL contribute to the development of language teachers' technological pedagogical knowledge in an online CALL PD?

2. Methods and limitations

A qualitative case study design was applied to explore how PBL (as the independent variable) contributes to language teachers' pedagogical understanding of CALL (as the dependent variable). Case study research aims at exploring or explaining an event, cases, or documents in their real context. As Shakir (2002: 191) states, "case study research is deemed suitable when the proposed research ... is largely exploratory; and addresses the 'how' and 'why' questions."

This study entails some limitations that must be acknowledged. Although Patton (2002: 244) notes that "there are no rules for sample size in qualitative inquiry," featuring a small sample size in a study with a short lifespan may have limited the breadth of the findings. The position of the researcher in the study as the course instructor and data analyst, and its possible impact on the research, carries with it certain limitations. Furthermore, the fact that all six participants were experienced in-service language teachers might have affected the findings. The research design and the methodology applied without randomizing the participants for a control might be considered as another source of limitation. Additionally, the thematic units extracted and coded based on one conceptualization of pedagogical knowledge of technology might have left out some aspects of teacher learning and knowledge development.

The impact of the context and the topics highlighted in the syllabus should not be overlooked in the obtained results. Consistent with Parsons *et al.* (2019: 40), it is also suggested that "voluntary participation supports teacher buy-in." In other words, the results are reflective of the impact of PBL on highly motivated in-service teachers who voluntarily attended the course. A PD course that comprises part of a compulsory teacher preparation program is likely to uncover realities about the design features of an online PD that might have not been addressed in this study. Although these limitations might make the implications tentative, effective online CALL PD that expands teachers' pedagogical understanding of technology-enhanced language teaching holds promise as a productive experience.

2.1 Participants

Participants comprised six (five females, one male) in-service English language teachers and instructors from different language institutes, high schools, and state universities in Tehran and Kashan provinces, with an age range of 35 to 56, who registered for a free online CALL PD course on a voluntary basis. Although all had substantial teaching experience, ranging from five to 18 years, five teachers self-rated their technological proficiency as novice and one considered herself as an average technology user. None of the teachers had prior experience of participating in a CALL PD course or using technology for pedagogical purposes. One of the participants held a PhD, two were PhD candidates, and five were master's degree holders in teaching the English language. To protect the anonymity of the participants, pseudonyms are used. The researcher participated in the study as the course instructor.

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2.2 Online CALL PD course

The in-service teachers who volunteered to attend the course were consulted in the design process to help them have a more convenient experience. They were contacted via email and were asked to select their preferred course format (i.e. face to face, synchronous, and blended) and duration (i.e. one month/three weekly sessions, two months/two weekly sessions, and three months/one weekly session). All the participants selected the synchronous online semi-intensive course with two weekly sessions, noting that as in-service working teachers they are busy throughout the academic year except for the first two months of the summer (the academic holidays in Iran). Hence, they preferred to attend the course during that period so that they had more time to reflect on the course content and work on the projects. Of the six participants, two believed that attending an online CALL PD would also help them learn more about online synchronous instruction. For the other four, online sessions were time saving compared to the face-to-face ones, as they were not required to waste their time traveling to the course site. All six also preferred a synchronous to blended online course, as they wanted to have real-time contact with peers and the instructor throughout the sessions. Accordingly, thirteen 120- to 180-minute synchronous online sessions were scheduled for two weekdays of seven consecutive weeks.

The sessions were held using the live-session feature of WizIQ cloud-based educational platform. The rationale for selecting WizIQ was twofold. First, WizIQ offers a very user-friendly interface that makes it easy to use for teachers with limited or average technology knowledge (as was the case with the participants in this study) compared to other virtual classroom platforms and learning management systems (LMSs) available for Iranian users at the time of the study. Second, it offers free virtual classroom and LMS functionalities. This way, those teachers/learners who cannot afford to pay for highly sophisticated LMS services would find an opportunity to use the service.

To enter each session, users are required to sign up on the platform. Except for two sessions in which the video-streaming feature was used, the communication was in audio- and text-based modes in other sessions to avoid possible connectivity problems and streaming delays. The course aimed at enhancing participants' technological and pedagogical knowledge of CALL via systematic instruction and inquiry-oriented projects and discussions. Upon registration, the participants received the syllabus via email. During the first session, they were informed about the course specifications, goals, and tasks. The design of the syllabus and the inclusion of topics and technologies were largely informed by the researcher's personal experience as a CALL teacher and teacher educator for about a decade.

Prior to each session, teachers were invited to read the selected readings listed in the syllabus, which addressed the conceptual foundations and pedagogical strategies for CALL. Digital technologies were introduced under two categories. The first (G1 tools) included tools and environments – podcasts, vlogs, blogs, audio/video editing technologies, wikis, presentation tools, digital storytelling tools, test-making tools, and e-book and animation/comic generators – with applicability for text-, audio-, and/or video-enhanced content development and computer-mediated communication. The second (G2 tools) included educational technologies and apps designed for language learning purposes (e.g. EFL WebQuests, websites, apps, and app-based games). These two groupings aimed at engaging teachers in two types of projects, which will be explained in detail in the following section.

About half of the classroom time during each session was dedicated to didactic instruction and discussions on the required readings. During these teaching periods, the instructor asked questions such as "What is your opinion?," "Do you agree?," "Does this apply to your teaching context?," and/or "How? Would you please elaborate?" to encourage participants to reflect on the topics introduced and engage in discussions. The instructor used the whiteboard feature to highlight important points. The rest of the session was usually devoted to discussions on technology use or review projects. These discussions aimed at engaging in-service teachers in

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post-project in-class reflection, opinion and experience sharing, and interactive problem-posing/solving.

2.3 Projects

While engagement in projects and follow-up discussions was the defining component of the design of this PD, the overall aim of the course was more about the development of a pedagogical knowledge base on technology integration for language instruction. In this respect, two types of projects were built into the design of this online CALL PD course to place participants in a meaningful learning context to experience using and evaluating different technologies. These included technology-use and technology-review projects.

Prior to each session, from session two onwards, teachers were required to practice using the technologies listed in the G1 tools section of the syllabus. The rationale behind technology-use projects was threefold. First, it aimed at developing teachers' technological proficiency. Second, consistent with the common assumptions that technology users will adopt innovations that are perceived to be advantageous for their purpose (Rogers, 1995), it was hoped to positively shape teachers' perceptions and increase the likelihood of technology integration into their future instructional plans. Third, it was expected that teachers would use these tools as a means to not only create and share their technology-review projects but also design and develop digital instructional content for their classrooms. A specific time during each session was dedicated to teachers' experience of using these tools and discussions on the possible problems encountered, since, according to Dickerson, Jarvis and Levy (2014), dialogue plays a determining role in PBL. These follow-up classroom discussions were expected to engage teachers in further reflection and collective problem-posing/solving. The course instructor participated in the discussions as a facilitator, avoiding immediate responses to the questions to promote more interaction and provide teachers with an opportunity to get engaged in problem-solving.

Additionally, participants were asked to create and share four technology-review projects throughout the course. From the third session onwards, every three sessions in between, each teacher was required to find sample websites, tools, or educational technologies related to the G2 tools section of the syllabus and, in an audio-narrated video screencast, review their educational applications. No duration limit was set for the screencasts. To promote reflective discussions and further critical thinking, participants were required to upload the screencasts in an online multimedia sharing platform and share the URL with the instructor, who hyperlinked the projects in the classroom weblog (see Figure 1). As Weber *et al.* (2018: 41) acknowledge, "videos can be reflected and analysed more than once and without the need to react immediately."

The project-sharing was expected to help teachers reflect on their own and peers' justifications and reviews. Authentic practice requires reflection, problem-posing/solving, and discussion to help teachers ground the theory and what is learned in actual classroom practice. A part of the classroom meeting following project-sharing was dedicated to discussions on review projects. Informed by Lin (2015: 540), the whole process aimed at making the experience "contextually relevant to the participants and ... classroom orientated." The whole process engaged teachers in interaction with the technology, instructional content, and peers. While interaction with the instructional content and technology occurred through the course of creating technology-review screencasts, the follow-up discussions supported collective interaction among teachers.

2.4 Data analysis

The study draws on qualitative data obtained from participants' audio-narrated technology-review projects ($n = 24$) and 7.5 hours (an average of 30 to 45 minutes in each session from session two onwards) of classroom discussions following the projects. The contents of the projects and follow-up discussions were transcribed verbatim. To make reliable inferences from the transcripts,

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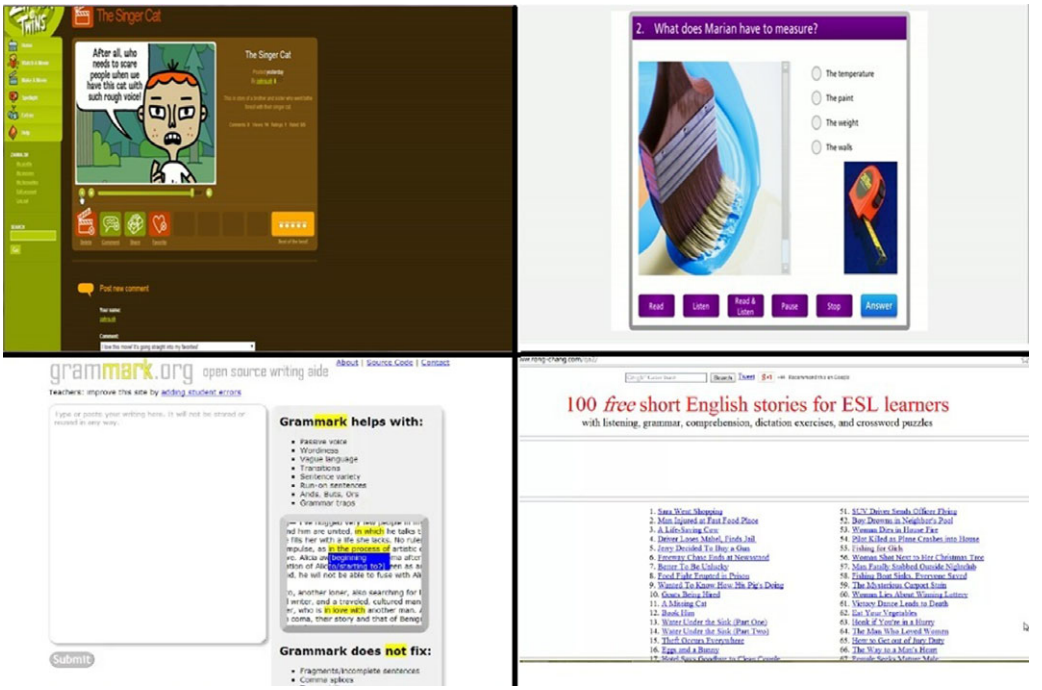


Figure 1. Screenshots of four technology-review screencasts from four participants

a qualitative content analysis strategy was applied. Content analysis is reliant on a codification process that is applied to identify and independently analyze meaningful categories from each data source (Blair, 2015) and interpret the results using *quantitative measures*, namely descriptive statistics (Koc, Peker & Osmanoglu, 2009). *A priori* coding strategy, in which previously established codes are applied for framing the data, was followed. As Blair (2015: 19) states, this coding scheme allows "the data to speak through me rather than at me" and "could offer specific terms that would give the data a voice."

Inspired by Hubbard and Levy's (2006) and Ertmer and Ottenbreit-Leftwich's (2010) conceptualizations of pedagogical knowledge of technology-enhanced instruction and CALL, the categories of codes were identified and labeled. To ensure coding reliability and trustworthiness and to protect data against projection, some procedures were followed. Following Wood, Mueller, Willoughby, Specht and Deyoung (2005), first, an explicit framework was developed including the labels, definitions, and instances to be used as a reference for identifying the thematic units that related to each code. Second, the coding scheme and the framework were further revised following the comments from a CALL expert. Finally, six categories of codes were finalized (see Table 1). These included the narratives that reflected teachers' knowledge/understanding of (1) technology, (2) the affordances for CALL, (3) constraints for CALL, (4) CALL materials development, (5) CALL materials selection, and (6) CALL evaluation.

This was followed by a careful scrutiny of the transcribed data through several rounds of rereading to identify narratives that directly related to the initially established codes. Given the fact that, in many cases, text chunks larger than a single sentence presented ideas (that sometimes were intertwined) and were related to a priori codes, the units of analysis varied from a single sentence to paragraph(s) or the whole message. The units of analysis that addressed similar codes were counted as one thematic unit. Multiple coding was applied for the units that addressed more than one code. The coding process was repeated after one month. The coded units were compared

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Table 1. A priori codes and their descriptions

Codes	Code descriptions
Technological knowledge	ability to use different platforms and web pages per se (no reference made to language instruction/practice)
Affordances for CALL	understanding of the affordances of such technologies for teaching different language skills and subskills
Constraints for CALL	understanding of the demerits of different tools or platforms for language instruction
CALL materials development	ability to use the tool to design/develop instructional material
CALL materials selection	ability to find relevant instructional content/tasks for language classes
CALL evaluation	understanding of how to assess students' learning with technology and/or evaluate their technology-enhanced language learning

to calculate intrarater correlation coefficient. The Cronbach's alpha reliability estimates were 0.80 for classroom discussion and 0.99 for technology-review projects. Descriptive statistics (i.e. frequency and percentages) were calculated for the thematic units under each category.

3. Results

3.1 Technology-review projects

A total of 73 thematic units were identified in technology-review projects, of which 32.8% and 11.0% respectively related to the affordances and constraints of different technologies for CALL; 31.5% offered information on how to create and activate accounts in different platforms, and introduced different user features, for example; 11.0% were about CALL materials selection; 6.8% dealt with CALL materials development; and 6.9% addressed CALL evaluation (see Table 2).

In a screencast, Kurosh highlighted the application of an online audio recording platform for improving students' speaking and listening proficiencies: "from a pedagogical point of view and for EFL classroom, Vocaroo can be used to improve their [students'] listening and speaking at the same time by asking them to create [and share] podcasts" (*affordances for CALL*). Next to such comments were the narratives in which participants showed the process of signing up and using different tools in the form of a short video tutorial. In these screencasts, participants focused on the technical aspect of the tools or platforms per se and no reference was made to their application for language teaching purposes. This is echoed in Maryam's review of an online aggregator: "You can add bookmarks, features, and images to the library . . . You can click on Capture [button] and take a screen capture and send it to the library or highlight the part of the text you are reading and send it to My Library page" (*technological knowledge*). Given that the reviewed tools were not previously practiced in the classroom, these parts of teachers' review projects were taken as a reflection of their technological knowledge.

The third most frequent thematic units in review projects were those that reflected teachers' understanding of the demerits of the tools/platforms for teaching or learning purposes. Reviewing Babel Fish (an online bilingual translation machine), Farnaz noted that "it does not support Persian language, so it is not suitable for my students" (*constraints for CALL*).

The least frequent thematic units were those that addressed CALL materials development, selection, and evaluation. In an almost eight-minute screencast, Newsha showed how Zimmer Twins can be used for creating an audio-enhanced animated comic strip "from scratch . . . and includes grammatical features and vocabularies and use it as our instructional text" (*CALL materials development*). In one of her screencasts, Mina introduced Writefix for selecting

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Table 2. Distribution and percentage of the thematic units identified in classroom discussions and projects

		Data sources			
		Technology-review projects		Classroom discussions	
		Freq.	%	Freq.	%
Thematic categories	Technology knowledge	23	31.5	165	38.5
	Affordances for CALL	24	32.8	146	34.1
	Constraints for CALL	8	11.0	92	21.5
	CALL materials selection	8	11.0	10	2.4
	CALL materials development	5	6.8	6	1.4
	CALL evaluation	5	6.9	9	2.1
	Total	73	100.0	428	100.0

instructional content for writing classrooms: "You can find tips and topics for improving essay writing in the site and comments on each text" (*CALL materials selection*). In a step-by-step video tutorial, Neda showed how an online test generator can be used for creating and scheduling a language quiz. She noted that the "accuracy results and immediacy of feedback" make them apt for teachers and learners by "saving time and facilitating self-assessment and even e-portfolio creation" (*CALL evaluation*).

3.2 Follow-up classroom discussions

Exploring 7.5 hours of classroom discussion throughout 12 sessions, 428 thematic units were identified (Table 2). The most frequent units addressed the affordances or constraints of different technologies and together constituted 55.6% ($n = 238$) of the identified units. Discussing their experience of using online diary tools, Kurosh and Newsha highlight the affordances and constraints of different platforms for developing different language skills in the following exchange:

Extract 1

Kurosh: Penzu can be used for improving writing by brainstorming, prewriting . . . a sort of peer-assessing . . . doing Group writing task. (affordances)

Newsha: And other social networking sites. But they are not user-friendly. (constraints)

Kurosh: The same about Edublogs . . . not handy in terms of adding Java scripts (constraints) but writing as a product is well suited with blogs. (affordances)

The second most frequent type of thematic units with 165 (38.5%) instances related to the comments that reflected teachers' technological knowledge. The thematic units that showed teachers' understanding of the use of technology for developing language materials or their knowledge of materials selection for CALL together constituted 3.8% ($n = 16$) of the total identified themes. In response to a peer who was dubious about the educational value of weblogs for language classrooms, Farnaz explained how she has designed a classroom blog and added hyperlinked glosses for essay writing practice with her students, reflecting her ability to create and use classroom blogs as a language learning environment:

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Extract 2

I made a blog for an essay writing class and uploaded the students' works. I have added some links to bilingual dictionaries, my own content, and a widget to search the words. They are required to visit their friends' work and read it. If there is any difficult word they can simply double click on the words and have dictionary entrance.

The least frequently addressed topic in participants' discussions related to CALL evaluation (2.1%). As the most experienced teacher in the group with the lowest level of technological knowledge and experience compared to her peers, Neda believed that WebQuests might not be useful for foreign language learners with limited language proficiency. While Mina acknowledged this argument, she drew her attention to the possibility of using WebQuests for assessing intermediate- and advanced-level students' speaking skills following a task-based strategy rather than focusing merely on the content. Mina noted that:

Extract 3

I used it for a class with male upper intermediate students ... it started with an audio intro and then a task. Students were required to carry out the task and submit it in the form of an audio-presentation. The meaningful task engaged them in authentic language use [speaking]. There were follow-up classroom discussions with a focus on their experience. I used the audio files and follow-up discussions to evaluate their speaking.

A careful look at the identified thematic units in the projects and classroom discussions reveals that participants mainly attended to the affordances of the tools and platforms for teaching different language skills. It was also observed that these activities provided an opportunity for them to use different tools and technologies and hence enhanced their technological knowledge. Next to these were the narratives that addressed the constraints of different technologies for CALL, CALL materials selection and development, and CALL evaluation.

4. Discussion

The results of this study corroborate previous findings on PBL for professional development. In particular, they revealed the potential of engaging teachers in inquiry-oriented projects as a way of developing their pedagogical understanding of the subject matter content. Specifically, it was observed that PBL provided each teacher an opportunity to improve their knowledge of the pedagogical application of digital technologies through using, reviewing, discussing, and reflecting on their affordances and constraints for language instruction, materials development, materials selection, and evaluation (Kessler, 2007). This echoes the contribution of *mastery* experiences (i.e. teacher practice) to the development of professional knowledge or a pedagogical know-how of technology (Wang *et al.*, 2010).

The findings support the idea that didactic instruction followed by PBL can help teachers develop procedural and conceptual knowledge. Hence, the systematic interplay of teacher- and student-centered approaches can be productive for teacher PD. This is echoed in the references made to CALL concepts (i.e. procedural knowledge stemming from direct instruction) during classroom meetings and teachers' review projects along with the critical and evaluative tone of the reviews, which can be indicative of their deep conceptual thinking. In line with Wallace (1991), it is suggested that technology practice and review help teachers develop an *experiential* knowledge base, which, in parallel with the knowledge *received* from instruction and follow-up discussions, develops their pedagogical understanding of the subject matter.

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Consistent with the constructionist views of learning, it is argued that creating artifacts (i.e. review screencasts) results in learning, namely knowledge about technology. Baskerville (2012) attributes this to the self-directed nature of such tasks, which engages teachers in an authentic process of learning through creating an artifact. That the participants were all experienced language teachers might have helped them to better evaluate the technologies from the perspective of their commonly used teaching strategy and from the scope of their target language learners. This way, the screencasts presented a plethora of different analyses based on different teaching styles. That is, each teacher reviewed different tools from a unique lens. At the same time, these differences appeared productive as they provided peers with multiple perspectives by being shared online and discussed collectively. As Teräs (2016: 270) put it, teachers "experience the learning situation in different ways ... affecting the learning experience of their peers through their actions and choices."

Teachers' reviews and follow-up classroom discussions gradually became, for the main part, more attentive to the pedagogical application of the technologies, whereas the first review projects were predominantly concerned with the technical aspects of the tools and platforms. In line with the social constructivist view of learning (Vygotsky, 1978), it is suggested that the projects situated teachers in a meaningful social context in which knowledge is shaped through individual and collective reflection, and interaction with the content. It may be indicative of the efficacy of practice, reflection on one's own and peers' experience, and dialogue for teacher learning.

As Seban (2013: 88) states, experiential tasks help teachers in "meaning-making and realizing connections between theory ... [and] classroom practices." As Dickerson *et al.* (2014) note, when PBL provides room for interaction and collective reflection, it creates a "*snowball effect*" that can promote deep learning. Through the process of interaction and experience sharing, the tacit knowledge shaped in each individual is converted into collective or group tacit knowledge (Prestridge & Tondeur, 2015).

The fewer number of references made to the application of different technologies for language assessment and evaluation of learners' technology-enhanced language learning (i.e. CALL evaluation) may be attributed to teachers' lack of attention to or limited knowledge in this regard. It may also indicate that although each tool and technology has its own affordances and constraints or can be applied for instructional purposes, not all of them might be applied for language assessment.

Project-sharing is viewed as a productive strategy for enhancing the effectiveness of PBL and thus teacher preparation (Weber *et al.*, 2018). Having access to one's own and peers' projects via the classroom blog page, teachers not only found an opportunity to reflect on and interpret their personal experiences at their own pace but also developed more insights for follow-up discussions on peers' projects. This way, the projects do not have the immediacy problem of real-time projects in which the teachers might not have adequate time for reflection and feedback generation. This might have reinforced the evolution of a solid basis for constant interaction with and reflection on personal/peer experiences.

5. Conclusion

The novelty of online CALL PD along with the interest in exploring the way PBL can be integrated into its design to effectively promote in-service teachers' pedagogical understanding of CALL developed a sense of urgency for sharing the findings of this study. Literature on PD highlights the essence of moving beyond stand-alone technology courses to effectively promote teachers' pedagogical knowledge by providing them opportunities for reflection and practice through the course of preparation.

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A careful content analysis of the collected data revealed that teachers gradually moved beyond using technology per se by offering an evaluative look into the educational affordances and constraints of the tool under scrutiny for language classrooms. At a lower level, the teachers were also attentive to the application of tools for designing CALL materials, being used as instructional content, and CALL evaluation. This inquiry-oriented approach toward CALL PD did not come without its intricacies, but the findings clearly highlight its productive value. Six experienced language teachers with limited technological knowledge demonstrated an improvement in their knowledge of CALL through technology review, follow-up discussions, and reflection.

Based on the findings, several practical implications can be offered to different PD stakeholders, ranging from curriculum/course designers to teacher educators and teachers. The first and foremost relates to the design of online CALL PD courses and programs to better promote teacher learning. As more programs draw on online PD opportunities for CALL teacher preparation, more empirical studies that explore the design and productivity of pedagogical approaches in such contexts are warranted. It should not be forgotten that internet connectivity and adequate hardware are prerequisites for experiencing effective online PD across any discipline. Although online PD is a solution, especially considering the difficulties for attending face-to-face courses during emergency cases, several factors should be addressed for its effective implementation.

The findings suggest that future CALL teacher education programs and courses should be redesigned so that participating teachers have more opportunities to practice and explore the pedagogical application of different digital technologies for language instruction. This requires devising strategies to help teachers understand how to select relevant technologies and effectively adopt them to productively enhance their learners' language learning experience. While the findings offer empirical support for the potential of PBL, "extending these general tenets to clarify important elements of the structure of tasks, learning environment, and supports can lead to more prescriptive design principles" (Moon *et al*., 2014: 173). It should not be forgotten that online PD, while supporting personalized learning more than conventional face-to-face preparation modes, cannot be one size fits all. Hence, teachers' preferences and learning styles need to be further explored in future studies.

Additionally, the implications of PD research contexts should be considered (Powell & Bodur, 2019). More insights into online CALL PD courses are needed to guide the design and development of future teacher education courses and better prepare teachers for CALL. Although the study did not aim at bolding the effectiveness of online real-time PD over face-to-face PD, the modality and its interaction with the type of PBL operationalized in this context might have played a determining role in the obtained results. Future studies that compare the efficiency of PBL across synchronous, asynchronous, and blended CALL PD are recommended to gain a more consolidated understanding of the impact of PD modality on teacher learning.

The findings reported in this study highlight peculiarities related to the interplay of experienced in-service language teachers (who were digital immigrants), their teaching styles, the instructional content offered throughout the course, the pedagogical strategy applied, and the unique design features of the online CALL PD. How digital native pre-service teachers fit into this design and how the intersect of content, pedagogy, and technology should be translated into the design of courses with more diverse groupings of teachers can be the focus of future studies.

Accounts of teachers' real classroom CALL practice should also be explored, as the pedagogical knowledge of CALL encompasses the knowledge and ability in teaching with technology, which might not be fully developed unless teachers experience it in a real classroom context. Hence, studies that track the impact of online CALL PD on teachers' actual classroom practice are crucial (Dana *et al*., 2017). Finally, this study focused on the potential of projects carried out individually, accompanied by collective discussions and reflections. Exploring the contribution of collective

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PBL experienced in online CALL PD attempts can be recommended. To conclude, it should be noted that the growing proliferation of educational technologies along with the growing consciousness about the potential of online learning platforms is deemed to attract more attention toward online CALL PD in the future.

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