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# Singaporean and Taiwanese Pre-service Teachers' Beliefs and their Attitude Towards ICT Use: A Comparative Study

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Teachers' epistemological and pedagogical beliefs and their attitude towards ICT use are identified as the second-order barrier for the integration of ICT in the classrooms. In this paper, we report the findings obtained from a recent survey and conducted among Singaporean and Taiwanese pre-service teachers (N=108). The results indicate that pre-service teachers' epistemological beliefs were generally relativistic. They were inclined to believe in the constructivist notion of teaching. The results also suggested that pre-service teachers from Singapore and Taiwan hold beliefs that are congruent to the educational reform effort from their respective countries. However, the pre-service teachers' attitude towards ICT use does not seem to be associated with their epistemological and pedagogical beliefs. The findings suggest that further efforts are required to foster more productive use of ICT to support constructivist teaching.

**Keywords:** Epistemological beliefs, pedagogical beliefs, attitudes toward ICT use

In recent years, the formation of the knowledge-based economy has prompted numerous educational reforms in many countries. These countries recognize the fact that, in order to stay ahead and remain competitive, they need to shift the emphasis in education towards cultivating knowledge workers and promoting more knowledge innovation oriented pedagogy (Hong, Scardamalia, Messina, & Teo, 2008; Hong & Sullivan, in press). To this end, using information

and communication technologies (ICT) to support constructivist-oriented pedagogies are generally reported to be an important strategy (Jimoyiannis, & Komis, 2007). Many educational technologists have argued that ICT has substantial potentials in facilitating the shift from traditional pedagogical practices to constructivist-oriented learner-centered teaching practices. For example, Jonassen, Howland, Marra and Crismond (2008) explain how ICT can support active and

collaborative learning among students by providing students with access to information resources through the Internet and the knowledge construction medium such as hypermedia authoring tools and concept mapping tools. They also argue that learners can form intellectual partnerships with ICT and exploit the affordances of computers to perform higher order cognitive tasks such as hypothesizing and meaning making. Bereiter & Scardamalia (2006), on the other hand, report how the use of computer-supported collaborative learning environment such as the Knowledge Forum encourages students to work creatively and constructively with their ideas as a knowledge-building community. Both Jonassen et al. (2008) and Bereiter & Scardamalia (2006) have documented how some constructivist-oriented use of ICT promote higher-order learning among students.

While the general provisions of ICT resources are improving in most countries, changes in teaching practices are less forthcoming. Recent research indicates that teachers' use of ICT is largely confined to productivity tasks such as preparing lessons with word processors (Lawless & Pellegrino, 2007; Paraskeva, Bouta, & Papagianni, 2008). From the literature, many factors have been found to inhibit teachers from utilizing ICT in engaging students in meaningful learning. These include the lack of ICT leadership (Ng, 2008); traditional assessment practices (Fox & Henri, 2005); teachers' characteristics such as self-efficacy (Paraskeva et al., 2008) and low perceived control over the computers (Teo, 2008); and environmental conditions such as the lack of facilitating conditions (Teo, in press). A survey conducted by Hu, A. Wong, Cheah, P. Wong, & D'Rozario (2004) of more than 3000 beginning Singaporean teachers revealed that while teachers were already using ICT for routine work, they did not engage learners to co-construct knowledge constructively with ICT. Ertmer (2005) reported a similar phenomenon in America and attributed this to teachers' epistemological and pedagogical beliefs as a deeply rooted barrier. For example, a teacher who views

knowledge as facts and knowing as a process of facts acquisition is less likely to engage students in constructing personal representations of understanding using ICT. On the other hand, a teacher who views knowledge as evolving conceptions and knowing as a process of meaning construction is likely to see the processes of constructing mental representations about a phenomenon by a group of students as a meaningful learning activity. Many computer programs can be utilized as knowledge construction platforms. Becker's (2000) study indicates that teachers who encourage student to use computers to investigate and research about phenomenon are also more oriented towards constructivist beliefs. Researchers in Asia have started to investigate how teachers' views affect educational reforms that are directed towards the constructivist teaching (Leung, 2008; Lim & Chai, 2008).

The aim of this study is to examine pre-service teachers' epistemological beliefs and pedagogical beliefs, and how these beliefs are related to their attitude towards ICT use. We also aim to establish a baseline description of the pre-service teachers' beliefs. This study has the potential to provide information regarding teacher professional development in Singapore and Taiwan. Such cultural comparison could balance the view that all Eastern cultures are similar (Nisbett, 2003; Tweed & Lehman, 2002). While Singaporean and Taiwanese cultures may generally be attributed to the same origin, there are subtle differences that influence teachers' beliefs. For example, the education system in Singapore is an extension of the British education system while the system in Taiwan is modeled after the American system. In terms of their ties towards traditional culture, Singapore's may not be as strong compared to Taiwan's as the former is a multi-ethnic society with English as the working language for education and commerce. Politically, while both Singapore and Taiwan are democratic societies, the latter has a more active political environment. These differences should be adequate to warrant a comparative study to be conducted.

## LITERATURE REVIEW

In this study, we examine teachers' epistemological beliefs and pedagogical beliefs in relation to their attitude towards the ICT use. We define epistemological beliefs to be one's views about knowledge and about knowing. Other constructs such as belief about learning effort and innate ability, which are usually reported as part of epistemological studies, are not treated as core epistemological beliefs (Hofer & Pintrich, 1997). They are not included in this study. We define pedagogical beliefs as one's views about teaching, which are broadly classified as constructivist oriented or transmissive oriented (Chan & Elliot, 2004; Teo & Chai, 2008). These constructs are reviewed sequentially in the following paragraphs with an emphasis on studies involving pre-service teachers.

Research on beliefs about knowledge and about knowing or personal epistemology by educational researchers began in the late 60s. Perry (1970) was among the first researchers who established a pattern of epistemological development among college students. Generally, college students progressed from a naïve epistemological belief that views knowledge as certain and is passed down from authority, to a more sophisticated and relativistic stance that emphasized knowledge as uncertain and constructed by individuals based on warrants. This general pattern of development was also observed by later researchers who also relied on interview as the method for data collection (Hofer & Pintrich, 1997). Building on these earlier works, Sutton, Cafarelli, Lund, Schurdell, & Bichsel (1996) reported the epistemological development of 32 student teachers near the end of their teacher education. More than half of them were assessed to be at the higher end of epistemological development. White (2000) and Brownlee's (2001) studies on student teachers further strengthened Sutton et al.'s (1996) findings. In summary, these studies indicate that student teachers' epistemological beliefs are distributed across the developmental stages with more of them holding relativistic beliefs. These studies also found

very few pre-service teachers had held absolutists/dualistic epistemological beliefs.

Schommer (1990) proposed a model of five more or less independent dimensions of epistemological beliefs. The dimensions include the structure, certainty, source of knowledge, and the control and speed of knowledge acquisition, with the last two dimensions pertaining to learning. Hofer & Pintrich (1997) contested that the last two beliefs should not be included in the study of epistemological beliefs as philosophically, the latter are not core matters of epistemology. However, it is not uncommon to see control and speed of knowledge acquisition being included in the literature as beliefs about learning. To measure the five dimensions of beliefs, Schommer (1990) developed the Epistemological Beliefs Questionnaire (EBQ) which has enabled many researchers to study the relationships among epistemological beliefs and their related constructs. On the issue of students' learning, myriad studies have documented that epistemological beliefs are associated with learning strategies, academic achievements, interpretation of text and conceptual change (for example, see Braten & Stromoso, 2005; Chan, 2007; Mason & Boscolo, 2004). In general, sophisticated epistemological beliefs are positively associated with learning and higher order thinking. However, studies that explored the relationships between teachers' epistemological beliefs, pedagogical beliefs and teaching practice are generally lacking (Chan & Elliot, 2004), especially in the Asian context (Chan, 2007). Obviously, this area warrants further research since epistemological beliefs are closely linked to teaching and learning.

The relationship between teachers' epistemological beliefs and their beliefs about teaching and learning is complex. First, beliefs about what teaching and learning can be broadly classified under the knowledge transmission category or the knowledge construction category (Entwistle, Skinner, Entwistle, & Orr, 2000; Samuelowicz & Bain, 2001). The former is characterized as teacher-centered, content-oriented didactic teaching practice that emphasizes passive

reception of knowledge by students. As for the latter, it is usually characterized as student-centered, learning-oriented constructivist teaching that encourages students to actively make sense of their experiences situated within the social cultural contexts. Second, teachers with more sophisticated epistemological beliefs seem to be more engaged than their peers with regards to personal learning. For example, Ravindran, Greene and DeBacker (2005) reported that pre-service teachers' epistemological beliefs and their goals of learning were related to their level of cognitive engagement during teacher preparation. Third, the relationship between pre-service teachers' epistemological beliefs and their pedagogical beliefs seems to be incongruent at times. A review of studies focusing on pre-service teachers' beliefs indicates that they are likely to perceive teaching as an unproblematic process of knowledge transmission (Richardson, 2003). The predominance of teacher-centered didactic views of teaching among pre-service teachers seems to contradict the above-mentioned studies that suggest pre-service teachers tend to hold relativistic epistemological outlooks. For example, Chan and Elliot (2004) surveyed 385 Hong Kong pre-service teachers and reported that most of the teachers were relativistic in their epistemological outlooks. However, they were not inclined towards constructivist teaching. Chan and Elliot's 2004 research indicate that beliefs towards authority as source of knowledge and the view of knowledge as certain are both significantly and positively correlated to traditional teaching. The belief towards authority is also significantly correlated to the conception of constructivist learning. This seems to point to a possibility that the pre-service teachers may hold inconsistent views about epistemological beliefs and their pedagogical beliefs. Sinatra and Kardash's (2004) study of American student teachers, however, indicates that teachers who see knowledge as evolving and learning as a process of constructing understanding are also more receptive towards the idea of teaching as facilitating knowledge and

beliefs revision among students. Given that studies in different contexts may indicate different relationships between epistemological beliefs and beliefs about teaching and learning, it seems clear that more cross-cultural studies are required (Hofer, 2008).

Research that studied the relationships between teachers' epistemological beliefs and their perception of ICT use generally suggests that teachers who hold constructivist beliefs are more likely to engage their students to use computers and the Internet (Becker & Ravitz, 1999). However, epistemological belief is just one factor among many others that influence teachers' attitude towards ICT use. Wozney, Venkatesh, and Abrami (2006) employed the expectancy-value theory to study relationship between teachers' use of ICT and their perceived value of ICT. The results indicate a positive relationship between the two constructs. Zhao, Pugh, Sheldon, and Byers (2002) investigated the complexities involved in integrating ICT into classrooms. Their analyses indicate that a successful integration of ICT depends on the interrelationships among the school contexts, the key drivers (teachers) of the integration project, and the information technology involved. Specifically, when the technology chosen for implementation is compatible with the teachers' pedagogical beliefs, there is a higher chance for integration to occur. Fox and Henri's (2005) investigation of Hong Kong teachers' perspective on the use of ICT reveals that a perception towards the goal of education as producing good examination results will inhibit teachers' use of ICT. In addition, Teo, Chai, Hung, and Lee (2008) found that teachers' beliefs in teaching and learning played a significant role in teachers' ICT usage, whether it was used in a traditional or constructivist way.

The above literature review has mapped out the complex relationships among teachers' epistemological beliefs, pedagogical beliefs, and their perception of ICT use. The study attempts to investigate the beliefs of pre-service teachers from two cultures. The research questions are as follows:



1. What is the profile of the pre-service teachers from Singapore and Taiwan in terms of their epistemological beliefs and pedagogical beliefs?
2. Are there significant differences between Singaporean and Taiwanese pre-service teachers in terms of their epistemological and pedagogical beliefs?
3. To what extent are pre-service teachers' epistemological and pedagogical beliefs related to their attitude towards ICT use?

As discussed above, more comparative studies are required in order to better understand the different relationships between epistemological beliefs and beliefs about teaching and learning across different cultural contexts (Hofer, 2008). The present study represents such research initiative, and we selected Singapore and Taiwan due to their similar reform emphasis on constructivist education and their cultural and contextual difference gradually developed in history.

## METHODS

### *Participants and data collection*

The participants for this study were pre-service teachers who volunteered for this study. They were selected from the teacher preparation classes that were taught by the authors. The participants completed a questionnaire containing items that were adapted from various sources (Table 2). The Singapore sample completed the questionnaire in

English as shown in Table 2 while those from Taiwan responded to a translated version of the questionnaire in Chinese. The translation was done by a Chinese language expert from Taiwan. And to ensure the validity of the Chinese version of the questionnaire, it underwent a reverse translation (from Chinese to English) in Singapore by an academic with a high level of proficiency in both the English and Chinese languages. Each participant spent approximately 15 minutes to complete the questionnaire. No course credits or any form of reward was offered to participants in this study. Table 1 shows the profile of the participants in this study.

### *Measures*

The questionnaire contained three parts. The first part of the questionnaire solicits demographic data such as age, gender, and qualification. The second part of the questionnaire was an abridged version of the instrument that was used in Chan and Elliott (2004). This modified version covers four dimensions: (1) Certainty of Knowledge (CK) and (2) the Authority/Expert knowledge (AEK) as the two dimensions of epistemological beliefs (and sophisticated epistemological beliefs means less inclined to believe in both dimensions); (3) Traditional Teaching (TT) and (4) Constructivist Teaching (CT) as the two dimensions of pedagogical beliefs. The third part of the survey measured the teachers' attitude towards computer use (ATCU). These items were adopted from a recent survey by Teo, Lee and Chai (2008). All items employed a 5-point Likert scale (5 = strongly agree, 1 = strongly disagree). A high score

**Table 1**

*Background information of the participants*

Country	Age		Qualification		Gender	
	Mean	SD	Undergraduate	Postgraduate	Male	Female
Singapore (N=59)	26.8	2.99	0	59	28	31
Taiwan (N=49)	24.0	2.47	23	26	24	25
Overall (N=108)	25.5	3.08	23	85	52	56

indicated a favorable response towards the measured construct. Table 2 shows the beliefs and constructs that were measured in this study.

## RESULTS

The mean and standard deviation for each construct are shown in Table 3. Both the means for CK and AEK are below the mid-point of 3.0 in the scale. In terms of the standard deviation, there is a narrow spread ( $< 1.0$ ). The overall reliability of all constructs is satisfactory as compared to those reported in recent literature (Chai, Khine, & Teo, 2006; Chan & Elliot, 2004; Ravindran et al., 2005). For the t-test, the Levene's test of equality of variances suggests that equal variance can be assumed.

To understand the relationship between the two belief constructs, a correlation test was performed. First, "expert knowledge" and "certainty of knowledge" are found to be significantly correlated ( $r=.031$ ,  $p<.01$ ). Second, it was found that

participants' constructivist teaching beliefs were not significantly correlated with their traditional teaching beliefs ( $r=.03$ ,  $p>.05$ ). Further, to understand the relationships between the attitude towards computer use (ATCU) construct and the measured belief constructs, we ran another inter-construct correlation test. The results are shown in Table 4. A correlation matrix revealed no significant correlations between ATCU and other belief constructs for all participants. But upon looking into each specific country, it was found that there are two significant correlations (both at the .016 level). There was a significant negative correlation between ATCU and Authority/Expert Knowledge (AEK) for the Singaporean sample ( $r=-.31$ ,  $p=.016$ ). In addition, there was another significant positive correlation between ATCU and Traditional Teaching (TT) for the Taiwanese sample ( $r=.34$ ,  $p=.016$ ). In contrast, no significant correlation was found for both the Singaporean and Taiwanese samples between ATCU and Certainty of Knowledge (CK), and between ATCU and Constructive Teaching (CT).

**Table 2**

*Dimensions and sample items*

Belief	Construct	Number of items	Sample Item
Epistemological	Authority/ Expert Knowledge	6	a. Even advice from experts should often be questioned. b. I often wonder how much experts really know.
	Certainty of Knowledge	4	If scientists work hard enough, they can find the truth to almost anything
Pedagogical	Traditional teaching	6	a. The major role of a teacher is to transmit knowledge to students. b. Learning occurs primarily through drill and practice.
	Constructivist teaching	8	a. The ideas of students are important and should be carefully considered. b. Good teachers always make their students feel important.
Attitude towards computers use	Attitude towards computer use	4	a. I like using the computer. b. Working with the computer is fun.

**Table 3***Mean, SD and t-test values for the measured constructs*

Construct	Alpha	Country	N	Mean	SD	t-test
CK	.68	SG	59	2.36	.77	-.356
		TW	49	2.51	.71	
AEK	.67	SG	59	2.70	.60	-1.501
		TW	49	2.75	.48	
CT	.78	SG	59	4.15	.48	3.913*
		TW	49	4.50	.38	
TT	.90	SG	59	2.55	.55	6.473*
		TW	49	3.26	.58	
ATCU	.77	SG	59	3.54	.70	-.721
		TW	49	3.64	.73	

\*  $p < .001$ **Table 4***Correlations between pre-service teachers' attitude towards computer use and their epistemological and pedagogical beliefs*

Correlations	Epistemological Beliefs		Pedagogical Beliefs	
	Authority/Expert Knowledge	Certainty of Knowledge	Constructivist teaching	Traditional teaching
Attitude towards computer use				
All subjects together	-0.071	0.023	0.096	0.064
SG subjects only	-.313*	-0.101	0.2	-0.065
TW subjects only	0.15	0.163	0.021	.343*

\*  $p < .05$ 

## DISCUSSION

The results of this study indicate that both Singaporean and Taiwanese pre-service teachers do not believe strongly in authorities and experts as sources of knowledge. They are also not inclined towards seeing knowledge as certain and unchanging. In other words, the epistemological beliefs that these teachers hold are generally consistent with what is reported in literature that we have reviewed earlier. For example, surveys of Hong Kong and Singapore pre-service teachers' epistemological beliefs using similar items from

Chan and Elliot (2004) had documented comparable epistemological profile (see also Chai & Khine, 2008). In these studies, 85 of the surveyed teachers had obtained their first degree and the remaining 23 undergraduates were in their fourth years. Their epistemological profiles were consistent with most literature for students near graduation from college (Perry, 1970; Chai & Khine, 2008). These teachers have the basic epistemological outlooks that are consistent with constructivist teaching. These profiles should also support the efforts of reform geared towards constructivist teaching.



In terms of the differences of their epistemological beliefs, the Taiwanese and the Singaporean teachers' profiles seem to be similar. There is no statistical difference in the dimensions measured. Both Singapore and Taiwan pre-service teachers are strongly inclined towards constructivist teaching and less inclined towards traditional teaching. This should be a logical stance given their relativistic epistemological profile. However, this may not always be the case as Chan and Elliot's (2004) study had testified. The authors surveyed 385 Hong Kong pre-service teachers and reported that most of the teachers were relativistic in their epistemological outlooks, but they were not inclined towards constructivist teaching. Based on the reported mean score, it seemed that the Hong Kong pre-service teachers are neither inclined towards constructivist ( $M=1.86$ ) nor traditional teaching ( $M=2.63$ ). It seems that the Singaporean and Taiwanese pre-service teachers are holding more compatible epistemological and pedagogical beliefs.

Statistical differences were detected between the Taiwanese and Singaporean teachers' pedagogical beliefs. While the Taiwanese teachers had expressed a stronger inclination towards constructivist teaching, they also expressed an inclination towards traditional teaching. Usually, constructivist teaching and transmissive teaching are treated as forming the two opposing ends of a continuum as reported by western literature (Entwistle et al., 2000; Samuelowicz & Bain, 2001). However, this is not the case for the Taiwanese pre-service teachers. Further analysis of correlation was conducted for the Taiwanese teachers and it shows that the two conceptions of teaching were not correlated ( $-.083$ ). Paradoxically, Taiwan as a society is generally more open than Singapore but it is also more traditional. Historically, Taiwan has deeper ties with Confucianism than Singapore. If we assume that mother tongue languages are the main media for the transmission of cultural value, this may be due to the differences in the language policies between the two countries. In Singapore, secondary school students study 5-6 periods of Chinese language

per week. All the rest of the lessons are taught in English. In Taiwan, the situation reverses. English is just one of the subjects and all other subjects are taught in Chinese. In addition, the reform effort in Taiwan education has also been more thorough for the past decades, resulting in a general de-emphasis of academic results since most Taiwanese high school graduates are likely to gain entrance to a university if they desire. Academic results still matters a lot for gaining university entrance in Singapore, which is restricted to about 30% of each cohort of high school graduates. This may also explain the differences in the pre-service teachers' pedagogical beliefs from the two countries. In terms of their attitude towards computer use, both Singaporean and Taiwanese pre-service teachers expressed moderately positive attitudes. In addition, the results for the Singaporean teachers are comparable to a recent research by Teo, Lee and Chai (2008).

As expressed in our research question, a major interest in the present study is to look at ways in which pre-service teachers' epistemological and pedagogical beliefs are related to their attitude towards ICT use. As baseline information, the two major dimensions "expert knowledge" and "certainty of knowledge" in epistemological beliefs are found to be correlated ( $r=.31$ ,  $p<.01$ ), suggesting that the de-emphasis on expert knowledge (for the most part) goes hand-in-hand with relativism. Further results showed that there is a significant negative correlation between ATCU and Authority/Expert Knowledge (AEK) for the Singaporean sample ( $r=-.31$ ,  $p=.016$ ). In contrast, it was found that there was a significant correlation between ATCU and Traditional Teaching (TT) for the Taiwanese sample ( $r=.34$ ,  $p=.016$ ). This seems to suggest that additional effort to help Taiwanese teachers avoid using ICT to support more traditional teaching may be necessary. Although the cultural context in both countries is generally considered as similar, there still exists some subtle cultural difference in beliefs that influences how teachers use ICT to support teaching. On the other hand,

in terms of relationships between ATCU and Constructive Teaching (CT), no significant correlation was found for both the Singaporean and Taiwanese samples. It is possible that despite showing support for constructivist teaching, the pre-service teachers from both countries were not yet ready to adopt ICT into actual constructivist teaching practice. Arguably, there may be a misalignment between the teachers' teaching beliefs and actual practices, indicative of the tension between what should be done and what is being done. This may have something to do with cultural or contextual factors. For example, high-stake testing culture (see Hong & Chen, 2008; Lim & Chai, 2008) can force teachers with constructivist beliefs to compromise with less constructivism-oriented teaching in order to help students pass tests. As mentioned in the literature review, how epistemological beliefs and pedagogical beliefs are related to the teachers' attitude towards computer use is not a well-researched area; therefore, these results need to be verified with further studies. In future studies, items measuring the teachers' attitude towards computer should be replaced with items measuring teacher's attitude on the use of computer in education, in general, and in constructivist education, in particular. We note the unbalanced distribution in the Taiwan and Singapore samples and in terms of undergraduate and postgraduate qualifications. We plan to address these issues in further studies. We also suggest that future research should employ multiple regression to investigate the relationships of the constructs with larger sample size.

## CONCLUSION

The extent of technology integration in classroom is influenced by, among other factors, teachers' epistemological and pedagogical beliefs and their attitude toward computers. Our survey seems to indicate that the pre-service teachers both from Singapore and Taiwan were at least reportedly expressing beliefs that may be congruent for reform

initiatives targeted towards constructivist teaching. However, reports from field studies conducted in Singapore classrooms are pointing out that the use of ICT has not really transformed traditional classroom practices (Hu et al., 2004). While some researchers suggest that one of the remaining barrier is teachers' beliefs, this research suggest that it may not be the case. For example, culture may play an important mediating factor that influences how teachers relate their beliefs to ICT use. Further studies that investigate relationships between practicing teachers' beliefs and their teaching practices, and their use of ICT in schools are needed for educators to better understand the dynamics at play.

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## REFERENCES

- Becker, H. J. (2000). Findings from the teaching, learning, and computing survey: Is Larry Cuban right? Education Policy Analysis Archives, 8(51), Retrieved April 12, 2007, from <http://epaa.asu.edu/epaa/v8n51/>
- Becker, H. J., & Ravitz, J. (1999). The influence of computer and internet use on teachers' pedagogical practices and perceptions. *Journal of Research on Computing in Education*, 31, 356-384.
- Bereiter, C., & Scardamalia, M. (2006). Education for the Knowledge Age. In P. A. Alexander, and P. H. Winne (Eds.), *Handbook of Educational Psychology* (2<sup>nd</sup> ed.) (pp. 695-713). Mahwah, NJ: Lawrence Erlbaum.

- Braten, I., & Stromso, H. I. (2005). The relationship between epistemological beliefs, implicit theories of intelligence, and self-regulated learning among Norwegian postsecondary students. *British Journal of Educational Psychology*, 75, 539-565.
- Brownlee, J. (2001). Knowing and learning in teacher education: A theoretical framework of core and peripheral epistemological beliefs. *Asia-Pacific Journal of Teacher Education and Development*, 4, 131-155.
- Chai, C. S., & Khine, M. S. (2008). Assessing the epistemological and pedagogical beliefs among pre-service teachers in Singapore. In M. S. Khine (Ed.), *In Knowing, knowledge and beliefs: Epistemological studies across diverse cultures* (pp. 287-299). Amsterdam, Netherlands: Springer.
- Chai, C. S., Khine, M. S., & Teo, T. (2006). Epistemological beliefs on teaching and learning: A survey among pre-service teachers in Singapore. *Educational Media International*, 43, 285-298.
- Chan, K. W. (2007). Hong Kong teacher education students' epistemological beliefs and their relations with conceptions of learning and learning strategies. *The Asia-Pacific Education Researcher* 16, 199-214.
- Chan, K. W., & Elliot, R. G. (2004). Relational analysis of personal epistemology and conceptions about teaching and learning. *Teaching and Teacher Education*, 20, 817-831.
- Entwistle, N., Skinner, D., Entwistle, D., & Orr, S. (2000). Conceptions and beliefs about "good teaching": An integration of contrasting research areas. *Higher Education Research & Development*, 19, 5-26.
- Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology, Research and Development*, 53, 25-39.
- Fox, R., & Henri, J. (2005). Understanding teacher mindsets: IT and change in Hong Kong schools. *Journal of Educational Technology & Society*, 8, 161-169.
- Hofer, B. (2008). Personal epistemology and culture. In M. S. Khine (Ed.), *Knowing, knowledge and beliefs: Epistemological studies across diverse cultures* (pp. 3-24). Amsterdam, Netherland: Springer.
- Hofer, B. K., & Pintrich, P. R. (1997). The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research*, 67, 88-140.
- Hong, H. Y., & Chen, F. C. (2008). Assessing prospective teachers' initial views on teaching as knowledge-building practice. In B. Chang & H. J. So (Eds.), *Supplementary Proceedings of International Conference of Computer in Education (ICCE), 2008* (pp. 109-113). Taipei, Taiwan: Asia-Pacific Society for Computers in Education.
- Hong, H. Y., Scardamalia, M., Messina, R., & Teo, C. L. (2008). Principle-based design to foster adaptive use of technology for building community knowledge. In G. Kanselaar, V. Jonker, P. A. Kirschner, & F. J. Prins (Eds.), *International Perspectives in the Learning Sciences: Creating a learning world. Proceedings of the Eighth International Conference for the Learning Sciences – ICLS 2008*, (Vol. 1, pp. 374-381). Utrecht, The Netherlands: International Society of the Learning Sciences, Inc.
- Hong, H. Y., & Sullivan, F. R. (In press). An idea-centered, principle-based design approach to support learning as knowledge creation. *Educational Technology Research & Development*.
- Hu, C., Wong, A., Cheah, H. M., Wong, P., & D'Rozario, V. (2004). *Effectiveness of NIE's IT teacher training programme: Have we prepared them enough?* (Academic Research Fund Report 18/01). Nanyang Technological University: Singapore.
- Jimoyiannis, A., & Komis, V. (2007). Examining teachers' beliefs about ICT in education:

- Implications of a teacher preparation programme. *Teacher Development*, 11, 149-173.
- Jonassen, D., Howland, J., Marra, R., & Crismond, D. (2008). *Meaningful learning with technology* (3<sup>rd</sup> ed.). Upper Saddle River, NJ: Pearson.
- Lawless, K. A., & Pellegrino, J. W. (2007). Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of Educational Research*, 77, 575-614.
- Leung, W. L. A. (2008). Teacher concerns about curriculum reform: The case of project learning. *The Asia-Pacific Education Researcher*, 17, 75-97.
- Lim, C. P., & Chai, C. S. (2008). Teachers' pedagogical beliefs and their planning and conduct of computer-mediated classroom lessons. *British Journal of Educational Technology*, 39, 807-828.
- Mason, L., & Boscolo, P. (2004). Role of epistemological understanding and interest in interpreting a controversy and in topic-specific belief change. *Contemporary Educational Psychology*, 29, 103-128.
- Ng, W. L. (2008). Transformational leadership and the integration of information and communications technology into teaching. *The Asia-Pacific Education Researcher* 17, 1-14.
- Nisbett, R. E. (2003). *The geography of thought: How Asians and Westerners think differently and why*. New York: Free Press.
- Paraskeva, F., Bouta, H., & Papagianni, A. (2008). Individual characteristics and computer self-efficacy in secondary education teachers to integrate technology in educational practice. *Computers & Education*, 50, 1084-1091.
- Perry, W. G. (1970). *Forms of intellectual and ethical development in the college years: A scheme*. New York: Holt, Rinehart and Winston.
- Ravindran, B., Greene, B. A., & DeBacker, T. K. (2005). Predicting pre-service teachers' cognitive engagement with goals and epistemological beliefs. *The Journal of Educational Research*, 98, 222-232.
- Richardson, V. (2003). Pre-service teachers' beliefs. In J. Raths, & A. C. McAninch. (Eds.), *Teacher beliefs and classroom performance: The impact of teacher education* (pp. 1-22). Greenwich, Connecticut: Information Age Publishing.
- Samuelowicz, K., & Bain, J. D. (2001). Revisiting academics' beliefs about teaching and learning. *Higher Education*, 41, 299-325.
- Schommer, M. (1990). Effects of beliefs about the nature of knowledge on comprehension. *Journal of Educational Psychology*, 82, 498-504.
- Sinatra, G. M., & Kardash, C. (2004). Teacher candidates' epistemological beliefs, dispositions, and views on teaching as persuasion. *Contemporary Educational Psychology*, 29, 483-498.
- Sutton, R. E., Cafarelli, A., Lund, R., Schurdell, D., & Bichsel, S. (1996). A developmental constructivist approach to pre-service teachers' ways of knowing. *Teaching and Teacher Education*, 12, 413-427.
- Teo, T. (2008). Pre-service teachers' attitude towards computer use: A Singapore survey. *Australasian Journal of Educational Technology*, 24, 413-424.
- Teo, T. (in press). Explaining the intention to use technology among volitional users in education: An evaluation of the Technology Acceptance Model (TAM) using structural equation modeling. *International Journal of Instructional Media*.
- Teo, T., & Chai, C. S. (2008). Confirmatory factor analysis of the Conception for Teaching and Learning Questionnaire (CTLQ). *The Asia-Pacific Education Researcher*, 17, 215-224.
- Teo, T., Chai, C. S., Hung, D., & Lee, C. B. (2008). Beliefs about teaching and uses of technology among pre-service teachers. *Asia Pacific Journal of Teacher Education*, 36, 165-176.

- Teo, T., Lee, C. B., & Chai, C. S. (2008). Understanding pre-service teachers' computer attitudes: Applying and extending the Technology Acceptance Model (TAM). *Journal of Computer Assisted Learning*, 24, 128-143.
- Tweed, R. G., & Lehman, D. R. (2002). Learning considered within a cultural context. *American Psychologist*, 57, 89-99.
- Wozney, L., Venkatesh, V., & Abrami, P. C. (2006). Implementing computer technologies: Teachers' perception and practice. *Journal of Technology and Teacher Education*, 14, 173-207.
- White, B.C. (2000). Pre-service teachers' epistemology viewed through perspectives on problematic classroom situations. *Journal of Education for Teaching*, 26, 279-305.
- Zhao, Y., Pugh, K., Sheldon, S., & Byers, J. L. (2002). Conditions for classroom technology innovations. *Teacher College Record*, 104, 482-515.