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# *Barriers to the adoption of ICT in teaching Chinese as a foreign language in US universities*

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**Abstract**

This study aims to investigate barriers to the adoption of information and communication technology (ICT) for teachers of Chinese as a foreign language (CFL) in US universities. Although the development of ICT for teaching is growing, few published studies address ICT specifically regarding CFL teaching. Therefore, this study has reviewed the existing ICT literature's treatment of important ICT-related matters, including barrier factors, and has examined them in the context of CFL teaching. The current study features a mixed method, consisting of a survey and semi-structured interviews. Of the 47 CFL teachers who participated in the study, five volunteered for in-depth interviews. According to our findings, the most critical barriers to these CFL teachers' adoption of ICT were insufficient support and insufficient time for developing technology-driven pedagogy and activities. These issues are reflected in CFL teachers' unique subject expertise and workloads in existing universities' curricula and approaches to instruction. In addition, age influences CFL teachers' confidence in their use of ICT for the preparation of subject material and for teaching, whereas gender influences their willingness to spend time working on ICT.

Keywords: ICT, technology-integration barriers, CFL teaching, teachers' perspectives

## 1 Introduction

Learning Chinese as a foreign language (CFL) is becoming increasingly popular, as can be seen in the increasing number of CFL classes offered by universities in the United States since about 2000 (Nelley, Goldberg, & Lusin, 2010). More recently, US universities' CFL programmes have been reforming their approaches to teaching and learning while developing information and communication technology (ICT)

(Yao, 2009). Technology integration has gradually gained prominence in CFL programmes as computers and the Internet, being free of many time and location constraints, have proven to be highly convenient facilitators of CFL learning. Studies have indicated the effectiveness of ICT in helping create or foster classroom-based language-and-culture curricula (Grant & Huang, 2010), blended-learning environments (Huang, Lin & Chiang, 2010), knowledge sharing (Lin & Wang, 2008), collaborative learning tasks (Chang, Lan, Chang, & Sung, 2010), language acquisition (Chen & Liu, 2008), and self-efficacy (Henderson, Huang, & Grant, 2012). Advances in ICT have encouraged many CFL coordinators and instructors in higher education to think critically about using computers, the Internet, and Web-based tools to enhance technology-mediated learning (Chin, Lin, & Chan, 2011; Hao, Hong, Jong, Hwang, Su & Yang, 2010; Huang, Hsin, & Chiu, 2010; Huang & Lin, 2011).

Current CFL programmes in the United States have recently entered a transformative stage in which ICT is helping to expand their curriculum, instruction, and faculty professional development. As the field of CFL teaching and learning has begun to embrace educational technologies, and as ICT applications have varied from campus to campus (depending on resources, availability of materials, faculty interest, and other factors), educators should pay more attention to issues surrounding barriers to ICT adoption in CFL teaching settings. Integration of ICT into CFL instruction still remains an issue for those teachers who, for whatever reason, cannot effectively apply ICT to teaching and learning. Available research has explored a wide variety of factors influencing ICT adoption and integration into other language and learning settings; however, existing research seldom centres on the combined impact of these variables in CFL contexts. The issue of incorporating ICT into CFL teaching is important, and yet little research has examined this topic; therefore, more needs to be known about the barriers that CFL teachers might encounter in US universities.

This study is significant for many reasons. First, the incorporation of ICT into CFL instruction has been growing along with both ICT developments and CFL learning in the United States. The gap between the existing literature on ICT and issues important to CFL courses makes this empirical study valuable. Second, this study used the questionnaire developed by Al-Senaidia, Lin, and Poirot (2009) to measure barriers that CFL faculty encounter. In addition, our in-depth interviews have shed light on CFL teachers' related reflections and experiences for the purpose of complementing the survey findings. Former studies in this field have tended to use only surveys developed for a uniquely quantitative approach (e.g., Ertmer, Addison, Lane, Ross, & Woods, 1999) and to present only item-level findings (Butler & Sellbom, 2002). In contrast, this study presents both item-level and factor-level findings coupled with data supplemented by a mixed-method approach. Third, drawing on pedagogical and instructional perspectives, this study examines the barriers that Chinese language teachers perceive as they try to incorporate ICT into their CFL curricula and instruction at US universities. These findings are expected not only to clarify what the barriers are, but also to help Chinese instructors who have not yet adopted ICT to begin doing so. It is also hoped that these findings can strengthen CFL programme coordinators' awareness of both the various barriers to and the feasibility of adopting ICT for the programmes. The following is

a review that summarizes the literature most essential to our study's theoretical underpinnings.

## 2 Barriers to the use of ICT in teaching and learning

Different uses of ICT tools have been identified among various applications in either generic or specific domains. The adoption of ICT in the language classroom has transformed teaching and learning from a behaviouristic paradigm to a communicative paradigm and subsequently to an integrative paradigm (Kern & Warschauer, 2000; Warschauer, 1996). The introduction of ICT has provided potential for enriching teaching pedagogies and methods in traditional teacher-fronted language courses. The main benefits of ICT for language learning can be understood by drawing on the perspective that technology-enhanced language learning is cooperative, authentic, and meaningful (Kumar & Tammelin, 2008). Students can listen, speak, read, write, and otherwise respond by using ICT tools in support of their language-learning tasks. Varied types of media can, when presented to learners, motivate them to communicate and collaborate with peers as well as to produce targeted linguistic output, all on the basis of diverse learning styles. With the help of ICT-based tools, language teachers can give individual and personalized scaffolding support to learners in line with their respective progress (Towndrow, 2007). ICT tools make it easier for language teachers to effectively accommodate the different needs of learners and to improve the quality of their learning experience (Samuel & Bakar, 2006). Thus, it can be expected that ICT can transform a traditional lecture/drill-based CFL classroom into a more interactive and dynamic learning environment.

Even though ICT adoption has been proved to benefit teachers and learners, many studies have been conducted to determine why certain teachers do not incorporate ICT into their teaching approaches (Levin & Wadmany, 2008; Wong, Li, Choi & Lee, 2008). To implement ICT-supported activities, a number of issues regarding provision of adequate facilities, training, and support can be expected in any university setting. Among the studied barriers to ICT incorporation are lack of institutional and financial support (Han, 2008; Lim, & Khine, 2006; Neyland, 2011), lack of time (Mukama & Andersson, 2008), lack of technological knowledge (Angeli & Valanides, 2009), and lack of technology support and equipment (Butler & Sellbom, 2002; Groves & Zemel, 2000). Time has been typically pinpointed as a primary issue with respect to participating in technology training and connecting such tools to teaching and learning activities (Tondeur, van Keera, van Braaka & Valckea, 2008). Other extrinsic barriers consistently noted include lack of inadequate and unreliable equipment (Demiraslan & Usluel, 2008), extra workload (Goktas, Yildirim & Yildirim, 2009), release time, and concerns about the quality of a given technology-supported course (Birch & Sankey, 2008). Where these issues surface often depends on the type of teaching context, and thus it is essential to determine particular problems in order to sustain better ICT use.

Although Chizmar and Williams (2001) did not rank the order of various barriers to ICT incorporation, they recommended that universities should create a selection of ICT modules tied to pedagogical strategies. A major impediment was that faculty seemed to lack the time for training, even though, according to the research, faculty

would most likely have benefited if they had come together to share experiences concerning ICT incorporation. The study concluded that sufficient resources and funding were necessary to satisfy the faculty's technology-use needs. Ertmer (1999) separated barriers to technological incorporation into two levels. The first-level barriers are those extrinsic to teachers, such as lack of technological access, support, and time. Second-level barriers are intrinsic and consist of teachers' beliefs about teaching, technology, and classroom practice, as well as a willingness to change. Ertmer (1999) also elaborated on the relationship between first- and second-order barriers, and provided specific strategies for overcoming the various barriers teachers face as they try to accomplish technological integration. Honey and Moeller (1990) pointed out a close relationship between teaching philosophy and technological incorporation. Teachers with a student-centred teaching philosophy were strong proponents and users of technology.

Problems related to the technical skills needed for ICT adoption are viewed as twofold (Bauer & Kenton, 2005). Faculty reported that their technical skills were insufficient for mastering and using Internet technologies; further, they were insecure about adopting technology that might decrease their professional performance, thus exposing their perceived weaknesses to students and colleagues. Successful adoption of ICT requires concentrated and continuous trials within different periods of time (Hayes, 2007). Because necessary preparation time decreases as faculty become familiar with technology, faculty's need to update their own ICT skills has been deemed labour-intensive in terms of time spent and effort required. Studies (e.g., Ferrarini & Poindexter, 1999; Liu & Huang, 2005) have consistently shown the necessity of providing faculty with incentives to undertake ICT development through grant awards, credit for promotion, or reduced workloads, as faculty have mandatory obligations competing for their time. This type of incentive can help ensure that teaching and learning tasks in a course to which ICT is to be applied are consistent with pedagogical goals.

One frequently explored reason for not adopting ICT derives simply from a lack of motivation (Löfström & Nevgi, 2008); in particular, the incentive structure system in most traditional universities may not be centred on teaching and learning *per se*. Rather, this phenomenon implies that what universities truly value is traditional research. Another major hindrance is inadequate training and a lack of professional development programmes for integrating technology into the existing curriculum (ChanLin, Hong, Horng, Chang & Chu, 2006; Georgina & Hosford, 2009). Faculty may feel exceedingly constrained by their university's expectations regarding subject-matter coverage and may dislike participating in teacher training where time and energy are devoted to preparing for tested material rather than to implementing innovative teaching activities based on, for example, ICT. To effectively use ICT in the educational domain, faculty must skillfully cultivate technical and communicative competencies. Faculty members who are effective within a traditional environment can make years of onsite experience transferable to online settings by engaging in trial-and-error experiments of ICT adoption. To better facilitate ICT usage by faculty, universities should situate it under teaching and learning goals.

Teachers' beliefs are also an influential factor regarding the adoption of ICT in teaching (Lucas & Wright, 2009; Tondeur, Van Braak, & Valcke, 2007). These beliefs

are formed through their interactions with the world. Most research has shown that the application of behavioural teaching methods is a product of our beliefs (Pajares, 1992; Tondeur, Van Braak, & Valcke, 2007). If a teacher considers ICT to be essential and can foresee potential value in its use, it is more likely that ICT integration will become part of his or her teaching beliefs and, as a result, will be incorporated into that teacher's methodology. Becker (2000) concluded that there was a clear relationship between teaching beliefs and teachers' use of computers in their approach to teaching. For example, studies indicated that teachers who use computers in the classroom are more constructivist-oriented than teachers who do not (Dexter, Anderson, & Becker, 1999; Rakes, Fields, & Cox, 2006). Successful implementation of ICT does not automatically take place simply when teachers start using technology to facilitate students' learning processes. Teachers' beliefs about the potential of technology to support the curriculum play an important role in successful ICT implementation (Chen, 2008; Ertmer, 2005).

Gender and age differences are two additional important factors associated with teachers' willingness to deepen their understanding of ICT and to develop new ICT-oriented pedagogical practices (Hakkarainen, Lipponen, Ilomaki, Rahikainen, & Lehtinen, 2001). In terms of gender, female teachers' classroom use of computers tends to be lower than male teachers' (Hermans, Tondeur, van Braak & Valcke, 2008), a phenomenon that may translate into a low willingness among female teachers to explore innovative ICT tools. In terms of age, research has found that the younger a teacher is, the more likely he or she is to have positive attitudes towards and confidence in ICT-oriented pedagogy (Jennings & Onwuegbuzie, 2001; Luan *et al.*, 2005). In sum, major categories of barriers identified include lack of confidence, time, training, and access to computer resources and institutional support; being resistant to innovative change; being a female teacher, and being an older teacher.

## 3 Research method

### *3.1 Research questions*

This study aims to (1) explore the perceptions that teachers have of their experiences using ICT in CFL classrooms, and (2) identify the perceived item-level and factor-level barriers that relate to and impact on ICT integration in CFL classrooms. We used descriptive statistics to answer the research question, coupled with interview data to supplement interpretation of our statistical analysis. Also, we used generalized linear modelling (Agresti, 2007) to analyze data concerning the relationship between participants' background information and five predetermined factors: lack of equipment, lack of support, lack of confidence, lack of time, and disbelief in ICT benefits. We chose a mixed-methods design because it can describe patterns of associations among variables and investigate effects of explanatory variables on responsive variables.

### *3.2 Participants and instrumentation*

Conducted during the spring semester of 2012, this study used a sample of 47 university-level CFL teachers whose ethnic backgrounds were similar to one another.

Table 1 *Demographic variables of the participants (N = 47)*

| Demographic variables | Frequency | Percentage (%) |
|---|---|---|
| *Gender* | | |
| male | 8 | 17 |
| female | 39 | 83 |
| *Age* | | |
| 21–25 | 5 | 11 |
| 26–30 | 18 | 38 |
| 31–35 | 21 | 45 |
| 41–45 | 1 | 2 |
| >46 | 2 | 4 |
| *Nationality* | | |
| China | 12 | 26 |
| Taiwan | 35 | 74 |

All of the teachers were from the states of Illinois, Texas, Pennsylvania, New York, and Michigan. Of these CFL teachers, whom we recruited through email inquiries, five (T1–T5) volunteered for follow-up interviews. Most participating teachers' specializations were in Chinese literature, linguistics, or language teaching, all with Master of Arts or Doctor of Philosophy. The demographic information for these CFL teachers is presented in Table 1.

We adopted the measure developed in Al-Senaidia, Lin, and Poirot's (2009) study to investigate CFL teachers' perceptions of barriers to ICT use in classrooms. The measure appealed to us because it could elicit sufficient information to illustrate the teachers' perceptions of ICT barriers in a higher education setting. The original measure was not changed much, but was modified through the addition of some words to fit ICT methods typical in CFL teaching settings in US universities. All participants were required to indicate to what extent they agreed or disagreed with each of the statements on a five-point Likert scale. This measure was validated and pilot-tested in advance of a formal examination application. Cronbach's alpha for the overall survey was 0.73, which is a good accepted value (Santos, 1999). Furthermore, the selected measure is suitable for this study because it is a standardized survey especially constructed to measure higher education faculty's perceptions of barriers to ICT-adoption.

## 4 Research findings

### *4.1 Item-level analysis*

Table 2 demonstrates that, at the item level, most of the mean scores for each question item are approximately 3.00 with a standard deviation of between 0.90 and 1.20. The mean scores range from 4.04 (i.e., the greatest agreement) to 1.98 (i.e., the least agreement). Notably, the five items that most of the participating CFL teachers agreed on are (in descending order) items 15, 10, 9, 14, and 18 (see Table 2).

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Table 2 *Survey of ICT-adoption barriers*

| Items | | *M* | *SD* |
|---|---|---|---|
| 1. | CFL teachers lack basic technological skills to adopt ICT in teaching and learning. | 2.62 | 1.13 |
| 2. | CFL teachers lack access to basic hardware in ICT integration. | 2.87 | 1.12 |
| 3. | CFL teachers lack access to basic software in ICT integration. | 3.20 | 1.20 |
| 4. | It takes too much time for CFL teachers to contact their students (e.g., email). | 2.60 | 1.14 |
| 5. | CFL teachers think ICT is not helpful for classroom teaching and learning. | 2.18 | 0.96 |
| 6. | CFL teachers lack time to adopt ICT. | 3.13 | 1.14 |
| 7. | CFL teachers lack time to implement ICT-based course delivery. | 3.24 | 0.96 |
| 8. | CFL teachers' universities do not provide the teachers a convenient time for ICT training. | 3.42 | 1.06 |
| 9. | CFL teachers lack administrative support for integrating ICT into teaching and learning. | 3.47 | 1.16 |
| 10. | There is a lack of ICT-related sharing, discussion, or support among CFL teachers in this school. | 3.49 | 1.06 |
| 11. | ICT does not fit well with the CFL courses taught. | 2.42 | 0.99 |
| 12. | CFL teachers perceive that classroom management is more difficult when using technology. | 2.62 | 1.09 |
| 13. | CFL teachers lack interest in using technology in teaching and learning. | 2.64 | 1.03 |
| 14. | CFL teachers lack appropriate software for meeting students' needs. | 3.33 | 1.07 |
| 15. | CFL teachers lack sufficient financial support for developing technology-based activities. | 4.04 | 1.07 |
| 16. | CFL teachers are not comfortable using ICT. | 2.36 | 1.09 |
| 17. | CFL students are not comfortable using ICT. | 1.98 | 0.84 |
| 18. | CFL teachers lack technical ICT support. | 3.33 | 1.19 |

The idea of insufficient financial and administrative support, referred to in items 9 and 15, substantiated what T1, an experienced lecturer, suggested, i.e., that these issues were critical to her use of ICT in her teaching. She stated that, because her department's focus was on literature, there were insufficient resources and support that she could obtain as a language-oriented teaching-track faculty member. She indicated: "Without a top-down mandated implementation plan, it is difficult to acquire opportunities to talk to my colleagues about technology use within instructive classroom settings." CFL programmes are usually affiliated with an Asian Studies department or something along those lines, with their main areas of focus being literature and culture – areas to which most of the available resources are allocated. T1 pinpointed the lack of institutional support as a barrier to integrating ICT in teaching: "To understand the relationship between technology and pedagogy, we [teachers] have to investigate students' perspectives. However, people

[department administrators] may generate the kind of barriers that hinder research-based technology integration.'' T1 deemed financial support and administrative support to be two forces critical to transforming her existing lecture- and drill-based curriculum.

T2 emphasized that ''the students are passive receivers [for learning a language]. I feel the programme coordinator should help provide as many resources as possible. Under many circumstances, the use of technology was not easy or accessible so the teachers opted to give it up.'' The core of the CFL curriculum seems to emphasize the learning of vocabulary and the application of syntactic rules to sentential construction, and thus the ICT was overlooked. T4 described her programme director's attitude towards using educational ICT: ''He [the director] did not really encourage us [teachers] to use too many media in support of the courses.'' Insofar as teaching materials were grounded only on a textbook and a CD, T4 was disappointed that the Chinese curriculum did not adopt any useful ICT. She recounted a specific situation: ''One time I designed a more complicated lesson plan to incorporate many technology tools, but was disapproved by [my] director.'' Rather than encourage T4 to invest time in developing ICT, her supervisor – considering the cost-effectiveness of lesson preparation – thought a blackboard and textbook would suffice. After all, the supervisor was not certain about the potential of ICT and its pedagogical impacts.

Many of the Chinese language teachers who participated in this study stated that CFL teachers, in general, lack technical support for ICT (Item 18) and software capable of meeting students' learning needs (Item 14). T4 opined on this issue: ''In addition to the traditional blackboard, our classrooms are only equipped with projectors. We [instructors] even have to carry CD players to class. The use of the Internet is not really convenient.'' The use of an audiovisual classroom or language lab, as T2 mentioned, is needed to enable students to easily watch a movie or an Internet video clip, although that approach is not necessarily applicable to all classes. T3 also acknowledged the necessity of reserving classrooms with special technological facilities and support, but making a reservation, as well as preparing for the presentation, can become a burden, thus hindering the utility of such a classroom or lab. According to T2, the school-assigned textbook and CDs for students were insufficient; subsequently, T2 had to spend extra time searching online resources regarding matters like stroke-order demonstrations and had to forward the supporting materials to students. T2 stated, ''Some students asked about the cultural or historical background [of a particular topic]; I would use an online database like Wikipedia, which has less Chinese text and is easier to comprehend.''

Teachers' belief in and readiness to use ICT are other factors essential to ICT adoption, as reflected in two items: Item 5 (i.e., CFL teachers do not consider ICT to be helpful for classroom teaching and learning) and Item 16 (i.e., CFL teachers are not comfortable using ICT). T3 indicated that her previous experience in studying computer-mediated communication in graduate school was a major reason for her decision to apply ICT to her teaching practice. Many Chinese teachers might not have considered using ICT, had they not received technology-related training within their traditional teaching framework. T4 felt that ''most of the students' language input comes from teachers. For my own class, they [students] are all beginners. The focus should zero in on their motivation; other issues are less important.'' Believing in the

significance of working with individual students' learning needs, T4 addressed the uncertain value of technology usage as an effective method of teaching CFL for teachers who did not have similar experience to hers.

Another interesting issue in the teaching community, according to this study's participants, is the lack of ICT-related sharing, discussion, or support among CFL teachers in US universities. This overall finding derives from Item 10 of the survey and also surfaced in the interview results from some teachers. The cultures that dominated the various CFL programmes where we conducted research were a contextual factor affecting ICT adoption, as was teachers' willingness to experiment with ICT. T4 revealed that some of her colleagues viewed Web technology as a tool that would increase their workloads, not as a tool that would promote students' learning, and did not consider integrating technology into their classrooms. T5 stated, "When there is no technology integration in the enacted curriculum, it will be difficult for the instructors to implement Web-supported teaching in the class." T5 even noted that some of his colleagues and his director regarded media, including the Internet, as toys more than as tools: "They perceive that my adoption of Web media can improve class activities and student interaction, but not learning outcomes. They feel the more tests and drills there are, the better students' performance will be." As expectations of learning efficiency are on the rise and mandatory tests have consumed most of teachers' time, incorporating ICT is almost impossible. T5 further explained the dilemma: "Many teachers have worked overtime. If there is no consensus among teachers, it is difficult to use computer and technology media."

In contrast, most teachers disagreed with the statements in Item 5 (i.e., CFL teachers think ICT is not helpful for class teaching and learning), Item 16 (i.e., CFL teachers are not comfortable using ICT), and Item 17 (i.e., CFL students are not comfortable using ICT). Most Chinese language teachers interviewed agreed that the adoption of ICT in CFL classes in US universities is of great help. As the respondents noted, CFL teachers' use of ICT can inject into classes a variety of language learning inputs that are more authentic than a textbook-only environment and that encourage students to apply their varying language skills to selected tasks. T2 clarified his viewpoint on this matter by stating, "I agree to have [my] students use technology to facilitate teaching and learning, but I disagree about digitalizing all assignments. This has to do with my perspective of learning." T2 expressed the option that optimal use of ICT for enhancing CFL skills is promising, even though some students may at times dislike ICT because they feel uncomfortable making their work (e.g., writing or recorded speech) available publicly. It is understandable that CFL students are still formulating their language structures and their production may be full of errors.

The potential for adopting Web technologies lies in free and user-friendly interfaces. Established and evolving tools such as blogs, wikis, YouTube, Facebook, and voice-recording applications (e.g., Chirbit and SoundCloud) are of pedagogical value in learning Chinese via collaborative sharing and exchange among peers. Most CFL teachers agreed that, to a certain extent, ICT fit with their courses (Item 11); nonetheless, some respondents also reported problems about its feasibility. T5 found that his students had positive responses by experimenting with blogs and wikis in

Table 3 *Descriptive factor-level statistics regarding perceptions of ICT-adoption barriers*

| Factors | M | SD |
|---|---|---|
| Factor 1 (lack of equipment): items 2, 3, 14 | 2.82 | 1.00 |
| Factor 2 (lack of support): items 8, 9, 15 | 3.49 | 1.16 |
| Factor 3 (disbelief in ICT benefits): items 5, 6, 12, 13 | 2.53 | .92 |
| Factor 4 (lack of confidence): items 1, 16, 17 | 2.22 | .91 |
| Factor 5 (lack of time): items 4, 7, 18 | 2.93 | .90 |

writing Chinese journals and stories. However, he was concerned about Internet security, an issue outside his own control. A survey conducted by T5's director showed that, as T5 discussed, "Some students don't have personal computers. If the instructor requires Internet-based assignments, such as recording [on line] or writing blogs, it will be a bit troublesome because students will need to check out the equipment from the university." Considering students' busy schedules, T4 pointed out: "My students are mostly seniors. Sometimes when I provide supplementary materials or ask them to browse [some websites], they would, but just a quick glance. Only one student would do it in a comprehensive way." Overall, most teachers reported that students accepted participation in online activities.

### *4.2 Factor level analysis*

Concerning the means of the selected factors, Table 3 shows that most factors reached a level around 3.00, except for Factor 4. The standard deviation was around 1.00. It is noteworthy that respondents regarded Factor 2 (i.e., lack of support) as the most influential factor impeding the adoption of ICT. Respondents cited Factor 5 (i.e., lack of time) as another critical factor that undermined incorporation of ICT into their teaching of Chinese. Factor 1 (i.e., lack of equipment) was also viewed as a critical barrier factor. The mean for Factor 3 (i.e., disbelief in ICT benefits) was relatively low, which indicates that some of this study's participating CFL teachers still did not believe that the adoption of ICT could benefit their teaching of Chinese. The mean of Factor 4 (i.e., lack of confidence) is close to 2 on a 95% confidence interval, and thus it can be argued that participating CFL teachers did not consider lack of confidence to be a barrier to ICT adoption in their pedagogy. Although the means for the five factors are not exactly identical, it is apparent that Factors 1, 2, 3, and 5 obtained statistical significance, whereas Factor 4 did not. In brief, these findings show that participants generally associated Factors 1, 2, 3, and 5 with ICT-integration barriers in CFL classes, but Factor 4 showed a less salient relationship.

The survey gathered respondents' demographic information (i.e., age, gender, teaching position, and nationality) and addressed the five chosen factors: lack of equipment, lack of support, lack of confidence, lack of time, and a disbelief in ICT benefits. Taking into account the background information and the five factors outlined in Table 3, a significant finding was revealed, as follows.

Table 4 *Goodness-of-fit test for log-linear Model 1*

| Criteria for assessing goodness-of-fit | | | |
|---|---|---|---|
| Criteria | *df* | Value | Value/*df* |
| Deviance | 8 | 12.68 | 1.59 |
| | | Global goodness-of-fit statistic | |
| | | Value | *df* | *p-value* |
| | Deviance, $G^2$ | 32.10 | 42 | .87 |

Table 5 *Estimations of parameters for Model 1*

| Analysis of maximum likelihood parameter estimates | | | | | | | |
|---|---|---|---|---|---|---|---|
| | *df* | Estimate | Standard Error | Wald 95% Confidence Limits | | Wald ChiSq | Pr > ChiSq |
| Intercept | 1 | 3.17 | 0.58 | 2.02 | 4.32 | 29.42 | <.0001 |
| 21–25 | 1 | −0.97 | 0.69 | −2.33 | 0.39 | 1.97 | 0.1607 |
| 26–30 | 1 | −1.33 | 0.62 | −2.54 | −0.13 | 4.70 | 0.0301 |
| 31–35 | 1 | −0.74 | 0.61 | −1.94 | 0.46 | 1.47 | 0.2254 |
| 41–45 | 1 | −0.17 | 1.01 | −2.15 | 1.81 | 0.03 | 0.8666 |
| 46 or older | 0 | 0.00 | 0.00 | 0.0000 | 0.0000 | . | . |
| Scale | 1 | 0.83 | 0.09 | 0.68 | 1.01 | | |

Model (1) illustrates the potential relationship, in which $\mu_i$ represents a lack of confidence, $\beta^C$ denotes the teachers' age, and *i* refers to each participant's identifying index.

$$\text{Model}: \mu_i = \alpha - \beta_i^C \quad (1)$$

According to the goodness-of-fit test, this model was not rejected and explains the data well ($G^2 = 32.10$, $p = .87$) (see Table 4). The result consequently suggests that age is an important factor that influences the confidence level of CFL teachers.

We used Wald statistics to identify which age group was significantly related to the lack-of-confidence factor. Data analysis reveals that the coefficient of the 26-to-30-year-old age group was −1.33, suggesting that teachers of this particular age group were significantly different from those of other age groups ($\chi^2 = 4.7$, $df = 1$, $p = .03$) (see Table 5). Except for the 26-to-30-year-old age group, other groups are not significantly different in terms of parameter estimate. As a result, these findings indicate that the age of CFL teachers influenced their perception regarding their lack of confidence about the use of technology in the classroom. In particular, those in the 26-to-30-year-old age group are more confident about using ICT in their CFL classrooms. This pattern makes sense insofar as a younger generation of teachers who have received better technology training are likely to believe more strongly in

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Table 6 *Goodness-of-fit test for log-linear Model 2*

| Criteria for assessing goodness-of-fit | | | |
|---|---|---|---|
| Criteria | *df* | Value | Value/*df* |
| Deviance | 8 | 12.68 | 1.59 |
| **Global goodness-of-fit statistic** | | | |
| | | Value | *df* | *p-value* |
| | Deviance, $G^2$ | 31.02 | 45 | .94 |

Table 7 *Estimations of parameters for Model 2*

| Analysis Of Maximum Likelihood Parameter Estimates | | | | | | | |
|---|---|---|---|---|---|---|---|
| | *df* | Estimate | Standard Error | Wald 95% Confidence Limits | | Wald ChiSq | Pr > ChiSq |
| Intercept | 1 | 3.71 | 0.29 | 3.15 | 4.27 | 166.72 | <.0001 |
| Female | 1 | −0.94 | 0.32 | −1.56 | −0.32 | 8.88 | 0.0029 |
| Male | 0 | 0.00 | 0.00 | 0.00 | 0.00 | . | . |
| Scale | 1 | 0.81 | 0.08 | 0.67 | 0.99 | | |

the potential efficacy of ICT for pedagogical purposes; and their teaching experience supports this view.

To better understand the effects of other factors, we subsequently tested the proposed model. The model was constructed as follows, in which $\mu_i$ represents lack of time for adopting ICT in the CFL classrooms, $\beta^C$ denotes teachers' gender, and *i* refers to each participant's identifying index.

$$\text{Model}: \ \mu_i = \alpha + \beta_i^C \tag{2}$$

Based on the goodness-of-fit test, the model was not rejected and it fits well to provide support of statistical evidence ($G^2 = 31.02$, $p = .94$) (see Table 6).

This finding suggests that gender was a significant factor in the participating teachers' perception that they lacked time to implement ICT in their own classrooms. Using Wald statistics, we calculated that the coefficient of female was −0.94, which proved to be significant ($\chi^2 = 8.88$, $df = 1$, $p = .003$) (see Table 7). These results imply that the participating female CFL teachers tended to be more willing than their male colleagues to spend additional time on the adoption of ICT for their CFL teaching duties. A possible explanation of this phenomenon may be attributed to Taiwanese and Chinese female teachers' characteristics. They are inclinded to take responsibility for exploring innovative teaching methods that might improve the efficacy of their teaching.

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## 5 Discussion

Educators' incorporation of ICT into teaching and learning has become prevalent in US universities. Relevant studies have demonstrated a positive relationship between the integration of ICT and learning motivation, learning satisfaction and instructional effectiveness (Sutherland, Robertson, & John, 2009). The present study has specified the main barriers to ICT integration in CFL classes in US universities, provided an overview of related integration issues, and informed researchers and practitioners about potential ways in which CFL teachers can successfully adopt such technology. To date, many institutions still cannot leverage the potential benefits of using ICT in their curriculum and course design. Undoubtedly, adequate support can assist in eliminating barriers and sustaining increased adoption of ICT. According to the item-level and factor-level results, the most significant barrier to ICT adoption is lack of support. CFL teachers reported that they required the support of their organizations, supervisors, and colleagues to apply ICT in their classes. The participating teachers stated that, without full and varied support, they could not successfully integrate ICT into their classrooms. In particular, financial, peer, and administrative support are the three major elements required by CFL teachers for the adoption of ICT.

Although the participating Chinese language teachers may have been confident about undertaking ICT-integration, they stated that sufficient time and equipment, as well as positive attitudes, would be necessary for the integration to be successful. The design of Chinese language programmes should take into consideration teachers' ICT-related beliefs, levels of confidence, instructional needs, and professional development. Only when these barriers are gradually resolved can we ensure the efficient effectiveness of CFL teachers' ICT usage in curriculum, teaching and learning tasks. Professional training and development for curriculum-based technology integration will help CFL teachers identify technology affordances and improve their pedagogical knowledge about the use of ICT (Harris & Hofer, 2011).

Among the participants in our study, we noted that younger CFL teachers were more confident than older ones when it came to integrating ICT into classrooms. This pattern makes sense because the younger teachers belong to Generation Y (born between the early 1980s and the mid-1990s), and are classified as "digital natives" – that is, as people who are more accustomed than their elders to using technology in daily life (Huntley, 2006). The younger CFL teachers who participated in this study displayed more signs of confidence than their older peers when it came to using ICT in their teaching. In addition to age, this study found that gender was associated with the amount of time that CFL teachers would devote to using ICT in preparation of their teaching materials. Our study's results indicate that, in general, female teachers are more patient and willing than their male peers regarding the devotion of time to both curriculum preparation and teaching itself. The characteristics of female teachers' attitudes towards their instructional preparation and goals may be related to their passion for and commitment to teaching. Although there might be some potential barriers, female and younger Chinese language teachers tend to be more confident and willing to apply ICT in their classrooms. Professional teacher development and teacher learning communities centered on ICT-driven applications and pedagogies

may consequently hold promise for knowledge sharing and dialogues among CFL teachers on the interwoven topics regarding ICT integration.

## 6 Conclusions

This study's aim has been to provide useful information about the barriers that teachers face when trying to integrate ICT into their CFL classes at US universities. However, some limitations in this study bear mentioning. Because of constraints on accessible resources and correspondence, the volunteer participants were recruited from only five US states. A larger sampling number would be not only desirable but also possible through the sponsorship of a national large-scale research project, thus serving to validate the current study's distinctive survey constructs by exploratory factor analysis. In terms of the sample size and the gender of this study's CFL teachers, we did not have an equal number of male and female participants. This unavoidable issue was driven by the simple fact that, at the US universities where we sought participants, more females than males were CFL teachers. Future studies could have equal recruitment of male and female participants for the qualitative interviews, if feasible. Finally, follow-up research using an ethnographic or multiple case-study approach would be advisable for exploring the specific barriers related to linguistic or cultural factors. In examining these themes, research might help identify effective strategies for mitigating these barriers. To benefit CFL teachers, more studies should document examples of how teachers accomplish meaningful and effective ICT integration, including teachers' use of freely obtainable Web tools. We hope that CFL teachers, administrators, and scholars can search for practical methods to help reduce these obstacles to the adoption of ICT at their universities. When Chinese language teachers are motivated to use ICT, teaching and learning of CFL can be effectively transformed for 21st century learners.

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