

Exploring the Impact of Teachers' Beliefs on Their Different Uses of Technology

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Abstract: This study explores how teachers' pedagogical beliefs and beliefs in students' readiness to use technology are related to their classroom uses of technology. The participants in this study were 202 foreign language teachers in China because these teachers often use technology in language teaching, hold a wide variety of beliefs, and represent an understudied population of teachers when it comes to technology usage. We found support for four types (i.e., clusters) of teachers' pedagogical beliefs, and that these types led to statistically significant differences in levels of both traditional and constructivist uses of technology. We also found that teachers' who held higher levels of beliefs about students' readiness to use technology led to significantly more uses of constructivist classroom technologies (but not traditional uses of technology). We discuss the implications of these findings for researchers and practitioners.

Introduction

Teachers' technology use has been examined in numerous studies and surveys. In this study, technology use refers to teachers' instructional use of information and communication technology (ICT), including both teachers' own use of ICT and teacher-directed student use of ICT. On one hand, teachers are generally confident about their computer self-efficacy, hold a positive attitude toward the use of ICT, and make "extensive use of ICT in their schools" (Fraillon, Ainley, Schulz, Friedman & Gebhardt, 2014, p. 22). On the other hand, teachers' technology use was described as "limited" (Drent & Meelissen, 2008, p. 188) in that ICT is often only used outside of classroom for purposes such as class preparation or administration.

Researchers have begun to address how and why teachers' use or do not use technology. Most generally, the Technology Adoption Model (TAM) (Davis, Bagozzi & Warshaw 1989) has been used to explain the conditions in which people come to use and accept technology. Although this model is not specific to teachers or classrooms, the widely used TAM model highlights the important connection between beliefs that inform intentions and ultimately actions. Educational researchers have specifically explored the connection between teachers' pedagogical beliefs and teachers' use of technology (Becker, Teo, Chai, Hung & Lee, 2008; Deng, Chai, Tsai & Lee, 2014). Researchers have also specified beliefs about self-efficacy and explored their impact on technology usage (Fathema, Shannon, Ross, 2015, Fathema, Ross, Witte, 2014).

The present study further explores the connection between teachers' beliefs and their use of technologies, through three main elaborations upon prior research: (1) it further develops the notion of pedagogical beliefs; (2) it explores the contribution of teachers' beliefs about their student readiness to use technology; and (3) it further develops the notion of technology usage.

Literature Review

In this paper, we studied how teachers' beliefs impact their use of technology in the classroom through a deeper consideration of three key components in the literature as described in each of the sub-sections below. While a lot of research has been conducted on the connections between teachers' beliefs and practices, there are three key weaknesses of the literature to date.

A Richer View of Pedagogical Beliefs

Pedagogical beliefs is defined as teachers' beliefs about teaching and learning (Chan & Elliot, 2004). Following Becker's (2000) definition of teachers' teaching philosophy, many follow-up studies (e.g., Teo et al.,

2008; Kim et al., 2013) have classified teachers' pedagogical beliefs into two categories, traditional and constructivist. Studies have suggested that when teachers hold traditional pedagogical beliefs, they act more authoritative, organize activities to be teacher-centered, and take a view of teaching that emphasizes the transmission of knowledge. In contrast, when teachers hold constructivist pedagogical beliefs, teachers view teaching as facilitation to students' own active and constructivist learning (Becker, 2000; Chan & Elliott, 2004).

Pedagogical beliefs reliably predict how teachers' use technology (Becker 2000; Ertmer, 2012; Teo et al., 2008). However, most research has taken a reductive view about what pedagogical beliefs mean. For example, most studies use a single dimension to measure teachers' pedagogical beliefs ranging from transmissive to constructivist (e.g., Becker, 2000; Deng et al., 2014; Teo et al., 2008).

In this paper, we take the position that teachers can hold both both kinds of pedagogical beliefs (traditional and constructivist) concurrently as supported by the most recent literature (Crespo, 2016; Tondeur et al., 2008; Tonedur et al., 2017). For example, Tondeur et al. (2008) examined teachers' pedagogical beliefs in two dimensions (i.e., traditional teaching; constructivist teaching), and found that teachers with strong constructivist pedagogical beliefs and strong traditional pedagogical beliefs use computers most frequently.

A Richer View of Pedagogical Uses of Technology

Studies that examine the connection between teachers' technology beliefs and usage have traditionally focused on teachers' *intentions* to use technology (e.g., Teo et al., 2008; Teo, 2011). For example, one of the more popular models for predicting who will use technology is the Technology Adoption Model (TAM) by Davis (1986) in which teachers' beliefs predict teachers' intentions (Figure 1). From there teachers' intentions guide their actual uses.

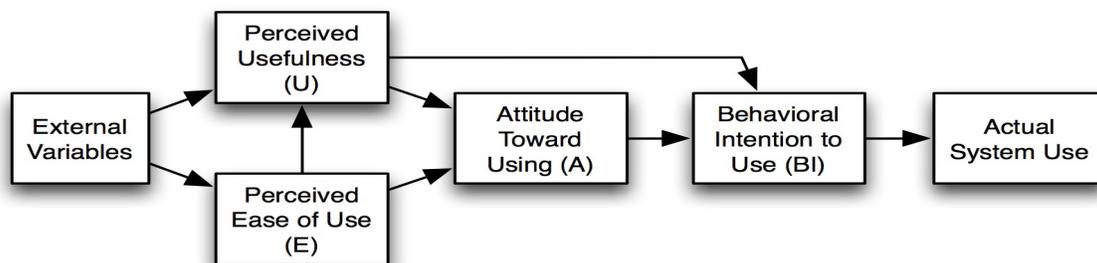


Figure 1. Technology Adoption Model (Davis, Bagozzi & Warshaw 1989)

One limitation of this view, however, is that research into the connection between intentions and behaviors is that intention only accounts for 28% of the variance in behaviors (Sheeran, 2002) across multiple types of intentions and behaviors. Studying the connections between teachers' beliefs and teachers' intentions to use technology is not sufficient – more research is needed to study the connection between teachers' beliefs and teachers' uses of technology. Even when research has examined teachers' practices with technology, the practices that have been studied have been rather limited. For example, consider Tondeur et al.'s (2008) study that related teachers beliefs in two dimensions (traditional and constructivist) to technology usage. In that study only three uses of computers were examined: used to access information, used as a learning tool, and used for learning computer skills.

In this paper we take the position that technology use should be studied as what teachers are implementing in classrooms, and not what they hope or plan to implement. Furthermore, similar to how teachers' pedagogical beliefs can be characterized as constructivist and tradition (or both), teachers' use of technology can also be viewed as either traditional or constructivist (or both). For example, uses such as employing powerpoint to deliver a lecture can be viewed as a traditional use of technology (e.g., Li, 2014). In contrast, using powerpoint to have children present their research findings can be viewed as a constructivist use of technology. Teachers may very well mix and match both constructivist and traditional uses of technology in their classrooms. Such a stance about how to conceptualize teachers' practices may better explain the nature of teachers' beliefs, and how they align to specific uses of technology is an important step in better understanding of this phenomenon.

Expanding the Set of Teacher Beliefs

In addition to studying the impact of teachers' pedagogical beliefs on their uses of technology, several other types of beliefs may play an important role in understanding how technology is (or is not) used in classrooms. In this paper, we extend the study of teachers' beliefs to include their beliefs about student readiness to use technology in constructivist ways.

Student readiness to use technology is defined as, teachers' judgement of whether students are ready to accomplish tasks that involves technology-related learning. Technology-related learning can be more learner-centered than face-to-face lecture (Lin, Lin, Yeh & Wang, 2015), therefore teachers' perception of students' readiness (e.g., motivated to learn with technology, academic level, self-regulation ability) are essential on their decision of adopting technology. Previous studies has pointed out that teachers differentiate instruction depending on students' readiness (Hall, 2002; Tomlinson et al., 2003). Similarly, several studies have already confirmed that teachers' perception of students' individual characteristics affect their ways of technology use. For example, Becker (1999) identified how students' prior achievement levels influenced teachers' Internet use and their perception of the value of using Internet. Also older students were thought to have "more developed ability" (Ravitz, Becker & Wong, 2000, p. 14) and therefore are more ready for constructivist pedagogy. However, little is known about how teachers perceive students' readiness and how such beliefs would influence their technology use.

Purpose and Research Questions

The purpose of this study is to examine the relationship between teachers' beliefs and teachers' use of technology in the context of foreign language teaching of undergraduates in Chinese Universities. This context is well-situated for examining the connection between teachers' beliefs and their technology use because on one hand Chinese culture of learning emphasizes learning as reception, repetition, review, reproduction, and memorization. On the other hand, the Chinese government has put effort on transforming language teaching from traditional methods (e.g., grammar-translation) to more constructivist methods such as communicative language teaching (Hu, 2002; Li, 2014). Accordingly, Chinese language teachers are employing a wide range of technology uses, under varied sets of pedagogical beliefs.

In this study, we examine teachers' pedagogical beliefs (both traditional and constructivist), teachers' beliefs about students' readiness to use technology, and teachers use of technology (both constructivist and traditional uses). In order to examine teachers' pedagogical beliefs, our first research question examines teachers' simultaneous (or not) beliefs as being both constructivist and traditional. To do so, we examine what general types (as profiles or clusters) of teacher beliefs exist in our population. For example, some teachers might hold both beliefs (traditional and constructivist), while other types of teachers may only hold one leading.

1. What profiles characterize Chinese foreign language teachers' pedagogical beliefs?

Our next research questions focus on how these belief profiles and how beliefs about student readiness predict teachers' use of traditional and constructivist ICT uses.

2. Do these profiles of pedagogical beliefs predict teachers' self-reported traditional and constructivist ICT use?
3. Do Chinese foreign language teachers' beliefs in student readiness predict teachers' self-reported traditional and constructivist ICT use?

Answers to these questions can shed light on how beliefs predict teachers' use of technology, and may be used to guide programs of teachers' professional development aimed at increasing teachers' use of technology.

Methods

Participants

202 (38 male and 164 female) foreign language teachers in universities in Guangdong, China participated in this study. Researchers of this study first randomly selected eight universities in Guangdong province. With the help of deans of foreign language schools in these universities, researchers of this study then sent invitation email to foreign language teachers who agreed to participate in the survey. Among the participants, most of them (84%) ranged in age between 31 and 49. Most instructors had a Masters degree (N=181) and some had a doctoral degree (N=21). Nearly all the participants owned personal computers at home (99%) and they all have computers, internet and projectors in their teaching environment (100%).

Measures

Participants completed a 30-item online survey that took approximately 15 minutes to complete. The measures derived from their responses are summarized in Table 1. Aside from the four demographic questions, most of the questionnaire were adapted of those items used by Teo et al. (2008) and Chan & Elliott (2004). However, survey items were modified to suit the special circumstances of the foreign language teaching. Samples of the instrument items are provided in the Appendix.

Measure	# Items	Cronbach's alpha	Description
Demographic	4	N/A	Age, gender, level of education, technology occupancy were assessed
TPB	5	.83	Assessed levels of teachers' traditional beliefs about teaching
CPB	5	.87	Assessed levels of teachers' constructivist beliefs about teaching
Readiness	6	.70	Assessed levels of teachers' beliefs about the readiness of their students to use technology
TUP	5	.77	Assessed levels of teachers' traditional uses of technology
CUT	5	.78	Assessed levels of teachers' constructivist uses of technology

Table 1. Description of measures used in this study

Data Analysis

In order to answer the first research question about emerging profiles of teacher beliefs, cluster analysis was performed to identify patterns (or types) in the range of responses teachers could give to the traditional and constructivist pedagogical beliefs items. In order to answer the second and third research questions a two-way analysis of covariance (ANCOVA) was conducted to examine the main and interaction effects of belief profiles and teachers' readiness beliefs on teachers constructivist uses of technology (CUT). A similar two-way ANCOVA was used to predict teachers traditional uses of technology (TUT).

Results

Table 2 shows the descriptive statistics for each measure and the correlation between each measure. Several general tendencies are evident. For teachers' pedagogical beliefs, teachers on average strongly support constructivist pedagogical beliefs (M= 4.411; SD=. 443) and hold a negative attitude toward traditional pedagogical beliefs (M= 2.551; SD= .877). For teachers' beliefs in students' readiness, they do not seem to have strong confidence in students' ability of learning with ICT as the mean score is 2.470 (SD= 1.493) with the highest score being 6. For technology use, teachers were found to favor both types of ICT use equally (for constructivist technology use: M= 3.744; SD= .531; and for traditional technology use: M= 3.790; SD= .488).

Measure	CPB	TPB	TUT	CUT	Readiness
Mean (std dev)					
CPB	1				
4.41 (0.44)					
TPB	-.038	1			

2.25 (0.87)					
<i>TUT</i>	.223**	.218**	1		
3.79 (0.49)					
<i>CUT</i>	.221**	.231**	.599**	1	
3.74 (0.53)					
<i>Readiness</i>	.182**	.110	.122	.197**	1
2.47 (1.49)					

* $p < .05$; ** $p < 0.01$; *** $p < 0.001$

Table 2: Descriptive statistics and relationship between measures

There are several notable significant correlations among teachers' beliefs and technology use. Constructivist pedagogical beliefs were significantly correlated with teachers' beliefs in students' readiness, but no significant positive or negative correlations exist between constructivist and traditional pedagogical beliefs. Both kinds of pedagogical beliefs (constructivist and traditional) are significantly correlated with both kinds of technology use (constructivist and traditional). The complicated correlations among the variables confirmed that teachers' traditional and constructivist pedagogical beliefs were not in polar opposites as pointed out by previous studies (e.g., Tondeur et al., 2008). It also proved that there is not a clear line between teachers' different technology use, instead teachers might choose traditional or constructivist ways of technology use to serve different teaching purpose. Finally, teachers' beliefs in students' readiness were significantly correlated with teachers' constructivist pedagogical beliefs, but not significantly correlated with traditional pedagogical beliefs, indicating that teachers' who are more constructivist tend to have greater confidence in their students' ability to learn with ICT.

Teachers' Belief Profiles

The first research question asked which profiles characterize Chinese foreign language teachers' pedagogical beliefs. Despite the overwhelming support for constructivist beliefs, four clusters emerged based upon traditional and constructivist pedagogical beliefs (see Table 3).

Cluster Name	Description
HIGH / NONE (n = 57 teachers)	Teachers with the highest scores in constructivist beliefs (M=4.83) and lowest scores in traditional beliefs (M=1.77)
HIGH / LOW (n = 60)	Teachers high in constructivist beliefs (M = 4.00) with some traditional beliefs (M= 2.11)
HIGH / MED (n = 57)	Teachers high in constructivist beliefs (M = 4.37) with moderate levels traditional beliefs (M= 2.98)
HIGH / HIGH (n = 28)	Teachers both high in constructivist beliefs (M= 4.54) and traditional beliefs (M=4.19)

Table 3: The four types of teachers' pedagogical beliefs

The four clusters all have high score on constructivist beliefs, with mean scores close or above 4. However, their levels of TPB vary among groups with mean scores ranging from 1.768 to 4.186. Unlike the Tondeur et al. (2008) study, teachers with high traditional pedagogical beliefs and low constructivist pedagogical beliefs did not appear in this population.

Relating Belief Profiles to Teachers' Traditional and Constructivist ICT Uses

The second research question examined the extent to which the four pedagogical belief profiles predicted teachers' traditional and constructivist uses of technology. We found that there were significant differences between the four profiles on levels of constructivist technology use [$F(4, 201) = 631.77, p < 0.001, \text{partial } \eta^2 = 0.928$] and traditional uses of technology [$F(1, 201) = 4.790, p < 0.05, \text{partial } \eta^2 = 0.941$].

In order to decide which specific groups differed from one another, post-hoc contrasts suggest that for constructivist uses of technology (CUT), the HIGH / HIGH cluster differed from all three other clusters. For

traditional technology uses (TUT), the HIGH / HIGH cluster differed from the HIGH / LOW group (High constructivist beliefs and low traditional beliefs).

Relating Student Readiness Beliefs to Teachers' Traditional and Constructivist ICT Uses

The final research question explored the extent to which teachers' beliefs about student readiness predicted their constructivist and traditional uses of technology. ANCOVA results that teachers' beliefs in students' readiness for technology significantly predicted constructivist technology use ($F(4, 201) = 4.79, p = 0.03 < 0.05, \text{partial } \eta^2 = 0.024$). However, teachers' beliefs in students' readiness was not related with their traditional use of technology ($F(4, 201) = 3.623, p = 0.058, \text{partial } \eta^2 = 0.018$).

Discussion

The first research question aimed to explore the status of Chinese foreign language teachers' pedagogical beliefs by examining their attitude towards both constructivist and traditional pedagogical beliefs statements. In this study, almost all of the teachers agree or strongly agree with statements associated with constructivist beliefs and were largely ambivalent with most statements relating to traditional traditional beliefs. Such results were inconsistent with the findings in previous studies (Tondeur et al., 2008; Sang et al., 2014), which found more varied profiles including some teachers who held mostly constructivist or traditional beliefs. Possible reasons for universally agreement with constructivist pedagogical beliefs might be that Chinese language teachers are urged to develop students' communicative and intercultural capability through more student-centered, communication oriented teaching method by the Ministry of Education in China (as cited in Li, 2014). Meanwhile, foreign language teaching has developed over the years from a teacher-centered methodology (such as grammar-translation, audio lingual) to a more student-centered methodology (such as communicative language teaching). On the other hand, for some Chinese foreign language teachers, who agree with two seemingly paradoxical pedagogical beliefs might be the dual influence both from traditional Chinese culture of learning, and the push on educational reform efforts from both Chinese Government and the Ministry of Education in China. These teachers are more tolerant for conflicting teaching philosophy and are more flexible in applying different teaching methodology in their teaching for different purposes.

The second research question tried to disentangle the complicated relationship between teachers' beliefs profiles and their different ICT use. Overall, ANCOVA results indicated that teachers' pedagogical beliefs is a significant predictor for both traditional and constructivist technology uses. This result corroborated with findings of previous research (e.g., Ravitz et al., 2000; Chai, 2010; Gil-Flores et al., 2017). This study went one step further and explored the connection to multidimensional beliefs (constructivist, traditional, or both), finding that teachers with both high traditional and constructivist pedagogical beliefs (High CPB & High TPB) were found to be significantly different from the other three groups in constructivist technology use *and* traditional uses of technology. It may be that teachers who have dual high pedagogical beliefs are better able to select and apply technologies in different teaching context (both as a tool, or for higher learning).

The last research question focused on teachers' beliefs about student readiness to learn with technologies. The descriptive statistics indicated that overall Chinese foreign language teachers do not have much confidence in their students' ability to learn independently using ICT. In particular, they lack confidence in students' ability to do self-regulated learning, such as to manage their learning progress online, or to restrain themselves from playing games or surfing on the internet. This may partially be attributed to Chinese culture of learning, in which teachers were often deemed as the authorities in classrooms and played a dominant role in deciding whether and how to learn (reference). Another possible reason is that teachers found that their students lack of self-control when learning online and come to this conclusion. What is intriguing is that teachers' differences in their beliefs toward students' readiness played a significant role in their constructivist technology use, but did not influence their traditional technology use significantly. For one thing, this result indicates that teachers' perception on students play a key role in their constructivist technology use. This finding corroborated with Becker's (2000) study, in which the participant

teachers were found to tend use computers in a more constructivist way when teaching students from higher grade, who are perceived as more ready to receive constructivist teaching.

Conclusion

This study strengthens prior, but limited, research findings (e.g., Prestridge, 2012; Tonduer, 2008) that suggest teachers' beliefs and their practices are multidimensional and their use of technology is often in a mixture of both constructivist and traditional uses. Teachers' with high traditional and high constructivist pedagogical profiles significantly outperform teachers of other three groups in different use of technologies. This finding is important in that it further solidifies the connection between pedagogical beliefs. But moreover, it points to how specific beliefs (traditional or constructivist) relate to specific uses (traditional or constructivist). This finding also helps dispel the myth that teachers are either traditional or constructivist in their beliefs, as the highest performing teachers held both beliefs simultaneously.

A second key finding is the possibility that teachers' beliefs about readiness were also an important factor when predicting teachers' use of technologies. Results from this study suggest that teachers' beliefs in students' readiness plays a significant role in their constructivist technology use but not in their traditional technology use. Teachers' choice of how to use technologies is partly based on their judgement of students' ability. Such findings shed some new lights on how researchers should approach the issue of technology use from different perspectives.

More research is needed to follow up on these findings, as these results may be limited to the context of Chinese foreign language teachers or limitations of measurement. Specifically, this study used teachers' self-report of their uses of technologies. Future work can, and should, observe teachers actual use of technologies which may or may not be strongly related to their self-reports.

The results of this study have implications for teacher educators, trainers, policy makers and administrators in schools, especially those in China. For teacher educators and trainers, it is important to realize that having beliefs in constructivism is just the first step to constructivist use of technologies. Other kinds of teachers' beliefs, such as about students' readiness or about disciplines might play a role as well. Also they need to recognize that teachers tend to hold both kinds of pedagogical beliefs and selectively adopt technologies to fit their teaching properly. Meanwhile policymakers and administrators need to recognize that change of pedagogical beliefs and practices involves both teachers and students, and make effort in that aspect to facilitate constructive use of ICT. Findings of this study also help researchers in this field to reconsider the construct of teachers' beliefs and its role in teachers' technology use. While teachers' beliefs in teaching and learning is found to be key predictor of their technology use, this study identified that teachers' beliefs in student readiness is related to teachers' constructivist ICT use.

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Appendix

An overview of sample survey items

Construct	No. of items	Sample item	Cronbach's alpha
CPB	5	Every child is unique or special and deserves an education tailored to his or her particular needs.	0.820
TPB	5	Learning to teacher simply means practicing the ideas from lecturers without questioning them.	0.871
CUT	5	I use technology to let students get information or ideas.	0.779
TUT	5	I use technology to provide pattern and drill practice to learn content knowledge.	0.771
Readiness	6	Do your students have the ability to manage their own time when learning with ICT?	0.702

Note: CPB = constructivist pedagogical beliefs; TPB = traditional pedagogical beliefs; Readiness = teachers' beliefs in student readiness; CUT = constructive technology use; TUT = traditional technology use