

MODELING THE DETERMINANTS OF FOREIGN LANGUAGE TEACHERS'
INTENTIONS TO USE TECHNOLOGY FOR STUDENT-CENTERED LEARNING: AN
EXTENSION OF THE THEORY OF PLANNED BEHAVIOR

By

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ABSTRACT

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Prior studies have highlighted the relative rarity of student-centered technology use among teachers, and concluded this was due – at least in part – to teachers' constructivist-oriented pedagogical beliefs (CPB) and their technological pedagogical content knowledge (TPACK). Nevertheless, few studies have included these concepts in models aimed at predicting teachers' intentions to use technology for student-centered learning; nor have many examinations of such teacher' intentions been conducted using the well-established theory of planned behavior (TPB). The present study helps fill this gap by testing how well the TPB predicts teachers' intentions to use technology for student-centered learning using 621 in-service college-level English as foreign Language (EFL) teachers, and also compares the original TPB's predictive validity, data fit, and variance explained against those of a modified TPB model that incorporates both CPB and TPACK. The participants, all of whom were from southern China, completed a survey that measured their attitudes towards student-centered technology use (ATTU), subjective norms about student-centered technology use (SN), and perceived behavioral control about student-centered technology use (PBC), along with their CPB, TPACK and intentions to use technology for student-centered learning. Structural equation modeling was employed to examine the validity of the TPB and the modified TPB, and the relationships among the factors in the models. The results indicate 1) that both models are effective at predicting Chinese EFL teachers' intentions to use technology for student-centered learning; 2) that two factors in the TPB (ATTU, PBC), together with TPACK, were significantly correlated with the participants'

intentions to use technology for student-centered learning, whereas SN and CPB had no such significant correlation with it; and 3) that the modified TPB model significantly outperformed the TPB model in terms of predictive validity, data fit, and variance explained. As well as contributing to our understanding of the TPB and teachers' intentions to use technology for student-centered learning, this study provides valuable guidance for policy-makers in the spheres of teacher education and technology use.

This dissertation is dedicated to my family
My beloved children, Yifei and Mila, for filling my life with happiness and joy
And my husband, Yong, for being supportive throughout this journey
Thank you!

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CHAPTER 1

INTRODUCTION

Statement of the Problem

Issues with student-centered technology use. Student-centered learning is “a philosophy of education that centers on the students as active participants in learning” (Nair, 2019, p.7). Such learning was found to be more effective than teacher-centered instruction in terms of enhanced learning and development (Weimer, 2013), promoting problem-solving and higher-level thinking skills (Doyle, 2012) and encouraging active and social learning (Cendana et al., 2019). Meanwhile, Information and communication technology (ICT) has been used in education for decades, but the question of how best to integrate ICT into classroom to facilitate student-centered learning remains a conundrum (Becker & Riel, 2000; Ertmer, 2012; Hall, 2010; Juniu, 2006; Tsai & Tsai, 2019; Voet & De Wever, 2017). As Kim et al. (2013) have pointed out, using technologies to merely present information has no “pedagogical advantage” (p. 76) over traditional classroom practices.

Technology should be used to support meaningful learning, which needs to be active, constructive, intentional, authentic and cooperative (Jonassen, Peck & Wilson, 1999) and to help build student-centered learning environment (Hannafin & Land, 1997; Moeller & Reitzes, 2011). Jonassen, Peck and Wilson (1999) further pointed out that when technology is used to facilitate student-centered learning, students are more likely to develop abilities and skills such as creative and critical thinking, problem solving, decision-making and self-regulation. Yet, teachers have often been found to use ICT only to transmit knowledge and facts, rather than to support student-centered teaching activities (European Commission, 2013; Voet & De Wever, 2017), and indeed tend to avoid using it during complex tasks of any kind (Fraillon et al., 2014).

To use technology in a student-centered way, teachers need to first have strong such intentions, as behavioral intentions are proposed to be a direct predictor of one's behavior (Fishbein & Ajzen, 1975; Ajzen, 2005). Intentions were consistently found to be a significant predictor of technology adoption by Jeyaraj, Rottman and Lacity (2006) when they review studies examining technology acceptance. Although a large body of literature has examined teachers' intentions to use technology in classroom (e.g., Teo et al., 2017; Mei et al., 2017; Liu et al., 2018), very few studies have zoomed in on teachers' intentions to use technology for student-centered learning. Teachers might have positive attitudes towards technology adoption and good intentions to use technology in instruction, yet they might not use technology in a student-centered way. It is therefore vitally important to understand what factors influence teachers' student-centered technology use, as well as how they influence it.

The theory of planned behavior and teachers' intentions to use technology for student-centered learning. Why is student-centered technology use by teachers so limited? Ertmer and her colleagues (2012) found that the key barriers to educators' meaningful technology integration are internal, given that external barriers such as lack of hardware, poor Internet access, inadequate training, and so forth was reported to have largely been overcome in recent years.

In the field of social psychology, the theory of planned behavior (TPB; Ajzen, 1985, 1991) is often used as a framework for explaining the mechanisms of human behavior that underlie an individual's decision-making process. In the three decades since Ajzen first proposed it, TPB has been the basis of a great deal of empirical research. It holds that human behavior can be predicted from a person's intentions, which in turn are determined by three key factors: *attitudes*, defined as an individual's positive or negative judgments toward a behavior, as derived

from both beliefs and experience; *subjective norms* (SN), i.e., the social influences over that behavior that he or she perceives; and *perceived behavioral control* (PBC), or his or her perception of how easy or difficult it is to perform or avoid performing the behavior (Ajzen, 2005).

Although various well-regarded models of technology acceptance exist, including the theory of reasoned action (TRA, Fishbein & Ajzen, 1975), the technology acceptance model (TAM, Davis, 1980), and the unified theory of acceptance and technology use (UTAUT, Venkatesh et al., 2003), TPB was chosen as the theoretical framework for this study for the following reasons. First, Ajzen (1991) proposed TPB as an improved form of TRA, with TPB having more predictive power than its predecessor due to the inclusion of a third factor. Second, the TAM model proposed by Davis focuses mainly on how *perceived ease of use* and *perceived usefulness* affect attitudes and intentions, at the expense of social influence; and a head-to-head comparison of TAM and TPB by Mathieson (1991) showed that TAM could not provide as much specific information to guide development as TPB did. It was subsequently recommended that TAM be amended to include human and social-change process variables (Legris et al., 2003). Finally, UTAUT does not include attitudes, despite this variable having been identified as vital to teachers' intentions to use technology (Liu et al., 2017; Teo et al., 2017).

A number of studies have confirmed that TPB is useful in predicting teachers' intentions to use technology (Cheng, 2018, Teo & Lee, 2010; Teo & Tan, 2012). However, it is not clear from the existing literature whether TPB's key factors extend to teachers' intentions to use technology for student-centered learning in particular. Further research is therefore needed to establish whether TPB can predict teachers' intentions to use technology in student-centered ways.

The need to extend the theory of planned behavior. TPB has been found to be a robust model across a wide range of social-scientific research topics (Ajzen, 2011), able to account for 41%-60% of the variance in intentions, and 28%-40% of the variance in behavior (Albarracin et al., 2001; Fishbein & Ajzen, 2010; Godin and Kok, 1996). Studies that applied TPB specifically to pre-service teachers' intentions to adopt technology found that 40%-50% of the variance in intentions was explained by TPB's three factors (Teo & Lee, 2010; Teo & Tan, 2012).

Although numerous studies have shown TPB to have high predictive power, a large proportion of variance in intentions and related behavior was not explained by it. Ajzen (1991) conceded that TPB is open to modification via altering its paths or adding variables so as to enable it to explain more of the variance in intentions and related behavior. Researchers have subsequently proposed that TPB be extended and developed via the addition of new variables such as perceived usefulness and perceived ease of use, or moderators such as age, gender, and educational attainment (e.g., Baker, Al-Gahtani & Hubona, 2007; Teo, 2011).

Moreover, researchers have consistently pointed out that internal factors including teachers' constructivist pedagogical beliefs (CPB; Ertmer, 2005, 2010) and teachers' technological pedagogical content knowledge (TPACK; Mishra & Koehler, 2006) have a deep impact on their meaningful technology use, yet few studies have included these factors in TPB. In response to this research gap, two teacher-level factors (i.e., CPB and TPACK) were added in TPB, to help elucidate the interactions among CPB, TPACK and TPB's existing constructs, and thus help to establish a hierarchy of importance for the antecedents of teachers' intentions to use technology for student-centered learning.

Purpose of the Study

Previous literature has pointed out the importance of examining differentiated technology use (i.e., traditional vs. student-centered) by taking a domain-specific perspective, as subject matter plays a key role on how technology is used (Haydn & Barton, 2007; Voet & De Wever, 2017). English as Foreign Language (EFL) teaching and learning is a domain chosen for this study as it would be a fertile context for studying student-centered technology use. On the one hand, research studies shown that technology has the potential to assist student-centered learning and to benefit EFL learners by improving learning outcomes (Arslan & Sahin-Kizil, 2010; Zou, 2013); helping them become autonomous learners (Wang & Coleman, 2009) and becoming more engaged in higher-order thinking and problem solving (Tsai, 2013). On the other hand, language teachers were reported to be reluctant or refuse to use technology in some studies (Toffoli & Sockett, 2015; He, Puakpong & Lian, 2015), or have difficulty to appropriately integrate technology into language learning (Gao, 2012; Levy & Caws, 2016). Moreover, despite their positive attitudes towards technology use, language teachers were found to lack technical support (Hu & McGrath, 2011) or need pedagogical and technological training for technology use (Yan, Xiao & Wang, 2012; Zhou, Zhang & Li, 2011).

This study has two purposes. First, TPB was applied to examine EFL teachers' intentions to use technology for student-centered learning in order to verify if TPB would be a valid model and whether the three factors in TPB significantly predict teachers' intentions to use technology for student-centered learning. Second, TPB was modified by adding the participants' CPB and TPACK to the model, for the purpose of examining if the modified model would significantly outperform the TPB model in explaining teachers' intentions to use technology for student-centered learning, and if the two added factors are significant predictors of teachers' intentions to

use technology for student-centered learning. More specifically, this study was designed to answer the following research questions:

1. Are the three factors in TPB and two additional teacher-level factors (CPB and TPACK) significant predictors of EFL teachers' intentions to use technology for student-centered learning?
2. Does the modified TPB model explain EFL teachers' intentions to use technology for student-centered learning better than the TPB model does?

Delimitations

Various factors in models such as TPB have been confirmed to be important predictors of teachers' acceptance of technology (e.g., Teo & Lee, 2010). However, these findings do not explain why teachers use technology in different ways, and few researchers have applied TPB to examinations of teachers' student-centered technology use. In part, this study is designed to fill that gap. Teachers' CPB and TPACK have also been claimed to be important determinants of their effective technology use (Ertmer et al., 2013; Koehler et al., 2007), but again, these factors have not been taken into consideration in models designed to explain individual differences in teachers' intentions to use technology. It is unclear how important these two factors are in determining teachers' intentions to use technology at different levels, especially as compared with attitudes and social influence.

One consequence of the limited research on using TPB to predict teachers' intentions to use technology for student-centered learning is that the guidance available to teacher educators on how to design courses or professional trainings that can enhance the integration of technology in classrooms. In order to address this problem, the impact of teachers' beliefs, knowledge, and

attitudes on their intentions to use technology for student-centered learning were examined in this study.

This study also has implications for theory development: contributing to the existing literature by combining teacher-level factors with TPB to predict teachers' intentions to use technology for student-centered learning. By using the verified modified TPB model, researchers and practitioners could garner important information about which factors are most likely to cause changes in teachers' student-centered technology use.

CHAPTER 2

LITERATURE REVIEW

Because the purpose of this study is to understand the factors behind teachers' intentions to use technology for student-centered learning, this literature review begins with an examination of the definition and measurement of student-centered technology use. It then reviews the literature on student-centered technology use in a specific context, i.e., EFL teaching in Chinese cultures. Next, it reviews literature on the theoretical framework of this study, TPB, followed by the prior research on teachers' CPB and TPACK. Finally, the research gap in prior work on teachers' student-centered technology use is identified.

Student-centered Technology Use

Researchers have proposed various classifications of technology use, ranging from low levels such as “nonuse” or “awareness” to high levels called “expansion” or “refinement” (Moersch, 1998, p. 42; see also Hall et al., 1975). At the lower levels, technologies play a supplementary role vis-à-vis existing curricula, whereas at the higher levels, technologies can be used as tools for identifying authentic problems, expanding student experience, acquiring information, solving problems and developing products. Furthermore, when teachers use technology at higher levels to facilitate teaching, students become more active participants of using technology and take more initiative in the learning process, which helps to realize student-centered learning. Many follow-up studies have also argued for technology use at higher levels to better facilitate teaching (e.g., Chen, 2010; Drent & Meelissen, 2008; Ertmer, 2012; Liu et al., 2019). Although different terms were used in these studies, such as “student-centered” (Chen, 2010; Liu et al., 2019), “exemplary” (Ertmer, 2012), or “innovative” (Drent & Meelissen, 2008)

technology use, these studies share the same view that technology needs to be used to support student-centered learning.

The definitions of student-centered technology use are similar across different studies. For example, Becker and Riel's (2000) classified technology use in educational contexts into different levels. According to them, *student-centered instructional use* was defined in terms of how frequently teachers allowed students to use technology to communicate, search for information, and complete and present complex projects. *Frequent simple use*, in contrast, referred to teachers' use of technology for skill-reinforcement, e.g., through word processing or word games. Likewise, Ertmer and her colleagues (2012) summarized student-centered technology use as teachers encouraging and enabling students to employ technology "to communicate, collaborate and solve problems" (p. 424). Following these definitions, student-centered technology use in this study was defined as teacher-directed student use of technology to assist learner-centered activities (e.g., communication, data analysis, collaborative work and finding solutions to authentic problems) for the purpose of develop students higher-order thinking skill, as opposed to the traditional use of technology to reinforce or remediate students' skills and knowledge via independent or individual work.

Researchers have used different approaches to measure student-centered technology use. For example, Becker (2000) proposed and ranked ten primary types of teachers' computer use, ranging from transmission oriented (e.g., skills reinforcement) to student-centered (e.g., facilitating student-student collaboration), and this schema was subsequently adopted by Teo (2008) and Deng et al. (2014). Another method, proposed by Ertmer and her colleagues (2012), is to rate teachers' technology-related practices on a scale from one to five; if a teacher uses technology for "exploration and knowledge construction" or "communication", or as a "tool for

writing, data analysis, [and] problem-solving” (p.427), then his or her practice should be considered exemplary, innovative and student-centered. Similarly, Drent and Meelissen (2008) rated teachers’ “innovative use of ICT” on a five-point scale measuring the extent to which they allowed students to use computers to orient themselves to new subjects, gather information, make presentations, process data, or solve problems. In light of the approaches on the measurement of student-centered technology use in prior literature, in this study, EFL teachers’ intentions to use technology for student-centered learning was measured on a five-point scale to investigate the extent to which EFL teachers’ intentions to use technology to support various learner-centered activities.

Context and Student-centered Technology Use

Clark and Peterson (1984) posited that teachers’ actions “are often constrained by the physical setting or by external influences such as the school, the principal, the community, or the curriculum” (p. 13). As such, any detailed examination of teachers’ student-centered technology use must take these contextual factors into consideration.

Student-centered technology use in foreign-language classrooms. Teachers’ technology-related teaching practices vary strongly with the academic subjects they teach, due to the “general set of institutionalized practices and expectations” that grow up around each subject (Goodson & Mangan, 1995, p. 615). Traditional foreign-language teaching methodology often includes direct instruction of teaching content such as pronunciation, vocabulary and grammar, rendering it inconsistent with the learner-centered approaches for more than two decades (Burston, 2014). Yet recent studies have been exploring various ways of achieving communicative, student-centered foreign-language teaching via technology adoption, such as to use social media tools for genuine communication, digital games and/or virtual worlds for

authentic learning environments and tasks, corpus analysis for cognitive skills development, online group editing (e.g. wiki, blog) for collaboration and writing skills enhancement etc.

Empirical studies of student-centered technology integration in foreign language classroom have yielded positive findings. For example, Zheng and her colleague (2018) pointed out that social media has the potential to benefit foreign language learners as it can provide them authentic communicative opportunities, increase their “motivation and engagement in writing” and “strengthen their awareness of audience and authorship” (p. 3). In another study (Warschauer, Zheng & Park, 2013), language learners who participated in live blogging were found to have significant improvement in their writing achievement. In addition, they were found to have more interactions during class, rely less on teachers for directions and “demonstrated broader use of advanced cognitive skills” (p. 827) than those who did not practice live blogging.

Digital games and virtual worlds as language learning platforms brought multiple affordances to language learners including “positive effects on motivation and opportunities for authentic learner interaction” (p. 225, Swier & Peterson, 2018). A review of 50 digital game-based language learning studies indicated an overall positive influence on both students’ affective or psychological states and their language acquisition (Hung, Yang, Hwang, Chu & Wang, 2018). Likewise, Sadler (2017) and Melchor-couto (2019) identified a number of affordances brought by virtual worlds when used as language learning tools in language classrooms, such as allowing for remote real-time authentic interaction, providing low-anxiety environments for language learning, enhancing motivation levels and collaboration among learners and so forth.

Data-driven learning such as corpus use is another example of student-centered technology use in language classroom and was reported to yield positive findings as well

(Chapelle et al., 2017; Kessler, 2017). For example, Garner's study (2013) examined students' use of linking adverbials and found that students who participated in two data-driven learning activities (indirect corpus use and direct corpus consultation) used more academic linking adverbials with a higher accuracy than students who were taught in a traditional manner. Corpus not only can benefit students' lexical learning, but also can serve as a reference to foreign language learners by providing access to examples of authentic language use in collections of electronic texts in their writing (Flowerdew, 2009) and by letting students engage in hands-on exploration of texts to facilitate teaching language for specific purposes (Cotos, 2017).

As summarized by Kessler (2018), current technology have the potential to "enable language educators to strive for a more robust and individualized learner centeredness" (p. 209) due to the affordances such as individualized experience, social communication, data access, tele-collaboration and so forth. Kessler further pointed out that language teachers needed to understand previous studies that aimed to make learning more student-centered and to know how this body of research can inform their teaching practice.

Although technology has considerable potential for promoting student-centered language teaching and learning, such potential has not always been reflected in foreign language teachers' attitudes towards technology use or their technology use behavior. Instead, they have been reported as less inclined to use technology in the classroom and less student-centered than teachers of other academic subjects (Ravitz et al., 2000); as more inclined to use technology for merely transmissive purposes (Li, 2014; Li, Jee & Sun, 2018; Li, Sun & Jee, 2019); and even as incapable of using technology in an effective or productive way (Yang & Huang, 2008; Gao, 2012; Levy & Caws, 2016). It should be noted, however, that the participants in the aforementioned studies were mainly elementary or middle school teachers, whose students were

unlikely to have been advanced foreign-language learners. Given that teachers' perception of students' achievement levels can influence their Internet use (Becker, 1999), it is possible that different results would have been obtained from different samples of learners. Indeed, one study did find that high-school foreign-language teachers were more student-centered than their middle-school counterparts (Ravitz et al., 2000). However, studies that have examined factors influencing college-level EFL teachers' intentions to use technology are few (Teo et al., 2018; Liu et al., 2017), even less if any studies have examined factors influencing college-level foreign-language teachers' intentions to use technology for student-centered learning.

Student-centered technology use in Chinese culture. Socio-cultural contexts can also exert profound influences on teachers' technology use. Cuban (1994) attributed low technology integration in schools to "certain cultural beliefs about what teaching is, how learning occurs, [and] what knowledge is proper in schools" (p. 50). Chinese culture has traditionally viewed teachers as authoritative (Hu, 2005), and Chinese-language teachers' classrooms are often "teacher-centered, textbook-directed and exam-oriented" (Li, 2014, p. 107). A more recent study (Liu et al., 2019) found that Chinese EFL teachers were reluctant to use technology for student-centered activities as they felt both "assessment pressure" (p. 12) from the society and pressure from students and administrators who might accuse them of "failing to fulfill their teaching responsibilities" (p.12). On the other hand, the Chinese government has in recent years been trying to improve technology application at all educational levels (Chinese Ministry of Education, 2013), and urging language teachers to develop students' communicative and intercultural capability through more student-centered, communication-oriented teaching methods (Hu, 2002; Chinese Ministry of Education, 2007, 2017). However, relatively fewer studies on EFL teachers' technology use have been conducted in Chinese socio-cultural contexts.

The Theory of Planned Behavior

TPB posits that an individual's actual behavior can be predicted by a combination of his/her intentions (a concept closely related to motivation) and perceived behavioral control (which is similar to self-efficacy) (Ajzen, 1991). Intentions, in turn, are partly determined by behavioral attitudes and subjective norms (see Figure 1).

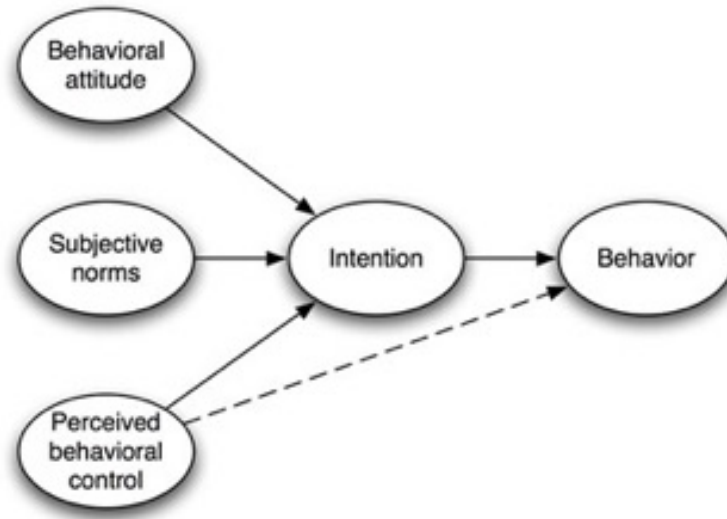


Figure 1. Theory of Planned Behavior

Note: Adapted from “The theory of planned behavior”, by Ajzen, 1991, *Organizational Behavior and Human Decision Processes*, 50, P.182.

Since its introduction, TPB has been “one of the most frequently cited and influential models” of human behavior in various fields (Ajzen, 2011, p. 1113). It has frequently been employed as a framework for predicting and explaining teachers’ classroom behavior (e.g., Salleh, 2016; Teo, 2012) and therefore was chosen as the theoretical framework for this study. As the behavior of interest in this study was Chinese EFL teachers’ student-centered technology use, the variables within TPB were all defined in relation to student-centered technology use (as shown in the following paragraph).

First, behavioral attitudes (ATTU) in this study were operationally defined as “Chinese EFL teachers’ positive/negative feelings about, or favorable/unfavorable appraisal of student-centered technology use”. Second, subjective norms (SN) were originally defined as an individual’s perception that “most people who are important to him or her” think the behavior of interest should (or should not) be performed (Fishbein & Ajzen, 1975, p. 302). In their updated TPB (Fishbein & Ajzen, 2010), however, this monolithic view of SN was revised to include both what others consider to be correct behavior, and what others are actually doing. In this study, SN was operationally delineated to mean, “Chinese EFL teachers’ perceptions of what others (e.g., people important to them or close to them) consider student-centered technology use or what others are doing in terms of student-centered technology use”. The third determinant of intentions, perceived behavioral control (PBC), began as a component of TPB, by way of acknowledging that individuals do not always have complete control over their behavior, and that in these cases, intentions alone are not sufficient to predict behavior. Ajzen (1991, p. 183) defined PBC as “people’s perception of the ease or difficulty of performing the behavior of interest” and is “most compatible” with “perceived self-efficacy”. He subsequently suggested that this construct was also underpinned by individual beliefs in the existence or non-existence of factors that may “facilitate or impede performance of the behavior” (Ajzen, 2005, p. 125). Therefore, PBC in this study was operationalized to mean “Chinese EFL teachers’ perceptions about their ability, existing resources and opportunities available to them in order to use technology for student-centered learning”. Lastly, behavioral intentions (BI) – an individual’s willingness or reluctance to perform the behavior in question – is an immediate antecedent of actual behavior (Ajzen, 1985, 2005) and its most influential predictor (Armitage & Conner,

2001). In this study, it is operationalized as “Chinese EFL teachers’ willingness or reluctance to use technology for student-centered learning”.

Outcome variable in TPB. In TPB, the dependent variable is *behavior*, yet it is important to point out that *behavioral intentions* and *actual behavior* have both been used as outcome variables in previous literature when studying technology adoption (see a review in Jeyaraj et al’s, 2006; Wu & Du, 2012; Scherer et al., 2018). Moreover, two meta-analyses (Lee et al., 2003; Wu & Lederer, 2009) showed that most of the studies on technology use behavior focused on behavioral intentions rather than usage. Only 15 out of 99 studies in Lee’s et al’s (2003) review and 21 out of 71 studies in Wu and Lederer’s (2009) review have actually scrutinize usage. According to Wu and Du (2012), the phenomenon of focusing on intentions rather than actual usage might be attributed to the dearth of research in providing a theoretical basis for the usage construct and the lack of reliable method to measure this construct. Given this reason, the researcher of this study only partially replicated TPB by employing behavior intentions as the outcome variable, which is also conducive to comparing the results of this study with previous findings.

Demographic factor in TPB. Ajzen (2005:134) pointed out that a multitude of background variables may be related to people’s underlying beliefs and behavior, including age, gender, ethnicity, socio-economic status, education, nationality and so forth.

Three factors have been examined in relation to teachers’ technology use in prior literature. The first factor is gender. Male teacher were found to have higher computer self-efficacy (Adodo, 2012) and more positive attitudes towards using ICT in teaching (Sipila, 2010). The second factor is age as teachers of different age might have different attitudes towards and confidence levels of technology use (Venkatesh, Morris, Davis, & Davis, 2003), yet the results

are not consistent. In a study conducted by Ahmad et al (2013), age was not significant related with teachers' attitudes; however, in other studies (Gopala Krishnan Sekharan et al., 2012; Kale & Goh, 2014), teachers who were older were less likely to find Internet integration in classroom appealing. The last factor is teaching experience, teachers who have less years of teaching experience are found to be more confident in ICT use and more positive toward ICT tools (Ahmad et al., 2013; Maden, 2012). However, results of Sipila's (2010) study showed that although less experienced teachers (<10 years) were more positive, the differences were not statistically significant.

Few studies have examined the influence of these factors on teachers' student-centered technology use. Yet it is likely that these factors would become potential confounding variables, therefore in this study, these three factors might need to be hold constant to prevent confounding with the variables in the models to be examined.

The Theory of Planned Behavior and Teachers' Intentions to Use Technology

Many studies (e.g., Salleh, 2016; Teo, 2016) aimed at explaining intentions to adopt technology in educational settings have employed TPB, whose three factors have been repeatedly confirmed as key predictors of technology use. Previous studies have consistently reported that teachers' attitudes towards technology use are significant predictors of their intentions to use technology (e.g., Lee et al., 2010; Sadaf et al., 2012; Salleh, 2016; Teo et al., 2016). Lee et al (2010) found that the influence of attitudes was two to three times larger than the other two factors; and similarly, Teo et al. (2016) reported it to have the largest positive influence on intentions to use technology.

Research findings regarding SN have been mixed and inconclusive, with some studies reporting considerable positive impacts on intentions to use technology (Hopp, 2013; Liu et al.,

2017; Teo & Lee, 2010), and others, a weak effect (Salleh, 2016) or even a negative effect (Teo et al., 2016). Armitage and Conner's (2001) meta-analysis of TPB-based studies concluded that SN was a weak predictor of BI, possibly due to single-item measurement.

The third factor, PBC, has been conceptualized differently by various prior researchers, as reflecting perceptions of internal and/or external constraints on behavior (Taylor & Todd, 1995). Salleh (2016) took both internal and external constraints into consideration, and measured PBC in terms of capability and external resources, finding that it was able to predict teachers' intentions to use and actual use of technology. For Teo (2012), on the other hand, PBC was represented by facilitating (i.e., external) conditions only, and did not significantly predict teachers' intentions to use technology. This inconsistency in prior findings is in part due to lack of consensus on how to measure this construct (Pavlou & Fygenson, 2006).

Previous findings regarding TPB and teachers' intentions to use technology are also limited insofar as the effectiveness of teachers' intentions to integrate technology is unlikely to be a perfect reflection of their actual technology-use behavior. Furthermore, the relationships between TPB's three factors and teachers' student-centered technology use have seldom been the focus of research.

The Modified Theory of Planned Behavior

TPB can be modified by altering its paths and/or adding additional, important, context-specific constructs. As the focus of this study is teachers' intentions to use technology for student-centered learning, adding teacher-specific factors to TPB might enhance its predictive validity for this research purpose. It is also expected that the extended model can enrich our understanding of TPB's mechanisms and thus contribute to its further development (Ajzen, 1991; Perugini & Bagozzi, 2001).

Constructivist pedagogical beliefs. Pedagogical beliefs are teachers' beliefs about the nature of teaching and learning. The prior literature has often defined pedagogical beliefs dichotomously (i.e., as transmissive-oriented vs. constructivist-oriented) and has tended to portray them as closely bound up with specific teaching practices. For instance, Becker (2000) stated that teachers with traditional transmissive beliefs emphasize “skill and knowledge transmission from teacher to students” (p. 10), whereas constructivist-oriented teachers focus on “attending to the ‘meaningfulness’ of instructional content” and “developing students’ capacities to understand a subject” (p. 10). In practice, teachers with transmissive beliefs tend “to communicate knowledge in clear and structured ways, to explain correct solutions, to give students clear and resolvable problems, and to ensure calm and concentration in classrooms” (p. 92), and teachers with constructivist-oriented view “prefer to give students the chance to develop solutions to problems on their own, and allow them to play an active role in instructional activities” (OECD, 2009, p. 92).

A considerable body of empirical evidence (e.g., Kim et al., 2013; Liu, 2011; Mueller et al., 2008) indicates a significant positive relationship between CPB and technology integration. Moreover, teachers’ CPB have been found to have a variety of positive influences on their technology use, such as higher frequency of computer use (Chen, 2010; Petko, 2012; Tondeur, Hermans, Van Braak & Valcke, 2008), more varied professional computer use, and greater technical expertise (Ravitz, Becker & Wong, 2000). As studies aforementioned have shown a close alignment between teachers’ CPB and their technology practices, the first factor to add to the TPB model is teachers’ CPB.

TPACK. Discussion over what teachers must know if they are to meaningfully integrate technology into their teaching have been heated and long-running (Ertmer & Ottenbreit, 2010;

Koehler et al., 2013; Mishra & Koehler, 2006). Certainly, teachers need multiple kinds of knowledge to achieve this, covering computers and software, the academic subjects they are teaching, and teaching methods. Yet, for “good teaching with technology” (Koehler et al., 2007, p. 741), teachers need knowledge that goes beyond the three kinds mentioned above, by including an understanding of the connections and interactions among them (Mishra & Koehler, 2006). This led Mishra and Koehler (2006) to identify seven kinds of knowledge relevant to this topic: pedagogy, content, technology, pedagogical content, technological content, technological pedagogy, and technological pedagogical content (i.e., TPACK); and of these, TPACK in particular is “central to teachers’ work with technology” (p. 1029) by providing a foundation for teachers’ meaningful technology integration and helping them use technology in teaching in a student-centered way. Chinese EFL teachers, in particular, have been found to lack technological knowledge, technological content knowledge and TPACK to engage in student-centered technology use, with the last kind of knowledge being the greatest challenge for them (Liu et al., 2019).

TPACK has been integrated into models predicting teachers’ technology acceptance in recent studies, which is a progress as previous models often fall short of specifying the kind of professional knowledge teachers need for meaningful technology integration (Scherer, Siddiq & Tondeur, 2018). For example, researchers (Mei et al., 2017; Teo et al., 2018) integrated TPACK into the TAM found that TPACK had statistically significant direct effects on pre-service teachers’ intentions to use Web 2.0 technology and was a significant determinant of pre-service math teachers’ intentions to use computers in a student-centered way (Teo et al., 2017). Meanwhile Scherer et al. (2018) found that Flemish pre-service teachers’ attitudes towards technology were positively correlated with their TPACK self-beliefs.

TPACK has also been examined in studies in the field of foreign-language learning and teaching (Baser et al., 2016; Bostancioglu & Handley, 2018; Chai et al., 2013). The instrument measuring TPACK in Chai and his colleagues' study (2013) mainly focused on teachers' knowledge of using technology to support collaborative and self-directed learning, whereas the one designed by Baser et al. (2016) emphasize more on teachers' knowledge of using technology for communicative competence. The instrument used in Bostancioglu and Handley's (2018) study, on the other hand, examined teachers' general knowledge of how to use technology effectively for language learning and teaching.

Summary

Three important research gaps in the literature can be identified from the above review. First, TPB has rarely been used to predict teachers' intentions to use technology for student-centered learning. Teo (2008, 2010) did use both the original TPB and an extended form of it to predict teachers' intentions to use technology, but did not differentiate between teachers' different kinds of intentions to use technology. To bridge the research gap, the researcher of this study focused specifically on teachers' intentions to use technology for student-centered learning, i.e., as a mind-tool rather than as a mere conduit for knowledge searching or transmission.

Second, previous studies have pointed out the importance of teachers' TPACK and pedagogical beliefs to their student-centered technology use. However, few if any have included these two factors in models such as TPB, and therefore the question of how well extended versions of these models (e.g., TPB) can predict teachers' intentions to use technology for student-centered learning remains unanswered. For this reason, the TPB model was expanded to predict teachers' intentions to use technology for student-centered learning in this study. The

modification of TPB model can help deepen and develop TPB, by reinterpreting the roles of existing predictors and the mechanisms of all the modified model's factors.

Third, the college-level EFL teachers' intentions to use technology for student-centered learning is a new departure from the extant findings. For one thing, Chinese EFL teachers' technology use was reported as low-level (Gao, 2013), transmissive (Li, 2014) and teacher-centered (Li, Sun & Jee, 2019) despite their positive attitudes towards technology use, yet studies for explaining this phenomena are still insufficient, which may cause difficulty in answering the call for meaningful technology use. For another, previous studies have mainly focused on examining intentions to use technology among pre-service teachers (e.g., Teo, 2017, 2018) or K-12 teachers (e.g., Becker, 2000; Li, 2014), yet this study shed light on a sample of college-level in-service foreign-language teachers in China, which can enrich our understanding of the key factors influencing foreign language teachers' intentions to use technology for student-centered learning in this specific context.

Research Questions

As explained above, the purposes of this study are twofold: 1) to examine the extent to which the TPB model is applicable to the study of teachers' intentions to use student-centered technology; and 2) to create a modified TPB model that incorporates CPB and TPACK, and to compare the TPB and the modified TPB' predictive validity, data fit, and variance explained. This study was guided by the following research questions:

Research Question 1: To what extent is the TPB a valid model for explaining EFL teachers' intentions to use technology for student-centered learning? (See Figure 2).

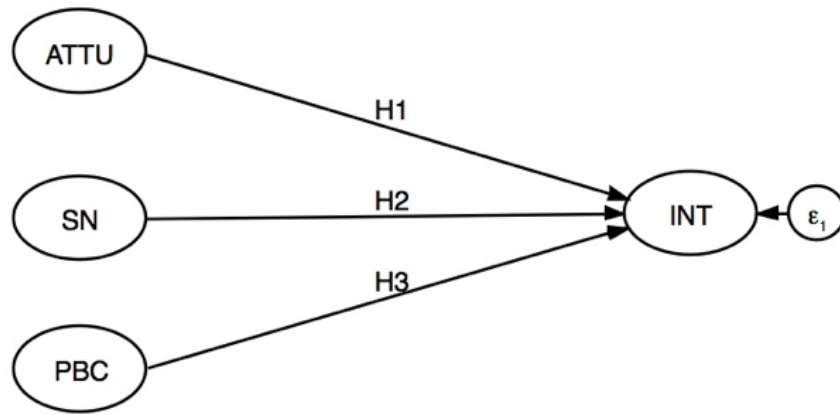


Figure 2. Applying TPB to Student-centered Technology Use

Note: ATTU = attitudes towards student-centered technology use; SN = subjective norms about student-centered technology use; PBC = perceived behavior control about student-centered technology use; INT = intentions to use technology for student-centered learning.

Three hypotheses in this model were examined:

H1: Chinese EFL teachers' attitudes towards student-centered technology use significantly and positively predict their intentions to use technology for student-centered learning.

H2: Chinese EFL teachers' subjective norms about student-centered technology use significantly and positively predict their intentions to use technology for student-centered learning.

H3: Chinese EFL teachers' perceived behavior control about student-centered technology use significantly and positively predicts their intentions to use technology for student-centered learning.

Research Question 2: Will the TPB predict EFL teachers' intentions to use technology for student-centered learning more accurately if CPB and TPACK are added to it? (See Figure 3).

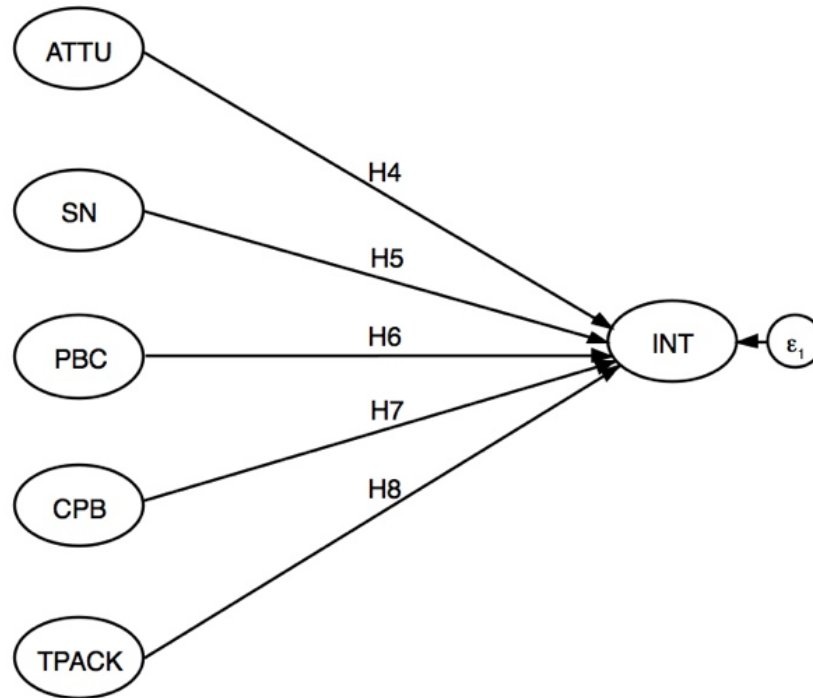


Figure 3. Applying a Modified TPB Model to Student-centered Technology Use

Note: ATTU = attitudes towards student-centered technology use; SN = subjective norms about student-centered technology use; PBC = perceived behavior control about student-centered technology use; INT = intentions to use technology for student-centered learning; CPB is constructivist pedagogical beliefs; TPACK is technological pedagogical content knowledge.

Five hypotheses in this model were examined:

H4: Chinese EFL teachers' attitudes towards student-centered technology use significantly and positively predict their intentions to use technology for student-centered learning.

H5: Chinese EFL teachers' subjective norms about student-centered technology use significantly and positively predict their intentions to use technology for student-centered learning.

H6: Chinese EFL teachers' perceived behavior control about student-centered technology use significantly and positively predicts their intentions to use technology for student-centered learning.

H7: Chinese EFL teachers' CPB significantly and positively predict their student-centered technology use their intentions to use technology for student-centered learning.

H8: Chinese EFL teachers' TPACK significantly and positively predicts their student-centered technology use their intentions to use technology for student-centered learning.

CHAPTER 3

METHODS

A quantitative approach was employed in this study and data were collected data using a web-based survey tool called Qualtrics, which is an easy tool to create and spread surveys and to export data directly for statistical analysis.

Context

This study was conducted in the spring of 2019 in Guangdong Province, a developed area on the coast of the South China Sea, and among EFL teachers who were recruited from 18 higher-education institutions (see Appendix A). These institutions provide easy access to computers, the Internet, multimedia projectors, computer labs to EFL teachers. Of the eighteen selected sites, three were national key universities; ten, provincial key universities; and five, three-year colleges. Participants were selected from three respective tiers of China's higher-education ranking system, as they are different in terms of resource allocation, teaching staff, and student quality (Wu, 2017).

All the participants chosen for this study were instructors for the course *College English* in their respective institutions. *College English* is a course offered in most colleges in China as a required course for first and second year college students, who are expected to pass College English Test (Band 4) to get their Bachelor's degree diploma. College English classes have three different sessions: Listening, Speaking, Reading & writing. Chinese EFL teachers often are assigned to teach two sessions (Reading & writing, Listening) whereas Speaking is generally taught by native speakers of English. In this study, data were collected from Chinese EFL teachers only. They teach Reading & writing face-to-face, yet Listening class may be conducted in an online or a hybrid form (i.e., online with face-to-face) because teachers are accompanying

students for online practices and teachers can switch between online or face-to-face teaching when needed.

Participants

Survey link (or QR code for the survey) were sent to 982 teachers and a total of 709 individuals participated in this study. Of which 621 participants completed the questionnaires. Eighty-eight responses were excluded from the analysis due to missing data.

Most the participants were female ($N = 510$, 82%) and only 18% of the participants were male ($N = 111$). The participants' age range was 20~30 years (11%, $N=70$), 31-40 years (54%, $N=338$); 41-50 years (26%, $N=160$), over 51(8%, $N=53$). As for teaching experience, most of them have 11~20 years teaching experience (44%, $N = 278$) or over 20 years of teaching experience (21%, $N = 132$). Relatively fewer of them have 5~10 years of teaching experience (19%, $N=117$), followed by teachers with less than five years of teaching experience (15%, $N = 94$).

Procedure

Participants were recruited in two ways. First, an invitation poster was emailed to the local education authorities (deans and/or renowned professors) in the foreign language departments of the targeted colleges. The local authorities helped in sending the invitation posters to their colleagues' email addresses or their social chat groups (Wechat platform). The poster (see Appendix B) briefly stated the length of and the reward for the survey, followed with a description of the target teachers needed. Both the survey link and a QR code for the survey were provided so that potential participants could easily participate using mobile devices. Second, email invitations (see Appendix C) were sent to EFL teachers in Guangdong universities whom the researcher of this study contacted to ask for help in spreading the invitation email to

their colleagues. The email briefly explained the purpose of this study, followed with a description of the target teachers needed. To accelerate the data collection process and to help ensure a high response rate, the researcher provided red packets worth 10 RMB each to award teachers who completed the survey.

The survey had 29 questions in total and typically took around 10~15 minutes for the participants to finish. Before answering any questions, all the participants needed to confirm that they had the experience of teaching *College English* for at least a year and had access to technology devices (such as computers and internet) in their teaching environment. Then they read a consent form (see Appendix D) explaining the nature of the study and were informed that their participation was completely voluntary and they had rights to withdraw data from the research at any point. In addition to that, they were informed that their responses were anonymous and would be kept confidential to avoid any negative effect on them. Following the consent form, they also read a page explaining the key terms (e.g., learner-centered language teaching, technology, Wiki etc.) mentioned in the questionnaire and then started the survey.

Measures

Because this study examined teachers' attitudes, intentions and beliefs, a survey was chosen as a suitable means to measure their opinions, attitudes or characteristics (Creswell, 2005). A survey-based approach is also ideal for this study given the number of participants involved and the statistical analysis conducted. During the SEM analysis, the measured constructs were treated as latent variables (Raykov & Marcoulides, 2012), which means the values for latent variables were calculated through an analysis of the variance and covariance of its indicators (i.e., items in instrument).

The survey had seven parts, which collected participants' demographic information and their responses to the items for the six constructs in the extended model (See Appendix E for the complete instrument). Except for the demographic information part, all other parts were presented in statements, which were measured using a five-point Likert scale with one being *strongly disagree* and five being *strongly agree*.

Demographic information. There were four demographic survey questions: age, gender, level of education and years of teaching experience. Multiple choices were given and the participants chose the one that matches with their situation.

Attitudes towards technology use. This part was modified from the TAMPST scale developed by Teo (2010). There were three items in this construct, and a sample item for this construct was: *I like using technology (e.g., computers, internet, software, mobile devices) for student-centered language teaching*. Internal consistency as measured by Cronbach's alpha was 0.78, which was above 0.70 and considered acceptable according to George & Mallery (2003).

Subjective norms. This construct was derived from four survey items, and was adapted from Teo's study in 2011. A sample item was: *People who influence my behavior think that I should use technology for student-centered language teaching*. Internal consistency as measured by Cronbach's alpha was 0.84, which was above 0.80 and considered good (George & Mallery, 2003).

Perceived behavioral control. This construct was derived from three survey items, and was adapted from Taylor & Todd's (1995) study. A sample item for this construct was: *I have the resources, knowledge and skills to use technology effectively for student-centered language teaching*. Internal consistency as measured by Cronbach's alpha was 0.79 and was considered acceptable (George & Mallery, 2003).

Constructivist pedagogical beliefs. This construct was derived from five survey items, and was adapted from Chan and Elliot (2004). A sample item for this construct was: *It is important that a teacher understands the feelings of the students*. Internal consistency as measured by Cronbach's alpha was 0.83 and was considered good (George & Mallery, 2003).

TPACK. This construct was derived from five survey items, and was adapted from the study by Bostancioglu and Handley (2018). Although the scale in their study had seven dimensions, only items for the dimension called TPACK were selected for this study. A sample item for this construct was: *I can teach lessons that appropriately combine English linguistic concepts, technologies, and teaching approaches*. Internal consistency as measured by Cronbach's alpha was 0.85, and was considered good (George & Mallery, 2003).

Behavioral Intentions. This construct had five survey items, and was adapted from two studies: the section on the constructivist computer use from Becker's (2000) study and the innovative technology use items in Drent and Meelissen's (2008) study. Internal consistency as measured by Cronbach's alpha was 0.81, and was considered good (George & Mallery, 2003). A sample item for this construct was: *I plan to let students use technology (e.g., search engine) to orientate themselves to a new theme/topic in language learning in the future*.

Survey items adapted from prior literature were written in English in their original studies. Chinese versions of these survey items were difficult to find in extant literature. Accordingly, a method called "back translation" (Brislin, 1970) was used for a Chinese version of the survey with reliable translation. To be more specific, these English survey items were first translated in Chinese, and then two associate professors in the field of English Language and Literature in China were invited to translate the Chinese survey items back into English. Then the original Chinese survey items with the back-translated Chinese survey items were compared

to identify the difference. Then changes were made to the translated survey items until there was agreement on the revised Chinese translation of all the survey items.

Data Analysis

Studies examining teachers' intentions to use technology often use SEM as their main data analysis technique as well (e.g., Deng et al., 2014; Mei et al., 2017; Teo & Lee, 2010). SEM was also chosen as the statistical technique to test and estimate the proposed models in this study for the following reasons. First, SEM is a multivariate technique that has the ability to construct latent variables that are not measured directly, and can examine complex relationships among multiple variables in a hypothesized model (Raykov & Marcoulides, 2012). Second, researchers using SEM can take all the variables into consideration and make decisions (i.e., acceptance, rejection or modification) on the hypothesized model (Kline, 2016). Finally, SEM explicitly takes measurement error into consideration and hence is used pervasively in many disciplines (Raykov & Marcoulides, 2012). Major steps of data analysis were listed below, and were conducted using STATA 14.0. For SEM, the maximum likelihood estimation (MLE) procedure was used, which is a robust procedure for use in SEM (Schumacker & Lomax, 2010).

Descriptive statistics. Before SEM analysis, data was first checked for missing data or outliers. Cases with missing data were deleted. Then univariate normality for each variable was checked by examining the skewness and kurtosis values of each variable. Descriptive data was then reported in Table 1.

Controlling demographic variables. Because previous studies have found that age, gender and length of teaching had influence on teachers' self-efficacy in and attitudes towards technology use, these three demographic variables (age, gender and length of teaching) were considered as covariates in this study. *Gender* was coded as a 0/1 dummy variable (0 = female;

1= male). *Age* and *length of teaching* were operationalized via dummy variables that took ordinal values of 0, 1, 2 or 3. The increasing ordinal values indicate the increasing age or increasing levels of teaching experience. It is consistent with prior research to recode these three categorical variables as dummy variable (e.g., Venkatesh et al., 2003). Then the correlations between the demographic factors and the constructs in the proposed model were examined. When significant correlation existed, these three covariates were treated as exogenous variable to influence the dependent variable (i.e., intentions) and to be set as have no observation error.

SEM. SEM was conducted on the condition that the constructs in the proposed model were proved to have acceptable reliability and validity. Generally a two-step approach is recommended to conduct a SEM analysis (Anderson & Gerbing, 1999). The first step is an analysis of the measurement model, in which the relationships between observed variables (i.e., survey items) and latent variables (i.e., constructs in the proposed model) were tested. The second step is the analysis of the structural model, which includes displaying the relationship (both direct and indirect) among variables using statistical-significance tests of the path coefficients, and a report of the fitness of the model examined. The first step is a necessary requirement for the second step, as the testing of the structural model may not be meaningful if the measurement model does not hold (Anderson & Gerbing, 1988).

Instrument Validation. Although the instrument selected for this study has been reported to have sound reliability and validity in previous studies, the reliability and validity of the instrument were examined again because items were adapted and contextualized. Cronbach's alpha was first examined to evaluate reliability of the sample of the present study.

Two more kinds of validity were examined: convergent validity and discriminant validity. Convergent validity is how well a factor is measured by its set of items (Campbell & Fiske,

1959) and it can be assessed using item reliability of each measure, composite reliability and the average variance extracted (AVE; Fornell & Larcker, 1981). Discriminant validity is used to assess the extent to which constructs differ. For discriminant validity at the item level, if an item correlates more highly with items in the same construct than with an item from other constructs, discriminant validity is considered to be present (Thompson, Barclay & Higgins, 1995).

Test of the Measurement Model. The measurement model (see Figure 4) in this study had 25 items in total, which were loaded on six constructs: ATTU (3 items), SN (4 items), PBC (3 items), CPB (5 items), PBC (5 items) and intentions to use technology for student-centered learning (5 items). Confirmatory factor analysis (CFA) was used to define the relationships between observed variables and latent variables (Wang & Wang, 2012).

Fit indices are used to decide whether the measurement model was a good fit or not. Fit statistics can tell researchers whether a given hypothesized model is confirmed by the data. Chi-square test, as a “traditional measure for evaluating overall model fit” (Hooper, Coughlan, Mullen, 2008, p. 53), is a test that compares the magnitude of difference between the sample and fitted covariance matrices (Hu & Bentler, 1999, p. 2). For a good model fit, the chi-square value needs to be non-significant (Schumacker & Lomax, 2010). As the chi-square test is easily influenced by sample size (Chen, 2007), the ratio of X^2 to its degree of freedom is computed (X^2/df). If the ratio computed is equal or less than 3.0, then it indicates that the hypothetical model fits the sample data (Carmines & McIver, 1981).

Several additional fit indices were also examined. Comparative fit index (CFI) compares the sample covariance matrix with the baseline model (Schumacker & Lomax, 2010). Tucker-Lewis index (TLI) analyzes the discrepancy between the chi-square value of two models: the hypothesized model and the null model (Schumacker & Lomax, 2010). The suggested cutoff

value of CFI and TLI for a good model fit is equal or larger than 0.9 (Hu & Bentler, 1999). Aside from CFI and TLI, the root mean square error of approximation (RMSEA) and the standardized root mean square residual (SRMR) were also examined. RMSEA examines how well the model fits the baseline covariance matrix with optimal parameter estimates and SRMR analyzes the square root of the covariance matrix discrepancy between the sample and the model (Schumacker & Lomax, 2010). For the cutoff criteria for RMSEA and SRMR, Hu and Bentler (1999) suggested that a value of RMSEA less than 0.06 and a value equal or less than 0.08 for SRMR to decide whether the hypothesized model shows a relatively good fit to the observed data.

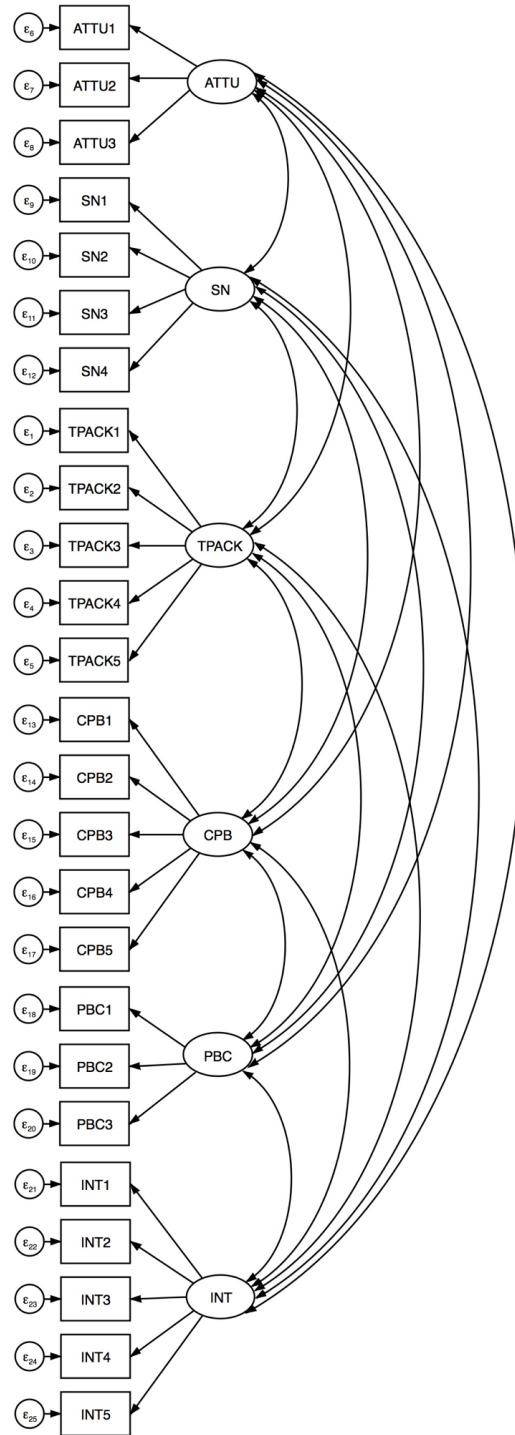


Figure 4. Confirmatory Factor Model

Note: ATTU = attitudes towards student-centered technology use; SN = subjective norms about student-centered technology use; PBC = perceived behavior control about student-centered technology use; INT = intentions to use technology for student-centered learning; CPB is constructivist pedagogical beliefs; TPACK is technological pedagogical content knowledge.

Test of the Structural Model. Likewise, the test of structural model also employed CFA, which displays the statistical significance of the path coefficient from one latent variable to another variable. If the t-value for a path coefficient is greater than 1.96, then the path coefficient is considered significant at 0.05 level (Hahs-Vaughn & Lomax, 2013). If the path coefficient is between 0.1 and 0.3, a small effect size is suggested. And if the path coefficient is between 0.4 and 0.5, a medium effect size is suggested. If the path coefficient is larger than 0.5, the effect size is considered large (Cohen, 1988).

The overall goodness of fit for hypothesized models and the variance explained by the hypothesized model (i.e., the value of R^2) were reported as well. For the fit indexes, the results of chi-square test, CFI, TLI, RMSEA and SRMR were reported. Similar to the test of measurement model, the chi-square value needs to be non-significant for a good model fit (Schumacker & Lomax, 2010). And the ratio of χ^2 to its degree of freedom was also computed (χ^2/df). If the ratio computed is equal or less than 3.0, then it indicates that the hypothetical model fit the sample data (Carmines & McIver, 1981). As for other fit indexes, the value of CFI and TLI needs to be greater than 0.9. The value for RMSEA needs to be close to or less than 0.06 and the value of SRMR .08 or less (Hu & Bentler, 1999).

Model Comparison. Model comparison was conducted to answer the second research question: will a modified TPB predict teachers' intentions to use technology for student-centered learning better if CPB and TPACK are added? Two additional factors were included in the original TPB model but their paths were fixed as zero. This way both models to be compared would have the same amount of predictors but in essence it is a comparison between the original TPB model and the modified TPB model (See Figure 5).

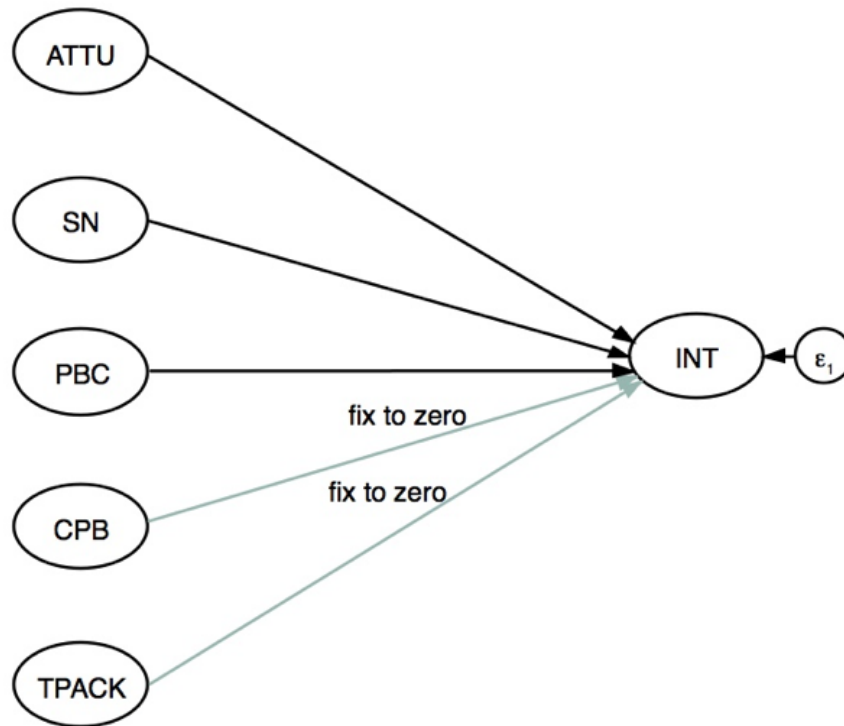


Figure 5. TPB Model for Comparison

Note: 1. ATTU = attitudes towards student-centered technology use; SN = subjective norms about student-centered technology use; PBC = perceived behavior control about student-centered technology use; INT = intentions to use technology for student-centered learning.

2. The two added factors will be kept to allow comparison with the extended model, but the path from the two added factors to the dependent variable will be fixed to zero.

Several indices were used to compare models, including a X^2 difference test (Werner & Schermelleh-Engel, 2010), the Akaike's information criterion (AIC; Akaike, 1974) and the Bayesian information criterion (BIC; Schwarz, 1978). According to Werner and Schermelleh-Engel (2010), if the models to be compared are nested models, then a X^2 difference test can be employed. In this test, the model with fewer parameters will be the smaller model and the model with more parameters will be the larger model. If the X^2 value difference decreases significantly, then the larger model fits the data better than the smaller model. The AIC indicates model's predictive validity and a lower value shows a more desired fit (Akaike, 1974). According to

Burnham and Anderson (2004), if the difference in AIC value is less than 2, the two models to be compared can be considered as equal in fit. Yet if the difference in AIC value is larger than 10, then it is strong evidence that the model with a lower value fits data better. Like AIC, BIC is also a criterion for model selection among a finite set of models (Vrieze, 2012) and a smaller BIC value indicates a better fit than other models (Schwarz, 1978). The guideline to assess the relative merits of models based on BIC is similar to that of AIC: if the difference in BIC value is less than 2, the evidence against the model with higher BIC is “not worth more than a bare mention”; if it is between 2 to 6, the evidence is “positive”; and if it is between 6 ~10 or larger than 10, the evidence is “strong” or “very strong” (Kass & Raftery, 1995, p. 777).

In addition, the R^2 for the two models was compared. R^2 refers to the proportion of the variance explained in the dependent variable as predicted from the independent variables (Hahs-Vaughn & Lomax, 2013). After obtaining R^2 value for both the TPB and the modified TPB, a R^2 change F-test was conducted to decide whether the R^2 change from the TPB model to the modified TPB model was significant or not.

CHAPTER 4

RESULTS

This chapter includes statistical analyses results in relation to the research questions proposed in this study. Specifically, it includes report of descriptive statistics, the measurement model and the structural model, instrument validation and model comparison results.

Descriptive Statistics

All survey items were first inspected for univariate normality and screened for outliers. The following Table 1 shows that the mean scores for all items ranged from 2.88 to 4.02, and standard deviation ranged from .62 to 1.04, indicating an overall positive response to the items. The skewness ranged from -.99 to .45 and the kurtosis is within the range of 2.05 to 4.55. Although the skewness and kurtosis do not indicate a true normal distribution, they are within the acceptable level of |3| and |10| respectively (Kline, 2016) or |2| and |7| suggested by Finney and Distefano (2006).

Table 1. Descriptive Statistics

Construct	Item	Mean	SD	Skewness	Kurtosis
ATTU	ATTU1	3.77	.81	.01	2.31
	ATTU2	3.70	.80	-.02	2.61
	ATTU3	3.68	.82	-.20	2.81
SN	SN1	3.63	.90	.40	2.74
	SN2	3.39	.82	-.07	2.93
	SN3	3.20	.88	-.01	2.95
	SN4	3.38	.80	.05	3.00
PBC	PBC1	3.05	.97	.04	2.56
	PBC2	3.33	1.04	-.19	2.40
	PBC3	3.18	.91	.17	2.68
INT	INT1	3.48	.98	.0	2.21
	INT2	3.64	1.00	-.16	2.05
	INT3	3.08	.94	.45	2.43
	INT4	3.31	.95	.24	2.30
	INT5	3.24	.98	.27	2.20

Table 1 (cont'd)

TPACK	TPACK1	3.85	.72	-.41	3.49
	TPACK2	4.02	.68	-.42	3.72
	TPACK3	3.92	.75	-.33	2.84
	TPACK4	3.91	.73	-.21	2.80
	TPACK5	3.76	.71	-.03	2.93
CPB	CPB1	3.60	.64	-.99	4.55
	CPB2	3.57	.62	-.66	4.03
	CPB3	3.48	.63	-.49	3.40
	CPB4	3.42	.71	-.79	4.40
	CPB5	3.55	.67	-.59	4.29

Note: SD = standard deviation; ATTU = attitudes towards student-centered technology use; SN = subjective norms about student-centered technology use; PBC = perceived behavior control about student-centered technology use; INT = intentions to use technology for student-centered learning; CPB = constructivist pedagogical beliefs; TPACK = technological pedagogical content knowledge.

The sample size of 621 meets the ideal subjects-to-variable ratio requirement for factor analysis, as there were more than 20 cases per variable (Comrey & Lee, 1992). In addition, the Bartlett's Test of Sphericity and the Kaiser-Meyer-Olkin (KMO) test for sampling adequacy were conducted to decide how suitable the sample data is for factor analysis (Hair et al., 2010). KMO value ranges from 0 to 1. If the KMO value falls between 0.8~1, it shows adequate sampling and if the value is less than 0.6, it indicates inadequate sampling. If the value falls within 0.6 ~ 0.79, it shows a mediocre or middling sampling adequacy (Kaiser, 1974). The KMO result was .89 (>.80) and the Bartlett's Test of Sphericity result was 7038.08 (df = 300, $p < .001$), both indicating adequate sampling for factor analysis.

Evaluation of the Measurement Model

As the skewness and kurtosis of the variables did not indicate true normal distribution, the parameters were estimated using the maximum likelihood estimation with Satorra Bentler correction, which is robust to non-normal variables (Langer & Wittenberg, 2019). The measurement model initially reported results as follows: $\chi^2(260) = 910.00, p < .001, \chi^2/df =$

3.50; RMSEA = .06; CFI = .91; TLI = .89; SRMR = .05. One correlation was added within the latent variable CPB (CPB4 with CPB5) based on the modification indices to improve the model. The revised measurement model yielded satisfactory model fit: $\chi^2 (259) = 808.06, p < .001, \chi^2/df = 3.12$ (close to 3); RMSEA = .06 (less than 0.08); CFI = .93 (greater than .9); TLI = .91 (greater than .9); SRMR = .05 (less than 0.06). The model fit indices showed that all items were reliable indicators of the latent constructs they were to measure (see Figure 6).

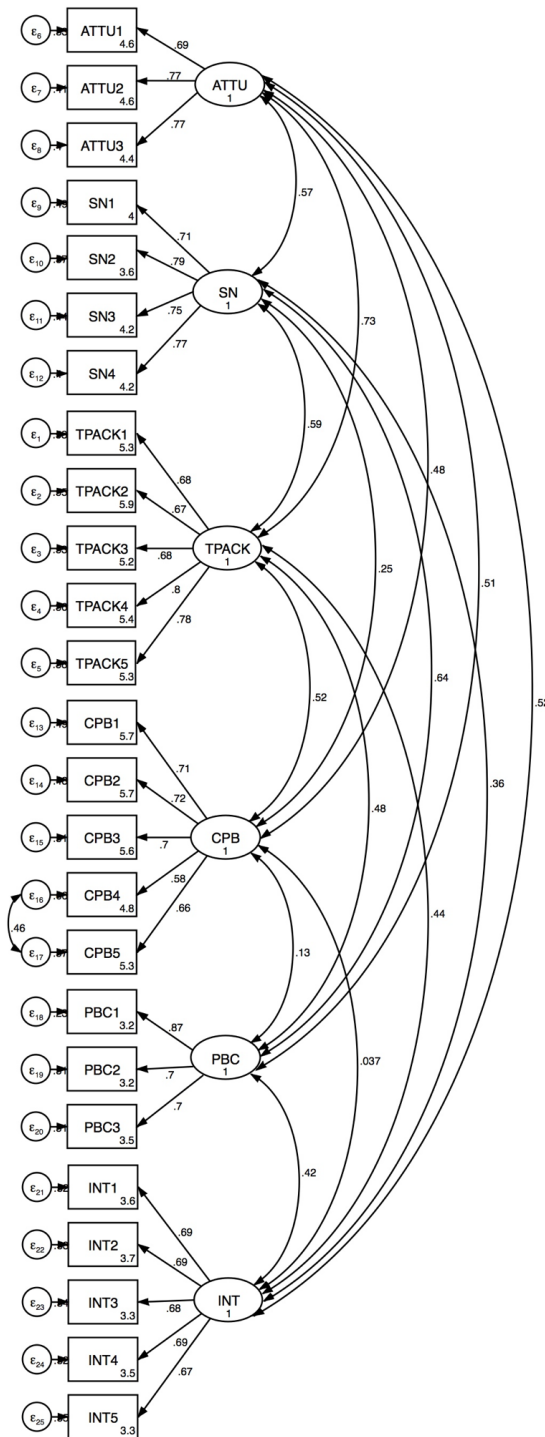


Figure 6. Results of the Measurement Model

Note: ATTU = attitudes towards student-centered technology use; SN = subjective norms about student-centered technology use; PBC = perceived behavior control about student-centered technology use; INT = intentions to use technology for student-centered learning; CPB = constructivist pedagogical beliefs; TPACK = technological pedagogical content knowledge.

Prior to the testing of the structural model, convergent validity and discriminant validities of the constructs were examined.

Convergent Validity

To assess the convergent validity, item reliability, composite reliability (CR) and average variance extracted (AVE) were examined for each construct (Fornell & Lacker, 1981; Hair et al., 2010). The item reliability for each item could be assessed by its standardized estimates, which reflect how significant it is loaded on the underlying construct. The second indicator is the reliability at the construct level. Both Cronbach's alpha coefficients and CR can provide information on construct reliability. Another indicator is the AVE, which measures the overall amount of variance that was attributed to the construct compared to the amount of variance attributed to measurement error. Results were shown below in Table 2.

Table 2. Results for the Measurement Model

Latent Variable	Item	USE	SE	t-Value	CR	α	AVE
ATTU	ATTU1	1.00	.69***	-	.79	.78	.55
	ATTU2	1.10	.77***	15.60			
	ATTU3	1.14	.77***	16.11			
SN	SN1	1.00	.71***	-	.84	.84	.57
	SN2	1.09	.79***	18.12			
	SN3	.95	.75***	16.65			
	SN4	.95	.77***	16.83			
PBC	PBC1	1.00	.87***	-	.80	.79	.58
	PBC2	.86	.70***	18.28			
	PBC3	.76	.70***	16.57			
INT	INT1	1.00	.69***	-	.81	.81	.48
	INT2	1.01	.69***	14.75			
	INT3	.94	.68***	14.29			
	INT4	.96	.69***	14.45			
	INT5	.97	.67***	13.89			
CPB	CPB1	1.00	.71***	-	.81	.83	.46
	CPB2	.99	.72***	15.05			
	CPB3	.97	.70***	14.76			
	CPB4	.90	.58***	12.67			
	CPB5	.97	.66***	14.30			

Table 2 (cont'd)

TPACK	TPACK1	1.00	.68***	-	.85	.85	.52
	TPACK2	.93	.67***	15.18			
	TPACK3	1.04	.68***	15.12			
	TPACK4	1.19	.80***	17.27			
	TPACK5	1.14	.78***	16.74			

Note: *** $p < .001$; ATTU = attitudes towards student-centered technology use; SN = subjective norms about student-centered technology use; PBC = perceived behavior control about student-centered technology use; INT = intentions to use technology for student-centered learning; CPB = constructivist pedagogical beliefs; TPACK = technological pedagogical content knowledge; USE = unstandardized estimates; SE = standardized estimates; CR = composite reliability; AVE = average variance extracted; α = Cronbach's alpha coefficients.

As shown in Table 2, of the 25 standardized estimates, 14 items showed estimates larger than .70; 10 items had estimates were in the range of .60 to .70 and one item was .58. All values of the standardized estimates of the items were above .50 (Hair et al., 2010), indicating acceptable item reliability and satisfactory construct validity of the measurement model.

Composite reliability measures the internal consistency of scale items and is an indicator of the shared variance among the observed variables that were purported to measure the latent structure (Fornell & Larcker, 1981). It is recommended to have a composite reliability from 0.7 and up in previous literature (Nunnally & Bernstein, 1994). The composite reliability for the six constructs (ATTU, SN, PBC, INT, CPB, TPACK) in Table 2 was .79, .84, .80, .81, .81, and .85 respectively, showing an acceptable level of internal consistency of the scale items.

For CR and AVE, convergent validity requirement is met on conditions that the value of CR is greater than the value of AVE and the value of AVE is 0.50 and above (Fornell & Larcker, 1981). For the first condition, the CRs of all constructs were greater than the AVEs in their correspondent constructs (see Table 2). For the second condition, most of the CRs and AVEs were at the acceptable range, except the AVEs for two constructs (INT = .48, CPB = .46), which were slightly below 0.50. Nevertheless, as the CRs and Cronbach's alpha coefficients of the two

constructs were above 0.80, it is reasonable to still consider the convergent validity for these two constructs were acceptable.

Discriminant Validity

Different from convergent validity, discriminant validity examines whether a given construct has its uniqueness and hence can capture phenomena of interest that other constructs fail to do (Hair et al., 2010). To establish discriminant validity, the square root of the AVE of a particular construct is compared with the correlations between that construct with other constructs and the value of the square root of the AVE needs to be higher than the correlations (Fornell & Larcker, 1981). The following Table 3 compares the inter-construct correlations between each latent construct with the square roots of their AVEs, which are on the diagonal and in the parenthesis. The results in Table 3 indicate satisfactory discriminant validity, as all the square roots of AVEs were greater than the inter-construct correlations.

Table 3. Discriminant Validity for the Measurement Model

Latent construct	ATTU	SN	PBC	CPB	TPACK	INT
ATTU	(.74 ^a)					
SN	.46***	(.75 ^a)				
PBC	.42***	.54***	(.76 ^a)			
CPB	.36***	.20***	.12*	(.68 ^a)		
TPACK	.59***	.49***	.41***	.42***	(.72 ^a)	
INT	.42***	.29***	.36***	.04	.36***	(.69 ^a)

Note: 1. ATTU = attitudes towards student-centered technology use; SN = subjective norms about student-centered technology use; PBC = perceived behavior control about student-centered technology use; INT = intentions to use technology for student-centered learning; CPB = constructivist pedagogical beliefs; TPACK = technological pedagogical content knowledge;

2. ATTU, SN, PBC, INT, CPB, TPACK are the composite scores of the measured items.

3. ^a Diagonals in parentheses are square roots of the AVE from the latent construct. Off-diagonals are the inter-construct correlations between each of the latent construct.

4. *** $p < .001$; * $p < .005$

Evaluation of the Structural Model

To answer the two research questions in this study, structural models proposed for each research question were examined and path coefficients were presented below.

RQ1. Evaluating the TPB model. The first research question investigated the extent to which the TPB model is applicable to explaining EFL teachers' intentions to use technology in a student-centered way. This model has four latent variables and 15 indicators, ATTU (3 items), SN (4 items), PBC (3 items) and INT (5 items). For this model, the resulting goodness-of-model-fit indices were $\chi^2(80) = 225.99, p < .001, \chi^2/df = 2.82$; RMSEA = .05; CFI = .96; TLI = .95; SRMR = .04, which all indicate a good model fit based on the cutoff values suggested in previous literature (Kline, 2016). Therefore, TPB model was supported when predicting EFL teachers' intentions to use technology for student-centered learning.

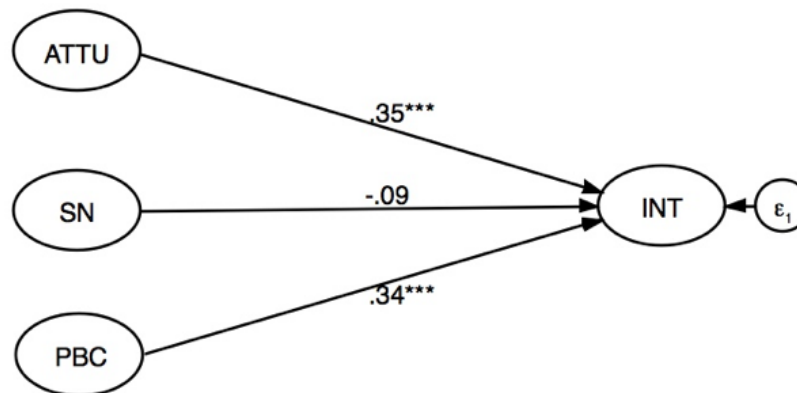


Figure 7. The Path Coefficients of TPB Model

Note: ATTU = attitudes towards student-centered technology use; SN = subjective norms about student-centered technology use; PBC = perceived behavior control about student-centered technology use; INT = intentions to use technology for student-centered learning.

The standardized coefficients of TPB model are shown in Figure 7. The first hypothesis in this model is supported as EFL teachers' attitudes towards student-centered technology use were found to significantly and positively influences their intentions to use technology for

student-centered learning ($\beta = .35, p < .001$). The second hypothesis is rejected as their intentions to use technology for student-centered learning were not significantly predicted by their subjective norms about student-centered technology use ($\beta = -.09, p = .26 > .05$). The third hypothesis is supported as EFL teachers' perceived behavior control about student-centered technology use was found to have significant and positive impacts on their intentions to use technology for student-centered learning ($\beta = .34, p < .001$). Moreover, 30.0% of variance in intentions to use technology for student-centered learning was explained by the factors in TPB model ($R^2 = 0.30$).

The three demographic covariates were not included in the structural model as none of these variables was found to have significant correlations with the dependent variable. The correlation between Gender and intentions to use technology for student-centered learning was positive but not significant ($r = .06, p = .13$). Similarly, the correlation between Age and intentions to use technology for student-centered learning was .06 ($p = .13 > .05$), and between Teaching Experience and intentions to use technology for student-centered learning, $-.01$ ($p = .84 > .05$).

RQ2. Evaluating the modified TPB model. The second research question explores a modified TPB model that incorporates CPB and technology pedagogical content knowledge. It also aims to compare the modified model with the TPB model. To answer this research question, the first step is to evaluate the modified TPB model and the second step is to compare results of the modified TPB model with the original TPB model.

The modified TPB model consisted of six latent constructs: ATTU, SN, PBC, INT, CPB and TPACK. Four of these six constructs were the same as those in the TPB model. The two added constructs (CPB, TPACK) have 5 indicators each. From the factor analysis results, the

proposed modified TPB model has a good fit: $\chi^2 (259) = 808.06, p < .001, \chi^2/df = 3.11$; RMSEA = .06; CFI = .92; TLI = .91; SRMR = .04.

Overall, three out of five hypotheses in this model were supported by the data (H4, H6, H8). The standardized coefficients of the structural model for the modified TPB model were shown in Figure 8. The path between EFL teachers' attitudes towards student-centered technology use and their intentions to use technology for student-centered learning has the highest coefficient ($\beta = .46, p < .001$), indicating the existence of a significant positive effect. Two more path coefficients were found to be significant: one is between teachers' perceived behavior control about student-centered technology use and their intentions to use technology for student-centered learning ($\beta = .16, p < .05$); the other is between teachers' TPACK and their intentions to use technology for student-centered learning ($\beta = .22, p < .01$). However, two path coefficients (subjective norms about student-centered technology use and constructivist pedagogical beliefs) were found to be insignificant (SN to INT: $\beta = -.06, p = .397 > .05$; CPB to INT: $\beta = .05, p = .303 > .05$). Around 37% of the variance in the dependent variable in this study was accounted for by the independent variables ($R^2 = 0.37$).

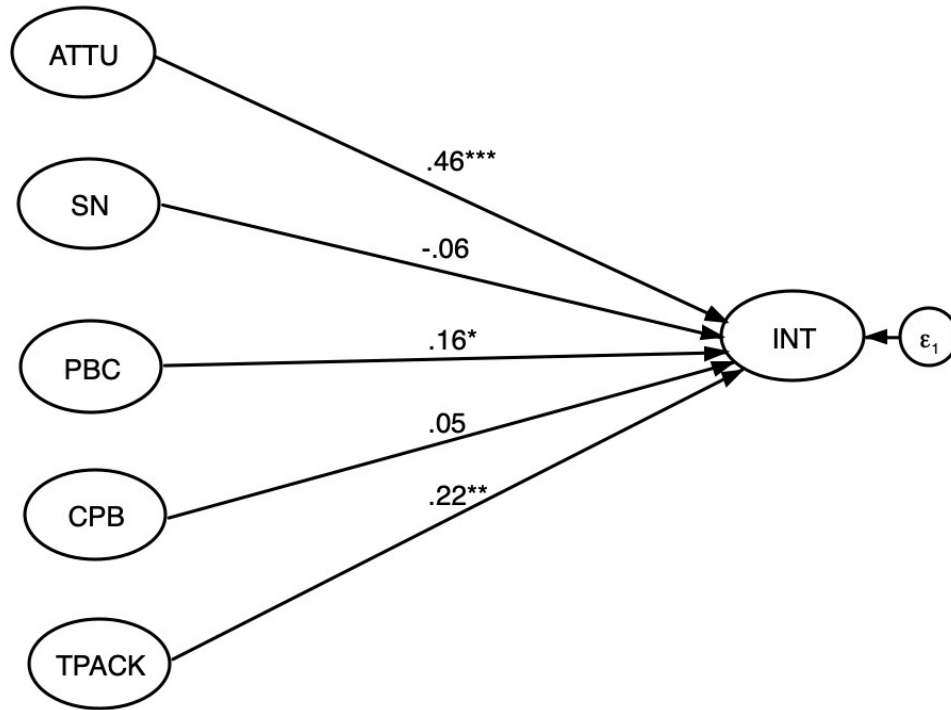


Figure 8. The Path Coefficients of the Modified TPB Model

ATTU = attitudes towards student-centered technology use; SN = subjective norms about student-centered technology use; PBC = perceived behavior control about student-centered technology use; INT = intentions to use technology for student-centered learning; CPB = constructivist pedagogical beliefs; TPACK = technological pedagogical content knowledge

Model Comparison. To answer the second research question, the modified TPB model was compared with the TPB model. As explained above, the TPB model kept the two factors (CPB and TPACK) but the two paths between these two factors and the dependent variable were fixed to zero for the purpose of comparison (see model results in Figure 9). For this model, the resulting goodness-of-model-fit indices were: $\chi^2 (261) = 835.97, p < .001, \chi^2/df = 3.20$; RMSEA = .06; CFI = .92; TLI = .90; SRMR = .05.

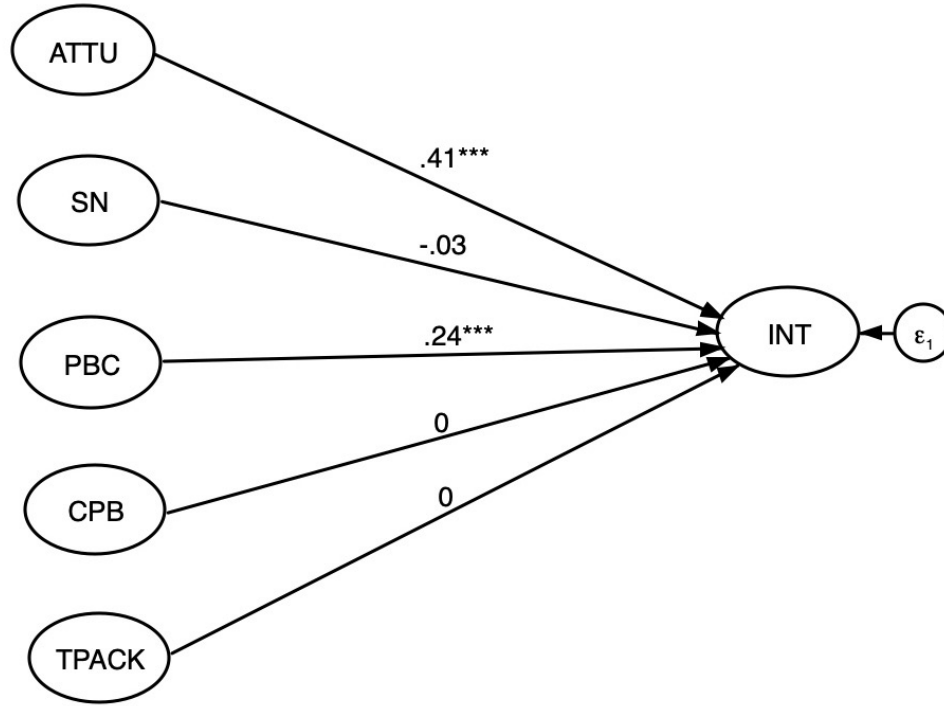


Figure 9. The Path Coefficients of the TPB Model for comparison

Note: ATTU = attitudes towards student-centered technology use; SN = subjective norms about student-centered technology use; PBC = perceived behavior control about student-centered technology use; INT = intentions to use technology for student-centered learning; CPB = constructivist pedagogical beliefs; TPACK = technological pedagogical content knowledge.

Table 4 presents a comparison between the modified TPB model and the TPB model in terms of model fit. Chi-square difference testing (Werner & Schermelleh, 2010) was first used for comparison. The χ^2_{diff} value is 27.91 and df_{diff} is 2, the chi-square difference is significant ($p < .001$). Therefore the modified TPB model fits the data better than the TPB model.

Table 4. Fit Indices of the TPB model and the Modified TPB Model

Indices	TPB Model (Two variables fixed to zero)	Modified TPB Model (Five variables)
χ^2	835.97	808.06
df	261	259
p	< .001	< .001
RMSEA	.06	.06
TLI	.90	.91
CFI	.92	.92

Table 4 (cont'd)

SRMR	.05	.04
R ²	.30	.37
AIC	31290.70	31266.80
BIC	31685.09	31670.05

Both AIC and BIC were used as a standard to compare and select models in terms of predictive validity and data fit. According to Akaike (1974), for models of the same sample size, a lower value reflects a better fit. Because the modified TPB model has a smaller AIC value than the AIC value for the TPB model and the difference is 23.90 (> 10), which provide strong evidence that the modified TPB model is a better model in terms of predictive validity. As for BIC, the value difference for the two models is 15.04 (> 10), also showing strong evidence that the modified TPB model (with smaller BIC) was a better fit to data than the TPB model (with larger BIC).

As the modified TPB model increased the R^2 from .30 to .37, a R^2 change F-test was also conducted to determine the significance of the R^2 change. The computed F value is 34.17, which is significant at .001 level according to the F table: $F(2, 621, \alpha = .001) = 6.91$. This means the modified TPB model has significantly increased the R^2 value compared with the original TPB model.

In sum, the examination of chi-square difference, the comparison of AIC and BIC between the two models and the R^2 change F-test all indicated that the modified TPB model was better than the TPB model (with two fixed path values) in terms of data fit, predictive validity and variance explained.

CHAPTER 5

DISCUSSION

There is a plethora of studies exploring teachers' technology adoption intentions and behavior, whereas few of them have explicitly focused on student-centered technology use using TPB as framework. The present research is a response to this research gap and other researchers' calls for further study in understanding teachers' different kinds of technology use behavior (e.g. Ertmer, 2012; Teo et al., 2017; Liu et al., 2019).

The researcher of this study expands on previous research by answering two research questions. First, whether a prominent previously established model (i.e., TPB) can usefully be applied to teachers' intentions to use technology for student-centered learning in a setting of EFL teaching in China. Second, whether the addition of teachers' CPB and TPACK to TPB would lead to a significantly improved model that fit data better, explain more variance and perform better in predicting teachers' intentions to use technology for student-centered learning.

Overall, the results support both the TPB model and the modified TPB model. Five of the eight hypotheses in relation to the two models were supported in this study. Results of the hypotheses testing help to identify some key variables to predict Chinese EFL teachers' intentions to use technology for student-centered learning. The tested hypotheses were summarized in Table 5 below and detailed discussion in relation to these hypotheses and the research questions is presented in the following section.

Table 5. Summary of the Tested Hypotheses

Model	Hypothesis	Result
TPB	H1: EFL teachers' attitudes towards student-centered technology use significantly and positively predict their intentions to use technology for student-centered learning.	Supported
	H2: EFL teachers' subjective norms about student-centered technology use significantly and positively	Not supported

Table 5 (cont'd)

	predicts their intentions to use technology for student-centered learning.	
	H3: EFL teachers' perceived behavior control about student-centered technology use significantly and positively predicts their intentions to use technology for student-centered learning.	Supported
Modified TPB	H4: EFL teachers' attitudes towards student-centered technology use significantly and positively predict their intentions to use technology for student-centered learning.	Supported
	H5: EFL teachers' subjective norms about student-centered technology use significantly and positively predict their intentions to use technology for student-centered learning.	Not supported
	H6: EFL teachers' perceived behavior control about student-centered technology use significantly and positively predicts their intentions to use technology for student-centered learning.	Supported
	H7: EFL teachers' CPB significantly and positively predict their intentions to use technology for student-centered learning.	Not supported
	H8: EFL teachers' TPACK significantly and positively predicts their intentions to use technology for student-centered learning.	Supported

The Theory of Planned Behavior's Predictive Validity for Teachers' Intentions to Use Technology for Student-centered Learning

With regard to the first research question, about the TPB's predictive validity for teachers' intentions to use technology for student-centered learning, the results indicated that TPB is a robust model for predicting Chinese EFL teachers' intentions to use technology for student-centered learning. Moreover, ATTU and PBC were significant predictors of intentions to use technology for student-centered learning, whereas SN was found to have no significant relationship to intentions to use technology for student-centered learning. These results largely corroborate those of Armitage and Conner's (2001) meta-analysis of the efficacy of the TPB,

which utilized a database of 185 studies. Specifically, their findings indicated that TPB accounted for 39% of the variance in intentions to use technology for student-centered learning, and PBC “accounted for significant amounts of variance in intentions”, whereas SN was “a weak predictor of intentions” (p. 471).

The present study’s results also confirm the efficacy of TPB for computer-assisted language learning applications in China. As such, they echo and supplement the findings of prior studies in other cultural contexts, such as EFL teachers’ application of e-learning in Iraq (Keong, Albadly, & Raad, 2014) or EFL teachers’ intentions for mobile learning in Taiwan (Cheng, 2017).

Attitudes towards and intentions for using technology for student-centered learning.

The path coefficient between EFL teachers’ attitudes towards student-centered technology use and their intentions to use technology for student-centered learning was significant, in keeping with numerous prior studies that have consistently found teachers’ attitudes towards computer use to exert significant influence over foreign language teachers’ intentions to integrate technology (e.g., Liu et al., 2017; Teo et al., 2016).

The significant correlation found between the sampled Chinese EFL teachers’ attitudes towards student-centered technology use and intentions to use technology for student-centered learning suggests that it is important for school administrators and policy-makers to sustain and promote teachers’ positive attitudes towards student-centered technology use. The significant correlation also points to the importance of understanding the factors shaping teachers’ attitudes towards student-centered technology use. An earlier study among EFL teachers in Syria (Albirini, 2006) pointed out teachers’ attitudes towards ICT was related to teachers’ experience with it, their cultural perception and computer competence etc. Moreover, people’s attitudes

towards computer use “are modifiable” (p. 329) across different age groups (Czaja & Sharit, 1998). Therefore, in order to promote student-centered technology use, the stakeholders (school administrators, teacher educators, policy makers etc.) can make an effort on promoting teachers’ attitudes towards student-centered technology use. Indeed, college-level foreign-language teachers in China are encouraged to use advanced technology to build favorable language-learning environments for their students and to transform their teaching in a student-centered direction (Chinese Ministry of Education, 2007, 2017), which may be a chief attributor for the significant relationship identified in this study. Still, more efforts can be made to promote teachers’ attitudes towards student-centered technology use, such as to let teachers experience student-centered technology use or to provide a vision of student-centered technology use in classrooms.

Subjective norms about and intentions for using technology for student-centered learning. Although Ajzen’s (1991) TPB model proposes that subjective norms, as a reflection of social influence, is a significant factor in people’s intentions, the present study did not find a significant relationship between the respondents’ subjective norms about and intentions for using technology for student-centered learning. This result, however, is supported by previous inconclusive findings regarding the impact of subjective norms on intentions to use technology. Ajzen’s analysis of 16 TPB-based studies indicated that “the results for subjective norms were mixed, with no clearly discernible pattern” (p. 189) and Armitage and Conner’s (2001) meta-analysis on 185 studies using TPB also reported subjective norms to be “a weak predictor of intentions” (p. 471).

Several possible reasons exist for this insignificant relationship identified in this study. First, it is possible that for Chinese EFL teachers, personal considerations (e.g. attitudes toward

or beliefs about student-centered technology use) tended to overshadow the influence of perceived social pressure regarding their intentions to use technology for student-centered learning. Second, as shown in Table 3, Chinese EFL teachers' subjective norms was highly correlated with both their attitudes towards student-centered technology use and perceived behavior control about student-centered technology use ($r = .046, p < .001$; $r = .54, p < .001$), which indicates possible collinearity problem that might also lead to the insignificant relationship in this study. Third, Armitage and Conner's (2001) highlighted "poor measurement and the need for expansion of the normative component" (p. 471) as possible reasons that subjective norms has emerged as a weak predictor of behavioral intentions. The insignificant relationship in this study might also was caused by measurement issue. For example, one item in this construct asks whether the participants' colleagues are engaging in student-centered technology use. However, it is quite possible that the participants' colleagues were not doing this, yet they themselves still had strong intentions to use technology for student-centered learning due to the government's encouragement of this behavior.

The insignificant relationship between subjective norms and intentions in terms of student-centered technology use has implications for further research. It is of interest for researchers to further understand the contextual factors that may mediate or moderate the relationship between subjective norms and intentions. Researchers should also focus on ways to measure subjective norms differently and more accurately. For Chinese EFL teachers in particular, further study (both quantitative and qualitative) on their perceptions of subjective norms and intentions regarding student-centered technology use can be conducted to provide further explanations for the insignificant finding in this study.

Perceived behavior control about and intentions for using technology for student-centered learning. PBC in this study encompasses two components (facilitating condition and self-efficacy) and was found to be a significant predictor of the sampled Chinese EFL teachers' intentions to use technology for student-centered learning. It should be noted that prior researchers have conceptualized PBC in a variety of ways, and unsurprisingly, their results regarding the correlations between PBC and intentions vary as well. For example, Teo (2012) theorized PBC as being essentially similar to facilitating conditions, yet did not identify a significant relationship between it and teachers' technology adoption. Yet Salleh (2016), for whom facilitating conditions were just one dimension of PBC (along with self-efficacy) found it to be a significant predictor of not only teachers' intentions to use technology, but also their actual technology use.

There are two possible explanations for this finding. First, both components of PBC as conceptualized in the present study have separately been reported as essential to student-centered technology use. Liu et al. (2019) found facilitating conditions to be a key constraint to Chinese EFL teachers' student-centered technology use. Likewise, Chen (2010) found that self-efficacy in the area of teaching with technology had the strongest influence on pre-service teachers' technology use behavior to support student-centered learning.

The second potential explanation resides in the current study's dependent variable, intentions to use technology for student-centered learning. Teo (2012) study's fail to identify a significant relationship between facilitating conditions and teachers' intentions to use technology could have been due to the fact that certain low-level technology-use behavior (such as using PowerPoint to deliver presentations, or the Internet to prepare lectures) have become common practice in classrooms, irrespective of facilitating conditions in a broad sense. The researcher of

the current study, in contrast to Teo, clearly defined student-centered technology use and gave specific examples of technologies such as corpora, podcasts, and virtual worlds for student-centered learning in the survey. As such, the present research set a higher bar than Teo's for what constituted technology use, which in turn would have impacted both the participants' self-efficacy and their perceptions of facilitating conditions; and this could explain why PBC was found to be a significant predictor of intentions to use technology for student-centered learning.

The significant relationship between PBC and intentions regarding student-centered technology use is informative to both school administrators and teacher educators, particularly those in China. Chinese school administrators should strive to provide technical support and administrative policy support for EFL teachers' student-centered technology use, especially given that Chinese EFL teachers were reported to have facilitating condition issue such as lack of appropriate software, limited numbers of computers in classrooms, absence of training in using technology for student-centered learning etc. (Liu et al., 2019). Teacher educators, on the other hand, need to work on supporting EFL teachers' student-centered technology use by offering appropriate knowledge, training and guidance in relation to EFL teachers' technology integration practice to improve their self-efficacy in using technology for student-centered learning.

The Modified Theory of Planned Behavior's Predictive Validity for Teachers' Intentions to Use Technology for Student-centered Learning.

This study added two factors to Ajzen's (1991) TPB model, and SEM results showed the resulting modified model had a satisfactory fit and an added significant path coefficient between one of the two factors and teachers' intentions to use technology for student-centered learning, confirming that adding more factors to the existing framework could provide a more comprehensive picture of the mechanisms that predict teachers' intentions to use technology for

student-centered learning. Although the path coefficients for ATTU, SN and PBC toward intentions to use technology for student-centered learning in the modified model differed slightly from those in the unmodified TPB model, the results of significance tests for such path coefficients remained the same. Therefore, the following discussion focuses only on the two added factors, CPB and TPACK.

Constructivist pedagogical beliefs and intentions to use technology for student-centered learning. Despite CPB having been identified as a significant predictor in numerous studies of teachers' attitudes towards technology use (e.g., Liu et al., 2017) and technology use (Gil-Flores et al., 2017; Petko, 2012; Teo, Huang & Hoi, 2018), the present study did not find CPB to be a significant predictor. This means CPB has no effect on teachers' intentions to use technology for student-centered learning, which is an unexpected result, as it did not resonate with any previously published findings. However, it is important to point out that most previous studies did not focus specifically on CPB and intentions to use technology for student-centered learning in the context of EFL teaching in China as in this study, but studied the relationship of CPB and frequency of technology use (Gil-Flores et al., 2017; Petko, 2012) or intentions to use technology in general (Liu et al., 2017; Teo, Huang & Hoi, 2018). Still other studies (Ertmer et al., 2005; 2010; 2012) discussed the relationship between teachers' CPB and high-level, student-centered technology use, yet these studies were either conceptual papers or based on an analysis of qualitative data from a small sample size.

Moreover, previous studies did not take both CPB and TPACK into consideration when examining teachers' technology use using SEM as the analysis method. In current study, both CPB and TPACK were included in the model, and CPB was found to correlate highly with TPACK ($r = .42, p < .001$) and with other three factors as well (attitudes, subjective norms,

perceived behavior control). It is possible that the effect of CPB on teachers' intentions to use technology for student-centered learning is indirect rather than direct when other factors are in the model. For example, CPB has the highest correlation with TPACK, which might indicate that CPB exert an indirect effect on teachers' intentions to use technology for student-centered learning via TPACK.

Several other explanations can plausibly be offered for this discrepancy between the present study's findings and those of prior research on similar topics. One possible explanation lies in the measurement of the CPB construct. The five items adopted to measure CPB were selected from Chan and Elliot's (2004) scale for teachers' conceptions about teaching and learning that contains 30 items, and it is possible that the selected five items did not fully measure the concept of CPB. It is also possible that CPB can be better captured if items from other surveys are employed, such as the Teacher Beliefs Survey developed by Woolley et al in 2004, which measures teachers' constructivist pedagogical beliefs in multiple dimensions. Finally, teachers' beliefs about technology integration have often been found to be inconsistent with their behavior (e.g., Spector & Merrill, 2008). For example, Liu (2011) and Teo et al. (2008) both demonstrated that teachers with constructivist pedagogical beliefs conducted both constructivist and traditional activities associated with technology integration, because they felt that lecture-based teaching activities could save time, and thus help ensure that they delivered all the required teaching content. Moreover, teachers with CPB may not use technology in a student-centered way due to incompetence (Sandholtz & Reilly, 2004), the intensity of their focus on student test scores (Liu, 2011), lack of appropriate training (Gil-Flores et al., 2017), and so on. Any or all of these factors might have led the current study's participants to not want to use technology in a student-centered way, despite holding constructivist beliefs.

As findings regarding CPB and student-centered technology use in this study go against existing prior research, more studies are needed to investigate issues related to CPB such as to explore a more valid scale to measure CPB, to examine the correlation between CPB and TPACK (or other variables within TPB) or to reexamine the relationship between CPB and teachers' intentions to use technology for student-centered learning in different populations and regions.

Technological pedagogical content knowledge and intentions to use technology for student-centered learning. Teo et al. (2017, p. 811) found TPACK to be “the most dominant determinant” of behavioral intentions to use computers in both traditional and innovative ways among mathematics teachers in Serbia; and Liu et al. (2019) identified lack of TPACK as a key constraint of Chinese EFL teachers' technology use for student-centered learning. In a similar vein, the present study found that TPACK in the modified TPB model significantly predicted EFL teachers' intentions to use technology for student-centered learning. This significant effect supports previous studies' conclusions regarding the positive impact of TPACK on teachers' meaningful technology use (Koehler et al., 2007), as well as those of prior studies that integrated TPACK into the TAM and identified statistically significant direct effects of this construct on teachers' intentions to use Web 2.0 technology (Mei et al., 2017; Teo et al., 2018).

The significant correlation reported here is not unexpected, insofar as teachers' knowledge has long been considered to have a significant impact on their decisions (Shulman, 1986). Borko and Putman (1995) recommended that teacher educators must help “expand and elaborate” (p. 37) teachers' knowledge systems if they are to successfully encourage change in their practices. In this context, it is important to remember that using technology to support student-centered learning is a new practice for many EFL teachers, and requires them to have

skills, knowledge and expertise that are relevant to integrating various technologies into classroom instruction (Mei et al., 2017). Indeed, Liu et al.'s (2019) recent empirical study confirmed that lack of certain knowledge (i.e., technological knowledge, technological content knowledge and TPACK) was a major impediment to Chinese EFL teachers' attempts to use technology in a student-centered way. Gil-Flores (2017) also pointed out the importance of proper teacher training to the achievement of good ICT integration, and further argued that such training needs to focus not only on TPACK itself, but also on the effective incorporation of such knowledge into the teaching and learning process.

Moreover, without an appropriate knowledge base for meaningful technology use, technology could be a curse rather than a blessing in the foreign-language classroom. For example, Li and her colleagues (2019) found that technology “played a negative role in facilitating communicative classroom discourses”, as teachers often used it merely to display questions and directives rather than to promote “spontaneous and authentic output” (p. 24). Therefore, they recommended that EFL teachers continuously update their technology-related knowledge through professional development, communities of practice, and school-based mentoring.

The significant relationship between TPCAK and teachers' intentions to use technology for student-centered learning and the possible detrimental effect caused by teachers' lack of appropriate knowledge base for meaningful technology integration have deep implication for both EFL teachers and teacher educators. On one hand, teacher educators need to support the development of TPACK within EFL teachers, by designing courses aiming at fostering TPACK for student-centered technology use, and by providing EFL teachers with examples of good practice and opportunities to fulfill their needs for TPACK in the context of EFL teaching. EFL

teachers, on the other hand, need to understand student-centered technology use requires more than technological knowledge, instead a combination of technological, pedagogical and content knowledge is needed. They also need to strive to gain TPACK via different appropriate approaches, such as the learning-technology-by-design approach as examined by Mishra & Koehler (2006).

Comparing the Theory of Planned Behavior Model against the Modified Theory of Planned Behavior Model

Because models “summarize the statistical properties of the data and identify parameters of interest” (Teo, 2013, p. E81), model comparison allows researchers to choose models that provide better data characterization, and thus gain clearer understandings of the phenomena of interest. The results of a chi-squared significance test, an R^2 change F-test, AIC and BIC difference test indicated that, with regard to the constructs that both measured, our modified TPB model was significantly superior to the original TPB model in terms of data fit, variance explanation and predictive validity. Moreover, the modified TPB model identified a significant relationship between TPACK and teachers’ intentions to use technology for student-centered learning, and a non-significant relationship between CPB and teachers’ intentions to use technology for student-centered learning. These results indicate that increased precision in the prediction of teachers’ intentions to use technology for student-centered learning could be achieved by assessing teachers’ TPACK.

The model comparison results in this study are also useful in establishing a model with better explanatory power and predictive validity than TPB, which in turn has the potential to generate meaningful insights into teachers’ “under-use” (Blackwell et al., 2014, p. 310) or “limited use” (Drent & Meelissen, 2008, p. 188) of technology. Moreover, the examination of the

factors in both models yielded a clearer picture of specific relations among factors in TPB, CPB and TPACK, and thus, new insights into the possible mechanisms behind teachers' student-centered technology use, which can reasonably be expected to be beneficial to teacher education and professional development. For example, in light of the significant relationship we have identified between TPACK and teachers' intentions to use technology for student-centered learning, it would be possible to formulate strategies for boosting teachers' intentions to use technology for student-centered learning via increasing their TPACK. In any case, it is only after the key factors in teachers' intentions to use technology for student-centered learning are identified can stakeholders (such as teach educators, school administrators, policy makers etc.) intervene effectively to achieve meaningful technology integration in teaching.

CHAPTER 6

CONCLUSION

Scholarly debates over the societally critical issue of technology adoption in schools have rumbled on for years (Teo, 2016), and yet the key factors influencing teachers' student-centered technology adoption and use remain unclear. Therefore, a theoretical framework capable of capturing the relationships among the various relevant factors is long overdue. To help fulfill this need, the present study tested the TPB and proposed a modified TPB model aimed at explaining teachers' intentions to engage in student-centered technology use in the context of EFL classrooms in China. The study's major findings, implications, limitations, and recommendations for future research are discussed in turn below.

Key Findings

This study's main findings can be summed up as follows. First, the original TPB model can effectively explain Chinese EFL teachers' intentions to use technology for student-centered learning, but only two of its factors – ATTU and PBC – were found significant in this regard. Second, the modified TPB model also has strong predictive validity for these teachers' intentions to use technology for student-centered learning, though of its two added factors, CPB and TPACK, only the latter is a significant predictor of teachers' intentions to use technology for student-centered learning. Finally, the modified TPB model was found to have improved upon the original one in terms of data fit, predictive validity and variance explained.

Implications

The findings of this study have both theoretical and practical implications. Theoretically, it replicates TPB in an area that has rarely been examined, i.e., the student-centeredness of teachers' technology use and in the context of Chinese EFL learning. Moreover, its modified

TPB model's identification of a significant relationship between TPACK and teachers' intentions to use technology for student-centered learning provides empirical evidence in support of previous scholars' theorizations of the importance of TPACK to meaningful technology integration (Koehler et al., 2009).

This study could also inform practice, especially among school administrators and teacher educators in China, who are currently striving to promote both effective technology use and communicative language teaching. Since teachers' attitudes towards and PBC about student-centered technology use were both identified as significant predictors of the sampled teachers' intentions to use technology for student-centered learning, due attention should be given to the development of positive attitudes towards student-centered technology use among teachers, and to the fostering of environments that will facilitate their student-centered technology use. In addition, this study's confirmation of TPACK's importance to teachers' intentions to use technology for student-centered learning not only echoes previous findings that Chinese EFL teachers lack support and training and are generally not well prepared (Hu & McGrath, 2011; Liu et al., 2019), but also sheds light on possible future directions for high-quality teacher education aimed at meaningful technology integration. That is, the mere provision of one-size-fits-all training about apps or software is not enough to induce student-centered technology behavior; and in its place, it is hoped that learning to use technology for student-centered activities is seen as processes of integrating new knowledge into teachers' existing knowledge systems (Liu, Liu, Yu, Li & Wen, 2014) and of placing new culture-related educational patterns or methods alongside existing ones (Stockman, 2017).

Limitations

This study has several limitations that must be acknowledged here. First, all data were self-reported, which may mean that they were subject to self-response bias. If data could be triangulated with information obtained from other sources, such as students' reports of their teachers' technology use, the results would undoubtedly be more accurate, as this would allow for examination of discrepancies between self-reports and actual practice. Nevertheless, due to the relatively large number of participants involved, such triangulation would have been very difficult.

Second, the number of questions for some constructs in the survey was limited. As pointed out by Ajzen (2014), using fewer than five items might impair the validity of TPB measures, by allowing only incomplete capture of the underlying construct. Because this study utilized SEM analysis, the number of participants involved limited the number of items per construct that could be employed. Nevertheless, future studies would ideally recruit enough participants that more items per construct could be included.

Third, this study's generalizability is limited, because its data were only collected from China, and from college-level EFL teachers who could access technology in their teaching environments. It is highly likely that participants chosen from different countries, academic subjects/levels, and technological settings would provide different survey data that would possibly yield different findings.

Finally, this study is limited in its explanatory power, insofar as it employed a cross-sectional design that did not include experimental manipulation of theoretical constructs. As such, the significant path coefficients are only indicators of association and not of causal relationships. If causal explanations were sought, carefully designed longitudinal studies would

be more able to provide them. Moreover, in the case of our modified TPB model, just 37% of variance in the dependent variable was explained by the other variables, meaning that 63% of such variance remained unaccounted for. Thus, the inclusion of additional relevant factors might be helpful in further improving the explanatory power of the TPB framework.

Recommendations for Future Research

Given the limitations listed above, further studies are needed to gain more in-depth understandings of the factors that influence teachers' intentions to use technology for student-centered learning. For example, this study focused on TPB and two additional factors, CPB and TPACK. Yet, different models (including but not limited to TAM and UTAUT) are also worth considering as theoretical frameworks for exploring the issue of limited student-centered technology use. And as briefly noted above, in the specific case of TPB, researchers should consider adding more or different factors to the model to broaden our understanding of the influences on teachers' student-centered technology use. Other factors that may need to be considered in this context include habit (Liu et al., 2019), experience with technology (Hubbard, 2018), and beliefs in students (Liu et al., 2018).

Aside from psychological factors such as attitudes, norms, and beliefs, contextual and cultural factors demand further attention, and should be considered as variables when interpreting teachers' technology-use decision-making processes. For example, Zhao (2003) identified 11 salient factors for classroom technology innovation, which can be divided into three domains, i.e., the teacher, the context, and the innovation itself; and yet, the factors in the contextual domain remain under-explored, in the present study as in others (but see Straub, 2009; Ertmer & Ottenbreit, 2013). Therefore, studies focusing on contextual aspects could help researchers gain more in-depth understandings of current critical issues.

APPENDICES

APPENDIX A: List of the targeted colleges

Table 6. List of the targeted colleges

No.	Cities	Colleges
1	Zhuhai	Zhuhai Branch of Beijing Normal University
2		Beijing Institute of Technology, Zhuhai
3		Zhuhai college of Jilin University
4		Jinan University School of Translation studies
5	Guangzhou	Sun Yat-sen University, School of translation studies
6		Guangdong University of Foreign Studies
7		Sun Yat-sen University
8		South China university of Technology
9		South China Normal University
10		Guangdong University of Technology
11		Guangzhou University
12		Jinan Universities
13		Guangzhou Medical University
14	Shenzhen	South China University of Technology International
15		Guangdong Pharmaceutical University
16		Shenzhen University
17		Shenzhen Polytechnic
18		Southern University of Science and Technology

APPENDIX B: Invitation Poster

Participants Needed
Take a 10 min Online Survey

**and get
a 10¥ gift !**

via Wechat Red Packet

**Join if you are a college English teacher
and have been teaching for over a year**

Survey link in the QR code

**Or ask for a suvey link
by sending me an email:
liuhaixi@msu.edu**



Made with PosterMyWall.com

APPENDIX C: Invitation Email

Hello,

We are writing to ask you to respond to an online survey on Chinese English as Foreign Language (EFL) teachers' technology use. The result of this study can help researchers and teacher educators understand better the key factors influencing Chinese EFL teachers' technology use.

The potential participants need to be EFL teachers who have at least one year of teaching experience and can access to computers and Internet in their teaching environment. You will be asked a few questions at the beginning to confirm that you are eligible to complete the study.

Please click the link to go to the survey:

https://msu.co1.qualtrics.com/jfe/form/SV_0GIb1XXxjvlb5Gt

Or scan the QR code if you prefer to use mobile devices:



As a token of our appreciate for giving your time, all teachers selected to participate who submit their completed survey will be eligible to get 10 RMB reward via WeChat Red Packet.

Your individual response is very important to us and will be treated as confidential. Your participation in this survey is completely voluntary and will not affect any aspect of your work. Thank you in advance for completing the survey.

Thank you,

Haixia Liu

APPENDIX D: Consent form

Research Participant Information and Consent Form

You are being asked to participate in a research study. Researchers are required to provide a consent form to inform you about the research study, to convey that participation is voluntary, to explain risks and benefits of participation, and to empower you to make an informed decision. You should feel free to ask the researchers any questions you may have.

Study Title: Modeling the Determinants of Teachers' Constructivist Technology Use: An Extension of the Theory of Planned Behavior (TPB)

1. PURPOSE OF RESEARCH

The purpose of this research study is to understand how and why foreign language teachers are using technology in their teaching in constructivist way. The study can help teachers, teacher educators and school administrators understand teachers' technology use and possible ways to support such uses.

2. WHAT YOU WILL DO

We will send you a survey link to your email address and you will log into the website by clicking the link to complete the survey. You need to read the instructions carefully and indicate your choice in an honest manner.

Before the survey, you will read a consent form explaining the purpose of the study and would be informed that they have rights to withdraw data from the research. Moreover, you are free to skip any questions that you would prefer not to answer. The survey will take around 10-15 minutes for you to finish.

3. POTENTIAL BENEFITS

You will not benefit personally from being in this study. However, we hope that, in the future, other people might benefit from this study from a better understanding of key factors that influence teachers' constructivist use of technology.

4. POTENTIAL RISKS

There are no foreseeable risks, as the survey questions only focus on your attitudes; beliefs, knowledge and teaching practice. Your responses are confidential. If any questions make you feel uncomfortable, you are free to skip these questions or withdraw from the study at any time.

5. PRIVACY AND CONFIDENTIALITY

There will be no physical record of research data since the survey data will be entered into a secured web-based interface. The data will be maintained for three years after closing the project. After three years, the data will be destroyed. The data will not be used for other purposes other than this study. And the final product of this study (e.g., presentation, publication) will not include any identification information of any participants in the study.

6. YOUR RIGHTS TO PARTICIPATE, SAY NO, OR WITHDRAW

Participation is voluntary, you may choose not to participate at all, or you may refuse to participate in certain procedures or answer certain questions or discontinue your participation at any time without consequence.

7. COSTS AND COMPENSATION FOR BEING IN THE STUDY

You will receive a Red Packet in the amount of 10 RMB via WeChat. After you finish the survey, please inform the liaison person in your school to receive your red packet.

8. ALTERNATIVE OPTIONS

N/A

9. CONTACT INFORMATION

If you have concerns or questions about this study, such as scientific issues, how to do any part of it, or to report an injury, please contact the researcher (Haixia Liu, 620 Farm Lane, Erickson Hall, East Lansing, MI 48823, Email: liuhaixi@msu.edu) or the responsible investigator (Dr. Matthew J. Koehler; 513H Erickson MSU, Lansing, MI 48910, Tel 517-353-9287; mkoehler@msu.edu)

If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 4000 Collins Rd, Suite 136, Lansing, MI 48910.

10. DOCUMENTATION OF INFORMED CONSENT.

By clicking "I consent, begin the study", you indicate that you voluntarily agree to participate in this research study.

研究知情同意书

您被邀请参与一项调查研究。研究者必须提供一份知情同意书来告知此项研究为自愿参加，以及参加后可能存在的风险及利益，以帮助您做出决定。如您有任何疑问，请无需担忧向研究者提出即可。

1. 研究目的

本研究的目的在于理解当今外语教师使用教育技术来支持以学生为中心的学习。此项研究可以帮助教师，教师教育者以及学校管理者理解当今老师教育技术所存在的问题及其解决方式。

2. 您将做的是

您需要仔细阅读问卷内容并如实填写。在问卷开始之前，您会先读问卷知情同意书解释研究目的，并告知您有随时退出研究的权利。此外，您可以选择不回答其中的某些问题。此项问卷调查需要花费大概 10-15 分钟时间。

3. 潜在利处

此项研究并不能对您个人带来直接利益。但是我们希望在未来，其他人会在此项研究中受益因为此项研究的结果可以为告知相关利益者（如教师训练者，学校管理人员，政策制定者）有哪些重要因素会影响到教师的建构主义技术运用。

4. 潜在风险

问卷问题将会集中在你的态度，信念，知识与教学上，而且您的答案将会匿名保存，因而无可预见的风险。唯一可能存在的风险是你也许会部分涉及隐私的问题上（如您的年龄）感到不太舒服。或者您会因为担心自己的答案会被让研究者持有偏见。我们希望您明白您的回答是保密的而且研究者对任何回答都不会持有偏见。同时，您可以在任何时候退出研究，因此没有可预见的风险。

5. 隐私及保密

研究数据将不会以实物形式存在，因为所有数据都被键入一个安全的网络界面中。如果有任何的实物数据，将会被存入研究者在密歇根州立大学的办公室的文件箱中并且会锁上保存。仅此项研究的研究者可以接触到这些数据。数据将会在研究结束后保存三年。三年后研究数据将会被永久删除。数据仅用于该项研究切研究成果（如会议论文发表）中不会包含任何研究参与者的个人确认信息。

6. 您的参与权利及拒绝或退出的权利

您的参与是自愿的。您可以选择不参加，或者您可以拒绝回答其中某些问题。您也可以在任何研究开始后的任何时间段选择终止此项研究。如果您中途放弃，不会有任何不良后果。

7. 酬谢

为感谢您的参与，您完成问卷后，我们将赠送您微信红包 10 元作为酬谢。当您完成问卷

后请告知您学校的联络人并领取红包。

8. 其他选择

无适用条款。

9. 联系信息

如果您对此项研究还有顾虑或疑问，如科学问题，如何参与，或报告受伤事件，请联系研究者（刘海霞：620 Farm Lane, Erickson Hall, East Lansing, MI 48823，邮件 liuhaixi@msu.edu）或研究负责人（Dr. Matthew J. Koehler：513H Erickson MSU, Lansing, MI 48910，电话 517-353-9287; 邮件 mkoehler@msu.edu）

如果您对于自己作为研究对象的角色和权利有任何疑问或顾虑，希望获取信息或提供信息，或希望投诉此项研究，你可以（匿名或实名）联系 the Michigan State University's Human Research Protection Program，电话号码：517-355-2180；传真：517-432-4503。您也可以发电子邮件到：irb@msu.edu 或邮寄信件至 4000 Collins Rd, Suite 136, Lansing, MI 48910。

10. 知情同意并确认签名

如果您点击“我同意，开始研究”，就表明您是自愿参与本项研究。

APPENDIX E: An Overview of Measures for Latent Constructs

Table 7. An Overview of Measures for Latent Constructs

Latent variable	Indicator variable	Statement of questionnaire items
ATTU (independent)	ATTU1	I like using technology (e.g., computers, internet, software, mobile devices) for student-centered language teaching.
	ATTU2	I feel that using technology for student-centered language teaching is a good idea.
	ATTU3	I feel that using technology for student-centered language teaching is appropriate.
SN (independent)	SN1	People who influence my behavior think that I should use technology for student-centered language teaching.
	SN2	People who are important to me think that I should use technology for student-centered language teaching.
	SN3	My fellow colleagues are using technology for student-centered language teaching.
	SN4	Our school district encourages us to use technology for student-centered language teaching.
PBC (independent)	PBC1	When I encounter difficulties in using technology for student-centered language teaching, I know where to seek specific expert guidance.
	PBC2	When using technology for student-centered language teaching, I am given enough support on knowledge about technology use.
	PBC3	I have the resources, knowledge and skills to use technology effectively for student-centered language teaching.
TPACK (independent)	TPACK1	I can teach lessons that appropriately combine English linguistic concepts, technologies, and teaching approaches.
	TPACK2	I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn.
	TPACK3	I can use technology effectively to communicate relevant information to students and peers.
	TPACK4	I can use a range of technologies that enable students to become active participants.
	TPACK5	I can provide equitable access to digital language learning tools and resources.

Table 7 (cont'd)

CPB (independent)	CPB1	It is important that a teacher understands the feelings of the students.
	CPB2	Good teachers always encourage students to think for answers themselves.
	CPB3	Learning means students have ample opportunities to explore, discuss and express their ideas.
	CPB4	In good classrooms there is a democratic and free atmosphere, which stimulates students to think and interact.
	CPB5	Every child is unique or special and deserves an education tailored to his or her particular needs.
INT (dependent)	INT1	I plan to let students use technology (e.g., search engine) to orientate themselves to a new theme/topic in language learning in the future.
	INT2	I plan to let students acquire or analyze information from electronic databases (e.g., Corpus) in the future.
	INT3	I plan to let students use technology to do collaborative work (e.g., via cloud-based writing; wikis) to facilitate language learning in the future.
	INT4	I will continue to let students use technology to practice oral or written expression (e.g., via presentation software, podcasting, blogging) on given topics in the future.
	INT5	I expect that I would let students use technology to practice problem solving (e.g., use virtual world to let students navigate or communicate within simulated environments) in the future.

APPENDIX F: Questionnaire

Scale of Foreign Language Teachers' Student-centered Technology Integration

The purpose of this study is to understand how foreign language teachers use technology in classroom. Before the survey starts, we want to make sure you are the right participant for us, please indicate your status for the following questions:

- | | |
|--|--|
| 1. I am teaching or have ever taught College English. | Yes ☐ No ☐ |
| 2. I have at least one year of experience in teaching College English. | Yes ☐ No ☐ |
| 3. I can easily access to technology in my daily teaching environment. | Yes ☐ No ☐ |

Great. You chose **Yes** to all three questions, so you are the right participant for us. We would like to extend our sincere thankfulness for your participation in this study. Also please be noted that all information will be kept confidential. We would appreciate your most honest responses. Please click ***Continue*** to start the survey.

First, we would like to provide a glossary, which intends to assist you in understanding certain words, phrases or concepts defined in the context of this study. We would appreciate it very much if you can read carefully before the survey starts.

Technology: Information and communication technology such as computers, tablets, devices that can be attached to computers (e.g., LCD projector, interactive whiteboard, digital camera), networks (e.g., Internet, local networks), and computer software. We specifically are not including non-computer technologies such as overhead projectors and VCRs (Gary, Thomas & Lewis, 2010, p.2).

Student-centered language teaching: a teaching method that allow students to have control over the planning for what and how they learn in language classroom under the teachers' guidance (Warschauer & Kern, 2000).

Use technology for student-centered language teaching: teacher directed student use of technology to let students build language knowledge through learner-centered activities that aiming for exploration, information gathering, communication, collaboration, expression, data-analysis, problem solving etc (Becker, 1999; Ertmer, 2012).
E.g., online chatting; blogging; collaborative cloud-based writing; e-portfolio

Corpus: A collection of authentic language in spoken form, written form, or both.

Wikis: A website that allows multiple users to post or edit information

Blog: A web application that displays entries authored by the blog owner with time and date stamps and is visible to other web users

ePortfolio: A digital archive of student work created by a learner that records evidence of the learner's experiences, progress, achievements, and self-reflections

Virtual world: A virtual world is a program that allows learners to move a representation of a character, or "avatar", through a 3-D graphical environment.

Part One Basic Information

Please select the choice that match with your situation:

1 what is your gender?

- ☐ Male
- ☐ Female

2 what is your age?

- ☐ 20~30
- ☐ 31~40
- ☐ 41~50
- ☐ more than 51

3 what is your education background?

- ☐ Bachelor
- ☐ Master
- ☐ PhD & above
- ☐ Other (Specify) _____

4 How many years have you been teaching English as a foreign language?

- ☐ less than 5 years
- ☐ 6 ~ 10 years
- ☐ 11 ~ 20 years
- ☐ More than 20 years

Part Two: Beliefs, Attitudes and Technology Use

Please respond to the following items using the scale: 1 Strongly Disagree, 2 Disagree, 3 Undecided, 4 Agree, 5 Strongly Agree.

1. I like using technology (e.g., computers, internet, software, mobile devices) for student-centered language teaching.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

2. I will continue to let students use technology to practice oral or written expression (e.g., via presentation software or blogging) on given topics in the future.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

3. People who influence my behavior think that I should use technology for student-centered language teaching.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

4. I can teach lessons that appropriately combine English linguistic concepts, technologies, and teaching approaches.
- ☐ Strongly Disagree
 - ☐ Disagree
 - ☐ Undecided
 - ☐ Agree
 - ☐ Strongly Agree
5. It is important that a teacher understands the feelings of the students.
- ☐ Strongly Disagree
 - ☐ Disagree
 - ☐ Undecided
 - ☐ Agree
 - ☐ Strongly Agree
6. I feel that using technology for student-centered language teaching is a good idea.
- ☐ Strongly Disagree
 - ☐ Disagree
 - ☐ Undecided
 - ☐ Agree
 - ☐ Strongly Agree
7. When using technology for student-centered language teaching, I am given enough support on knowledge about technology use from an expert.
- ☐ Strongly Disagree
 - ☐ Disagree
 - ☐ Undecided
 - ☐ Agree
 - ☐ Strongly Agree
8. I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn.
- ☐ Strongly Disagree
 - ☐ Disagree
 - ☐ Undecided
 - ☐ Agree
 - ☐ Strongly Agree
9. I plan to let students use technology (e.g., search engine) to orientate themselves to a new theme/topic in language learning in the future.
- ☐ Strongly Disagree
 - ☐ Disagree
 - ☐ Undecided
 - ☐ Agree
 - ☐ Strongly Agree
10. My fellow colleagues are using technology for student-centered language teaching.
- ☐ Strongly Disagree
 - ☐ Disagree
 - ☐ Undecided
 - ☐ Agree
 - ☐ Strongly Agree

11. Good teachers always encourage students to think for answers themselves.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

12. I have the resources, knowledge and skills to use technology effectively for student-centered language teaching.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

13. In good classrooms there is a democratic and free atmosphere that stimulates students to think and interact.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

14. I expect that I would let students use technology to practice problem solving (e.g., use virtual world to let students navigate or communicate within simulated environments) in the future.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

15. I can provide equitable access to digital language learning tools and resources.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

16. People who are important to me think that I should use technology for student-centered language teaching.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

17. I feel that using technology for student-centered language teaching is appropriate.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

18. I can use technology effectively to communicate relevant information to students and peers.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

19. Learning means students have ample opportunities to explore, discuss and express their ideas.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

20. I plan to let students acquire or analyze information from electronic databases (e.g., Corpus) in the future.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

21. I can use a range of technologies that enable students to become active participants.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

22. Every child is unique or special and deserves an education tailored to his or her particular needs.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

23. I plan to let students use technology to do collaborative work (e.g., via cloud-based writing; wikis) to facilitate language learning in the future.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree
- ☐ Strongly Agree

24. When I encounter difficulties in using technology for student-centered language teaching, I know where to seek specific expert guidance.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Undecided
- ☐ Agree

☐ Strongly Agree

25. Our school district encourages us to use technology for student-centered language teaching.

☐ Strongly Disagree

☐ Disagree

☐ Undecided

☐ Agree

☐ Strongly Agree

外语教师以学生为中心的技术使用调查问卷

本研究旨在了解外语教师教学中是如何使用教育信息技术的。在问卷开始前，我们希望确认您是否适合本研究，请根据您的实际情况对以下陈述做出选择：

1. 我现在或曾经教授过大学英语课程 是 ☐ 否 ☐
2. 我至少有一年以上的大学英语课程教授经验 是 ☐ 否 ☐
3. 我在教学中能方便地使用信息技术工具。 是 ☐ 否 ☐

太好了。上述三个问题您都选择了“是”，因此您正是我们需要的问卷参与对象。衷心感谢您能抽时间参与我们的研究。请注意您所提供的信息都是仅限于研究者所以是保密的，我们希望您能如实回答。请点击“继续”进入问卷部分。

为了帮助您理解本研究的一些特定词汇，短语或概念的含义，我们提供了如下的词汇表。如果您能在做问卷前仔细阅读，我们将非常感谢。

技术：指的是信息交流技术比如计算机，平板电脑，移动设备以及可以连接到的设备（比如液晶投影仪，互动式白板，电子相机），网络（因特网，局域网）以及电脑手机软件。不能连接电脑的设备如透明片放映机，录像机等不包括在内。

以学生为中心的语言教学：学生在教师的指引下可以自主选择语言学习与学习方式

运用技术来支持以学生为中心的语言教学：在教师的指导下学生运用技术来进行以学生为中心的语言学习活动及构建语言相关知识。技术支持的以学生为中心的语言学习活动旨在培养学生的探索，收集信息，交流，合作，表达，数据分析及解决问题的能力。如：在线聊天，写博客，合作网络写作，电子化学习历程档案等。

语料库：真实语言表达（口头或书面或二者兼有）的综合数据库

维基：一个允许多用户发布或编辑信息的网页

博客：网络软件以供网络用户展示其输入的信息，日期等并可供其他网络用户浏览

电子化学习历程档案：是学生作品的电子档案，由学习者自己记录其学习经验，进程，成就及自我反思等。

虚拟世界：一个计算机软件模拟的网络世界，学习者可以通过虚拟的人物，如同“阿凡达”一样，在三维的图画环境中行动交流。

第一部分 基本信息

请根据您的实际情况做出选择

1 您的性别是

☐ 男

☐ 女

2 您的年龄是

☐ 20~30 之间

☐ 31~40 之间

☐ 41~50 之间

☐ 超过 51

3 您的教育程度

☐ 本科

☐ 硕士

☐ 博士及以上

☐ 其他（请注明）_____

4 您从事外语教学的年限是多少？

☐ 5 年以内

☐ 6~10 年

☐ 11~20 年

☐ 20 年及以上

第二部分 教学信念，态度及信息技术运用相关问题

以下陈述将询问您对于信息技术及语言教学中的理解和感受。请从“非常同意”，“同意”，“不能确定”，“不同意”，“非常不同意”的级别中，根据您的实际情况在对应的方框中打勾。

1. 我喜欢运用技术于以学生为中心的语言教学中。

☐ 非常不同意

☐ 不同意

☐ 不能确定

☐ 同意

☐ 非常同意

2. 将来我会让学生运用信息技术（如社交软件，电子日记软件）来锻炼口头(或书面)表达。

☐ 非常不同意

☐ 不同意

☐ 不能确定

☐ 同意

☐ 非常同意

3. 能影响我行为的人认为我应该使用技术来支持以学生为中心的语言教学。

☐ 非常不同意

- ☐ 不同意
 - ☐ 不能确定
 - ☐ 同意
 - ☐ 非常同意
4. 我能够在课程教学过程中恰当的将语言学习中的概念，技术及教学手段融合在一起。
- ☐ 非常不同意
 - ☐ 不同意
 - ☐ 不能确定
 - ☐ 同意
 - ☐ 非常同意
5. 老师了解学生的感受很重要。
- ☐ 非常不同意
 - ☐ 不同意
 - ☐ 不能确定
 - ☐ 同意
 - ☐ 非常同意
6. 我觉得使用技术来支持以学生为中心的语言教学是一个不错的想法。
- ☐ 非常不同意
 - ☐ 不同意
 - ☐ 不能确定
 - ☐ 同意
 - ☐ 非常同意
7. 在运用技术于以学生为中心的语言教学时能寻求到专人给我提供充足的支持。
- ☐ 非常不同意
 - ☐ 不同意
 - ☐ 不能确定
 - ☐ 同意
 - ☐ 非常同意
8. 我可以根据我的教学内容来选择适当的技术来提升我的教学内容，教学方式及学生所学。
- ☐ 非常不同意
 - ☐ 不同意
 - ☐ 不能确定
 - ☐ 同意
 - ☐ 非常同意
9. 未来我打算让学生使用技术（如搜索引擎）来自己确定或了解一个新的语言教学主题。
- ☐ 非常不同意
 - ☐ 不同意
 - ☐ 不能确定
 - ☐ 同意
 - ☐ 非常同意

10. 我的同事在运用技术来辅助以学生为中心的语言教学。

- ☐ 非常不同意
- ☐ 不同意
- ☐ 不能确定
- ☐ 同意
- ☐ 非常同意

11. 好老师总是鼓励学生独立思考自己的答案。

- ☐ 非常不同意
- ☐ 不同意
- ☐ 不能确定
- ☐ 同意
- ☐ 非常同意

12. 我拥有资源，知识及技术来保证有效地运用技术于以学生为中心的语言教学。

- ☐ 非常不同意
- ☐ 不同意
- ☐ 不能确定
- ☐ 同意
- ☐ 非常同意

13. 良好的教室气氛是民主及自由的，会刺激学生思考和交流。

- ☐ 非常不同意
- ☐ 不同意
- ☐ 不能确定
- ☐ 同意
- ☐ 非常同意

14. 我将来会让学生运用技术来练习解决问题（如通过虚拟世界游戏来让学生在模拟的语言环境中交流）。

- ☐ 非常不同意
- ☐ 不同意
- ☐ 不能确定
- ☐ 同意
- ☐ 非常同意

15. 我能给学生提供合理的电子语言学习工具和资源。

- ☐ 非常不同意
- ☐ 不同意
- ☐ 不能确定
- ☐ 同意
- ☐ 非常同意

16. 对我很重要的人认为我应该使用技术来支持以学生为中心的语言教学。

- ☐ 非常不同意
- ☐ 不同意
- ☐ 不能确定

- ☐ 同意
 - ☐ 非常同意
17. 我觉得运用技术于以学生为中心的语言教学是恰当的。
- ☐ 非常不同意
 - ☐ 不同意
 - ☐ 不能确定
 - ☐ 同意
 - ☐ 非常同意
18. 我能有效使用技术来将有关信息沟通给我的学生及同事。
- ☐ 非常不同意
 - ☐ 不同意
 - ☐ 不能确定
 - ☐ 同意
 - ☐ 非常同意
19. 学习是指学生有充分的机会去探索，讨论并表达自己的想法。
- ☐ 非常不同意
 - ☐ 不同意
 - ☐ 不能确定
 - ☐ 同意
 - ☐ 非常同意
20. 我打算让学生从电子数据库（如语料库）中获取信息或分析信息。
- ☐ 非常不同意
 - ☐ 不同意
 - ☐ 不能确定
 - ☐ 同意
 - ☐ 非常同意
21. 我能运用一系列的技术来让我的学生主动参与语言学习。
- ☐ 非常不同意
 - ☐ 不同意
 - ☐ 不能确定
 - ☐ 同意
 - ☐ 非常同意
22. 每个孩子都是独特的或特殊的，需要因材施教。
- ☐ 非常不同意
 - ☐ 不同意
 - ☐ 不能确定
 - ☐ 同意
 - ☐ 非常同意
23. 我计划将来让学生运用技术通过合作方式（如云写作，维基编辑等）来进行语言学习。
- ☐ 非常不同意
 - ☐ 不同意

☐ 不能确定

☐ 同意

☐ 非常同意

24. 当我运用技术于以学生为中心的语言教学遇到困难时，我知道去哪里寻求专业指导。

☐ 非常不同意

☐ 不同意

☐ 不能确定

☐ 同意

☐ 非常同意

25. 我所在的学区鼓励我们运用技术于以学生为中心的语言教学。

☐ 非常不同意

☐ 不同意

☐ 不能确定

☐ 同意

☐ 非常同意

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