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The Relationships among Singaporean Preservice Teachers' ICT Competencies, Pedagogical Beliefs and their Beliefs on the Espoused Use of ICT

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Integration of ICT into classroom teaching and learning has been a challenging task in many countries. There are many barriers that teachers have to negotiate before ICT can be employed meaningfully in the classroom. This paper investigates the relationships among Singaporean preservice teachers' ICT competencies, pedagogical beliefs, and their beliefs on the espoused use of ICT. These variables are important predictors for the preservice teacher's future use of ICT. The findings affirm that the preservice teachers' ICT competencies and their pedagogical beliefs are significantly related to their espoused use of ICT.

Keywords: preservice teachers, information and communication technology (ICT), pedagogical beliefs

Information and Communication Technology (ICT) has been viewed as the key enabler and tool for promoting co-construction of knowledge among students (Jonassen, Howland, Marra, & Crismond, 2008; Scardamalia & Bereiter, 2006). However, while more schools are being equipped with varied array of ICT tools, and that teachers are using ICT more often (Becta, 2007; Selwyn, 2008; Valcke, Rots, Verbeke, & van Braak, 2007), the provision of ICT in schools has not brought about the shift in pedagogy towards the more constructivist oriented models in many countries (Hermans, Tondeur, van Braak, & Valcke, 2008; Laurillard, 2008; Lim & Chai, 2008; Selwyn, 2008). There are many reasons as to why ICT did not bring about relevant changes as envisioned by many educators. These factors, which interact to form seemingly formidable barriers, can be broadly categorized as either contextual or personal. The former includes issues such as time, access, resources availability, and administrative structures while the latter includes teachers' knowledge and skills and their beliefs about teaching and learning (Hew & Brush, 2007; Lim & Chai, 2008; Lim & Chan, 2007; Mishra & Koehler, 2006). It seems that as the logistical and administrative problems are being addressed, more efforts have to be directed towards changing the assessment practices and helping the teachers to change their beliefs (Chai, Teo & Lee, 2010; Ertmer, 2005; Hermans, Tondeur, van Braak, & Valcke, 2008). This paper investigates the relationships between Singaporean teachers' ICT competencies, pedagogical beliefs and their views about the use of ICT. It provides further insights into the relationships between teachers' beliefs and their use of ICT. More research that study how various variables are interconnected is needed (Sang, Valcke, van Braak, & Tondeur, 2010).

LITERATURE REVIEW

In the following review, we provide a brief overview of preservice teacher education for the integration of ICT in classroom, teachers' pedagogical beliefs and how these variables are linked to the constructivist or traditional use of ICT in the classrooms. The review will be followed by the articulation of the set of hypotheses that this study aim to investigate.

Teachers' ICT and pedagogical ICT competencies

Typically, preservice teachers in teacher education institutes from most of the developed countries such as Singapore and US have to go through at least one introductory course on educational technology. These courses usually address a range of technical skills (Office skills, Internet, desktop publishing, digital resource editing tools, instructional software), and constructivist oriented pedagogy. In these courses, pre-service teachers are likely to be required to design some ICT-based teaching and learning materials (see for example, Anderson & Maninger, 2007; Kay, 2006; Lee, Chai, Teo & Chen, 2008). While preservice teachers in most of these developed countries rarely enter teacher education without basic ICT literacy, developing preservice teachers ICT skills is still necessary (Markauskaite, 2007; Steketee, 2005). A survey by Lee et al. (2008) among Singaporean preservice teachers reveals the lack of advanced ICT skills such as those pertaining to producing multimedia and web-based resources. Furthermore, preservice teachers who possess a range of ICT skills may still perceive a strong need for skill development (Evans & Gunter, 2004). The relationship between teachers' level of ICT skills and how they would use ICT in classroom is however an area that has not received much attention. Littrell, Zagumny, and Zagumny's (2005) research indicate that Tennessee practicing teachers' self-efficacy is a significant predictor in their use of instructional technology for classroom management and instructional development purposes. The former is akin to the traditional use of ICT while the later is related to the constructivist use of ICT. Fleming, Motamedi, and May (2007) suggest that research on relationships between preservice teachers perceived ICT competencies and their use of ICT should be carried out. We conjecture that preservice teachers who have higher level of ICT skills would be more inclined towards using ICT for both traditional and constructivist oriented teaching. Sang et al.'s study (2010) provide further support for our view. Having high level of technical skills would put teachers more at ease in integrating ICT. This is especially true for constructivist teaching with ICT since it is a more demanding pedagogy (Windchitl, 2002). Teachers who are more confident in using ICT can focus more on the pedagogical matters rather than issues pertaining to technical skills.

Other than ICT skills that are purely technical in nature, it is clear that preservice teachers also need some pedagogical knowledge pertaining to the use of ICT. Such competencies are now commonly referred to as technological pedagogical knowledge (Angeli & Valanides, 2005; Mishra & Koehler, 2006). Researchers emphasize the importance of acquiring this form of integrated understanding before teachers can integrate technology with ease. This form of knowledge involves understanding how technology-enhanced learning environment should be managed, how to use technology with appropriate grouping strategies, how to use or adapt various informational resources for teaching and learning, among other things. It is a general form of knowledge that may be required for both traditional or constructivist use of ICT in classrooms. Research examining the relationships between the general pedagogical use of ICT and how it relates to the traditional/constructivist use of ICT is again lacking. It seems reasonable to assume that preservice teachers who have a higher self-efficacy on the pedagogical use of ICT would be more willing to use ICT in general. Williams, Foulger and Wetzel's (2009) study indicates that preservice teachers who have explored the pedagogical use of selected technologies expressed higher willingness to use ICT in their future classrooms.

Teachers' pedagogical beliefs

Teachers' pedagogical beliefs refer to those that teachers hold pertaining to the nature of teaching and how teaching should be carried out. Studies on teachers' pedagogical beliefs reveal that it varies along a continuum of viewing teaching as a process of knowledge transmission at one end to a process of facilitating students' knowledge construction at the other end (Chan & Elliott, 2004; Laurillard, 2008; Samuelowicz & Bian, 2001). We label the former as the traditional transmissive view of teaching while the latter as the constructivist view of teaching. The transmissive view of teaching emphasizes teaching as a process of passing on knowledge from the teachers to the students, of which teachers are regarded as authority of knowledge and the controller of classroom environment. The students are treated as passive receivers of knowledge. This form of teaching is practiced widely in classrooms all over the world though it has been criticized for its lack of focus on developing independent and critical thinkers (Laurillard, 2008). The constructivist view of teaching, on the other hand, sees teaching as helping students to actively make sense of the world they experience. The teachers' roles become that of a designer of learning environments and a guide to scaffold students' epistemological quest. The teachers' knowledge about the students' lived world becomes an important source of knowledge for the design of appropriate learning environment (Villegas, 2008).

Van Driel, Bulte, and Verloop (2005) investigated how teachers perceive the relationship between the traditional and the constructivist teaching approaches. Around three quarters of the participants (N=348) in the study appear to adopt an eclectic stance towards both approaches. The teachers mix and match elements from both approaches as they deem necessary for the context. As for the preservice teachers, their stance towards the approaches is complex. While they are likely to be inclined towards relativistic epistemological stance and constructivist-oriented pedagogy (Wong, Chan, & Lai, 2009), they may also see teaching as a simple process of transmitting knowledge (Richardson, 2003; Wideen, Mayer-Smith, & Moon, 1998). In summary, it seems that the research to date indicate that the preservice teachers' beliefs may be in a stage of change and it could be rather context sensitive (Chai, Khine, Teo, 2006; Chai et al., 2010).

A number of studies reported that teachers use ICT either to enhance the traditional approach or the constructivist approach to teaching (Becker, 2000; Tubin, 2006). Research on the relations between teachers' pedagogical beliefs and their espoused use of ICT has also begun to reveal some patterns. Generally, it seems that teachers who are holding constructivist beliefs are inclined towards using ICT for constructivist teaching (Judson, 2006; Ravitz & Becker, 2000). At the same time, they also seem to be open to using ICT for traditional teaching (Teo, Chai, Hung & Lee, 2008). However, Chai, Hong and Teo (2009) also reported that preservice teachers' beliefs of constructivist teaching was not correlated to their attitudes of using computers in the classroom for both Singaporean and Taiwanese participants. More research is therefore needed to clarify the situation. Recently, Sang et al. (2010) investigated the relationship among constructivist beliefs, teacher efficacy, attitudes towards computers, use of computers in classroom among China preservice teachers. The four constructs were significantly correlated. This study differed from Sang et al.'s research in terms of its participants and the granularity of the construct tested. In particular, their use of computers scale did not distinguish between constructivist and traditional use of ICT. This was important for the preservice teachers education in Singapore as the targeted use of technology should be akin to using ICT as cognitive tools (Jonassen et al., 2008). Sang et al's (2010) study of educational beliefs was confined to constructivist beliefs and the teachers' efficacy tested was not connected to technology. Nonetheless, their study provides good support for the formulation of the following hypotheses.

Purposes and hypotheses

The current study aims to examine the relationships among Singaporean preservice teachers' ICT competencies, pedagogical beliefs and their espoused use of ICT. Based on the above literature review, the following hypotheses were proposed:

H1: General ICT competencies relate positively to the traditional use of ICT.

H2: General ICT competencies relate positively to the constructivist use of ICT.

H3: Pedagogy-oriented ICT competencies relate positively to the traditional use of ICT.

H4: Pedagogy-oriented ICT competencies relate positively to the constructivist use of ICT.

H5: Traditional pedagogical beliefs relate positively to the traditional use of ICT.

H6: Traditional pedagogical beliefs relate negatively to the constructivist use of ICT.

H7: Constructivist pedagogical beliefs relate negatively to the traditional use of ICT.

H8: Constructivist pedagogical beliefs relate positively to the constructivist use of ICT.

The above hypothesized relationships (see Figure 1) are tested by structural equation modeling with the AMOS 7.0 software.

METHOD

This study was conducted in the National Institute of Education, which is the sole teacher education institute in Singapore. An online survey was set up to collect the necessary data, details of which are discussed in the succeeding sections.

Participants

A total of 1230 (84% of the 2007 July semester enrollment) preservice teachers (511 primary and 719 secondary preservice teachers) participated in this study. They were enrolled in teacher preparation programs at the National Institute of Education (NIE) in Singapore. There were about 60% female participants and the overall mean age was 25.2 years (SD= 4.8 years). The participants comprise of different ethnic groups: Chinese (70.3%), Malay (18.3%), Tamil (7.2%), and others (4.2%). The ethnic distribution is consistent with the general demographics in Singapore.

Procedure and instruments

An online survey was created and the preservice teachers were invited to participate in the survey both via announcements through the online portal and through their tutors who were teaching the core ICT course. Participants were asked to supply some demographic details (e.g., gender and age), but not their names, as a part of the questionnaire. The survey questionnaire mainly consisted of three 7-point Likert-type scales with 1 indicating "strongly disagree" and 7 indicating "strongly agree". These scales are:

ICT Competencies Scale (IC). The IC comprised two subscales: General ICT Competencies (GIC) and Pedagogical-oriented ICT Competencies (PIC). Both GIC and PIC were adapted from an earlier evaluative study on Singaporean preservice teachers (Lee, Chai, Teo & Chen, 2008). The creation of this scale was informed by need for the local teachers to fulfill the baseline standards articulated by the local ministry of education. There are three items for each subscale. Examples of the items in the GIC and PIC subscales are "I am able to use the Internet to search for information

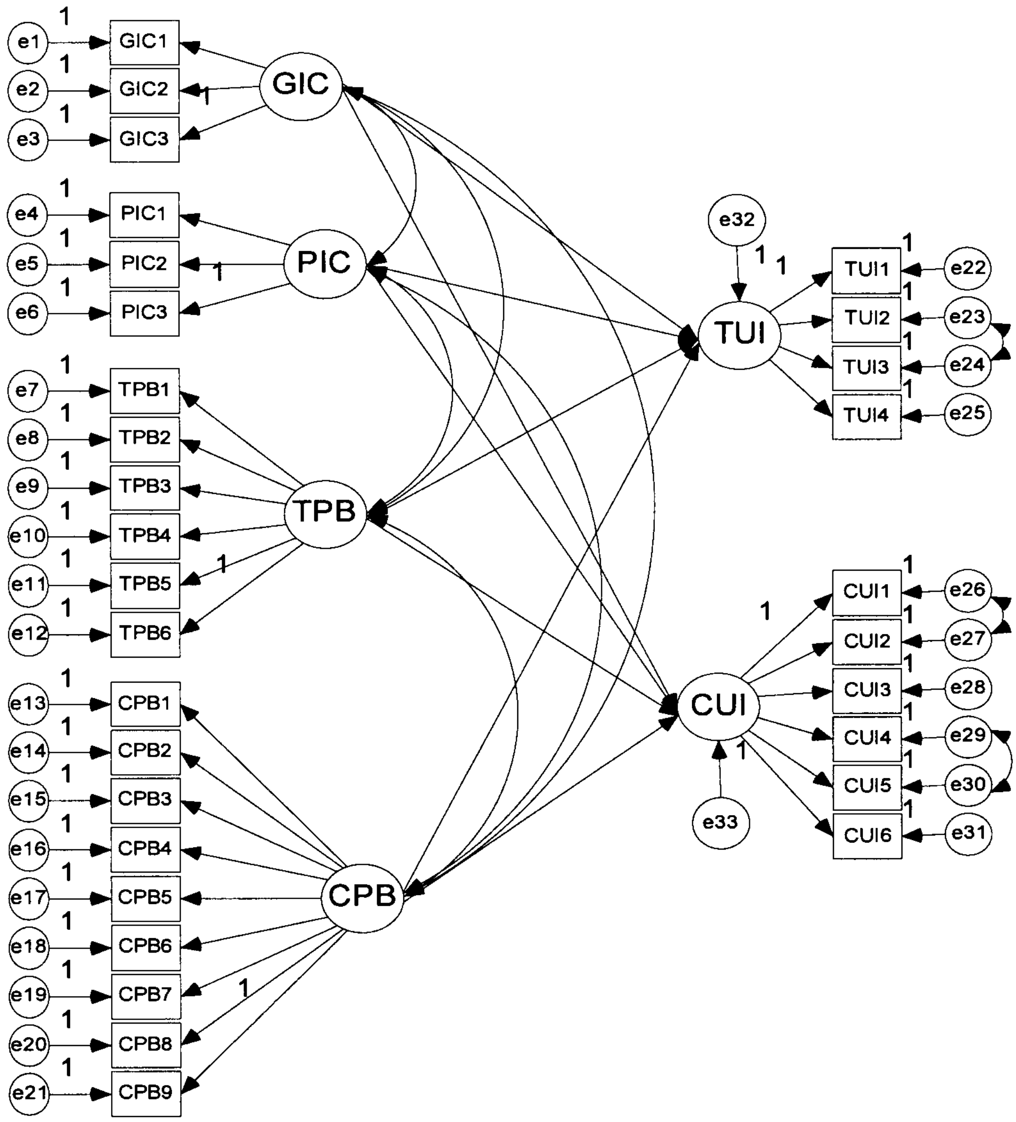

Figure 1. *Proposed research model*

and resources" and "I can manage ICT-based learning activities in a computer laboratory" respectively.

Pedagogical Beliefs Scale (PB). The PB was measured by Traditional Pedagogical Beliefs (TPB) and Constructivist Pedagogical Beliefs (CPB). These scales were adapted from previous studies that were used in the Asian cultural context with satisfactory psychometric properties (Chan & Elliott, 2004; Teo & Chai, 2008). TPB and CPB were examined by six items and nine items, respectively. Examples of the TPB include "Good teaching occurs when there is mostly teacher talk in the classroom" and "Teaching is simply telling, presenting or explaining the subject matter". The CPB is expressed by items such as "In good classroom there is a democratic and free atmosphere which stimulates students to think and interact" and "Good teachers always make their students feel important".

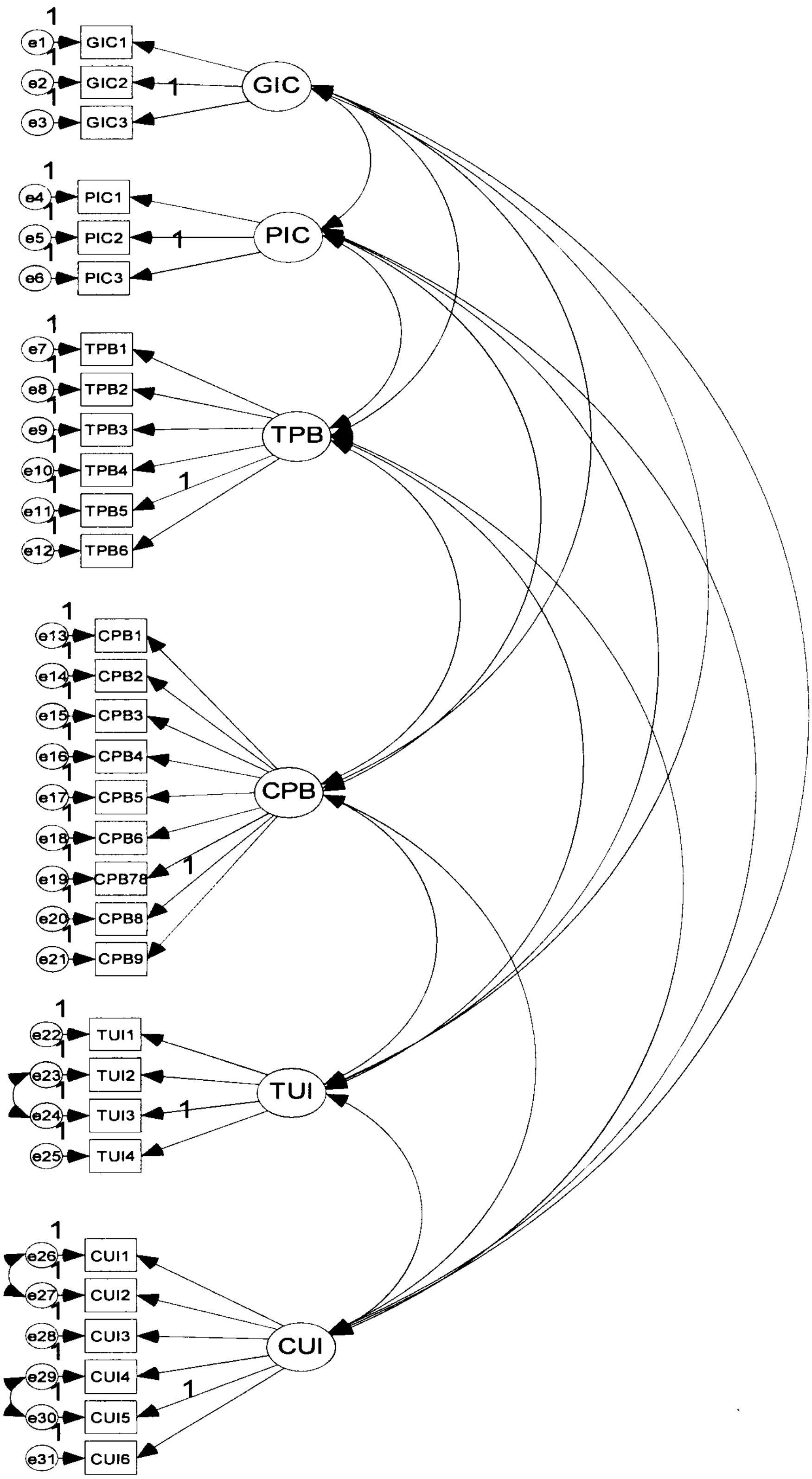

Figure 2. *The measurement model*

Technology Use Scale (TU). The TU was examined by two subscales: Traditional Use of ICT (TUI) and Constructivist Use of ICT (CUI). This scale was adapted from a study that demonstrated satisfactory internal consistencies (Teo et al., 2008). Comprising 10 items, there are four examples of how teachers would make use of technology in a traditional (e.g., "Mastering skills just taught") and the other six in a constructivist (e.g., "Learning to work collaboratively") manner. Although the above cited studies mainly used Cronbach's alpha to indicate the reliability of the scales, this may be less reasonable due to its disadvantages (see Anderson & Gerbing, 1988). For example, it assumes that all of the measured items have equal reliabilities, and it cannot be used to infer uni-dimensionality (Chai, Teo, & Lee, in press). We thus examined the reliability of the scales and relevant items by referring to other criteria such as convergent validity (Fornell & Larcker, 1981) and discriminant validity (Hair, Black, Babin, Anderson, & Tatham, 2006). In this study, a confirmatory factor analysis (CFA) was applied to validate the measurement model (see Figure 2). Structural Equation Modeling (SEM) was also employed to examine the relationships among these constructs. More details are shown in the Results section.

RESULTS

The descriptive data of the scales used, such as mean, standard deviation, skewness, kurtosis, and Crobach's alpha coefficient were examined. The low standard deviations, ranging from .56 to 1.29 suggest a narrow spread of the item scores around the mean. No items showed a skewness or kurtosis value greater than the cutoffs of |3| or |8| (Kline, 2005), and this supported univariate normality in the items. The Cronbach's alphas were all above .70, indicating an adequate internal consistency of all scales (Hair et al., 2006). In the following paragraphs, we report (a) the reliability of the scales, (b) the results of testing the measurement model comprising all scales, and (3) the structural model proposed in the study.

Reliability of the scales

As noted previously, this study focused on convergent validity and discriminant validity when examining the reliability of the scales.

Convergent validity. According to Hair et al. (2006), items belonging to a specific construct should converge or share a high proportion of variance in common (i.e., convergent validity). Three major indicators of convergent validity were advocated by most researchers (e.g., Fornell & Larcker, 1981): factor loadings, average variance extracted (AVE), and construct reliability (CR). The reliability of an item is significant when its factor loading exceeds .50. As shown in Table 1, the eigenvalues of all constructs were greater than 1.00 and these six constructs jointly explained about 59.69% of the cumulative variance. The factor loadings of all the items ranged from .500 to .898. This supports an acceptable convergent validity at the item level. An AVE of .50 or higher, or a CR of .70 or above, can be a good rule of thumb suggesting adequate convergence at the construct level (Hair et al., 2006). As presented in Table 2, only two constructs (i.e., CPB and CUI) showed relatively low AVE values. Given that all constructs expressed satisfactory construct reliability, we argued that all six constructs generally presented acceptable convergence.

Discriminant validity. Discriminant validity can be used to measure the extent to which constructs differ. At the construct level, it is considered adequate when the square root of the average variance extracted (AVE) for a specific construct is greater than the correlation estimates between that construct and all other constructs (Fornell & Larcker, 1981). Table 3 shows the correlation matrix for the six constructs. The diagonal elements (i.e., square roots of AVE) were greater than the off-diagonal elements (i.e., correlation coefficients) in the corresponding rows and columns. This implies that each construct shared more variance with its items than it does

Table 1. *Principal Component Analysis*

	CPB	TPB	CUI	TUI	PIC	GIC
CPB9	**.728**	-.115	.257	.076	.048	.044
CPB8	**.720**	-.065	.197	.115	-.020	.066
CPB7	**.668**	-.032	.066	.159	.054	.008
CPB6	**.663**	.015	.158	.121	.022	.089
CPB3	**.630**	-.122	.224	.047	.020	.131
CPB5	**.607**	-.059	.048	.177	.025	.070
CPB2	**.575**	-.130	.206	.041	.084	.015
CPB4	**.571**	-.099	.135	.158	.036	.055
CPB1	**.500**	-.132	.371	-.001	.092	.166
TPB3	-.125	**.805**	-.033	.003	.001	-.012
TPB4	-.053	**.748**	-.001	.032	.009	-.027
TPB2	-.068	**.746**	-.058	.000	-.013	-.024
TPB5	-.155	**.743**	-.156	.076	.040	-.060
TPB1	-.069	**.738**	-.010	.021	.066	-.061
TPB6	-.057	**.726**	-.073	.008	.037	-.048
CUI4	.210	-.105	**.781**	.207	.088	.111
CUI5	.272	-.118	**.756**	.226	.033	.083
CUI1	.343	-.064	**.637**	.239	.021	.094
CUI6	.265	-.055	**.622**	.292	.077	.071
CUI2	.432	-.057	**.615**	.190	.008	.178
CUI3	.259	-.027	**.576**	.392	.065	.096
TUI3	.175	.015	.224	**.802**	-.008	.051
TUI2	.174	.071	.223	**.763**	.037	.066
TUI1	.234	.010	.201	**.615**	.089	.119
TUI4	.117	.077	.233	**.598**	.077	.021
PIC2	.081	.046	.057	.051	**.898**	.162
PIC3	.044	.094	.009	.086	**.879**	.089
PIC1	.086	.005	.123	.044	**.826**	.154
GIC2	.122	-.081	.122	.076	.089	**.872**
GIC3	.142	-.017	.118	.081	.199	**.819**
GIC1	.121	-.120	.136	.083	.136	**.758**
Eigenvalue	8.320	3.564	2.506	1.681	1.431	1.001
% Variance	26.839	11.498	8.084	5.423	4.617	3.230

Note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

Table 2. *Measures of average variance extracted (AVE) and construct reliability (CR)*

Factor	AVE	CR
General ICT Competencies (GIC)	.67	.92
Pedagogy-oriented ICT Competencies (PIC)	.75	.78
Traditional Pedagogical Beliefs (TPB)	.57	.81
Constructivist Pedagogical Beliefs (CPB)	.40	.89
Traditional Use of ICT (TUI)	.50	.76
Constructivist Use of ICT (CUI)	.46	.91

Table 3. *Inter-factor zero-order correlations (2-tailed)*

	1	2	3	4	5	6
1. General ICT Competencies	(.82)					
2. Pedagogy-oriented ICT Competencies	.33**	(.87)				
3. Traditional Pedagogical Beliefs	-.15**	.067*	(.75)			
4. Constructivist Pedagogical Beliefs	.31**	.17**	-.24**	(.63)		
5. Traditional Use of ICT	.24**	.18**	.037	.43**	(.70)	
6. Constructivist Use of ICT	.35**	.19**	-.19**	.64**	.62**	(.67)

** $p < .01$; * $p < .05$

Diagonal (in brackets): square root of average variance extracted from observed variables (items); Off-diagonal: correlations between constructs

with other constructs. That is, discriminant validity seems acceptable at the construct level. At the item level, Hair et al. (2006) suggested that discriminant validity is evident when an item correlates more highly with items in the same construct than items from other constructs. Considering very few cross-loadings were observed in Table 3, a satisfactory level of discriminant validity at the item level was established.

In general, the above results indicate acceptable convergent validity and discriminant validity at both the item and construct levels. Therefore, the six constructs in the proposed research model are considered to be adequate. Below, structural equation modeling was utilized to test one measurement model and the structural model proposed.

Test of the measurement model

According to Anderson and Gerbing (1988), testing the originally specified theory (structural model) may not be meaningful unless the measurement model holds. Thus, a confirmatory factor analysis (CFA) with AMOS 7.0 was conducted to validate the measurement model (see Figure 2) comprising the aforementioned six scales. The CFA results implied a model fit. The fit indices revealed $\chi 2$= 1141.33, *df*= 416; GFI=.943; TLI=.951; CFI=.956; SRMR=.036; RMSEA=.038. The values of these indices were regarded by most researchers as indicative of a good model fit to the data (Hair et al., 2006; Kline, 2005). All items were found to have significant parameter estimates with standardized estimates greater than .50. This also suggests a satisfactory convergent validity of each subscale, since each subscale can explain the items it measures better than the items from another subscale (Fornell & Larcker, 1981).

Test of the structural model

The test of the structural model includes examining the statistical significance of the path coefficients from one latent variable to another. In this study, a structural model (see Figure 1) with six latent variables (i.e., TUI and GIC as endogenous variables and the other four as exogenous variables) were specified to ascertain the relationships among ICT competencies, pedagogical beliefs, and espoused use of technology. The overall goodness of fit can be considered satisfactory for this structural model ($\chi2$=1392.20, *df*= 417; GFI=.931; TLI=.934; CFI=.941; SRMR=.046; RMSEA=.044). Five out of eight paths were statistically significant at the .001 level (GIC→TUI, β = .137, t= 3.43; GIC→CUI, β = .126, t= 5.26; TPB→TUI, β = .191, t= 6.92; CPB→TUI, β = .813, t= 14.36; CPB→CUI, β = .726, t= 19.20). Among the eight hypotheses, only four were supported in the current study. They are as follow:

H1: General ICT competencies relate positively to traditional use of ICT,

H2: General ICT competencies relate positively to constructivist use of ICT,

H5: Traditional pedagogical beliefs relate positively to traditional use of ICT,

H8: Constructivist pedagogical beliefs relate positively to constructivist use of ICT.

These four supported hypotheses are marked by the thick line in Figure 3. Furthermore, the R^2 value of TUI and CUI are .469 and .658

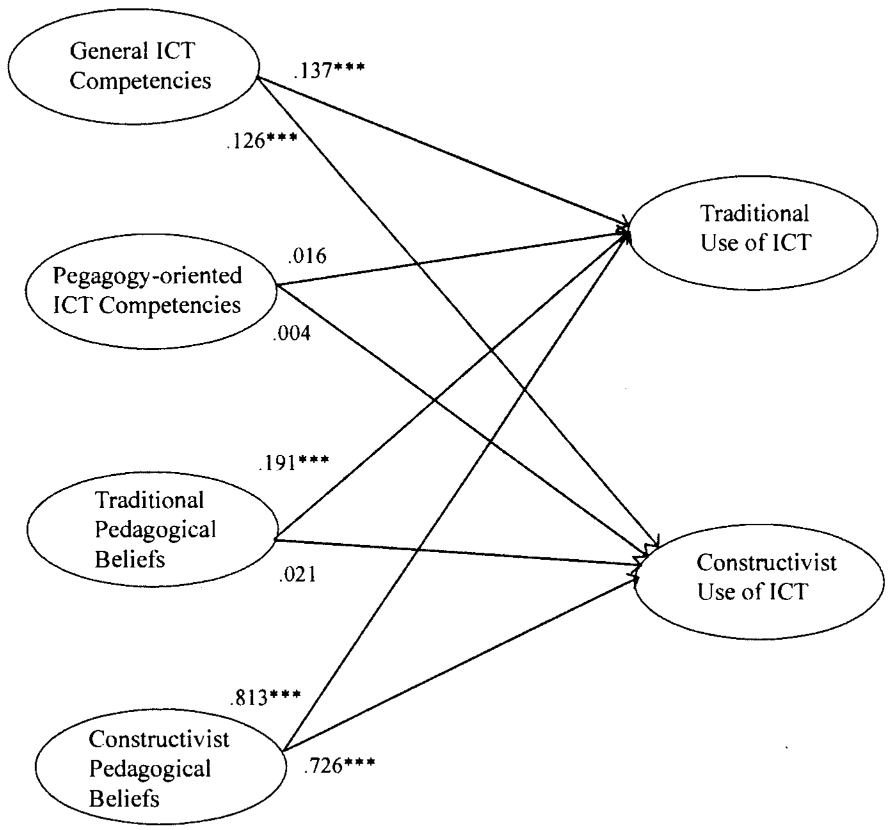

Figure 3. *Path coefficients of the structural model*

respectively. This implies that the exogenous variables (GIC, PIC, TPB, and CPB) accounted for 46.9% and 65.8% of the variance in TUI and CUI respectively.

DISCUSSION AND CONCLUSION

The findings suggest that basic ICT skills form the foundation of teacher use of ICT in the classrooms. Efforts from teacher education institutes in alleviating preservice teachers' technological skills should continue to be an important aspect for the promotion of use of ICT in classroom. While this and recent studies (Lee et al., 2008) indicate that preservice teachers from various developed countries seem to rate themselves highly in basic ICT skills such as working with word processors and presentation tool, how other forms of ICT skills could impact on teachers' use of ICT, especially on the constructivist use of ICT in classroom, need further investigation. In general, a re-conceptualization of the types of tools (e.g. Office tools, web 2.0 tools, content authoring tools) and level of technical competencies (e.g. user, advanced user, programmer), and studies on how these various types of technical competencies impact on teachers' use of technologies may provide a more refined understanding for teacher educators to structure curriculum for different types of use of technology in classrooms.

Our investigation on the pedagogy-oriented ICT competencies does not yield any significant paths towards the use of ICT. The reason behind the insignificant results may be due to the fact that the construct is targeted towards general pedagogy such as classroom management and the adaptation of existing electronic resources for teaching. The items are adapted from the baseline standards articulated by the local ministry of education. The usefulness of measuring this construct in the future is doubtful. More specific survey relating clear theoretical orientation, such as what will be discussed next, may be more desirable. The Sang et al. (in press) study, however, indicates that teacher efficacy influence teachers' attitudes towards computers in education and their computer self-efficacy.

Generally, the structural model generated in this study affirms that teachers' beliefs have significant influences over their espoused use of ICT. The results are in general agreement with other recent studies in these areas (Becker & Ravitz, 2001; Hermans, et al., 2008; Sang et al., in press; Teo et al., 2008). Teachers who believe in traditional teaching espoused the use of ICT for knowledge acquisition. The relationship between these teachers' beliefs and the constructivist use of ICT, though not negative as we have hypothesized, is insignificant. On the other hand, teachers' constructivist beliefs are strongly correlated with both constructivist use and traditional use of ICT in schools. The fact that teachers' constructivist beliefs are associated with traditional use of ICT has been reported in earlier study and it is further confirmed in this study. A possible explanation is that teachers see that the traditional use of ICT could be a way to enhance students' understanding before engaging the students in collaborative co-construction of knowledge.

Many educators have been arguing about the potential of technology in changing teaching and learning towards the constructivist-oriented model (Scadrdamalia & Bereiter, 2006; Greenhow, Robelia, & Hughes, 2009). While studies of Asian preservice teachers' pedagogical beliefs indicate that the preservice teachers from Singapore, Taiwan, Hong Kong and China generally are inclined to agree with the constructivist beliefs (Chai et al., 2009; Sang et al., 2009; Wong et al., 2009), studies also indicate that the teaching practices may not be congruent to the reported beliefs (Lim & Chai, 2008; Lim & Chan, 2007). Expressing constructivist beliefs is a necessary first step towards constructivist teaching. However, to implement the constructivist use of ICT in classroom as part of the regular teaching repertoire requires more than just agreeing with the ideals. The teachers need to develop capacity for scaffolding students' meaning making with ICT tools, which possibly involves substantial integration of their technological, pedagogical, and content knowledge (Mishra & Koehler, 2006).

Finally, one obvious limitation of this study is that all the results are based on the preservice teachers' self-reports. Further studies on how preservice teachers are able/ unable to develop their reported beliefs into practice, based on multiple sources of data that include observations and documents such as implemented ICT-based lesson plans, are essential.

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