Qualitative Research: Chinese language faculty's use of technological pedagogical content knowledge to engage students during emergency remote teaching

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Abstract

The purpose of the study was to investigate college language faculty's use of technologies to organize teaching and learning in language classrooms during emergency remote teaching necessitated by the pandemic in the spring semester of 2020. The study used Mishra and Koehler 's (2006) theoretical framework of the Technological Pedagogical Content Knowledge (TPACK) to analyze the five Chinese language instructors' strategies to virtually engage their students. The results indicate three themes in the participants' ERT relative to student engagement: Frequent communication, ERT-sustainable materials, and quick turnaround times for interaction. The study results offer theoretical and practical implications for both researchers and instructors.

Keywords: TPACK, emergency remote teaching (ERT)

Introduction

Language classrooms are typically interactive because the instructor and students are often engaged in a variety of activities to practice the language skills, such as drills, instant feedback, role-plays, and discussions. These exercises usually work well with the participants' physical presence. However, what would happen to language teaching and learning when a face-to-face spontaneity is absent from the instruction and when an exclusive reliance on technology as an instructional medium is necessary? The pandemic outbreak during the spring semester of 2020 abruptly migrated most college faculty and students in the United States from an in-person instructional setting to an emergency remote teaching (ERT) environment. ERT in this study refers to a temporary shift in the teaching modality that extemporaneously transforms what would have otherwise been face-to-face teaching components into a digital form.

One of the key differences that sets apart ERT from well-structured online instruction is its urgent, emergent nature. At many institutions, teaching online in a regular semester is a "bottom-up" affair (Lesht & Windes, 2011), in which faculty members elect to do so and have time for preparation. In addition, typically students are enrolled in web-based courses by choice. The willingness of faculty and students can be pivotal for successful technology integration into the instructional practice in non-emergency circumstances (Reid, 2012). Moreover, virtual teaching and learning involves instructors and learners in a process of role transformation (Cochran & Bemuto, 2016). Many online educators and students experience a shift in their roles from an in-classroom instructor and student with a visible center of attention to an invisible

facilitator and users of online materials (Bair &Bair, 2011). Such a transition is often a movement on a continuum, and the faculty and students continue to adjust themselves in their new roles and learn to navigate how they can better engage with one another and with the subject content as online instruction proceeds. That is, in a non-crisis online educational setting, both faculty and students can pace themselves in their practical and psychological preparation as they transition to online instruction. However, that is not the case for ERT, when the situation indiscriminately demands a rapid transition from faculty and students, including those who did not have the skills or resources needed to thrive in the digital landscape. While less than ideal, this underprepared transition in the teaching modality presented both pedagogical challenges and growth opportunities.

The purpose of the study was to analyze college faculty's use of technologies to organize teaching and learning in language classrooms during ERT. Guided by Mishra and Koehler 's (2006) theoretical framework of the Technological Pedagogical Content Knowledge (TPACK), the study attempts to answer the following research question: How did Chinese language faculty apply their technological pedagogical content knowledge to engage students during ERT? The research findings are important because they evaluated the technological pedagogical content knowledge of instructors, who were not pedagogical technology specialists but completed their ERT successfully. The evaluation offers insights on the theoretical and curricular role that TPACK plays in faculty development. Moreover, this study discussed student-content engagement, one core emergent theme in the data, and raised questions regarding sustainability of virtual teaching materials.

Literature Review

Mishra and Koehler (2006) assert that when using technology to facilitate teaching, teacher knowledge of technology is context-dependent and integral to the knowledge system of subject matter and pedagogy. The technology knowledge has "a ripple effect" (p.1025) affecting faculty's instructional decisions because the use of technology, such as a Learning Management System (LMS), can change how instructors organize and then present the content information in a way that would have been different in the absence of technology. These technological pedagogical knowledge and skills need to be learned by faculty before effective application of educational technology can take place (Mohr & Shelton, 2017). However, in the reality, online instructors in a well-planned teaching context can still experience challenges. The faculty participants in Eichelberger and Leong's study (2019) reported that technical failures caused students' frustration and impatience with the instructors during their synchronous sessions. The participants in their study believed that these negative outcomes would have been mitigated had teachers and students had more specific knowledge to troubleshoot effectively. While some technical issues are evidently beyond faculty's control (e.g., an internet outage), they still affect instructional productivity. This leads to an inquiry regarding what faculty can do to plan and foster positive online student engagement and offer both instructional and social support in terms that enhances the teaching outcomes that technological efforts alone or the lack thereof cannot achieve in a virtual learning environment.

TPACK Framework

Teaching online is a complex cognitive activity that relies on teachers' flexible access to their many organized knowledge systems fundamental to teaching. To offer grounding that describes interplay among essential qualities of teacher knowledge necessary for successful use of educational technology in their teaching, Mishra and Koehler (2006) proposed Technological Pedagogical Content Knowledge (TPACK) framework based on Shulman's (1986) epistemological concept of pedagogical content knowledge with an integrative addition of technology. Shulman's model considers pedagogical content knowledge as a qualifier that defines the profession of teaching: teachers consider the process of teaching and learning and then accordingly interpret, organize, represent, and formulate the subject matter in comprehensible ways for their students. That is, content is transformed for teaching through teachers' application of pedagogical knowledge. Mishra and Koehler's TPACK is conceptualized in a similar way with an added domain of technology knowledge, and the integrated technological pedagogical content knowledge can change educators' consideration for not only instructional delivery but also the overall curriculum design (Voogt et al., 2011), such as offering online options in addition to in-person sessions.

TPACK is commonly represented using a Venn diagram with three overlapping circles representing the three core types of knowledge: content, pedagogy, and technology. The model proposes that the interplay among the three circles results in four additional types of knowledge with technological pedagogical content knowledge sitting in the center (see Figure 1).

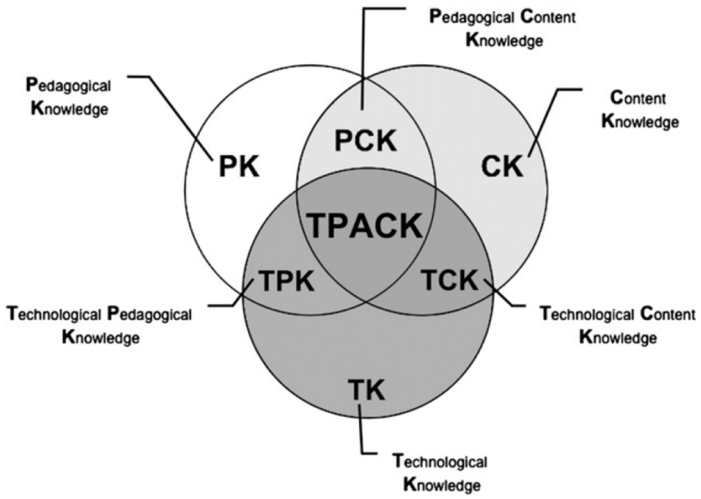

Figure 1 The TPACK framework (Archambault & Barnett, 2010, p. 1954)

The framework addresses three core interdependent constructs, three pairs of connected knowledge domains, and the centrally overlapped area. Pedagogical content knowledge is the integration of subject matter expertise and mastery of teaching skills. Technological content knowledge concerns the ways that application of technology changes the nature of content representation and learning processes. Technological pedagogical knowledge points to a teacher's knowledge regarding the available technological tools and teachers' capacity to strategically choose technologies to enhance learning outcomes. Coming together, technological pedagogical content knowledge is the basis of meaningful teaching with technology and requires faculty's understanding of

> the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones (Mishra & Koehler, 2006, p.1029).

The TPACK theoretical model is often used for analyzing teacher's integrated knowledge of technology, pedagogy, and content and examining how teachers apply technologies to represent, formulate, and transform the subject so it is comprehensible to learners. However, teachers' knowledge is complex, and an interconnectedness of multiple elements can make isolation and measurement of these individual types of knowledge challenging. Hence, while TPACK offers multiple categories of teachers' knowledge relative to content, pedagogy, and technology, researchers have been challenged by the fuzzy boundaries between adjacent constructs that are uneasy to separate out (Graham, 2011). Moreover, TPACK does not fully examine contextual factors known to impact instruction, such as faculty beliefs about their online teaching using TPACK (Eichelberger & Leong, 2019). Nevertheless, TPACK is helpful in organizing teachers' relevant knowledge domains (Archambault & Barnett, 2010).

Student engagement

Student engagement is crucial to improve student satisfaction, motivation to learn, sense of learning community, and academic performance (Martin & Bolliger, 2019). In understanding the importance of student engagement, Laurillard (2000) articulated that the purpose of higher education moves far above information access and aims to enable individuals to develop their capabilities to the fullest through "engagement with others in the gradual development of their personal understanding" (p.133). Such engagement, according to Anderson (2003), is developed through interaction among faculty, students, and subject content. In other words, both human and nonhuman engagement activities are essential and complementary elements of quality teaching and learning experiences. The research findings of Handelsman et al. (2005) suggested that an individual's interactivities with their peers, instructor, and content leads to an engaged learner, and that engagement is a significant predictor for the student academic achievement. The study of Abdous and Yen (2010) also supported the significant role of learner-to-teacher interaction in learning outcomes and student satisfaction in an online environment. Moreover, the study of Lear et al. (2010) showed that social engagement fostered among peers and faculty through class interactivity develops a sense of community, and this sense of belonging contributes to student learning and places faculty at the center of community development. Quality teaching and learning is reciprocal, responsive, and social, not competitive or isolated, and engagement among faculty, students, and content affords the participants opportunities to exchange ideas and sharpen thinking (Chickering & Gamson, 1987). Hence, educational engagement involves both social and cognitive aspects in an online learning community. The construct of student engagement in this study is situated within the ERT parameters and therefore refers to the instructor's use of technologies to organize their teaching activities and purposefully create virtual learning opportunities through students' interaction with the instructor, their peers, and the subject content.

Methodology

Participants

With the approval from the institutional review board at the researcher's university, a non-probability purposive sampling procedure was adopted to identify five faculty participants to represent the most diversity within the constraints (Teddlie & Tashakkori, 2008). A snowball recruitment technique was used to compile an initial list of twenty college Chinese language instructors who taught during ERT in the United States. Subsequently, the twenty instructors were cross-categorized by their genders, years of experience, position titles, and institutional types. One or two participants from each category were then selected to form the purposive sample. The five participants taught in four different classifications of institutions in the United States: state research-oriented, state teaching-focused, private research-emphasized, and private liberal arts. The participants were all native speakers of Chinese originated from either China or Taiwan between the ages of twenty-eight and sixty-five. The participants included both male and female, and their position titles ranked from Instructor I to Full Professor.

Interview questionnaire instrument

Voogt et al. (2013) pointed out that ultimately online instructors need to be competent in teaching their specific subject areas with technology and thus suggested that teacher's use of technology be assessed using TPACK that addresses domain-specific knowledge. As such, the instrument specified the interconnectedness among technology, language pedagogy, and Chinese language. Guided by the theoretical TPACK framework and the research question, an open-ended, semi-structured interview instrument was used for data collection during the videoconferencing interviews. To increase the instrument content validity and questioning techniques, three college professors who taught Chinese language during ERT but were not participants in the study were recruited for the field test. The instrument was subsequently revised according to the three professors' feedback. The five interviews ranged from sixty to eighty minutes, and they were centered on the following four core inquiries with varying follow-up questions based on the participants' narratives.

1. Can you share an overview of the differences in how you engaged your students before and during ERT?
2. Technological knowledge: Please describe your experience in using educational technologies before and during ERT.
3. Content knowledge: Please describe your specialized areas in Chinese language teaching and the materials you used before and during ERT.
4. Pedagogical knowledge: Please describe your teaching rationale and how you purposefully presented the subject content and create an effective learning experience before and during ERT?

Data analysis

The data included the video recordings, field notes, and analytic memos. They were member checked and coded using Saldana's (2009) the first and second coding procedure for

recursive themes and explanations. The initial round of coding sought to list major topics relative to TPACK within individual interviews. The second coding focused on the shared topics across the five interviews. The third round of coding analyzed the interconnectedness among sub-datasets within and across the interviews. The final coding synthesized the thematic sub-datasets and prepared for listing findings. To verify the validity of the findings, two colleagues, who participated in the field test, checked the final codebook for data consistency and repeatability (Trochim, 2006) and verified that the listed findings were supported by the data (Guion, 2002).

Findings

This study sought to answer the question: How did Chinese language faculty apply their technological pedagogical content knowledge to engage students during ERT? The participants shared that while they were neither specialized in educational technologies nor a regular user of technologies beyond emailing and creating presentation slides before ERT, they became able to proficiently apply new technologies to engage students in a variety of learning activities during ERT. Three types of engagement that were described across the participants during ERT are as follows.

- Instructor-students interaction, such as intentional and frequent communication with students via voice messages for pronunciation assistance, routine check-in emails with Graphic Interchange Formats (GIFs) and emoji inserted, and one-on-one synchronous meetings to support both students' academic and personal needs
- Student-content interaction, such as the use of thought-provoking materials recorded by the students to invite sustainable virtual discussions
- Student-student interaction, such as adoptions of discussion-board topics that allowed quick responses and short turnaround times

One common theme in the discussions regarding the participants' approaches to create an effective ERT experience was their use of the course suspension days to transition their classes into ERT. During the course suspension periods, which ranged from three to fourteen days depending on the institution, while the faculty were not allowed to assign students any academic work, the participants strategized the time to collect information about their students' academic and personal needs. The participants used online free survey tools or connected with their students individually through email or videoconferencing to inquire about the students' expectations of their learning during ERT. Based on the information, the faculty participants revised the syllabi accordingly. Participant One reported, "My students indicated in the survey that they wanted to finish the semester strong and were concerned that the learning outcomes would be compromised. As such, my goal during ERT was not only to survive but also to thrive." The participants also communicated with their students using online discussion boards during the suspension periods to share questions and answers among the students. In this endeavor, the participants intended their information exchanges to be frequent, quick, and brief. The twofold intentions of frequent communication through varying modalities were reported to provide timely academic and psychological support during the learning interruption. Moreover, in creating an effective ERT experience, the participants needed to reorganize teaching materials in effective ways, such as digitalizing the materials and centralizing the location of the files on the LMS. Furthermore, considering the challenges associated with students' personal lives (e.g., home environments not suitable for synchronous learning), the participants offered their students

frequent individualized assistance through supplementary text-based, recorded, and synchronized instruction so the students could achieve the learning outcomes as they would have had they remained on campus.

The participants reported that the development of students' spoken skills and grammar knowledge continued to be key instructional objectives during ERT. In explaining the implementation of different pedagogies during ERT, Participant Two shared that "Technological constraints affected my instructional clarity. Hence, I sent pronunciation corrections through voice messages alongside text explanations. I also recorded a series of grammar lectures that my students could watch outside the class hours and have more time and space to reflect on them." Examples of technological constraints in this case are as follows. Pronunciation drills on videoconferencing were less effective due to the lack of eye contact and rhythm. Moreover, the instructor could not instantly pick up markers of different colors to enhance key points or handwrite Chinese characters on the screen easily. According to the student evaluation of teaching, the students found voice messages and videos helpful because they were engaged with the content through a familiar voice and pedagogy.

In addition to increasing more time and space for students' independent learning during ERT, the participants discussed the need for shortening turnaround times in a videoconferencing setting. Videoconferencing technology did not allow the instructor to attend to multiple breakout rooms simultaneously. Moreover, the transition between big and small groups often interrupted the class momentum. Upon realizing the technological limits, all participants chose not to continue virtual small group practice. As a result, when the entire class was present, only one student or one group could practice conversations at a time, and the rest had to just wait on the screen. This arrangement then created a new challenge, for large group provided less practice opportunities for each individual than small groups work. In responding to the technological challenges, keeping the class momentum, avoiding unmoderated breakout room activities, and involving more students to practice speaking during group learning, the participants compensated for the absence of small group work for smaller tasks. Specifically, Participant Three created a pool of varying smaller tasks for frequent teacher-student and student-student interactions by "downsizing" the regular speaking exercises, which would have otherwise been more extensive in a traditional classroom when physical contextual cues (e.g., body movements and acting) were available. Smaller-size language tasks using visual and audio prompts to elicit student output allowed quick turnaround times and enabled everyone in class to have new questions instead of repeating what had already been answered by their peers. Alongside the concept of quick turnaround times, the participants emphasized that the exchanges on the discussion boards featured frequent "short and sweet" responses to invite participation and move discussions along.

In elaborating on ERT pedagogies, the participants further discussed the importance of meaningful student-content interaction. To engage students with the subject content in a comfortable pace during ERT, Participant Four designed the speaking exercises in an online collaborative space where students regularly recorded their verbal comments based on multimedia prompts, such as videos, images, and voice recordings. The instructor then offered timely feedback on the same collaborative space. According to Participant Four, these exercises could make up for small group discussions, which were reported to be ineffective in their beginning-level language instructional context through videoconferencing. Moreover, to sharpen

students' critical thinking skills, sustain their interest in the discussion, and build students' vocabulary, Participant Five purposefully asked students to videotape masking and COVID-19 situations in their towns or countries to stimulate discussion on first-hand information. According to the participant, the students were enthusiastic, and the discussions were engaging, which pushed the students to use more expressive vocabulary words. Participant Two added that when the materials could cause reactions from students, they were "idle-time-free" materials that were especially valuable in an online classroom.

Discussions

Overall, the findings reported that the participants did not consider themselves as specialists in digital literacy over pedagogical technologies before ERT. Regardless, the participants did not encounter or perceive any technical difficulties that stopped them from engaging their students during ERT. The participants concluded that they achieved their teaching goals and finished ERT successfully. This finding supports Lee's (2009) study that foreign language instructors who teach remotely are encouraged to "have good general computer literacy and skills, but they do not necessarily have to be familiar with each technology" (p. 250) in order to succeed in their teaching. Their digital literacy enabled the participants to implement an array of ERT instructional activities, and the three reoccurring pedagogical themes relative to student engagement during ERT were frequent communication, ERT-sustainable materials, and quick turnaround times for interaction. The data suggested that the participants purposefully selected a variety of technologies to help them to meet these pedagogical needs. Informed by the TPACK model, this section discusses how the participants presented effective instruction with technology and analyzed the teaching activities that would not have been accomplished without the integration of technology.

Frequent communication

Teacher-student engagement was reported to be more frequent. The high frequency occurred outside the instructional time, including both the suspension periods and throughout ERT, via online survey tools, email, and one-on-one videoconferencing. The increased frequency in communication was intentional and strategized by the participants to gather students' input on how to best organize teaching, provide academic assistance, and offer student wellness support during the unprecedented interruptions. These purposeful, frequent communication activities with individual students (e.g. polling students' learning preferences during ERT and promptly answering pronunciation questions via voice messages in addition to a written explanation) wouldn't have been accomplished without the integration of technology. That is, to create varying representations of the subject content and achieve their teaching objectives, the faculty participants needed to deploy different types of technologies. These technological tools assisted the participants to include various communication genres and purposes, such as written and oral, visual, audio, and text, formal and informal, concise and elaborate, social-affective and educational, and individual and community-based. The participants' use of technology showed their "ability to choose a tool based on its fitness, strategies for using the tool's affordances, and knowledge of pedagogical strategies and the ability to apply those strategies for use of technologies" (Mishra & Koehler, 2006, p. 1028). These implementations are evidence of the participants' technological content knowledge.

In addition to the increased occurrence of communication, the participants' use of symbols in written communication also changed. Many emotions were derived from interlocutors' physical presence (e.g., proximity, body movement, and posture), and because they could not be replicated during ERT, the participants inserted emojis, GIFs, and memes more frequently as a means of establishing animated engagement with their students. According to Resnick (1991) that instructor-student rapport can greatly affect the nature of student learning and educational outcomes. It is because when members in a learning community find the communication and interaction enjoyable and personally fulfilling, they are more likely to remain in the learning circle for the duration of the educational process and uphold the academic rigor (Garrison et al., 2000). As such, the frequent, positive connections with the students may have contributed to the participants' achievement in attaining their pedagogical objectives during ERT. In this study, the participants first identified characteristics of communication during ERT, "the nature of the target audience" (Mishra & Koehler, 2006, p. 1027), and their pedagogical options. Subsequently, based on their understanding of the emergent instructional context, the participants chose technological tools that could easily poll student information, complement other tools (e.g., voice messages along with text explanations), and compensated for the loss of in-person communication during ERT. These teaching activities and decisions, which involved integration of the three core constructs of technology, pedagogy, and content, reflected the participants' application of TPACK in their virtual instruction.

ERT-sustainable materials

Academic rigor remained crucial to both the participants and their students during ERT. As such, the theme of sustainability in material creation and reorganization was reoccurring in the data. The analyses showed two characteristics of the materials that qualified them to be sustainable in terms of enacting student-content engagement and providing academic support during ERT. First, thought-provoking was the feature that the participants were looking for when selecting videoconferencing-effective materials. This rationale is supported by the study results of Martin and Bolliger (2018) that online discussions on topics that encourage deep reflection to be the most valuable engagement strategy. Specifically, the "heated" discussions over the masking policies engaged Participant Five's students with the content, and such pedagogically crafted learner-content interaction could introduce "changes in the learner's understanding, the learner's perspective, or the cognitive structures of the learner's mind" (Moore, 1993, p.20). Participant Five's use of contentious videos, which were filmed by the students, about how COVID-19 masking was enforced in different areas was an example of the participant's application of technological pedagogical content knowledge. This thought-provoking learning opportunity with every student meeting via videoconferencing in real-time but bringing first-hand materials from different physical spaces could not have happened had the students been on campus together or had the necessary technologies been absent. The physical distance between students in this case was central to Participant Five introducing unique teaching materials that actively maintained student interest on a flat screen. The physical distance also contributed to the student learning through collecting and using authentic materials. In this example, the participant used the knowledge of technology productively and considered both content and pedagogy concurrently when designing this well-timed activity to stimulate and sustain the virtual language practice through dynamic discussions.

Instructional clarity was the second feature that the participants aimed to achieve when creating ERT-sustainable teaching materials that students could resort to outside the synchronous instructional hours. Participant Two made brief teaching videos and make them accessible through a free video sharing website to supplement student learning. The goals were to enhance students' comprehension of the subject matter and allow the students additional space and time to interact with the content asynchronously. The participant's pedagogies in this regard are supported by Meskill and Anthony's (2010) view that instructors of remote teaching should use text, sounds, and visuals to amplify instruction. Such instruction should also provide with diverse accessibilities and computer-mediated cues that can appeal to learners of varying learning styles and encourage them to engage with learning activities via student-computer interaction. The participant's strategies to complement synchronous human interaction with reflective student-content interaction created a quality teaching and learning experience (Anderson, 2003). With the creation of the video lessons that supported student learning, Participant Two facilitated learning discourse by engaging the students in "interacting about and building upon the information provided in the course instructional materials" (Garrison et al., 2007, p. 164). The coming together of Participant Two's knowledge in technology affordance, subject matter, alternative representations of concept brought an innovative, well-received outcome and shows an example of faculty application of TPACK to teaching.

Quick turnaround times for interaction

The data showed that inefficient implementation of concurrent multiple breakout rooms for group work through videoconferencing was a common concern. The participants redressed this limitation by creating a greater variety of quick-turnaround exercises for synchronous interactions, keeping asynchronous discussion board activities short and focused, and offering prompt responses to students' recorded speeches in an online collaborative space. One feature shared in these pedagogical techniques is their quick turnaround times. Brevity and promptness in these teaching activities were intended to motivate and enable more individuals to participate in the exercises within the allotted time and space. In addition, the participants created varied representations of the subject matters using images, audio recordings, and videos to engage the students with the content through different stimuli. The choice of technologies afforded the varying types of content ideas for the faculty participants to enrich their teaching. Being able to navigate the spaces flexibly defined by the three components of content, pedagogy, and technology and the interplay among them in their specific contexts shows the participants' integrated knowledge of TPACK.

The examples aforementioned in this section involved participants knowing not just the subject matter but also "the manner in which the subject matter can be changed by the application of technology" (Mishra & Koehler, 2006, p. 1028). In addition, the participants demonstrated their knowledge of the existence and utilities of various technological tools and accomplished the delivery of their teaching virtually. These ERT experiences in relation to instructor-student, student-content, and student-student engagement would not have been possible without the integration of technologies. The faculty participants' teaching techniques and technological choices were based on their pedagogical rationale and their understanding of the content. Together,

it was the participants' discipline-specific TPACK knowledge that enabled them to enact "truly meaningful and deeply skilled teaching with technology (Koehler & Mishra, 2009, p.66).

Conclusion

The findings and implications must be interpreted within limitations. The study used a small, non-randomized sample. Hence, the results are not generalizable to a larger population. The interviews as the single data source also presents a limitation. Moreover, because the participants were asked to discuss their ERT experiences, potential recall errors and subjectivity are also limiting factors (Patton, 2001). Nevertheless, the qualitative study approach offers readers with a greater depth in analysis (Stake, 1995). The study results are significant in the following theoretical and practical implications. First, the participants of the study were competent in navigating the complex interactions among content, pedagogy, and technology as language teaching professionals who resorted to their general computer literacy and used varying technologies to organize their teaching rapidly during ERT. Their last-minute integration of technology into their pre-existing teaching practice was a success based on the participants' perceptions and the institutional student evaluation of teaching. This experience seems to suggest a different approach to TPACK than Koehler and Mishra's (2009) perspective that teachers and teacher educators should "move beyond oversimplified approaches that treat technology as an 'add-on'" (p. 67). In this study, technology was a component that joined the pre-existing teaching practice at a later stage during Spring 2020. The implication of this observation raises a question that if an "add-on" approach and general digital literacy suffice to lead to a positive result of faculty's use of the TPACK model, how does this inform the decision of teacher education programs and institutional professional development programs in relation to their curricular component of pedagogical technology? The issue with material sustainability and effectiveness in a virtual language learning environment reoccurred in the data. The participants had solutions to the challenges with varied degrees of success that need to be investigated. Moreover, practitioner research is necessary to evaluate the discipline-specific demands on online learning materials and subsequently to assess their effects on both teaching and learning.

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