

## **Preservice Teachers' Epistemological Beliefs and Conceptions about Teaching and Learning : Cultural Implications for Research in Teacher Education<sup>1</sup>**

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### **Abstract**

Four epistemological belief and two teaching/learning conception dimensions were identified from a questionnaire study of a sample of Hong Kong preservice teacher education students. The epistemological belief dimensions were labelled Innate/Fixed Ability, Learning Effort/Process, Authority/Expert Knowledge and Certainty Knowledge. The somewhat different results on epistemological beliefs from Schommer's findings with North American college students suggested possible influence of cultural contexts. The teaching/learning conceptions were labeled Traditional and Constructivist Conceptions. MANOVA indicated no significant statistical differences across age, gender and elective groups in their epistemological beliefs and conceptions. Canonical Correlation Analysis showed significant relations between epistemological beliefs and conceptions about teaching and learning. Implications were drawn for future research in teacher education with respect to the relations of epistemological beliefs and teaching/learning conceptions in different cultures.

### **Introduction**

Research in teacher education has suggested that teachers' classroom behaviour and activities are determined by a set of theoretical framework which is belief driven (Clark & Peterson, 1986; Marland, 1995, 1998; Richardson, 1996). This set of theoretical framework represents the teachers' conceptions about teaching and learning and is known by various labels such as implicit theories, conceptions, images and metaphors (Calderhead, 1996; Marland, 1995; 1998; Munby, 1986; Richardson, 1996). Irrespective of different labels used, these studies have suggested/assumed that teachers' conceptions about teaching and learning are derived from and influenced by individuals' beliefs of teaching and learning. There are various kinds of teachers' beliefs which are related to their conceptions about teaching and learning, for example, beliefs about values, beliefs about teacher efficacy and beliefs about the nature of knowledge and knowledge acquisition (epistemological beliefs).

Of the studies in epistemological beliefs, one line of research is on the dimensions of epistemological beliefs and the relation with meta-cognitive variables. (Hofer & Pintrich, 1997; Jehng et al., 1993; Qian & Alvermann, 1995; Schommer, 1990). Research in this area has suggested that epistemological beliefs are related to meta-cognitive activities such as reading comprehension, (Kardash & Scholes, 1996; Schommer, 1990; Schommer et al., 1992), mathematics problem solving (Schoenfeld, 1983, 1985), persistence in the face of a difficult task (Dweck & Leggett, 1988; Qian & Alvermann, 1995). Other studies attempted to examine if epistemological beliefs are disciplines dependent or not (Jehng et al, 1993; Schommer & Walker, 1995).

In classroom teaching and learning, a teacher has to make many decisions that influences his/her behaviour within a single period. Such decision makings are meta-cognitive in nature, affected by the classroom context and the teachers' beliefs about the nature of knowledge and knowledge acquisition or learning. Studies on

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<sup>1</sup>Paper presented at the NZARE AARE Conference 2003 at Auckland, New Zealand from 29th Nov. to 3<sup>rd</sup> Dec. 2003. Correspondence: The Hong Kong Institute of Education, 10 Lo Ping Road, Tai Po, NT, Hong Kong SAR, China. Email: kwchan@ied.edu.hk

epistemological beliefs have suggested that they influence one's conception of learning and teaching (Black & Ammon, 1992; Brousseau & Freeman, 1988; Dweck & Leggett, 1988; Qian & Alvermann, 1995). Researchers have also shown that educational beliefs or value orientations appear to play an influential role in teacher judgements about what knowledge to retain in memory, permitting individuals to select and store information they consider most relevant and useful (Ennis et al., 1997). Within the ill-defined classroom situation/context, it is possible that certain relation exists between the teachers' conceptions about teaching and learning with the epistemological beliefs held by the teacher. Nevertheless, there is no empirical research, with statistical output reporting on the relation between epistemological beliefs and teachers' conceptions about teaching and learning, leaving this area unexplored.

### **Objective of Study**

This study attempts to address the gap by investigating the relation between epistemological beliefs and conceptions about teaching and learning of Hong Kong teacher education students. Based on the objective of this study, five research questions are drawn.

1. What are the epistemological beliefs held by the Hong Kong teacher education students?
2. Are there any significant differences in epistemological beliefs with respect to age, gender and fields of study?
3. What are the conceptions about teaching and learning held by the Hong Kong teacher education students?
4. Are there any significant differences in such conceptions in terms of age, gender and fields of study?
5. What are the relations between Hong Kong teacher education students' epistemological beliefs and their conceptions about teaching and learning?

### **Method**

Two questionnaires were administered to 385 preservice teacher education students of the Certificate in Education (CE) program of a tertiary institution in Hong Kong. The CE program is a full-time two-year sub-degree program for training non-graduate teachers of primary and junior secondary level. The admission requirement is similar to other local universities in Hong Kong and the students can be considered equivalent to university undergraduate, comparable to the North American university students in Schommer's studies. The age of the teacher education students ranged from 19 to 40. Many were around 21 and 22 (28.1% and 30.9% respectively) and only very few was below 20 (1%) or above 30 (2%). There were 115 male and 263 female students (with 7 missing cases). The first questionnaire was to identify the epistemological belief dimensions held by the Hong Kong teacher education students (Epistemological Beliefs Questionnaire, EBQ). The second questionnaire was to examine the conceptions about teaching and learning held by the Hong Kong teacher education students (Teaching/Learning Conceptions Questionnaire, TLCQ). Students were asked to supply their demographic data such as age, gender and electives studied in the first part of the questionnaire.

### **Materials**

#### *Epistemological Beliefs Questionnaire (EBQ)*

The questionnaire (EBQ) was developed from adaptation of Schommer's 63-

item epistemological beliefs questionnaire, which was built upon Schommer's theoretical framework of five epistemological belief dimensions, viz. Innate/Fixed Ability, Omniscient Authority, Certain Knowledge, Simple Knowledge and Quick Learning (Schommer, 1994). Schommer's studies with North American college students only extracted four factors out of five in exploratory factor analysis, the factor or dimension on Omniscient Authority was not extracted (Schommer, 1990, 1993a, 1993b).

Pilot study conducted by the author raised doubt about the validity and applicability of Schommer's questionnaire in the Hong Kong context (Chan & Elliott, 2000). Following the strategies suggested by Burnett and Dart (1997), Fanshawe and Burnett (1991), a questionnaire ended up with 30 items was developed with satisfactory reliabilities of subscales/dimensions (Cronbach alpha ranging from 0.6 to 0.7). The 30-item scale was validated by confirmatory factor analysis with satisfactory goodness of fit index (GFI = 0.93, AGFI = 0.90, RMSEA = 0.058, RMR = 0.064). The developmental details of the epistemological beliefs questionnaire instrument was reported elsewhere (Chan & Elliott, 2000; 2002).

### *Teaching/Learning Conceptions Questionnaire (TLCQ)*

The teaching/learning Conceptions questionnaire (TLCQ) was developed on two sources: literature review and dialogues with students in class and before teaching practice. Literature review gave insights to the different perspectives about teaching and learning, including the prevalent conceptions viz. the traditional versus the constructivist views (e.g. Shuell, 1986; 1996) which are often addressed in teacher education programs. The survey questions reported in literature used to assess the beliefs and conceptions of pre-service teachers about teaching and learning were also considered in the design of the questionnaire items used in this study (Bramald et al., 1995; Dunkin & Precians, 1992; Hawkey, 1996; Tatto, 1996). The dialogues between the authors and the teacher education students allowed the authors to review the teacher education students' concerns, thoughts and beliefs about teaching and learning (Chan, 1999; Chan & Leung, 1999). Based on the dialogues and literature search, five categories of important issues about the teaching work related to the traditional versus constructivist conceptions were defined. These five categories were: (1) The meaning of teaching and learning (2) The role of the teacher and students (3) The role of peers, individual versus group learning (4) Students' abilities and needs (5) The ways of teaching and class management. Related to these five categories of teaching work, the teacher education students continually referred to two broad perspectives on teaching, viz. a traditional and a constructivist perspective. Subsequently, items were identified and drawn from both literature search and dialogues with the students. By conducting pilot studies with repeated processes of factor analysis, item identification and interview, a questionnaire with 30 items was developed. The Cronbach alpha value of the whole scale was good (about 0.86) and the scale was validated by confirmatory factor analysis with satisfactory goodness-of fit index (GFI = 0.93, AGFI = 0.91, RMSEA = 0.54, RMR = 0.50) (see Chan, 2001).

## **Results**

### ***Epistemological Beliefs***

Addressing research question 1, exploratory factor analysis and Oblimin Rotation (with eigen value greater than 1 and scree plot test) was applied to the EBQ item responses on a Likert five-point scale. Only items with factor loading equal to or greater than 0.3 were retained in the extracted factors. Four factors were extracted

representing the subscales or dimensions of epistemological beliefs identified within the sample of Hong Kong teacher education students. According to the nature of the items loaded on the factors, the four epistemological belief dimensions were labelled Innate/Fixed Ability, Learning Effort/Process, Authority/Expert Knowledge and Certainty Knowledge (see Table 1).

**Table 1 Identified epistemological belief dimensions of Hong Kong teacher education students**

Epistemological Dimensions	Alpha	Mean	S.D.
Innate/Fixed Ability (8 items)	0.69	2.82	0.49
Learning Effort/Process (11 items)	0.66	3.92	0.35
Authority/Expert Knowledge (6 items)	0.58	2.62	0.47
Certainty Knowledge (5 items)	0.60	2.62	0.56

Compared with Schommer's (1990) findings, the results of the present study differed in that the dimension Authority/Expert Knowledge (similar in nature to Omniscient Authority in Schommer's theoretical framework) was extracted, which was absent in Schommer's study. Instead of Simple Knowledge and Quick Learning as proposed and extracted in Schommer's study, this study extracted a merged or complex factor consisting of items representing learning effort and learning process. The other dimensions, viz. Innate/Fixed Ability and Certainty Knowledge resembled that of Schommer's findings. All these results reflected the possible influence of different cultural contexts on the epistemological beliefs of the students, in this case, the Hong Kong Chinese (non-Western) versus the North American (Western) culture.

For research question 2, MANOVA at a significance level of 0.01 was applied to the questionnaire response data of the four epistemological beliefs dimensions across age, gender and elective groups. For age groups, Wilks' lambda = .962,  $F(12, 955) = 1.18$ ,  $p > .01$ . For gender groups, Wilks' lambda = .988,  $F(4, 372) = 1.08$ ,  $p > .01$ . For electives1, Wilks' lambda = .988,  $F(4, 372) = 1.08$ ,  $p > .01$ , and for electives 2, Wilks' lambda = .970,  $F(16, 1115) = .70$ ,  $p > .01$ . In summary, the F values of the four dimensions were insignificant at 0.01 level implying there was no significant statistical differences in epistemological beliefs of the sampled students with respects to their age, gender and fields of study.

### ***Teaching/Learning Conceptions***

For research question 3, exploratory factor analysis and Oblimin Rotation (with eigen value greater than 1 and scree plot test) was applied to the questionnaire response data on a Likert five-point scale. Only items with factor loading equal to or greater than .3 were retained. Two factors were extracted, representing the dimensions of teaching and learning conceptions held by the teacher education students. According to the nature of loaded items, the two dimensions or subscales were labelled the Traditional and Constructivist Conceptions. The Traditional Conception subscale consists of 18 items (Mean = 2.63, S.D. = 0.46), with reliability (Cronbach alpha) equals to 0.84. The Constructivist Conception subscale consists of 12 items (Mean = 1.86, S.D. = 0.36), with reliability (Cronbach alpha) equals to 0.84.

To address research question 4, MANOVA analysis at a significance level of 0.01 was applied to the questionnaire response data. For the age groups, Wilks' lambda =

.983,  $F(2, 724) = 1.06$ ,  $p > .01$ . For the gender groups, Wilks' lambda = .991,  $F(2, 372) = 1.68$ ,  $p > .01$ . For electives 1, Wilks' lambda = .989,  $F(8, 732) = .53$ ,  $p > .01$ . For electives 2, Wilks' lambda = .958,  $F(8, 732) = 2.00$ ,  $p > .01$ . In summary, the results showed that there was no significant statistical differences in the conceptions about teaching and learning held by the Hong Kong teacher education students under study with respect to their age, gender and fields of study.

***Relation between epistemological beliefs and conceptions***

To answer research question 5, Canonical Correlation Analysis was conducted to and the result is shown in Table 2.

**Table 2 Canonical Correlation Analysis of Four Epistemological Beliefs Dimensions and Two Conceptions Dimensions (N = 380)**

Variables	Function 1		Function 2	
	Correlation	Coefficient	Correlation	Coefficient
<b>Dependent variable</b>				
Innate/Fixed Ability	-0.74	-0.55	0.05	-0.12
Learning Effort/Process	0.00	-0.07	-0.97	-0.97
Authority/Expert Knowledge	-0.75	-0.54	0.20	0.21
Certainty Knowledge	-0.58	-0.32	-0.21	-0.12
<b>Covariate</b>				
Traditional Conception	-1.00	-1.00	-0.01	-0.36
Constructivist Conception	-0.34	-0.01	0.94	1.06
Eigenvalue		0.40		0.22
Percentage of variance		63.91		36.10
Canonical correlation		0.53		0.43
Squared canonical correlation	0.28			0.18
<b>Percentage of variance in dependent variables explained by canonical functions</b>				
Dependent variables		36.16		25.85
Covariates		10.28		4.74
<b>Percentage of variance covariates explained by canonical functions</b>				
Dependent variables		15.87		8.09
Covariates		55.83		44.17

**Note:** F values of multivariate tests of Pillais, Hotellings and Wilks reached the 0.001 significance level. Correlation = correlation between variable and canonical function. Coefficient = standardized canonical function coefficient.

Epistemological belief and teaching/learning conception dimensions were related by the two roots, or canonical functions generated in the analysis. The first eigenvalue shows that the first canonical function accounts for the most variance (eigenvalue = 0.40, 63.91 per cent). The second canonical function accounts for the next most variance (eigenvalue = 0.22, 36.91 per cent). The two canonical correlations were moderate to moderately high (0.53 and 0.43).

As shown in Table 2, among the four dimensions of epistemological beliefs, Innate/Fixed Ability was strongly and negatively correlated with canonical function 1



(-0.74). The same applied to Authority/Expert Knowledge, which was strongly and negatively correlated with canonical function 1 (-0.75). Certainty Knowledge was moderately and negatively correlated with canonical function 1 (-0.58). Canonical function 1 explained about 36.2 per cent of the variance of all the epistemological belief dimensions. The dimension referred to as Learning Effort/Process was very strongly and negatively correlated with canonical function 2 (-0.97). Canonical function 2 explained about 25.85 per cent of the variance of all the epistemological belief dimensions.

Among the two dimensions of conceptions, Traditional Conception was very strongly but negatively correlated with canonical function 1 (-1.00) and there was a fairly moderate and negative correlation of Constructivist Conception associated with canonical function 1 (-0.34). The latter association was not as strong as that for the Traditional conception when the Standardized Canonical Coefficients for covariates were compared, and might be ignored on consideration of the relative standardized canonical coefficients (-0.01 versus -1.00). The Constructivist Conception was strongly correlated with canonical function 2 (0.94). Canonical function 1 explained about 15.87 per cent of the variance of all the conceptions dimensions and canonical function 2 explained about 8.09 percent of the variance of all the conceptions dimensions.

Based on the correlation of Canonical function 1 with the dependent variable and the covariate, the results suggest that teacher education students whose scores were low (below the mid-point 3) on epistemological beliefs subscales Innate/Fixed Ability, Authority/Expert Knowledge and Certainty Knowledge (all negative correlations) would be likely to have low scores (also below the mid-point 3) for the Traditional Conception of conceptions (negative correlation). It could also be taken that the teacher education students who had low scores in the Traditional Conception would also likely have low scores in Innate/Fixed Ability, Authority/ Expert Knowledge and Certainty Knowledge. Similarly students who were high in the subscale scores (above 3 in the score rating) of Innate/Fixed Ability, Authority/Expert Knowledge and Certainty Knowledge would also likely have high scores (score rating above 3) in the subscale of Traditional Conception about teaching/learning.

The above analysis implies that the Hong Kong teacher education students who have Traditional Conceptions of teaching and learning are most likely to hold beliefs that knowledge is certain, knowledge is derived from experts and one's learning ability is innate. Alternatively, the teacher education students who do not believe in the Traditional Conceptions are likely to believe that knowledge is constructed from one's experiences and judgment, knowledge is tentative and changing and that one's ability is not inborn and can be changed.

Similarly, with reference to the correlation of Canonical function 2 with the dependent variable and the covariate, the result suggests that teacher education students who scored high (score rating above 3) in the subscale Constructivist Conception were very likely to have a low subscale score (score rating below 3) in Learning Effort/ Process (negative correlation). In other words, the Hong Kong teacher education students who believe in the Constructivist Conception about teaching and learning were likely not to believe in Learning Effort/Process.

In summary, Table2 shows the relation between the dimensions of epistemological beliefs and conceptions about teaching and learning. Canonical function 1 indicates a positive relation exists between the Traditional Conception held by the Hong Kong teacher education students and their beliefs in Innate/Fixed Ability, Authority/Expert Knowledge and Certainty Knowledge. The correlations between the

Traditional Conception and the three epistemological beliefs dimensions are quite high, especially the former two. Subsequently, teacher education students who agreed with the Traditional Conception of teaching and learning also agreed that learning capacity is innate or fixed, knowledge is derived from authority or experts and that knowledge is permanent and unchanged.

Concerning Canonical function 2, the Constructivist Conception was inversely related to the student teachers' beliefs in Learning Effort/Process. The correlation between the conception and epistemological belief dimensions was very high but varies in the reverse direction. In other words, the Hong Kong teacher education students who hold a Constructivist Conception in their conceptions are likely not to believe that knowledge is created through learning effort and process.

## **Discussion**

Of the four epistemological belief dimensions identified in this study, the Hong Kong teacher education students tended to believe that knowledge is acquired through one's effort and the learning process rather than being handed down by authority figures or experts. The Hong Kong teacher education students also tended not to believe that ability is inborn and fixed; and they tended not to believe that knowledge is certain and unchanged. The value system in the traditional Chinese culture could be one possible factor accounting for the epistemological beliefs held by the Hong Kong teacher education students in the dimension Learning Effort/Process. The Confucian Chinese culture placed high value on education, effort and hardworking. To the Chinese, education and learning are always associated with effort. Effort or hardworking is considered a very important attribute of a person's success, especially for academic achievement. This has been demonstrated in a number of attribution studies with Hong Kong Chinese students (e.g. Hau & Salili, 1990, 1996). Chinese children are reared in an environment where effort, endurance, and hard working is emphasized (Yang, 1986). People who attempt tasks beyond their ability are admired and commended rather than ridiculed. "Knowing the impossibility of accomplishment but still working hard" is a highly praised virtue. People tend to emphasize the importance of effort rather than effort (Lau, 1996). The Hong Kong teacher education students represent a general "Chinese" way of beliefs associated with learning. Many of them are inclined towards working hard and learning how to learn. This may account for the much higher rating (highest mean subscale score) and the smallest deviation within the respondents in favour of Learning Effort/Process in this study.

The extraction of the dimension "Authority/Expert Knowledge" indicated the significance of the belief in "Authority" in traditional Chinese culture. In such a culture students are expected to show respect for, and be obedient, to elders and authority figures. It is assumed that authority figures or experts hand down knowledge. Nevertheless, Confucianism may be too narrow a focus for understanding the behaviour of Chinese people. While teachers were considered knowledgeable and enjoyed a high status in school and society in the traditional Chinese culture, there have been changes nowadays especially in Hong Kong which has been exposed to both Chinese and Western cultures and philosophy. Today's teenagers and adolescents may not abide to authority figures as strong as their elder generation. The parenting style of Hong Kong has gradually moved to be more liberal and authoritative. Children and teenagers are not forced to follow what the elders say. Despite some teachers and lecturers continue the traditional way of teaching and express themselves as authority figures of the subjects they teach (Watkins & Biggs, 1996), the educational reform in Hong Kong drives school and university teaching to

encourage students do more reflective thinking instead of mere memorization work. The existing traditional Chinese culture and philosophy and the interaction with increasing influence of Western philosophy might be an explanation for the relatively lower mean score and large range (minimum 1.00 and maximum 4.67) in the belief of Authority/Expert Knowledge compared to those of Learning Effort/Process and Innate/Fixed Ability.

The finding that Hong Kong teacher education students tended not to believe in Certainty Knowledge is in line with previous studies conducted by other researchers such as Perry (1968), Ryan (1984) and Schommer (1990, 1993a, 1993b). Younger students usually hold more naïve beliefs about the nature of knowledge, that is, they believe knowledge is certain and unambiguous. As they grow older and develop, they start to adopt a more sophisticated viewpoint toward knowledge and believe knowledge is changing and tentative. For the Hong Kong teacher education students, the majority of the students (92.7%) were in the age range of 20-25 and about 1.6% below 20, this might account for the relatively lower mean value (2.62) of the dimension and students' tendency to disagree with the notion "knowledge is certain and unchanging".

MANOVA study indicated no significant differences in the epistemological belief dimensions among demographic variables of age, gender and study electives. The results differ from those reported by Jehng et al. (1993) and Paulsen and Wells (1998) but resembled that of Schommer and Walker (1995) who reported that epistemological beliefs were electives independent. As there were similarities and variation in report findings in literature on whether epistemological beliefs depend on age, gender or electives (Jehng et al., 1993; Schommer, 1993a, 1993b, Schommer & Walker, 1995), further studies are required for confirmation of the findings.

The conceptions of the Hong Kong teacher education students towards teaching/learning comprised of two dimensions: Traditional and Constructivist Conceptions. Based on the mean values of the two conception subscales, it showed that the students in the sample did not exclusively believe in the Traditional or Constructivist Conception about teaching and learning. The intermingling of both the Traditional and Constructivist Conceptions of teaching and learning within the teacher education students in the study might be due to the impact of their past learning experience and an exposure to new perspectives in education encountered in the teacher education program. The students in Hong Kong are usually brought up in a traditional way of teaching and learning. They may be accustomed to this way of learning and teaching and gradually they fostered the Traditional Conception. This may explain why teacher education students accept the idea that learners have to be under control before teaching and learning can take place. Their usual practices or habits of rote learning and memorization work due to assessment requirement may have a diversified effect on their beliefs and conception. Some might find rote learning, drill and practice useful in passing examination. Others might feel bored and tired in continuing with this practice and wanted some more active ways of learning. The increased exposure to Western cultures and philosophies in the mass media, and the promotion of constructivism in learning in educational reform and in the teacher education program might trigger a different belief and conception towards learning which is different from what they have experienced. In turn, some teacher education students disagreed with the Traditional Conception of teaching and learning and were inclined towards the Western conception of progressivism, constructing knowledge from one's experiences and respect for learners' ideas. MANOVA studies suggested that the teaching/learning conceptions held by the Hong Kong teacher education



students were independent of age, gender and electives.

Canonical Correlation Analysis showed that three epistemological belief dimensions: Innate/Fixed Ability, Authority/Expert Knowledge and Certainty Knowledge were positively and significantly related to the Traditional Conception about teaching and learning. The epistemological belief dimension on Learning Effort/Process was negatively and significantly related to the Constructivist Conception (Table 2). It was speculated that a teacher education student who is strongly inclined toward the Traditional Conception is influenced by the Chinese Confucianism. Learning ability is not as important as learning effort. Hong Kong teacher education students who are influenced by Confucian-heritage Chinese culture and thought would be unlikely to hold a belief in Innate Ability as ability is perceived to be changeable and improvable. Authority figures, e.g. teachers should be respected and students depend on an authority/expert's knowledge, which is taken to be certain and unchanging. The Constructivist Conception emphasizes the arrangement or provision of an environment or learning experience for students to explore and generate knowledge by themselves. The ideas of students are considered important. Hard work with repetition and drilling simply reproduces what is known and taught by the teacher rather than generating/constructing knowledge by the learners themselves. This may account for the negative or inverse relation between the two dimensions: Learning Effort/Process and Constructivist Conception.

### **Conclusions and Implications**

The present study do not replicate the findings of North American students' epistemological beliefs as reported by Schommer (1990) in the Hong Kong context. The Hong Kong context is unique in that students are exposed to the interactive influences of both traditional Chinese Confucian-heritage culture and Western philosophies. Thus, this study on epistemological beliefs adds further evidence that cross-cultural and contextual differences exist in personal epistemological beliefs. The epistemological development of students is mediated by culture-specific educational environments and interactions. The result of this study implies that educational environments and academic practices in a culture, irrespective of students' gender and fields of study, seem to be an influential factor in the shaping/development of epistemological beliefs. Nevertheless, the roles played by age, gender and fields of study on the development of sophisticated epistemological beliefs are still subject to further verification. Caution must be exercised in applying epistemological hypotheses developed for studies in different contexts, and modification of these seems necessary before consider asking their relevance in a different context.

This study also found that epistemological beliefs held by Hong Kong teacher education students are related to their conceptions about teaching/learning. The results give support to researchers' assumptions in the literature that teachers' conceptions and class teaching are beliefs driven. If teacher education students are able to make their beliefs explicit, it would help their learning how to teach through discussion and analysis of what they believe to work in their teaching. Related to this are their beliefs in the nature and source of knowledge (epistemological beliefs). Teacher educators can help students to be aware of their epistemological beliefs and understand how epistemological beliefs influence and interact with teachers' conceptions about teaching. The significance of epistemological beliefs in teaching and learning is becoming obvious, with support found in other research literature and this study. Thus, epistemological beliefs are expected to become more significant in analysis of

teacher education, not only in understanding meta-cognitive activities and processes of learning how to teach but also in understanding strategies for the selection of prospective teachers.

Implications also rise for teacher educators in the design and development of teacher education programs when teacher education students' epistemological beliefs and related conceptions are considered. Teacher education programs should aim at developing within students an inquiring attitude, learn by analysis and reflection instead of strongly believing in what they consider to be delivered by authorities figures. In turn, teachers should inculcate such learning attitudes and beliefs within the students they teach in order to promote critical thinking and abilities to analyze amongst their students. In addition, teacher educators and program designers have to take teacher education students' prior beliefs and conceptions into consideration in the planning and provision of teacher education experiences if they wish to bring about changes within teacher education students.

Close to this, comparative studies of pre-service and in-service teacher education students may also be conducted to study the effect of different entry characteristics of students (such as maturity and teaching experiences) on epistemological beliefs and conceptions. Such studies could investigate the impact of previous teacher education experience acquired in the field on epistemological beliefs and conceptions and the changes.

While Canonical Correlation Analysis has indicated certain relationships existed between epistemological beliefs and conceptions about teaching and learning, any cause and effect relationship between the two may be attempted with models and path analysis study.

In summary, there remains much to be uncovered in the domain of epistemological beliefs and conceptions about teaching and learning. This study only serves as part of a continued attempt in this underdeveloped area of research to clarify issues. More is required in order to develop a deeper understanding of the area, which eventually should prove invaluable to the future development in teacher education research and an improvement in teaching and learning.

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