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A Comparative Study of Teachers' Mathematics Beliefs in the Context of Curriculum Reform in Hong Kong and Chongqing

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Abstract: This study investigated and compared the mathematics beliefs of junior secondary mathematics teachers and the level of consistency between their beliefs and the constructivist principles underlying the reform-oriented curriculum in Hong Kong and Chongqing. The questionnaire survey involved 113 Hong Kong and 114 Chongqing teachers. At both places, the teachers' mathematics beliefs were generally informal (reform-oriented), which indicated a relatively high level of consistency. Unexpectedly, the Chongqing teachers' mathematics beliefs were significantly more informal than Hong Kong's and also at a significantly higher level of consistency. It seems that the mathematics curriculum reform in Hong Kong and Chongqing are likely to succeed, with better chances in Chongqing.

Keywords: Teachers' mathematics beliefs; Curriculum reform; Constructivism; China

Introduction

At the turn of the 21st century, mathematics curriculum reforms have taken place in various countries and regions around the world, such as the United States, the United Kingdom, and the Netherlands in the West, and Mainland China, Hong Kong, Japan, and South Korea in the East. These reforms aim at preparing the younger generation of students for an era in which "the economy is globalized, and the society is knowledge-based and information-rich" (Wong, Han, & Lee, 2004, p. 28). Interestingly, with the development of mathematics education in various countries and regions, more and more curricular similarities have emerged (Atweh & Clarkson, 2001; Clements & Ellerton, 1996; Curriculum and Textbook Workgroup, 2002; Howson & Wilson, 1986; Wong & Wong, 1997). Wong et al. (2004) observed that an East-West distinction found in the past research has "become blurred in this round of curriculum revision" (p. 62), and more agreements

on curricular aims, pedagogy and assessment have been reached. These agreements suggest that more visions of reform are shared by curriculum policymakers, mathematics educators and researchers around the world. In particular, it has been argued that most of the current mathematics curricula, including those in Hong Kong and mainland China are built on similar theoretical principles, particularly constructivism (Chen, 2010; Eggleton, 1995; Fan, 2003; Frykholm, 1995; Gregg, 1995; Knapp & Peterson, 1995; Watson, 1995; Zheng, 2004). Actually, this is not surprising in view of the effects of the globalization of mathematics education (Atweh & Clarkson, 2001).

The literature suggests that the level of consistency between teachers' mathematics beliefs and the underlying philosophy of reform-oriented mathematics curriculum can be an important indicator of the success of curriculum reform (Handal & Herrington, 2003; Memon, 1997; Ross, McDougall, & Hogaboam-Gray, 2002). The higher the level of consistency is achieved, the more likely the reform is to succeed. It is noteworthy that although a low level of consistency has been suggested by the broad research literature (Battista, 1994; Wilson, 1990; Wilson & Goldenberg, 1998), few empirical studies have investigated this issue in the Eastern or Chinese contexts. In order to fill this research gap, this study aimed to investigate the level of consistency between junior secondary teachers' mathematics beliefs and the underlying constructivist principles of the reform-oriented mathematics curriculum in two different cities in China: Hong Kong and Chongqing. Through a comparative study of the two places, not only the level of consistency between the teachers' mathematics beliefs and the constructivist ideas underpinning the reform-oriented curriculum, but also similarities and differences in the teachers' beliefs between the two cities could be identified.

Hong Kong and Chongqing were selected as the research contexts mainly because that there are significant commonalities and differences between the two cities. Hong Kong and mainland China (including Chongqing) share the Confucian Heritage Culture (Biggs, 1996), and both started the implementation of the reform-oriented mathematics curricula in 2001. (For more details about the background of curriculum reform in the two places, please see Curriculum Development Council, 2000, 2002a, 2002b; Mathematics Curriculum Standards Development Team, 2002; Wang, 2004.) We were interested to find out, given that the reform in the two cities had been implemented for roughly the same period of time, to what degree the teachers' beliefs are consistent with the underlying philosophy of the new curriculum. On the other hand, there exist significant cultural differences between Hong Kong and Chongqing. Hong Kong, as a former British colony and one of major financial centers in the world, is deeply influenced by Western culture (Wong, Lam, Leung, Mok, & Wong, 1999). Chongqing, on the other hand, is one of

the biggest cities in western China. It has much less exposure to Western thoughts, and is also one of the Chinese cities with the most conservative values. Given that Hong Kong had experienced a constructivism-based educational reform before the current one (Mok & Morris, 2001) while mainland China had not, it was hypothesized that with more experience with constructivist ideas and practices, the Hong Kong teachers' mathematics beliefs would be more reform-oriented than Chongqing's. The research questions for this study were:

1. To what extent were the teachers' mathematics beliefs consistent with the underlying constructivist principles of the reform-oriented curriculum in Hong Kong and Chongqing?
2. How did the teacher' mathematics beliefs differ across the two places? Did a higher level of consistency between teachers' beliefs and the underlying constructivist principles of the reform-oriented curriculum exist in Hong Kong or in Chongqing?

Theoretical Background

Definition of beliefs and mathematics beliefs

Belief is a messy construct. In the literature, the term "belief" is often used as a synonym to terms such as attitude, value, disposition, opinion, perception, conception, and philosophy (Leder & Forgasz, 2002; Pajares, 1992). Through a broad review of studies on teachers' beliefs, Raymond's (1994) interpretation of beliefs was viewed adequate for this study:

> Beliefs are composed of self-truths and reflect how one defines reality in the world. Personal reality is subject to one's experiences and prejudices. Therefore, a belief is a point of view determined on an affective and/or cognitive basis according to one's set of personal experiences. (p. 19)

In the literature, diverse models have been employed to classify beliefs about mathematics (e.g., Ernest, 1989a; Lerman, 1990; Raymond, 1997) and beliefs about mathematics teaching (e.g., Kuhs & Ball, 1986). As Speer (2005) noted, "one of the striking features of work in this area is the plethora of categorizations schemes found in research reports" (p. 366). Among those schemes, the work of Ernest (1989a) and Kuhs and Ball (1986) are particularly influential.

In this study, beliefs were used interchangeably with "conceptions." Ernest (1989a) distinguished between three conceptions of the nature of mathematics:

> First of all, there is the instrumentalist view that mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end. Thus mathematics is a set of unrelated but utilitarian rules

> and facts. Secondly, there is the Platonist view of mathematics as a static but unified body of certain knowledge. Mathematics is discovered, not created. Thirdly, there is the problem solving view of mathematics as a dynamic, continually expanding field of human creation and invention, a cultural product. Mathematics is a process of inquiry and coming to know, not a finished product, for its results remain open to revision. (p. 250)

The problem-solving view is also referred to as social constructivist view by Ernest (1992, 1998) elsewhere and by other researchers (e.g., Roulet, 1998).

With regard to how mathematics should be taught, Kuhs and Ball (1986) identified the following four dominant and distinctive views:

1. Learner-focused: mathematics teaching that focuses on the learner's personal construction of mathematical knowledge;
2. Content-focused with an emphasis on conceptual understanding: mathematics teaching that is driven by the content itself but emphasizes conceptual understanding;
3. Content-focused with an emphasis on performance: mathematics teaching that emphasizes student performance and mastery of mathematical rules and procedures; and
4. Classroom focused: mathematics teaching based on knowledge about effective classrooms (Kuhs & Ball, 1986, p. 2, cited in Thompson, 1992, p. 136)

The first three of these views are allied to Ernest's (1989a) three conceptions of mathematics, i.e., the problem solving (social constructivist), the Platonist and the Instrumentalist views respectively, whilst the fourth assumes that the content to be covered is outside the control of the teacher whose only task is to present the material in ways found to be effective by process-product research studies (Andrews & Hatch, 2000; Thompson, 1992).

According to Kuhs and Ball (1986), the learner-focused view of mathematics teaching is typically based on a constructivist view of mathematics (Cobb & Steffe, 1983), because it centers around the students' active involvement in doing mathematics and in exploring and formalizing ideas. Thompson (1992) argued that this model is most likely to be advocated by those who have a problem-solving view of mathematics (Ernest, 1989a). From a learner-focused perspective of teaching, the teacher plays the role of facilitator and stimulator of student learning, posing interesting question and situations for investigation, challenging students to think, and helping them to uncover inadequacies in their own thinking (Kuhs & Ball, 1986). Students are considered as ultimately responsible for judging the adequacy of their own ideas.

The second view discussed by Kuhs and Ball (1986), the content-focused with emphasis on understanding, is the view of teaching that would follow naturally from Ernest's (1989a) Platonist conception of the nature of mathematics (Thompson, 1992). Kuhs and Ball (1986) described this view as one in which instruction makes mathematical contents the focus of classroom activity while stressing students' understanding of ideas and processes. This view of teaching emphasizes "students' understanding of the logical relations among various mathematical ideas and the concepts and logic underlying mathematical procedures" (Thompson, 1992, p. 136).

Kuhs and Ball (1986) made a distinction between the first two views of teaching according to the way subject matter is organized. In the learner-focused model, students' ideas and interests are of primary considerations. But in the content-focused model, content is organized according to the structure of mathematics, following some notion of scope and sequence the teacher may have. Kuhs and Ball (1986) indicated that what distinguishes the content-focused view emphasizing conceptual understanding from the other three views is "the dual influence of content and learner. On one hand, content is focal, but on the other, understanding is viewed as constructed by the individual" (p. 15).

The third view, the content-focused with an emphasis on performance, also makes mathematical content its focal point. However, underlying this view are conceptions of the nature of mathematics, of mathematics learning, and of schooling in general that are quite different from those underlying the first two views (Kuhs & Ball, 1986). The content-performance view of teaching would follow naturally from Ernest's (1989b) instrumentalist view of the nature of mathematics. In the instrumentalist view of teaching, the content is organized in line with a hierarchy of skills and concepts and it is presented in sequence to the whole class, to small groups or to an individual, following a pre-assessment of students' mastery of prerequisite skills. From this perspective, the role of teacher is to "demonstrate, explain, and define the material, presenting it in an expository style" (Thompson, 1992, p. 136). Consequently, the role of students is to "listen, participate in didactic interactions and do exercise or problems using procedures that have been modeled by the teacher or text" (Kuhs & Ball, 1986, p.23).

Underlying constructivist principles of the reform-oriented mathematics curricula in Hong Kong and Mainland China

Over the past two decades, the underlying philosophy of mathematics curricula (especially in the West countries) has undergone a substantial shift which can be generally described as change from absolutist to fallibilist view of mathematics, from behaviorist to (social) constructivist view of learning, and from teacher-centered to student-centered view of teaching (e.g., Davenport, 2000; Gregg, 1995;

Herbel-Eisenmann, Lubienski, & Id-Deen, 2006; Smith, 1996). The underlying philosophy of the current reform-oriented curriculum in Hong Kong and mainland China are in line with international trend, and is also viewed as constructivist (Chen, 2010; Fan, 2003; Xie, 2007; Zheng, 2004). Ernest's problem-solving (social constructivist) view of mathematics and Kuhs and Ball's learner-focused view of mathematics teaching are advocated to varying degrees in the key curriculum documents in both places, as expounded by Chen (2010). For example, in Hong Kong, the *Mathematics Education: Key Learning Area Curriculum Guide (Primary 1—Secondary 3)* uses a sentence to briefly summarize that

> Mathematics is a mode of thinking, a powerful means of communication, a tool for studying other disciplines and an intellectual endeavor (Curriculum Development Council, 2002b, p. iii).

This sentence not only describes the powerful role of mathematics as an instrument in human life, but more importantly agrees to the assumption of a falliblist, problem-solving view, i.e., mathematics is not discovered but invented and created by human. In terms of mathematics teaching, it is explicitly stated in the same document that "[a] learner-focused approach should be adopted" (Curriculum Development Council, 2002b, p. 37).

On the other hand, in mainland China, the *National Mathematics Curriculum Standards at the Compulsory Educational Level (Draft for Consultation)* (National Ministry of Education, 2001) described its view of mathematics as follows:

> Mathematics is an indispensable tool … Mathematics plays a unique role in enhancing people's ability to reason, abstract and imagine, create. Mathematics is a kind of human culture … (National Ministry of Education, 2001, pp. 1-2).

The *Analyzing the National Mathematics Curriculum Standards at the Compulsory Educational Level (Draft for Consultation)* noted that "Mathematics is not only knowledge of a subject, but also product of human creation" (Mathematics Curriculum Standards Development Team, 2002, pp. 111-112). With regards to mathematics teaching, the National Ministry of Education (2001) expressed the following views:

> Mathematics teaching should be built on students' cognitive development levels and existing knowledge and experiences. Teachers should stimulate students' interests for learning, and provide them with sufficient opportunities to engage in mathematical activities. .... Students are masters of mathematics learning, and teachers are organizer, guide and collaborator of mathematics learning. (p. 2)

The call for a learner-focused (student-centered) approach includes changing the role of teachers:

> Teachers should change from being a transmitter of knowledge to be a facilitator of students' development, from being authority in classroom to be an organizer, guide and collaborator of mathematics learning activities. (Mathematics Curriculum Standards Development Team, 2002, p. 117)

Studies on Chinese teachers' mathematics beliefs

Since 1990s, Chinese teachers' mathematics beliefs have attracted growing attention. Interestingly, most research are conducted in cross-cultural, cross-country or cross-region comparative contexts (e.g., Howard, Perry, & Fong, 2000; Leung, 1992; Perry, Wong, & Howard, 2006; Perry, Yu, Howard, Wong, & Keong, 2002; Wong, Lam, Wong, Ma, & Han, 2002), and one major concern of these researchers is understanding cultural differences in teachers' beliefs.

Perry et al. (2002) surveyed a total of 1254 primary teachers from Singapore (162), Philippines (189), Mainland China (Changchun, 111), Hong Kong (379), Taiwan (161), and Australia (252), using a questionnaire of teachers' beliefs. Hong Kong teachers were found to emphasize the traditional transmission modes of learning and teaching.

Starting from 1996, Wong and his colleagues (Wong, et al., 2002) carried out a series of studies on conceptions of mathematics, quantitatively as well as qualitatively, involving students and teachers at primary and secondary levels in different places. They found that secondary school teachers in mainland China generally held Ernest's Platonist view of mathematics.

More recently, several studies investigated the views of effective mathematics teaching and learning held by teachers in mainland China, Hong Kong, Australia, and U.S. using semi-structured interviews (e.g., Bryan, Wang, Perry, Wong, & Cai, 2007; Cai, 2007; Wang & Cai, 2007; Wong, 2007a). Based on the interviews with nine experienced mathematics teachers (ranging from 19 to 30 years of teaching experience), Wang and Cai (2007) found that in general, Chinese (mainland) teachers tend to view mathematics as an abstract and coherent knowledge system that is refined from real life mathematical problems. Their beliefs about the nature of mathematics were close to the Platonist view, which was in accord with the argument by previous researchers (Wong, 2002; Wong, et al., 2002). In accordance with this view of the nature of mathematics, these Chinese (mainland) teachers saw constructing a coherent knowledge system as the key to mathematics understanding. They emphasized that both learning and teaching should help students to understand abstract mathematics knowledge in a rational and coherent way. They also believed

that practice and memorizing are indispensable for mathematics learning (Wang & Cai, 2007). On the other hand, Chinese (mainland) teachers also realized the importance of "student-centered" teaching, but they often took into account the general needs of students instead of particular needs of individual students, due to the large classroom size and broad coverage of content required by the national curriculum (Wang & Cai, 2007).

Wong (2007b) also carried out face-to-face semi-structured interviews with 12 experienced elementary mathematics teachers in Hong Kong and found that to the participants, mathematics was generally regarded as a subject that is practical, logical, and useful and it involves thinking. He observed that these findings agree with those found in previous studies on student and teacher conceptions of mathematics conducted in the Chinese mainland and Hong Kong, namely conceptions close to the Platonist view of mathematics (Wong, 2002; Wong, et al., 2002).

To summarise, empirical studies have consistently provided evidence that mathematics teachers in Hong Kong and mainland China, even in the climate of curriculum reforms, often hold traditional mathematics beliefs. These evidences indicate a generally low level of consistency between Chinese teachers' mathematics beliefs and the underlying constructivist principles of the reform-oriented curricula in these places, and imply that the reforms have not brought about visible changes in teachers' beliefs. This review provides a backdrop for the present investigation into mathematics beliefs of teachers in Hong Kong and mainland China.

Method

Sample

This study was a belief survey carried out in Hong Kong and Chongqing. The purpose was to obtain a rough picture of the teachers' beliefs about mathematics and mathematics instruction in these two places by involving teachers with diverse demographic characteristics. It did not aim to generalize the findings from the survey samples to the two populations or to construct a valid questionnaire for the Chinese contexts.

Convenience samples comprising 113 Hong Kong and 114 Chongqing junior secondary mathematics teachers were used. Due to the different school systems in Hong Kong and mainland China, the Hong Kong teachers had taught mathematics for at least one class between Grade 7 and 9, while those from Chongqing were

selected from the mathematics department throughout Grade 7 to 9. These teachers were from schools located at different parts of the two cities and of varying quality levels. The details of the teachers are displayed in Table 1.

Although the two samples could not be considered as representative of the two populations, sample diversities in terms of various demographic characteristics of the teachers were achieved to a certain extent, as shown in Table 1. Compared to the Chongqing sample, a bigger proportion of the Hong Kong sample obtained non-mathematics degree, held master degree, had less mathematics teaching experience, and received less in-service training related to the reform-oriented curriculum.

Table 1
Summary of characteristics of Hong Kong and Chongqing teachers

Characteristics	*Categories*	*Hong Kong (%)*	*Chongqing (%)*
Gender	Male	52.2*	48.2
	Female	47.8	51.8*
Educational level	Junior College	7.1	18.4
	Bachelor	61.1*	78.1*
	Master	31.9	3.5
Specialty	Mathematics	68.1*	92.1*
	Non-mathematics	31.9	7.9
Mathematics teaching experience (years)	0-6	49.6*	25.4
	7-15	31.9	44.7*
	More than 16	18.6	29.8
New mathematics curriculum experience (years)	1-3	41.6	32.5
	More than 4	56.6*	66.7*
	Missing	1.8	0.9
Amount of in-service training (times)	0	23.0	6.1
	1-3	39.8*	46.5*
	4-6	19.5	14.0
	More than 6	15.9	33.3
	Missing	1.8	0
Medium of instruction	English	60.2*	0
	Chinese	39.8	100*
School type	Girl	17.7	0
	Boy	12.4	0
	Co-educational	69.9*	100*

Note: * indicates the largest characteristic category.

Instrument

The instrument used to measure teacher's mathematics beliefs was based on the two scales from Collier (1972), namely, Beliefs About Mathematics Scale (BAMS) and Beliefs About Mathematics Instruction Scale (BAMIS). These two scales underscore the close connection between these two types of beliefs, which has been identified by many researchers (e.g., Andrews & Hatch, 1999).

Two versions of these scales were prepared. The English and Traditional Chinese version was used in Hong Kong, and the Simplified Chinese version was used in Chongqing. The Collier's two scales in English were translated into Chinese by the authors, who are bilingual researchers. The translated questionnaire was piloted to obtain improvement of the wordings to ensure teachers' accurate understanding of the items. The English and Traditional Chinese version was used in Hong Kong with the hope that any weakness in Chinese wordings could be remedied by the presence of the original English version, thus enhancing the validity of the questionnaire.

Collier's (1972) two scales were chosen after much consideration. After a thorough search of the literature, the authors did not find any questionnaires that were developed in the Chinese contexts for measuring teachers' mathematics beliefs. Most of the questionnaires designed by Western researchers were considered unsuitable for this study for one or more of the following reasons. Firstly, important information about the instruments, for examples, procedures of development, reliability, and validity, were unknown. Secondly, these instruments were not well developed. For example, Raymond (1997) designed a questionnaire to measure beliefs of elementary teachers about mathematics and its learning and teaching. In his questionnaire, the two views of mathematics, i.e., "mathematics is applicable" and "mathematics is aesthetic" were treated as opposite ends of a continuum, and we did not agree that these two views were opposite in meanings. Thirdly, some instruments were too lengthy. For example, the scale developed by Stipek et al.(2001) contained 57 items, whereas each of the two Collier's scale had only 20 items.

Eventually, the Collier's scales were chosen as a compromise for several reasons. Firstly, the development of the scales were clearly described and explained (Collier, 1972). The scales were validated by its designer (Collier, 1969, 1972) and used by many subsequent researchers in different countries (e.g., Ly & Brew, 2010; Seaman, Szydlik, Szydlik, & Beam, 2005). The reported reliabilities of BAMS and BAMIS were 0.80 and 0.83 respectively, which were viewed to be reliable measures of teachers' mathematics beliefs. Secondly, the two scales place the beliefs of a teacher on a formal-informal continuum. This is very useful for identifying the patterns of distribution of beliefs within the samples. Thirdly, although the scales were

originally developed to measure prospective elementary teachers' beliefs about mathematics and mathematics instruction, the items were hardly linked with the elementary mathematics contents. Thus, the two scales were suitable for the junior secondary school mathematics teachers with little modification, as recognized by other researchers (Ly & Brew, 2010). Fourthly, Collier (1969, as cited in Seaman et al., 2005) described his study as one of understanding beliefs that would help teachers "shift from an authoritarian, teacher-dominated classroom, to a child-centered classroom" and also "shift from a program emphasizing formal mathematical content to a program emphasizing the creative, investigative nature of mathematics" (p. 198). Seaman et al. (2005) regarded the two scales as a reasonable measure of the constructivist philosophy and ideas about instruction that follow that philosophy. Thus, we recognize strong relevance of Collier's two scales to the current mathematics curriculum reforms in Hong Kong and mainland China.

BAMS contained 20 items devoted to distinguishing "the degree to which an individual viewed mathematics as (a) including elements of originality and creativity and characterized by the existence of choices as opposed to the view, (b) that mathematics is based on fixed, established forms and requires scrupulous adherence to rule" (Collier, 1969, p.1). View (a) is close to Ernest's problem-solving view of mathematics, while (b) is close to his Platonist/instrumentalist view. A sample item was: The laws and rules of mathematics severely limit the manner in which problems can be solved.

BAMIS contained 20 items designed to "give an indication of the degree to which individuals viewed the mathematics teacher as one who (a) encourages self-discovery and independence from memorized rules, as opposed to the view of the mathematics teacher as one who (b) defines and explains procedures for students" (Collier, 1969, p.1). View (a) inclines towards Kuhs and Ball's learner-focused view of mathematics teaching, while (b) is consistent with their teacher-centered, content-focused views (content-focused with an emphasis on conceptual understanding or performance). A sample item was: All students should be required to memorize the procedures that the text uses to solve problems.

A 6-point Likert scale (strongly disagree to strongly agree) was used. Half of the items were positive (advocating informal/reform-oriented, constructivist ideas) and the other half negative (advocating formal/traditional approaches to mathematics), with the negative items reverse scored. Collier (1972) described each scale as lying along a formal-informal dimension. A score higher than 70 was in the "informal" direction and a score less than 70 in the "formal" direction. For this study, beliefs in the "informal" direction were considered as consistent with the underlying constructivist principles of the reform-oriented curriculum. The closer a score was

to 120, the higher was the level of consistency. On the other hand, beliefs in the "formal" direction were considered as inconsistent with the constructivist principles, and the closer a score was to 20, the lower was the level of consistency.

Results

Reliability of the BAMS and BAMIS scales

The Cronbach's alphas of BAMS and BAMIS for the English and Traditional Chinese version were 0.69 and 0.71 respectively, and those for the Simplified Chinese version were 0.70 and 0.69 respectively. These values were very close to the acceptable value of 0.7, and the two scales were regarded as reliable for both the Hong Kong and Chongqing samples.

Teachers' mathematics beliefs in Hong Kong and Chongqing

As shown in Table 2, teachers in both cities held beliefs about mathematics and beliefs about mathematics instruction in the informal direction (with means greater than 70). Independent-samples *t*-tests show that the Chongqing teachers held significantly more informal or more reform-oriented beliefs than the Hong Kong teachers about mathematics ($t = 8.223$, $p < 0.01$) and mathematics instruction ($t = 8.168$, $p < 0.01$).

The Pearson correlations between beliefs about mathematics (BAMS) and beliefs about mathematics instruction (BAMIS) were significant in both Hong Kong ($r = 0.47$, $p < 0.01$) and Chongqing ($r = 0.59$, $p < 0.01$). This finding supports the argument for the existence of a close relationship between these two types of beliefs (Andrews & Hatch, 1999; Thompson, 1992).

Table 2
Descriptive Statistics of BAMS and BAMIS

		N	*Minimum*	*Maximum*	*Mean*	*Standard Deviation*
BAMS	Hong Kong	113	67	113	82.8	7.72
	Chongqing	114	67	110	92.0	9.09
BAMIS	Hong Kong	113	49	95	74.9	7.59
	Chongqing	114	65	105	84.1	9.24

Note: BAMS: Beliefs about Mathematics; BAMIS: Beliefs about Mathematics Instruction

Discussions

As mentioned earlier, only small convenience teacher samples were involved in the survey, and the findings had limited generalizability. Therefore, caution must be taken when the findings were interpreted. The following discussion relates the findings to the relevant literature.

Firstly, in both cities, there was a relatively high level of consistency between teachers' mathematics beliefs and the underlying constructivist principles of the reform-oriented curriculum. This finding does not agree with those from previous studies that indicate that Chinese teachers, including those from Hong Kong and mainland China, often held traditional views of mathematics and its teaching and learning, even in the climate of reform (e.g., Leung, 1992; Wang & Cai, 2007; Wong, 2002; Wong, et al., 2002). One possible explanation for the encouraging finding found in this study is that current curriculum reforms at the two cities have enabled the teachers to change their mathematics beliefs toward a reform-oriented direction. If this were the case, it gives an optimistic picture of the mathematics curriculum reform in the two cities.

Secondly, a significantly higher level of consistency between teachers' mathematics beliefs and the underlying constructivist philosophy of the reform-oriented curriculum seems to exist in Chongqing than in Hong Kong. This finding was surprising as it did not support the initial hypothesis that the Hong Kong teachers held mathematics beliefs that were more reform-oriented and at a higher level of consistency. One possible explanation is that more experience with constructive ideas and practices may enable the Hong Kong teachers to be more alert to and critical of these reform ideas. By contrast, the Chongqing teachers were more receptive to these new ideas, probably because they recognized the weaknesses of traditional ideas and practices, and experienced the need for change.

Limitations and Future Research

In this study, only small convenience samples were involved in the questionnaire survey, which reduced the generalizability of the findings. Better insights could be gained if the belief surveys include larger samples, or representative samples of different subpopulations in China.

Belief is a complicated construct (Pajares, 1992). In order to gain a more comprehensive understanding of teachers' beliefs, it is necessary to investigate teaching practices (Thompson, 1992), which were not covered in this study. Data and in-depth analysis regarding classroom practices will provide a better

understanding of how mathematics beliefs and level of consistency between beliefs and the constructivist principles underlying the reform-oriented curriculum may be related. Further research need to be conducted to determine the factors causing the high level of consistency reported above. This kind of research can provide valuable information for teacher educators and reform facilitators not only in the two specific cities but also other parts of mainland China. International researchers may also learn from similar studies and beliefs and their links to curriculum reforms.

Implications and Conclusion

The level of consistency between teachers' mathematics beliefs and the underlying philosophy of reform-oriented mathematics curriculum can be an important indicator of the success of curriculum reform. Given a relatively high level of consistency found in Hong Kong and a significantly higher one in Chongqing, it seems that the mathematics curriculum reform in the two cities are likely to succeed, and there are better chances for Chongqing. However, curriculum reform is a complicated undertaking affected by many factors, so that a high level of consistency between teachers' beliefs and the underlying philosophy of the reform-oriented curriculum alone cannot guarantee the success of reform; rather, this consistency must function jointly with other factors to achieve success.

This study makes two major contributions to the research literature. Firstly, it offers a new perspective of mathematics curriculum reform in China by investigating the level of consistency between teachers' mathematics beliefs and the underlying constructivist principles of the reform-oriented mathematics curriculum in two Chinese cities. Secondly, this study enriches extant literature on Chinese teachers' mathematics beliefs by providing empirical evidence of non-traditional mathematics beliefs held by some Chinese teachers.

Furthermore, this study provides two important implications. Firstly, more exposure to reform ideas does not necessarily bring about better receptivity to these ideas on the part of the teachers, while less exposure may not cause low receptivity. Hong Kong had experienced a failure of constructivism-based educational reform before (Mok & Morris, 2001), which may have caused an inertia in reform among teachers and make acceptance of the reform ideas even more difficult. Thus, reform advocates and teacher educators in Hong Kong may need to address this issue properly. Secondly, despite their roots in Western cultures, the student-centered constructivist ideas can be well accepted by teachers in Chinese cities with the most conservative values such as Chongqing. Thus, the apparent conflicts of East-West educational conceptions are reconcilable. ‘’

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