FROM TPACK-IN-ACTION WORKSHOPS TO CLASSROOMS: CALL COMPETENCY DEVELOPED AND INTEGRATED

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This study investigated the impact of a CALL teacher education workshop guided by the TPACK-in-Action model (Tai, 2013). This model is framed within Technological Pedagogical Content Knowledge (TPACK, Mishra & Koehler, 2006) and advocates a learning-by-doing approach (Chapelle & Hegelheimer, 2004) to understand how English teachers develop CALL competency and adopt the competency in their teaching. Participants were 24 elementary English teachers in Taiwan. The study used a mixed methods design (Creswell & Plano Clark, 2007), collecting and analyzing qualitative and quantitative data concurrently but separately before they were triangulated. Findings show that the TPACK-in-Action workshops had a positive impact on the 24 teachers. In addition to the development of CALL competency, it was also observed that participants demonstrated CALL competency in their teaching, such as selecting online materials and appropriate technology for content teaching, using cloud computing for student interaction, and matching the affordances of technology to meet their instructional goals and pedagogy. In sum, the study provides empirical evidence and a new perspective in the investigation of CALL teacher education. The theoretical and pedagogical implications for CALL teacher education research and practice are discussed.

Keywords: CALL, TPACK-in-Action, TPACK, Observation, Teacher Education

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INTRODUCTION

The future of Computer Assisted Language Leaning (CALL) is closely tied to the future of language teacher education because teachers are pivotal players in language classrooms (Hubbard, 2008). As Hubbard noted, teachers "select the tools to support their teaching and determine what CALL applications language learners are exposed to and how learners use them" (p. 176). Studies have not only reported significant improvement in students' achievement scores and motivation as an effect of learning with CALL (e.g., Al-Jarf, 2004; Almekhlafi, 2006) but also identified technology/CALL experience or competency as one crucial component that teachers need to be equipped with for real classrooms (Hubbard, 2008; Kessler, 2006).

Some language teacher education (TE) programs are introducing future teachers to CALL in order to equip them with the appropriate CALL competency for their future classrooms. The literature suggests that technology education courses help teachers acquire positive attitudes toward CALL (Kamhi-Stein, 2000; Redmond, Albion, & Maroulis, 2005; van Olphen, 2007 and gain confidence in incorporating technology in their classrooms (Hegelheimer, 2006; Hoven, 2007; Peters, 2006). However, there are still compelling issues related to TE in CALL that need further investigation, some of which are what CALL TE should entail to effectively help teachers integrate CALL and how CALL TE programs impact teachers' development of CALL competency and integration. Moreover, an extensive literature review showed that findings of CALL research are mostly based on self-reported data, such as surveys and interviews. Though such data shed important light on the topic, CALL researchers called for adding more

direct data sources, such as classroom observation since there might be potential for errors when recalling (Egbert, Paulus, & Nakamichi, 2002; Kilickaya, 2009). To bridge the gap between CALL TE and teachers' CALL integration in classrooms, this study investigated how the CALL workshops, guided by TPACK-in-Action model (Tai, 2013), impacts English teachers' development and adoption of CALL competency.

LITERATURE REVIEW

The present study seeks to examine the impact that the TPACK-in-Action CALL workshops have on the elementary English teachers in Taiwan. Therefore, the literature review focuses on relevant studies that emphasize TE in CALL and TPACK. First, empirical research on CALL and the impact of CALL TE programs is reviewed. Second, the theoretical framework, TPACK (Mishra & Koehler, 2006), is introduced to describe the framing of knowledge teachers needed to integrate CALL successfully, leading to the design of TPACK-in-Action model (Tai, 2013) to guide the CALL workshops.

CALL & Teacher Education in CALL

The literature in CALL research shows that teachers' CALL integration in classrooms can have significant impact on students' learning, which is reflected in their achievement scores and motivation and attitudes toward learning (e.g., Almekhlafi, 2006; Kozma, 2003). It is also reported that successful technology integration largely depends on teachers' ability to apply CALL activities meaningfully, especially in language classroom where technology supports not only the delivery of content but also the building of skills (Reinders, 2009). It has become increasingly clear that the future of CALL is closely tied to language teacher education because teachers are the gatekeepers, determining whether or what technologies enter the classroom and how they are used (Hubbard, 2008). Moreover, teachers' knowledge and perception of CALL may determine whether they integrate technology and the degree of success in CALL integration (e.g., Lam, 2000; Liu, Theodore, & Lavelle, 2004). In sum, how teachers learn to use technology plays a critical role in the process of integrating CALL activities.

Impact of CALL Teacher Education

The majority of studies examining the impact of CALL TE programs focused on how these courses influence teachers' perceptions and attitudes toward CALL and their confidence in integrating CALL. The literature indicates that CALL education courses have helped second language (L2) teachers establish a positive attitude and gain confidence in integrating technology (Kamhi-Stein, 2000; Peters, 2006; van Olphen, 2007). As Hong (2010) noted, teachers' confidence in incorporating CALL is the necessary first step toward expanding their knowledge of "how to harness the pedagogical potential of CALL technology" (p. 56).

However, little has been done to examine how CALL TE courses prepare teachers to develop sufficient CALL competency to integrate CALL, or what teachers' CALL integration looked like in their classrooms. Findings of the limited number of studies that focus on investigating the impact of CALL TE courses seem to indicate a favorable impact. For example, 20 teachers reported to have used at least one CALL activity in their classrooms and that the CALL course provided them with skills they did not have previously (Egbert et al., 2002). Peters (2006) also found a significant increase in participants' post course computer competency in epistemological, social, technical, and informational competence. Moreover, half of the participants in Kilickaya's (2009) study stated that they included CALL tools that they learned in the CALL course into their lesson plans and participants in Hegelheimer's (2006) study reported that the required CALL course helped them integrate technology into their teaching in freshmen composition courses.

While CALL education courses have been found to have a positive impact on teachers' perceptions of and confidence in the integration of CALL, the results of most previous studies were based on data collected

from primarily self-reported sources, such as surveys and interviews. Egbert et al. (2002) noted that the use of self-reported data was one of the major limitations of their study because with such data "there is always the potential for error in recall" (p. 121). In addition, they stated that their methodology did not permit them to capture teachers' actual classroom practices. Therefore, they recommended that future research include additional data sources while exploring teachers' adoption of CALL knowledge and skills into classroom practice. Along the same line, Kilickaya (2009) suggested that further research investigating the effect of the CALL course should involve some observation of teachers' classroom practices in order to affirm or negate the impact they claimed a program might have on their teaching. As Wong and Benson (2006) noted, through observations, they identified a discrepancy between one participating teacher's report and the researchers' observation where participant's use of technology was observed to be not as successful as she reported. In sum, research reported positive impact of CALL TE programs on teachers' perception of and their integration of CALL. However, CALL researchers have called for adding observation as one data source to complement self-reported data in investigating the impact of CALL teacher education.

The TPACK Framework

With regards to CALL teacher education, researchers reported that well-organized and well-prepared workshops/programs could help teachers integrate and adopt CALL (e.g., Desjardins & Peters, 2007; Hong, 2010; Hubbard, 2008). Not only should CALL teacher education play an important role in reinforcing positive experiences among English teachers' CALL integration (Hernandez-Ramos, 2005; Jung 2001; Lee & Son, 2006;), the CALL intervention should also aim at situating teachers in an authentic context as they learn to integrate technology (Chapelle & Hegelheimer, 2004; Hampel & Stickler, 2005; Slaouti & Motteram, 2006) and equipping them with more than just technology knowledge (Chisholm & Beckett, 2003; Kessler & Plakans, 2008; Levy & Stockwell, 2006; Nobles, Dredger, & Gerheart, 2012; Shoffner, 2007). Thus, in order to help teachers develop the knowledge they need to integrate CALL effectively, the TPACK framework (Mishra & Koehler, 2006) was introduced to guide the investigation in the present study.

Building upon Shulman's studies (1986) that introduced the construct of Pedagogical Content Knowledge (PCK) applicable to the teaching of specific content, Mishra and Koehler (2006) proposed inserting technology knowledge as one of the foundational knowledge components that teachers of 21st century classrooms should be equipped with and proposed, Technological Pedagogical Content Knowledge (TPCK), as a theoretical framework for understanding the specialized and multi-faceted forms of knowledge required for teachers to integrate technology effectively. Not long after TPCK was introduced, Thompson and Mishra (2008) proposed a change in the acronym for easier pronunciation and "to form an integrated whole, a Total PACKage" (p. 38) among the three fundamental knowledge domains; therefore, TPCK became TPACK (see Figure 1).

The TPACK framework advocates the incorporation of the three fundamental knowledge domains among teachers: a) content knowledge (CK), b) pedagogical knowledge (PK), and c) technological knowledge (TK) and emphasizes the importance of the complexities of interactions among all three. As Cox and Graham (2009) stated, the basic premise of TPACK is that "a teacher's knowledge regarding technology is multifaceted and that the optimal mix for the classroom is a balanced combination of technology, pedagogy, and content" (p. 4042). In other words, the TPACK framework gives "a holistic perspective of the knowledge associated with effectively integrating technology into learning environments, accounting for what teachers know and what teachers do" (Polly & Brantley Dias, 2009, p. 46). The framework is thus used to guide the investigation of teachers' decisions and actions on their technology integration and the understanding of the underlying factors that can foster and hinder their technology integration.

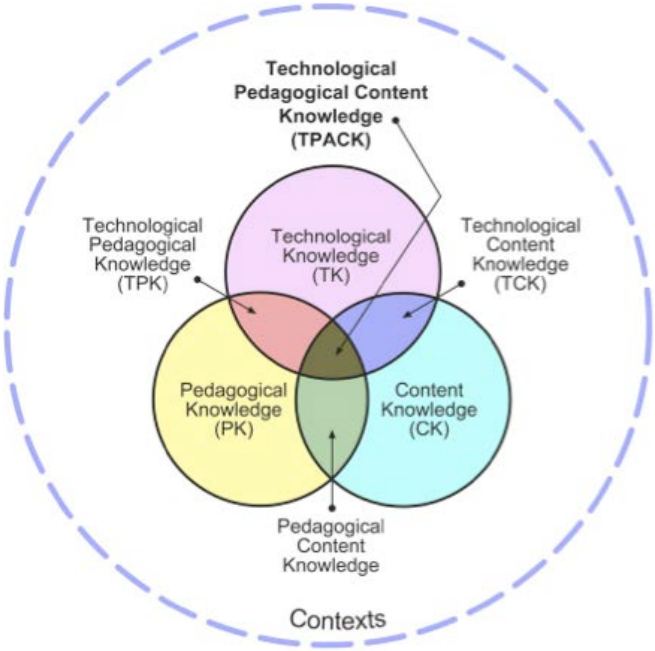

Figure 1. The TPACK framework (Mishra & Koehler, 2006).

The TPACK-In-Action Model

Researchers have devoted studies to identify approaches for TE workshops to effectively help teachers integrate technology in their teaching, such as learning to integrate CALL through first-hand experiences (Chapelle, 2003), consistent modeling of effective use and practice of technology (Hoven, 2006, 2007; Hughes, 2005), and in an authentic teaching context (Chapelle & Hegelheimer, 2004; Hampel & Stickler, 2005; Slaouti & Motteram, 2006). In response to this notion, the TPACK-in-Action model (Tai, 2013) was developed to guide the design and plan of the CALL workshop, advocating two themes: a) the learning-by-doing approach as research has called for; and b) teachers' understanding of TPACK, which is what teachers need to be able to meaningfully integrate technology into teaching (Mishra & Koehler, 2006). Thus, the TPACK-in-Action model proposes that a workshop follows these five steps: a) Modeling; b) Analyzing; c) Demonstrating; d) Application; and e) Reflection to achieve the intended goal of helping English teachers develop the competency needed to integrate CALL into their classroom teaching. Both the instructor and the participants play an equally important role in a TPACK-in-Action workshop. In other words, the model involves equal participation and contribution from both parties (see Figure 2).

Research Questions

Literature review indicates a need to examine the impact of CALL TE intervention from the aspect of classroom practice beyond self-reported data. Thus, the present study investigated the impact that the TPACK-in-Action CALL workshops had on elementary English teachers in Taiwan and sought to answer the following two research questions:

1. What was the impact of the TPACK-in-Action CALL workshops on the development of participants' CALL competency? What were the CALL competency/ies participants developed?
2. How did participants adopt what they learned in the workshops into teaching in their classrooms?

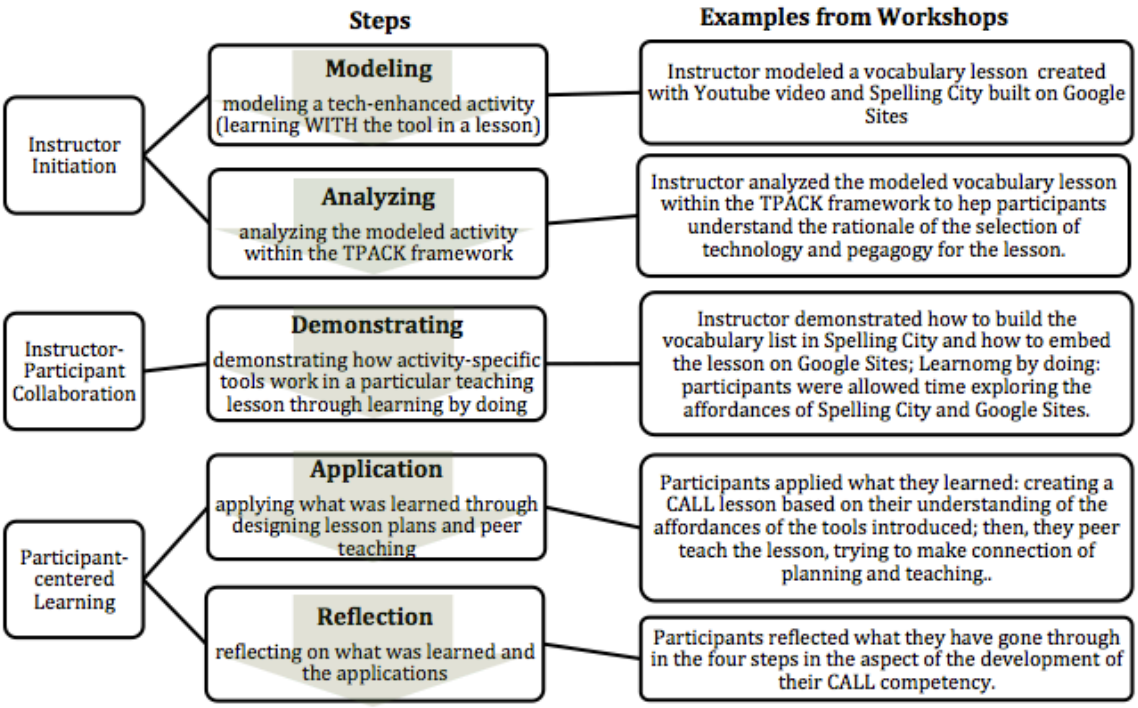

Figure 2. The TPACK-in-Action model.

METHODOLOGY

The study used a mixed methods design, following the Triangulation Design: Convergence Model (Creswell & Plano Clark, 2007), which allows different but complementary data to be collected and analyzed. The researcher collected and analyzed quantitative and qualitative data separately and then triangulated both sets of data to understand the impact of the TPACK-in-Action workshops. The different results of the qualitative and quantitative analysis were compared and contrasted. Quantitative data were collected through survey questionnaires before and after the CALL workshops. The qualitative data emerged from reflections, observations, interviews, and document analyses during and after the workshops. Findings from qualitative and quantitative data analyses were then compared, contrasted, and conclusions about convergence were drawn during interpretation.

Participants

Participants were 24 full-time elementary English teachers from six different elementary schools in Taiwan. The 24 teachers agreed to participate in the workshops voluntarily and underwent 15 hours of TPACK-in-Action CALL workshops. The majority of the participants were female (88%), aged between 30 and 40 (58%). Half of the participants held a Masters degree in English and education and the other half held a Bachelors degree. More than two thirds of the participants were experienced elementary teachers, with six to 16 years of teaching experience (70%). Two participants were novice teachers who only had two years of English teaching experience.

Participants were asked to indicate their background knowledge and experience in technology use for English teaching prior to the workshops. They were asked to identify from a list of 40 technologies, including iPad apps, web-based tools, and software-based tools, if they knew about the technology and also if they had used the technology in their teaching. Participants reported that they knew 17 (out of 40), including PowerPoint (21), Facebook (15), Google Sites (11), and Google Earth (10) which were the top

four tools identified by 10 or more participants. However, the participants had only used seven of the 17 tools in their teaching: PowerPoint (14), interactive whiteboard (7), Google Earth (4), Movie Maker (4), Blogger (3), Audacity (2), and Facebook (1).

The TPACK-in-Action CALL Workshops

A three-hour workshop each week was conducted over a period of five weeks. Two sets of the 15-hour TPACK-in-Action CALL workshops were conducted for 24 participants in two cities (nine and 15 participants in each set). The purpose of the TPACK-in-Action workshops was to help teachers develop the necessary knowledge to incorporate specific types of technologies, including software-based and web-based tools and iPad apps in pedagogically sound ways. A typical CALL workshop followed the five steps proposed in the TPACK-in-Action model (Tai, 2013): (1) Modeling; (2) Analyzing 3) Demonstrating; (4) Application; and (5) Reflection (see Figure 2), each of which took different amounts of time to complete, ranging from 25 to 60 minutes. The five workshops covered a variety of content, including vocabulary, writing, reading, speaking, pronunciation, and integrated skills, which was based on the set of English textbooks that teachers used to teach in their schools (see Appendix A). For each workshop, a particular CALL lesson, was developed with technology selected based on its affordances and integrated with appropriate pedagogical decisions. All lessons were built on Google Sites, which served as the online learning community where participants could retrieve all the resources between workshops and share thoughts with peer teachers.

The TPACK-in-Action workshop started with modeling the CALL lesson, in which technology was selected and incorporated with a specific content goal and a sound pedagogical decision. Upon completing the lesson, participants were taken through the analyzing step to understand the rationale behind the design of the lesson. In the first two steps, the instructor took the initiative role modeling the lesson and analyzing why the lesson was put together the way it was, while the English teachers participated in the lesson as students. Moving into the demonstrating step, the instructor demonstrated the features and affordance of the technology that was incorporated in the CALL lesson. After learning about the affordances of the technology, participants wrote a CALL lesson where they matched the technology with specific content and appropriate pedagogy and also peer taught their CALL lessons. After that, participants were given the opportunity to debrief and reflect on their learning. In the last two steps, participants played the center role constructing their own knowledge and making connections between knowledge and practice.

Procedures

The data collection process lasted five months. Before the first CALL workshop started, a CALL Teacher Education website was created as one course management tool and as a learning community for participants to share and collaborate. Second, all necessary teaching materials and lessons were developed based on the textbooks teachers were using and uploaded to the website. Before the workshops started, all participants were directed to the website to complete the pre-workshop survey. After that, participants underwent 15 hours of TPACK-in-Action workshops. Upon completing the last workshop, participants were asked to complete the post-workshop survey and then schedule classroom observations. Observations started after the third workshop upon participants' request because they had started integrating what they had learned in the first two workshops. After all observations were completed, two focus group interviews were conducted among the 13 participants. All observations and interviews were recorded and transcribed for data analysis. In order to ensure that participants' voices are truly represented, the quotes included in the study were translated by the researcher and then checked and verified by another native speaker of Chinese with a native-like proficiency level of English. Pseudonyms are used to address participants.

Materials

Surveys

Adapted from Chuang and Huang's (2012) measure of TPACK competency as a holistic, integrated, and transformative form of knowledge, 14 survey items were used to collect data on participant's self-perceived CALL competency. The Chuang and Huang's (2012) survey contains 24 items, which were factored into 4 dimensions. Two of the four dimensions were identified to have aligned well with the objectives of the TPACK-in-Action workshops, thus, the 14 items from Dimension I: *Use technology tools and the internet for teaching* and Dimension II: *Use cloud computing for student interactions and discussion* were included in the measurement of participants' CALL competency. CALL competency refers to teachers' ability to select technology based on its affordance with sound pedagogical strategies to achieve the language teaching objectives, such as *integrate different modes of media to help students understand the subject content more easily* and *utilize appropriate technologies that meet individual student's needs*. The surveys were administered before and after the workshops in order to examine participants' development of CALL competency.

Observations

Non-participant observations were conducted in participants' English classes. The purpose of the classroom observations was to capture participants' actions of technology integration in classrooms and to identify how CALL activities were integrated with appropriate pedagogy. In order to capture such data, an observation instrument, framed within TPACK, was developed to facilitate the observation process and to produce richer and thicker field notes (see Appendix B). The observation instrument contained three sections: (1) Background information to help situate the observers into the content and context; (2) CALL Competency containing TPACK codes to guide the observations; and (3) Post Observation to list the questions that emerge from the observations and need to be addressed in the after-class interview. Thirteen of the 24 participants gave consent to allow access to their classrooms for observation. A total of 26 classes were observed among the 13 participants.

Interviews

There were two types of interviews conducted: individual post-observation and post-observation focus group interviews. The former occurred right after each observation, with a focus on clarifying issues and questions that emerged from the observation and also allowing participants the opportunity to voice themselves and further elaborate their lessons; the latter were conducted after all observations were completed with 13 participants (eight for interview I and five for interview II). In addition to pre-determined questions that addressed participants' perceptions about CALL integration and the workshops, questionable survey responses were confirmed and verified; questions and issues that emerged from observations were also summarized; and member checks were performed.

Reflections

The fourth data source was reflections, which were collected during the reflection step in the workshops. There were two different types of reflections, individual and group reflections, through which participants had the opportunity to reflect on their learning and learn from each other by reading and commenting on peers' reflections in the online learning community. The individual reflections were implemented online where participants were asked to indicate how each of the five steps contributed to their learning of integrating technology into their teaching on a five-point Likert scale and elaborate further and make connection of their learning to their teaching. During group reflections, prompts and questions were provided to guide participants to compose and share their reflections in the learning community.

Analysis

Quantitative Data Scoring

Before the first workshop and after the fifth workshop, participants were asked to rate their CALL competency on a five-point Likert scale, with 1 as "Strongly Disagree" and 5 as "Strongly Agree." The scoring for responses to the survey items was straightforward: 1 point for "1 Strongly Disagree" indicating the lowest CALL competency level and 5 points for "5 Strongly Agree" indicating the highest level of CALL competency. A response of 3 indicated a medium-level competency. All survey responses were recorded and scored for statistical analysis, including descriptive statistics and the Wilcoxon signed-rank test. The Wilcoxon test, a nonparametric equivalent of paired-samples t-test, was performed to identify if any differences in participants' responses of the pre- and post-workshop surveys were significantly different (Dörnyei, 2007). The decision to select the Wilcoxon test was because of the small sample size and a concern for the data being normally distributed.

Qualitative Data Coding

Qualitative data were collected from observations, interviews, and reflections. Before the analysis, observation field notes and individual post-observation interviews were sorted into units of analysis (UoMs) based on Mohan's (2007) concept of social practice[1] (see Figure 3 for examples of UoMs). The UoMs were coded based on the exiting codes in the Tai, Schmidt, and Wang (2014) codebook, which was developed based on observations of 4 exemplary technology using elementary teachers. It contains 11 themes with 53 codes representing teachers' actions of technology integration cross all seven TPACK knowledge domains (see Appendix C for sample TPACK codes). To ensure the reliability of the coding results, a second coder was invited to code 20 percent of the data. The inter-coder reliability was 78% agreement, which was considered "good" based on Mackey and Gass (2005) standards.

The qualitative data collected from observations, interviews, and reflection were compared and contrasted with the survey—quantitative data—to help interpret participants' CALL competency.

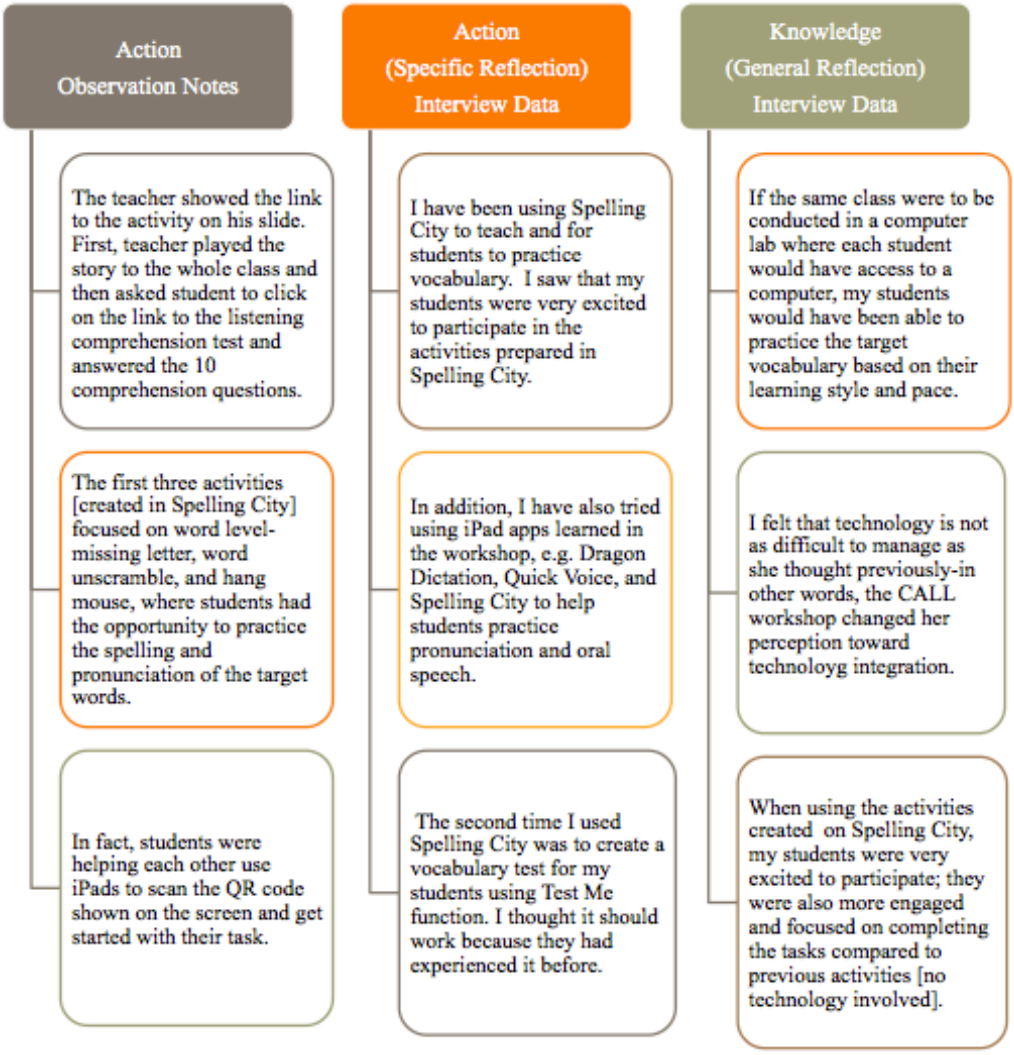

Figure 3. Sample UoMs for coding and analysis.

FINDINGS AND DISCUSSION

Based on the analysis of survey data, it was found that the TPACK-in-Action CALL workshops had a positive impact on elementary English teachers in Taiwan in the development of their CALL competency. The development of participants' CALL competency was confirmed through the analysis of observation and interview data where participants demonstrated what they learned in their teaching and CALL competency was observed in their classrooms.

Development of CALL Competency

As noted earlier, CALL competency in this study is considered as a holistic, integrated, and transformative form of knowledge where teachers demonstrate the ability to select technology based on its affordance with sound pedagogical strategies to achieve language teaching objectives, namely TPACK. Before the workshops, the average mean score for all 14 items was 3.41 (*SD*=0.57) showing that participants started at an above medium-level competency. The post-workshop mean score increased to 4.13 (*SD*=0.37), which is high-level competency, indicating that participants perceived themselves to have developed CALL competency after the workshops (as shown in Table 1). The results of the

Wilcoxon test confirmed that the differences between the two means were statistically significant (Z=4.29, p<0.001).

Table 1. *Wilcoxon Signed-Rank Test: Pre- and Post-Workshop CALL Competency*

Dimension of CALL competency	Pre		Post				
	M	*SD*	M	*SD*	*Z*	*dt*	*p*
14 items	3.41	0.57	4.13	0.37	4.29*	23	< .001
Use of technology tools and the Internet for teaching (10 items)	3.66	0.60	4.31	0.37	4.02*	23	< .001
Use of cloud computing for student interactions and discussion (4 items)	2.79	0.81	3.67	0.57	3.84*	23	< .001

Note: * *difference between means is at 0.001 level (p < .001).*

Looking at items of the two dimensions separately, the pre- and post-workshop mean scores showed that participants perceived their competency at a higher level for competency in Dimension I: *Use technology tools and the Internet for teaching* (M=4.31, *SD*=0.37) than in Dimension II: *Use cloud computing for interaction and discussion* (M=3.67, *SD*=0.57). Moreover, the Wilcoxon results indicated that participants' development of CALL competency was statistically significant and not due to chance (Z=4.02 and Z=3.84, p<0.001).

As seen in Table 2, participants showed high-level CALL competency (mean score≥4.00) for nine items (out of 10) in Dimension I: *Use of technology tools and the Internet for teaching*, indicating that teachers felt that they had developed the competency in using technology and the Internet for their teaching after the workshops. Participants' top five self-perceived CALL competency items (mean score≥4.50) were found in Dimension I, particularly related to integrating online materials and video clips as well as selection of appropriate technology for teaching content. Among the five items, item 2: *I can integrate different modes of media to help students understand the subject content more easily* and item10: *I can use appropriate technologies to teach specific subject matters* were the top two increased means. Among all 14 items, the biggest increase occurred in item 7: *I can utilize appropriate technologies to meet individual students' needs*. All three items were related to teachers' attention on students' learning in content when integrating technology, indicating that participants perceived themselves developed the

CALL competency to look beyond technology itself. In addition, the standard deviations (SDs) of participants' responses also confirmed the positive impact of the workshops. As the SDs for most items in the post-workshop survey decreased while the means increased, it indicated that the variation among participants' responses was smaller with regards to their development of the CALL competency, especially for item 4: *I can use multimedia interaction to help students understand the subject content more easily* and item 7.

Participants' responses indicated that after the workshops teachers were able to look beyond the teacher-centered context aiming to engage students in their learning process and to match the affordances of appropriate technology to their instructional goals and pedagogy for their target audience, which was exactly what the TPACK-in-Action workshops intended to help teachers develop. Shelly's explanation of her decisions trying out iPad apps supported this finding:

> After learning about these iPad apps in your workshops, I feel that they would be good for lower grade students practicing letters, phonics, and vocabulary. …As you said, some apps have simple and specific features that can help me achieve specific teaching goals. …After trying them in

teaching, I also realized that it took a few things to go together for it to work [content, pedagogy, technology]. (Focus Group Interview I)

Table 2. *Development of CALL Competency*

Dimension	CALL Competency Items	Pre		Post	
		M	*SD*	M	*SD*
	14 items	3.41	0.57	4.13 *	0.37
Dimension I	10 items	3.66	0.53	4.31*	0.49
Use technology tools and the Internet for teaching	1. I can use video clips (e.g., from YouTube) to teach specific abstract concepts.	4.21	0.88	4.54	0.51
	2. I can integrate different modes of media to help students understand the subject content more easily.	3.58	0.97	4.42**	0.58
	3. I can use technologies for different representations in teaching to help students understand the subject content	3.46	0.98	4.42**	0.58
	4. I can use multimedia interaction to help students understand the subject content more easily.	3.83	1.01	4.42**	0.50
	5. I can use video clips (e.g., from YouTube) to help students understand the subject content more easily.	4.29	0.55	4.54	0.72
	6. I can use technologies, such as virtual lab, museums, or digital archives that allow students to explore concepts of the subject matter.	2.63	1.01	2.96	0.81
	7. I can utilize appropriate technologies that meet individual student's needs.	2.96	1.08	4.17*	0.56
	8. I can select appropriate technologies to teach specific subject matter.	3.92	0.83	4.54**	0.51
	9. I can integrate online materials into teaching the subject matter.	3.96	0.69	4.63*	0.49
	10. I can use appropriate technologies for teaching specific subject matter.	3.75	0.79	4.50*	0.51
Dimension II	4 items	2.79	0.12	3.67*	0.46
Use cloud computing for student interactions and discussion	11. I can use appropriate technologies (e.g., social media, online forums, and blogs) that provide students with opportunities to express opinions and interact with others.	2.83	1.13	4.04*	0.55
	12. I can use appropriate technologies (e.g., social media, online forums, and blogs) to help students clarify misconceptions in the subject matter easily.	2.63	0.92	3.29*	0.86
	13. I can use appropriate technologies (e.g., online forums, blogs, and teaching websites) to respond to students' questions.	2.79	0.88	3.25***	0.85
	14. I can use technologies to let students present their learning outcomes.	2.92	1.14	4.08*	0.58

*Note: * difference between means is at 0.001 level ($p < .00$); ** $p < .01$; *** $p < .05$*

While participants indicated their development of CALL competency, the only exception was with item

6: *I can use technologies, such as virtual labs, museums, or digital archives that allow students to explore concepts of the subject matter*. The mean score showed that participants started at a low level and did not develop much after the workshop, which could be because virtual labs, museum, or digital archives were not the targets of the workshops and thus were not addressed. During the focus group interview, participants explained that they felt that virtual labs and museums might be appropriate for science teaching, which indicated that teachers had content in mind when they selected technology for teaching. This finding aligns with the results of the Chuang and Huang's (2012) study, in which English teachers were also found to have lower mean scores than mathematics and science teachers on items related to these particular technology items, indicating that the selection of technology could be content specific. That is, English teachers need to look into what technology can afford when selecting technology for the teaching of English to facilitate the teaching process and enhance students' language learning.

For items in Dimension II*: Use of cloud computing for student interactions and discussion,* participants perceived themselves at high-level competency for 2 items (11 &14) with decreased SDs but at medium-level for the other two (12 &13) with SDs remaining at similar level. The big increases in means with decreased SDs were related to participants' competencies in selecting technology to accommodate students' needs and to promote participation and interactions among students, indicating that the CALL workshops helped participants draw their attention to students' actions and interactions in learning when selecting technology. This illustration is Florence's description of her integration of QuickVoice for students to practice oral production:

> They were all very much engaged. It had given them the opportunity to hear themselves. No matter how they were doing, they all said that they had a sense of achievement and it was interesting to hear their own voice. They need to hear themselves indeed. They were very interested, in fact, and eager to record more. It's like a force that motivates them to do better. (Focus Group Interview I)

Along the same line, Stella incorporated iPad video recording with a sound pedagogical decision, which provided another alternative for students to practice their speech:

> I used the recording feature on iPads for my students to practice their speech production. Students were able to not only hear but also see themselves because a speech is more than just narration. I assigned them in pairs so that they can help each other. …They all were very engaged working together. I also heard students offering suggestions for their classmates to do better. (Focus Group Interview I)

As to the two items showing at low-level competency, participants explained in the interviews that they could see the use of online forums and blogs to promote students' language production and interactions as we practiced on Google Sites in the modeled lessons. However, it was going to take time to get used to in terms of responding to students' questions online since most of the feedback and grading had been provided on paper. This suggests that participants were fully aware that knowing and doing were two completely different things and it would take some time and effort for them to apply their knowledge fully.

Technology Integration for Content Teaching

Eighteen different tools were incorporated and modeled in the CALL lessons in the TPACK-in-Action workshops, 12 of which were observed in participants' classrooms to meet a variety of teaching objectives (see Figure 4). For example, three participants used Google Sites as a course management tool where the course materials were uploaded for teaching and links to vocabulary and speech practices were uploaded for students to practice beyond classrooms. In addition, Spelling City was observed in 10

participants' classrooms. A variety of activities were created and implemented in different ways to achieve different teaching goals, such as teaching target vocabulary in a whole class format, helping students practice spelling and pronunciation of target vocabulary individually, and assessing students' learning. Furthermore, Text to Speech, PowerPoint, and iPads to practice integrated skill assignments. As seen in Stella's classroom, she adopted Text to Speech learned in the workshops and combined its use with Google Sites to make it possible for her students to practice and prepare for their mid-term oral speech. As it was modeled in the TPACK-in-Action workshops, the sample speech created using Text to Speech was uploaded to the website, which allowed students' access even outside the classroom. Stella's goal was to allow students the opportunity to hear and practice the speech without her presence, which extended students' learning beyond the classroom walls.

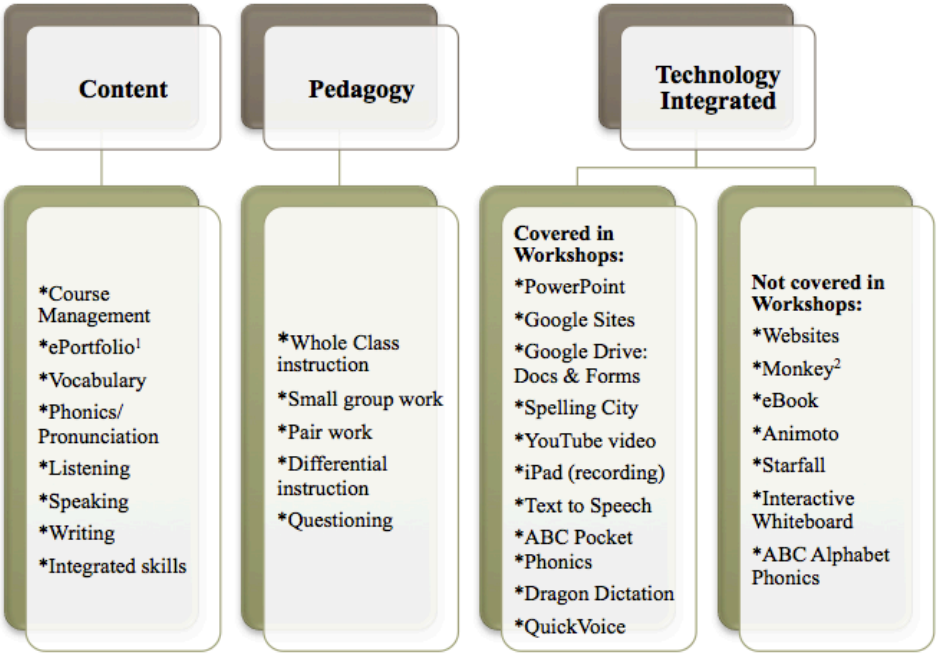

Figure 4. Analysis of participants' CALL integration observed

[1] ePortfolio is an activity that helped participants build an online portfolio on Google Sites, which allows multiple modes to present themselves. [2] Monkey is a customized course management system using the QR codes that allows teachers to connect to iPads for instant assessment on students' responses.

It was also observed that some participants integrated technology that was not introduced in the workshops, including web-based resources, such as Animoto and Starfall, eBook, and Monkey. After seeing a variety of technology in action in the workshops, Alice explored and combined the use of Starfall and eBook to more effectively help her students practice vocabulary. With Animoto embedded in Google Sites for the digital storytelling project, Gina found that students were more engaged in the learning process and demonstrated their productivity through multiple modes. She stated that students were more passionate and willing to push themselves further, which drove her to continue exploring further despite challenges and limitations occurred. Last but not least, Stella integrated Monkey, a customized course management tool that was developed to be incorporated with iPads. She stated that she volunteered to answer the call from her principal for a teacher to try Monkey. She felt that she was ready to take on the challenge after completing the CALL workshops. She said:

> After going through your workshops, I have learned a lot. I am not only more confident but also inspired. I feel that I should take on this challenge and give it a try. So I said yes to the principal's calling an English teacher to go on board. I have spent quite some time learning and playing with it. But it's worth it. (Focus Group Interview I)

The six tools introduced in workshops but not observed in classrooms were Schoology, Google Voice Search, Doodle Buddy, Paint & Story House, VoiceThread, and TitanPad. When asked why some technologies introduced in the workshops were not integrated in their teaching, participants reported that it had to do with their access to and the affordances of technology and the target curriculum objectives. For example, Google Sites and Dragon Dictation functioned similar to the first two tools as a course management tool and for pronunciation practice respectively. Participants also mentioned that they had easier access to PowerPoint, which affords similar features with Doodle Buddy and Paint & Story House especially after they learned about its recording feature in the workshops. Moreover, participants acknowledged TitanPad and VoiceThread as useful tools for writing and integrated skills; however, they explained that composing a passage or a paragraph were beyond the curriculum objectives since students were still at the level of learning vocabulary and writing sentences.

It showed that participants were actively exploring other tools for their English teaching and had more confidence in integrating CALL in their classrooms indicating that the TPACK-in-Action workshops helped teachers gain the confidence to go beyond their comfort zone and start exploring other possibilities. Moreover, participants not only looked at the affordances of technology when selecting what to incorporate in their teaching but also make connection of the use of technology to curriculum objectives, which matched the objectives of the TPACK-in-Action workshops.

Observed CALL Competency

While survey data showed that participants developed CALL competency after the TPACK-in-Action CALL workshops, a variety of CALL competencies were also observed in their classrooms. As shown in Table 3, all 13 participants were observed to have demonstrated three CALL competencies in their classrooms, including *700. Scaffold_Content*, *705. Resources_Content*, and *707. Engage*. First, participants used resources that they learned in the CALL workshops and selected appropriate tools to scaffold content teaching and engage students in content learning. As mentioned in the previous section, two thirds (12/18) of the technology introduced in the workshops were observed in participants' teaching with pedagogy in mind. For example, all participants integrated Spelling City to teach vocabulary, allowing students to practice spelling and pronunciation and assessing students' learning in vocabulary as modeled in the workshops. PowerPoint was integrated as an instructional tool for teachers as well as a productivity tool for students as in one of the modeled lesson. Based on the observations, students were all very much engaged and on task while CALL activities were carried out in classrooms. The changes in Alice illustrated these CALL competencies well. She expressed that she would not have time to integrate CALL during the workshops and thus would like to withdraw from being observed. After the workshops, she decided to give it a try and incorporated Spelling City into her teaching of vocabulary. She said: "I tried using Spelling City as well and it worked wonders. … My students were all very motivated and engaged in vocabulary practice. … I have decided to make it part of my teaching routine." (Focus Group Interview I). Alice identified with what technology could do if integrated appropriately into teaching through her action in the classroom, which led to her intention and continuous efforts to explore new tools and integrate CALL into her teaching.

In addition, nine participants were observed to have incorporated technology to assess students' learning formatively as demonstrated in the workshops, specifically Spelling City and Google Forms, namely the CALL Competency of *702. Assess Learning.* They mentioned that these two tools helped them shorten the preparation time, especially for Julia, Jasmine, and Shelly, who taught multiple classes from the same grade. Most importantly, the integration of the tools afforded the opportunity for teachers and students to

Table 3. *Participants' Development and Integration of CALL Competency*

Development of CALL Competency	CALL Competency Dimension	Pre		Post				
		M	*SD*	M	*SD*	*Z*	*dt*	*p*
	I & II (14 items)	3.41	0.57	4.13	0.37	4.29*	23	< .001
	I. Use of technology tools and the Internet for teaching (10 items)	3.66	0.60	4.31	0.37	4.02*	23	< .001
	II. Use of cloud computing for student interactions and discussion (4 items)	2.79	0.81	3.67	0.57	3.84*	23	< .001

Integration of CALL Competency	Participant	Integration Observed: CALL Competency	**Definitions**
	Alice	700, 705, 707	700. Scaffolding_Content. Teacher uses and models different scaffolding techniques, i.e., providing support to promote learning, in a class or across over classes to facilitate student learning in a content area(s) with technology.
	Darcy	700, 702, 705, 707, 709, 710, 713	702. Assess Learning. Teacher uses technology and strategies to assess students' content learning in classroom
	Faye	700, 702, 705, 707, 709	705. Resources_Content. Teacher uses resources (e.g., content & technology) that are collected over time, including professional development, workshops, conference, self-learning, etc. to teach the planned lesson in classroom.
	Florence	700, 702, 705, 707, 709, 710, 711	707. Engage. Teacher uses technology to engage (e.g. students show motivation or strong focus for the activity) students in learning about a specific content area.
	Gina	700, 702, 705, 707, 709	709. Match Affordance. Teacher selects technology based on his/her knowledge of what the technology can do (affordances) and can not do (limitations) in relationship to teaching strategies used to teach content.
	Heather	700, 702, 705, 707, 709	710. Reflect. Teacher reflects on teaching episode (rethinking the lesson plan and how technology is used) and making connections to previous teaching episodes. The interplay between technology, content and pedagogy are addressed.
	Jasmine	700, 702, 705, 707, 713	711. Collaborate. Teacher collaborates with others such as tech coordinator or tech coach to plan or teach a technology-enhanced lesson.
	Julia	700, 702, 705, 707, 709	712. Learner Centered. Teacher allows students to take control on their learning in content.
	Sabrina	700, 705, 707	713. Connect Learning. Using technology to connect students to others outside the classroom, e.g. students in different classes, schools, districts, states or countries or content experts in different locations, for purpose of learning content.
	Sarah	700, 702, 705, 707, 709	
	Shelly	700, 705, 707, 709, 712	
	Stella	700, 702, 705, 707, 709, 712, 713	
	Zelda	700, 705, 707	

receive instant test results and feedback. Florence used Spelling City to create the midterm vocabulary exam and stated that the use of the tool helped her students do better in the midterm exam.

Moreover, eight participants demonstrated the competency of 709. *Match Affordance*, indicating that they developed overall knowledge of the affordance of technology when selecting technology for teaching. Participants were also observed to have demonstrated the CALL competencies of *712. Learner Centered* promoting learner-centered learning environments and *713. Connect Learning* extending students learning to beyond the classroom. With the use of iPads and apps, Shelly and Stella demonstrated the CALL competency of allowing students to take control of their own learning in the practice of speech/presentation and phonics/pronunciation in pair or small group learning environments, namely. Jasmine created the Jeopardy activity on PowerPoint for reviewing grammar, vocabulary, and sentence patterns and implemented it as a competition among all six 6th-grade classes she taught, which motivated students greatly in content learning. Jasmine's CALL integration connected students to peers outside of their own classrooms to promote content learning.

Through the use of Google Sites, Stella and Darcy made it possible for learning to occur outside the classroom (see Figure 5 & 6). Along with using Text-to-Speech, Stella's students were able to practice for their mid-term oral examination at their own pace to meet their own needs. Combining Google Sites, Docs, Forms, and TitanPad, Darcy created a whole lesson, which allowed students to practice and complete assignments at their own pace. Darcy explained the rationale behind the creation of this lesson in the focus group interview,

> I learned to use Google Sites and Spelling City. … I created vocabulary activities, uploaded them to the class website, demonstrated how to access the pages and activities, and provided specific instructions. So they now have an alternative resource to practice target vocabulary outside classroom. (Focus Group Interview II)

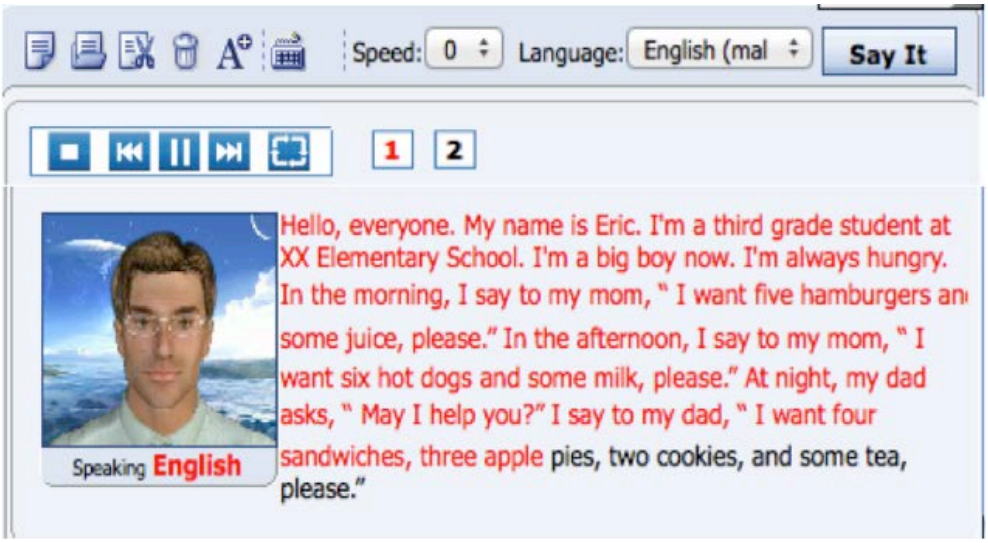

Figure 5. Stella's CALL integration-Google Sites and Text-to-Speech

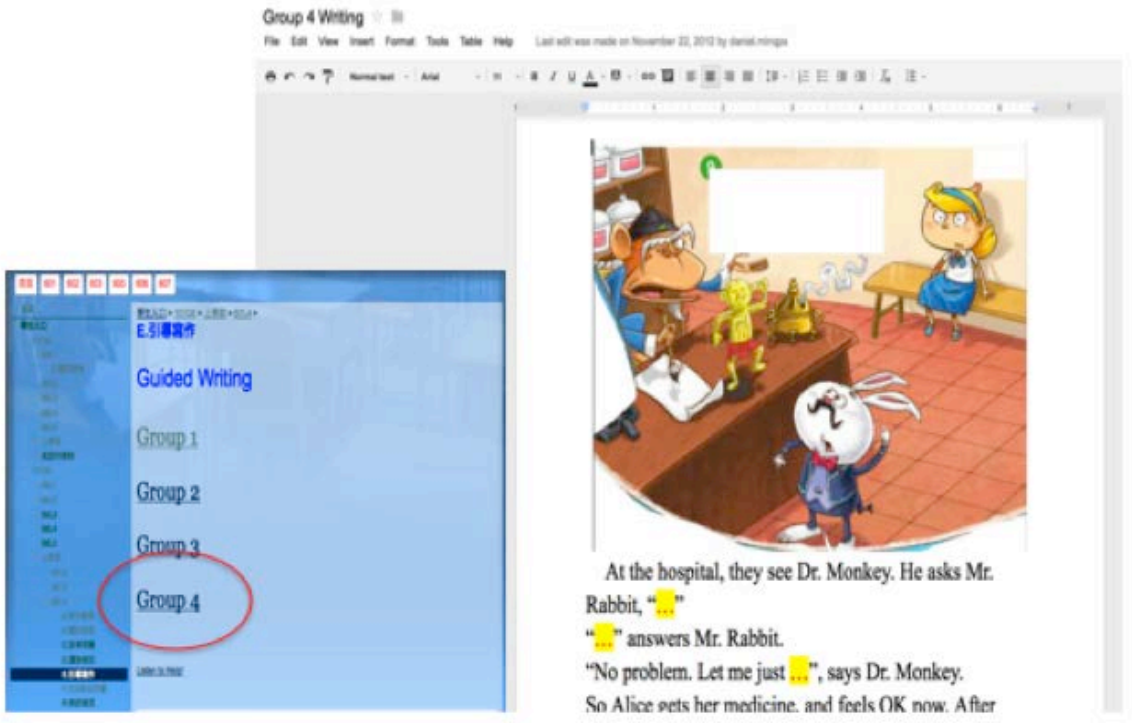

Figure 6. Darcy's CALL integration-Google Sites for collaboration

Among all CALL competencies, 710. *Reflect* and *711. Collaborate* were observed in very few participants' classrooms. These two competencies shared a similar nature, that is, it required data from multiple sources to determine and verify. For example, 710. *Reflect* was observed in Stella and Darcy's classrooms where the observations took place in two back-to-back classes. Both teachers noticed one thing that did not go well in the first class and decided to modify the second class in order to facilitate the content teaching. Stella decided to make an adjustment in the sequence of her teaching in target words and sentence patterns in a second 4th-grade class, which was observed to run more smoothly. In Darcy's classroom, one PowerPoint slide was added to facilitate his instruction in explaining the content related assignment, which was observed to help students' comprehension. Based on what was observed, it was brought up during the post-observation interviews with both participants to confirm and verify their rationale behind the changes made in classes.

As to *711. Collaborate*, teacher collaboration was identified during the observation in Florence's classroom. It was observed that her lesson planning was very similar to Julia's. It was confirmed in the post-observation interview that she worked together with Julia to plan the lesson. When asked, Julia stated, " We think working together will help us prepare for the class since we teach the same grade. Two people working together and sharing the resources saves time" (Focus Group Interview I). Gina agreed and further illustrated:

> I agree [with Julia]. If we can all work together, teachers teaching the same grade. We can share the workload and plan for the curriculum for the whole semester. It will make the preparation easier and more effective. We'll be very happy to integrate CALL. (Focus Group Interview I)

While the above three CALL competencies were observed in participants' classrooms, it was necessary to

clarify with participants in the post-observations interviews in order to verify if teachers' intentions and rationale matched the researchers' observations. Moreover, participants' competency in reflection would not have been identified had it not been for the back-to-back observations scheduled.

CONCLUSION

Participants reported that the TPACK-in-Action CALL workshops helped them develop CALL competency to incorporate certain software-based tools, web-based tools, and iPad apps into their teaching. In addition, they developed the confidence to push themselves beyond their comfort zone and take their CALL integration to a new level. Moreover, participants were observed to have demonstrated CALL competencies in their teaching, which indicated that the TPACK-in-Action workshops served the purpose of preparing them to transform the knowledge learned into actions. Through comparing and contrasting quantitative and qualitative data, participants' development of CALL competency was clearly identified and they appeared to align to the objectives of the workshops where technology should be integrated with content and pedagogy in mind and brought into actions. In all, the study yields evidence that the TPACK-in-Action CALL workshops specifically designed to help teachers integrate CALL into teaching through doing CALL within the TPACK framework holds a great promise for teachers' development and adoption of CALL competency into their teaching actions.

LIMITATIONS

However, as with any study, there are limitations that need to be addressed. First, observation was not included in the pre-workshop data collection. Collecting baseline information through direct sources at the pre-workshop stage will help the researcher understand the participating teachers' teaching styles and actions better. Second, the multiple roles the researcher played, as the instructor, the researcher, and the observer, could have influenced the data collected. Though the researcher played no role in the formal evaluation system of the participating teachers, they may still have felt that they were being assessed during the observations, which might have affected teachers' participation and performance.

IMPLICATIONS

Despite the limitations, the findings of the study have theoretical and pedagogical implications. First, the study provides a new perspective on investigating the impact of CALL TE courses through observation. Responding to CALL researchers' call (Egbert et al., 2002; Kessler, 2007; Kilickaya, 2009) to add observation as one data source to complement survey and interview data has been found to be a beneficial measure in the investigation process, which has shed some important light on the methodology for research in CALL teacher education. Triangulating observation data with the self-report data contributes to preventing potential discrepancies such as occurred in the Wong and Benson study (2006). Moreover, observations can also be used to identify and visualize teachers' CALL competency and effective CALL integration.

Second, findings also contribute to addressing and conceptualizing CALL competency. Using the TPACK framework (Mishra & Koehler, 2006) to guide the design of the workshops suggests that effective CALL integration rests on the interaction among the three fundamental types of knowledge: content (language), pedagogy, and technology. The workshops helped teachers realize CALL integration beyond the traditional technocentric approach. Conceptualizing CALL competency within the TPACK framework helps teachers look beyond technology for its own sake and examine the relations between a technology, what has to be taught (content), and how it ought to be taught (pedagogy).

Third, the study proposes that the TPACK-in-Action model be used to guide the design for CALL TE courses. The literature on CALL teacher education indicates that there is a need for training models that facilitate more successful integration of CALL in the classroom (e.g., Healey et al., 2011). Findings of

this study contribute to filling that gap by providing evidence on how the TPACK-in-Action CALL workshops helped English teachers in Taiwan developed CALL competency and integrate CALL successfully. The TPACK-in-Action CALL workshops provide a useful model that informs the planning and design of CALL TE programs and courses.

APPENDIX A: Schedules & Contents Of The TPACK-In-Action Workshops

Workshop	Content/Language Skills	Technology integrated	
1	Course Management, ePortfolio	Google Sites Google Drive: Docs & Forms	Google Voice Search Schoology PowerPoint
2	Vocabulary, Pronunciation Listening	Google Sites Spelling City YouTube Google Drive: Docs & Forms	PowerPoint *Dragon Dictation *Quick Voice Text to Speech
3	Integrated Skills, Reading & Writing	Google Sites Bubbl.us PowerPoint	TitanPad Google Drive: Docs & Forms
4	Integrated Skills, Reading, Writing, & Oral Communication	Google Sites PowerPoint TitanPad	VoiceThread Text to Speech iPads
5	Integrated Skills, Vocabulary, Pronunciation, Reading, Listening, Writing,	Google Sites PowerPoint Google Drive: Docs & Forms *Dragon Dictation *ABC Pocket Phonics	*QuickVoice *Doodle Buddy *VoiceThread *Paint & Story House *iBook

**iPad apps*

APPENDIX B: TPACK-In-Action Observation Instruments

Date: _____

Start-End Time: _____

Observer(s): _____

Background Information	
Teacher Name	
Class/Topic	
Student Level	
Number of Students	
Brief Description of Classroom/Instructional Context: Is it a traditional classroom? Or a lab? Describe the settings of the classroom. Are there computers? Projector? Others?	
Description of Lesson Procedure (Step by step):	

During Observation:
Identify role of technology and TPACK codes

Role of Technologies Incorporated		
Teacher Preparation	Teachers use technology to prepare for teaching, e.g., produce, store, organize, and retrieve teaching and learning materials electronically, find instructional materials online.	
Teacher Productivity	Teachers use technology to facilitate the instruction, e.g., deliver presentations with graphics, visuals, and sounds.	
Student Productivity	Teachers use technology to facilitate students' production in learning activities, e.g., facilitate group discussion and lesion, lead students in brainstorming and sharing ideas.	
Student-Centered Learning Environment	Teachers use technology to actively engage students in individual & collaborative learning activities, e.g., engage students in collaborative project-based learning,	

TPACK Codes:
Observe teacher's actions and categorize them based on the TPACK codes

TPACK Competency	
700. TPACK_ Scaffolding-Content	
701. TPACK_ Learning_ needs	
702. TPACK_Assess	
705. TPACK_ Resources_ content	
706.TPACK_ Connect_ others_ learn_ content	
707. TPACK_ Engagement	
708. TPACK_Teacher-Needs	
709. TPACK_Affordance-Teaching	
710. TPACK_Reflect	

Post Observation Questions to be addressed for clarification and further elaboration during interviews	

APPENDIX C. Sample Codes from the Tai, Crawford, and Wang (2014) codebook.

Code	Full Code	Definition
700. TPACK_Use	Using technology and instructional strategies to teach content.	Teacher uses technology and instructional strategies (i.e., inquiry-based learning, Writer's Workshop) to teach content area curriculum (i.e. literacy, math, science, social studies)
701. TPACK_Match Affordance	Selecting technology with pedagogy in mind to teach content	Teacher selects technology based on his/her knowledge of what the technology can do (affordances) and can not do (limitations) in relationship to teaching strategies used while teaching content.
703. TPACK_Prepare	Preparing instructional and content-related materials with technology.	Teacher creates instructional and content-related materials with technology to use for teaching. Examples include setting up technology platform (e.g., wiki, web page, blog), supplemental materials (e.g., worksheets, tutorials, locate instructional videos), or reading materials (e.g. subtext, Google Drive). (Note: This code has nothing to do with students/learning.)
705. TPACK_Assess_Learning	Using technology and strategies to assess students' content learning	Teacher uses technology and strategies to assess students' content learning in classroom.
707. TPACK_ Engage	Using technology to engage students in learning.	Teacher uses technology to engage (e.g. students show motivation or strong focus for the activity) students in learning about a specific content area.

NOTES

1. According to Mohan (2007), a social practice is a combination of knowledge and action, meaning that teachers participating in a social practice are required to know (knowledge/reflection) something and to do (action) something. Moreover, discourse of reflection could be further divided into specific reflection, where participants talked specifically about what happened, i.e., the action, and general reflection where participants addressed their thoughts in more general terms that lend insight to knowledge of why something was happening. For example, "verb (specifically past tense)" could mark discourse of specific reflections while "if/then" could mark discourse of general reflections. Identifying specific reflections and general reflections helped determine the unit of meaning (UoM) for analysis and sort the interview and observation data into UoMs for coding and analysis (see Figure 3 for examples of UoMs).

ABOUT THE AUTHOR

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