

# RELATIONSHIP BETWEEN CLASSROOM AUTHORITY AND EPISTEMOLOGICAL BELIEFS AS ESPOUSED BY PRIMARY SCHOOL MATHEMATICS TEACHERS FROM THE VERY HIGH AND VERY LOW SOCIO-ECONOMIC REGIONS IN THAILAND

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**ABSTRACT:** *This article presents findings of a larger single-country comparative study which set out to better understand primary school teachers' mathematics education-related beliefs in Thailand. By combining the interview and observation data collected in the initial stage of this study with data gathered from the relevant literature, the 8-belief / 22-item 'Thai Teachers' Mathematics Education-related Beliefs' (TTMEB) Scale was developed. The results of the Mann-Whitney U Test showed that Thai teachers in the two examined socio-economic regions espouse statistically different beliefs concerning the source and stability of mathematical knowledge, as well as classroom authority. Further, these three beliefs are found to be significantly and positively correlated.*

## **Introduction**

While the research field of teachers' beliefs has existed for several decades (Thompson, 1984; Ernest, 1989; Pajares, 1992), the majority of these studies are conducted in the Western culturally dominant context. Given that teaching and learning are culturally-situated activities evolving "over long periods of time in ways that are consistent with the stable web of beliefs and assumptions that are part of the culture" (Stigler & Hiebert, 1998, p. 2), it is important that teachers' beliefs should thus be understood "in relation to the cultural beliefs and assumptions that surround them" (ibid, p. 2). Given that no studies concerning Thai teachers' mathematics education-related beliefs have been conducted, and given that people in different socio-economic settings are found to adopt different values and beliefs (Willits et al., 1977; Komin, 1991); it is thus the intention of this study to carry out a single-country comparative study to examine more closely whether mathematics education-related beliefs as espoused by primary school Thai teachers in different socio-economic contexts might vary.

The role of teachers' beliefs cannot be overlooked, especially when Pajares (1992) points out that "the beliefs teachers hold influence their perceptions and judgements, which, in turn, affect their behaviour in the classroom" (p. 307). Studies, such as Staub & Stern (2002), Clooney

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(2001) and Lubinski & Jaberg (1997), have all shown significant relationship between teachers' pedagogical beliefs and their instructional practices. Thus, the importance of teachers' beliefs should not be neglected, despite such beliefs may not be fully transformed into instructional practices due to various contextual constraints (Ernest, 1989).

Further, Thompson (1984) notes that "any attempt to improve the quality of [...] teaching must begin with an understanding of the conceptions held by the teachers and how these related to their instructional practices" (p. 106). Unless these beliefs are being scrutinised thoroughly, Richardson (1994, p.6) argues, "teachers may perpetuate practices based on questionable assumptions and beliefs"

### **Epistemological and Classroom Authority Beliefs**

Given the scope of this article, a strategic decision has been taken to focus on three beliefs, namely the two epistemological beliefs concerning the source and stability of mathematical knowledge on the one hand, and the classroom authority belief on the other. Further, given that the field of mathematics education lacks a comprehensive theoretical model of epistemological beliefs (Muijs, 2004), a decision is made to adapt Schommer's (1990) epistemological framework to help guide the subsequent discussion of some of the seminal studies that deal with epistemological questions in the field of mathematics education.

Drawing from the works of Perry (1970), Dweck & Leggett (1988) and Schoenfeld (1983), Schommer (1990) designed the 63-item Epistemological Questionnaire (EQ) to elicit U.S.-based undergraduate students' epistemological beliefs and investigate how they might affect students' comprehension in reading. Factor analysis yielded five different constructs - three of which are epistemological dimensions i.e. *source of knowledge* (alternatively known as *omniscient authority*), ranging from knowledge as

[H]anded down by authority [such as teachers or textbooks] to derived from reason and evidence"; *stability of knowledge* (alternatively known as *certain knowledge*), ranging from knowledge as "certain to evolving"; and *structure of knowledge* (alternatively known as *simple knowledge*), ranging from knowledge as "isolated bits to integrated concepts" (Schommer-Aikins et al., 2005, p. 209).

While Schommer's (1988, 1990, 1993, 1994, 1998) classification of epistemological beliefs was not designed with mathematical knowledge and mathematics teachers in mind, and that while the on-going debate concerning whether epistemological beliefs are domain-general (Schommer & Walker, 1995) or domain-specific (Stodolsky et al., 1991; Hofer, 2000) still remains inconclusive; such epistemological classification is thought to be applicable and useful to frame the current study as it appears to encompass most of the recurring themes emerging in the following literature on epistemology and mathematics education. However, given the word limit of this article, only the beliefs relating to the source and stability of knowledge beliefs will be examined here.

#### *Source of Mathematical Knowledge*

Drawing from Plato's perspective on the nature of mathematical entities, *Platonists* argue that mathematical knowledge exist "outside space and time [and] independent of any

consciousness, individual or social” (Hersh, 1997, p. 9). Alternatively put, mathematical knowledge has always been out there waiting for human to discover it. They were never created. They never change. Similarly, Hardy (1940) believes that,

[M]athematical reality lies outside us, that our function is to discover or observe it, and that the theorems which we prove, and which we describe grandiloquently as our ‘creations’, are simply our notes of our observations (p. 35).

For Platonists, external authorities are the main source of knowledge, as Hersh (1997, p.9) highlights that “what mathematicians publish, cite, and especially teach, will decide the rules”. The *constructivist* school of thought appears to disagree with Platonists concerning the source of knowledge, arguing that knowledge is not discovered, but constructed by humans (i.e. learners) themselves. Platonists would, however, challenge that view by arguing that

When two dinosaurs wandered to the water hole in the Jurassic era and meet another pair of dinosaurs happily sloshing, there were four dinosaurs at the water hole, even though no human was present to think, “ $2 + 2 = 4$ .” This shows [...] that  $2 + 2$  really is 4 in reality, not just in some cultural consciousness.  $2 + 2 = 4$  is a law of nature [...] independent of human thought” (Hersh, 1997, p. 15).

### *Stability of Mathematical Knowledge*

Drawing from Lakatos’s (1978) notions of Euclidean and Quasi-empirical, Lerman (1990) distinguishes two major perspectives of the nature of mathematics, namely *absolutism* and *fallibilism*. In terms of the former view, mathematical knowledge is seen as “timeless truths” (Lerman, 1990, p. 54) and as an “objective, absolute, certain and incorrigible body of knowledge, which rests on the firm foundations of deductive logic” (Ernest, 1995, p. 451). In brief, mathematical knowledge is thus perceived to be highly stable, permanent and fixed. Fallibilists, on the other hand, view mathematics as “a social construction, its results relative to time and place, and subject to revolutionary change as much as other forms of knowledge” (Lerman, 1990, p. 55), and as such mathematical knowledge is understood to be “fallible and eternally open to revision, both in terms of its proofs and its concepts” (Ernest, 1995, p. 452).

An example to illustrate both views can be found in geometry, which served from the time of Plato as proof that certainty is possible in human knowledge (Hersh, 1997). However, it was not until the nineteenth century that the foundation of this belief was challenged by the advent of non-Euclidean geometries, which showed that the Fifth Postulate (or the Parallel Postulate) of Euclid’s Elements was not always certain. In brief, while it could be logically deduced from the Fifth Postulate that the sum of the angles in every triangle is  $180^\circ$  (Lewis, 1920), non-Euclidean geometries prove that the three angles of a triangle do not always add to  $180^\circ$ , whereby in hyperbolic geometry the sum of the three angles is always less than  $180^\circ$  and can approach zero, while in elliptic geometry it is greater than  $180^\circ$  (Milnor, 1982). Subsequently, this illustrates how what once was perceived as absolute and permanent, was subject to revision upon new knowledge and rules.

### *Classroom Authority*

This belief is associated with Thai culture, and is grounded in the empirical data gathered from Thai teachers, that was not evident in the Western culturally dominant literatures. From the interview data, one teacher, for example, talked about how pupils in Thai society needed to respect teachers as they are regarded as pupils' second parents. This resonates the observation data in which the observed teachers established power distance within the classroom by expecting the class to demonstrate their respect to them, through prompting the class prefects to order their classmates to give them a 'wai' – a respectful gesture made by placing one's hands together in front of their face and bowing a little. This act can be done while either sitting or standing.

Power distance can be taken to mean the extent to which less powerful members of a society (i.e. juniors) accept and expect that power is distributed unequally (Hofstede, 2007). According to Hofstede (1994), such extent could be measured using Power Distance Index (PDI): the bigger the index, the higher the level of acceptance and expectation of such mutual inequality. According to Hofstede (2007)'s study, Thailand scored 64 on the Power Distance Index (PDI), indicating a relatively high level of acceptance and expectation of power being distributed unequally in the society. Hofstede (1994) describes the classroom environment in a culture with high PDI score as follows:

Teachers are treated with respect; students may have to stand up when they enter. The educational process is teacher-centred [...]. In the classroom there is supposed to be a strict order with the teacher initiating all communication (...) Students in class speak up only when invited to; teachers are never publicly contradicted or criticised and are treated with deference even outside school (p. 34).

Subsequently, given the above social expectations and features of Thai society, it becomes apparent why Thai pupils tend to be very respectful to their teachers, and why Thai teachers expect them to do so.

### *Socio-Economic Differences in Thailand*

The United Nations Development Programme's (UNDP) *Human Development Index (HDI)* is a well-established socio-economic status indicator and is employed in this study to distinguish different provincial-level socioeconomic settings in Thailand. The Index is ultimately Weberian, as it is essentially a composite index comprising eight different indices, covering both economic-related and non-economic-related dimensions of social stratification i.e. Health, Education, Employment, Income, Housing and Living Environment, Family and Community Life, Transportation and Communication and Participation Indices (UNDP, 2007).

From this report, the following ten provinces have the highest HDI scores: Phuket, Bangkok, Pathum Thani, Phra Nakhon Si Ayutthaya, Nonthaburi, Songkhla, Sing Buri, Nakhon Pathom, Rayong, and Samut Prakan; while the following ten provinces have the lowest HDI scores: Mae Hong Son, Tak, Surin, Kamphaeng Phet, Sisaket, Narathiwat, Chaiyaphum, Nakhon Phanom, Phetchabun, and Nong Bua Lam Phu.

One major weakness of the HDI is the extent to which a socio-economic status, given to each province, being representative to the entire population who live in that province. Clearly, the fact that Bangkok is thought to be doing *very well* socially and economically does not necessarily

imply that every single person who lives in Bangkok experiences the same level of status. However, given the fact that the *HDI – Thailand* report (UNDP, 2007) appears to be the only and most credible source of information being available on socio-economic status of all Thailand's provinces, it is thus considered appropriate to adopt the HDI to help categorise provinces according to their socio-economic status.

### *Research Questions*

In accordance with the discussion above, two central research questions are subsequently formulated as following: "To what extent are Thai mathematics teachers in the very high and very low socio-economic settings share their beliefs on classroom authority, the source and stability of mathematical knowledge?"

Furthermore, as Ernest (1989, p.251) points out that "teachers' views of the nature of mathematics provide a basis for the teachers' mental models of the teaching [...] of mathematics", it would thus be of great interest to ascertain whether there is any relationship between beliefs concerning mathematical knowledge on the one hand, and their beliefs concerning mathematics learning and teaching on the other.

Consequently, the second and final research question reads: "To what extent are Thai mathematics teachers' beliefs concerning classroom authority, and the source and stability of mathematical knowledge related across the two socio-economic settings?"

### **Method**

As previously mentioned, given that there is no existing literature on Thai teachers' mathematics education-related beliefs, it is subsequently essential that Thai teachers' beliefs are elicited during the pilot stage, and also included in the final questionnaire statements. For this, a sample of Thai teachers will be interviewed and their mathematics lessons observed to elicit their espoused beliefs as an attempt to ensure that as many unexplored beliefs, if any, are being considered. Therefore, a mixed-methods research can be said to help minimise the threats to the validity and representativeness of the research findings.

### *Participants*

For the qualitative stage, eight Thai teachers in four Thai state primary schools were observed and interviewed. The first and second schools were located in Bangkok and Samut Prakan respectively (i.e. the very high socio-economic cohort), while the third and fourth schools were located in Tak and Nong Bua Lam Phu respectively (i.e. the very low socio-economic cohort).

During the pilot survey stage, of the 120 Thai mathematics teachers in both the very high and very low socio-economic settings to whom the pilot survey had been sent to, 98 teachers responded. Forty of these teachers were from the very high socio-economic cohort, while the remaining 58 teachers were from the very low socio-economic cohort.

For the final survey stage, 500 teachers in each of the two socio-economic cohorts were asked to complete the final TTMEB survey, totalling 1,000 teachers. As many as 745 teachers completed and returned the survey, resulting in a 74.5% response rate. Of these 745 teachers, 379 teachers (or 50.9%) were from the very high socio-economic cohort, while the remaining 366

teachers (or 49.1%) were from the very low socio-economic cohort. Across the two socio-economic cohorts, the majority of Thai teachers participated in this study were female (65.6%), aged 51-60 year old (39.3%) with some 21-30 years of teaching experience (33.4%) and whose highest education level was bachelor's level (85%), with a class size of 21 - 30 pupils (38.9%) as the most common class size.

### *Development of the TTMEB Questionnaire Instrument*

In order to answer the two central research questions, a five-point Likert "Thai Teachers' Mathematics Education-related Beliefs' (TTMEB) scale was first developed. Since the majority of existing scales on this topic at the time were created in the Western culturally dominant context, it was crucial not to assume that a survey instrument developed in one socio-cultural context would also be applicable and relevant in another.

The TTMEB scale was thus created by combining existing survey items (e.g. those found in the studies of Raymond, 1997; Nisbet & Warren, 2000, Barkatsas & Malone, 2005; Ernest 2006), with newly constructed items using fieldwork data that were collected from interviewing eight Thai mathematics primary school teachers, and observational data of their associated mathematics lessons. These qualitative data were then analysed systematically using the coding and constant comparative methods. While it is beyond the scope of this paper to discuss in detail these two methods, it might suffice to say that the former is the process in which labels are given to words, phrases, or sentences, found in a given transcript, that appear regularly and significant (Creswell, 2005; Ayr et al., 2006). In the context of this study, some 16 codes (e.g. 'Pupils' Prior Knowledge' and 'Roles of Teachers') emerged from the interview transcripts and the observation field notes. In the final stage of this qualitative analysis, efforts were made to apply the derived codes onto the original transcripts to see if all the data now fit into these codes, for if there is a poor fit between data and codes, then the codes have to be modified until all the data are accounted for (Cohen et al., 2007). Such process is referred to as *constant comparative method*, a continuous refinement where initial codes may be changed, merged, or omitted; and new codes are generated (Ayr et al., 2006).

By combining existing survey items and those newly constructed items using fieldwork data, this gave a 99-item pilot survey instrument, covering 16 aspects of teachers' mathematics education-related beliefs, grouped under four broad categories i.e. 1) beliefs concerning the nature of mathematical knowledge ('*Source of Mathematical Knowledge*'; '*Stability of Mathematical Knowledge*'; '*Structure of Mathematical Knowledge*'); 2) beliefs concerning mathematics learning ('*Roles of Learners*'; '*Pupils' Autonomy*'; '*Prior Knowledge*'; '*Personal Relevance*'); 3) beliefs concerning mathematics teaching ('*Roles of Teachers*'; '*Classroom Organisation*'; '*Classroom Activities*'; '*Assessment*'; '*Intended Instructional Outcome*'; '*Use of Mathematics Textbooks*'); and 4) beliefs concerning constraints to mathematics teaching ('*Classroom Mobility*'; '*Time*'; '*Exams and Math Core Curriculum*'). To help maximise the validity of the survey instrument, accuracy of the Thai translation of the survey items was checked by a group of bilingual Thai native speakers whose task was to translate the survey items back to English to see whether the original meaning of the survey items remain intact.

Given that it cannot be assumed that the belief structures of Thai and Western mathematics teachers are identical, the exploratory factor analysis was performed on the pilot survey data to reveal the underlying structure of Thai teachers' beliefs. The analysis yielded an 8-factor 26-item solution, which provides a meaningful, robust and interpretable set of factors. With an exception of

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one factor, each of the remaining seven factors comprises between 3 to 4 relevant survey items with loadings higher than 0.5. These eight factors can be grouped under two broad themes, namely 1) beliefs concerning the nature of mathematical knowledge (*'Source of Mathematical Knowledge'*; *'Stability of Mathematical Knowledge'*; *'Structure of Mathematical Knowledge'*); and 2) beliefs concerning mathematics learning and teaching (*'School Mathematics as Relevant Experience'*; *'Classroom Authority'*; *'Learning Activities'*; *'Constraints to Mathematics Teaching'*; *'Exam Pressures'*).

The fact that the exploratory factor analysis reduces the original 99-item 16-belief structure into a newly arranged 26-item 8-belief structure, arguably shows that while some mathematics education-related beliefs are central to Western mathematics teachers, the same cannot be said about their Thai counterparts, and vice versa. More specifically, three specific beliefs found in the TTMEB scale, namely, *'Classroom Authority'*, *'Constraints to Mathematics Teaching'* and *'Exam Pressures'*, were not found in any of the reviewed studies, especially those conducted in Western culturally dominant contexts.

The exploratory factor analysis was again performed on the final survey data derived from a much larger sample size. Of the five potential factor solutions (4-, 5-, 6-, 7- and 8-factor solutions), the 8-factor solution was chosen as it provides the most meaningful, robust and interpretable set of factors than the rest. With an exception of Factor 2 (*'Source of Mathematical Skills'*), the remaining seven factors appeared in both pilot and final factor analysis, increasing the likelihood that these factors are indeed, replicable and thus relevant across the Thai state primary mathematics teacher population. Table 1, as shown below, gives the pilot and final item loadings of the *'Classroom Authority'* belief; the *'Source of Mathematical Knowledge'* belief; and the *'Stability of Mathematical Knowledge'* belief only. Secondary factor analysis was performed on both the pilot and final data, and yielded no sub-factors for each of these three examined beliefs.

<b><i>Classroom Authority</i></b>	Pilot	Final
My role is to ensure that my pupils are obedient	0.673	-.799
All mathematical questions always have a right answer	0.672	n/a
Learners should be obedient to their teacher	0.664	-.816
<i>Percentage of Variance</i>	4.70	5.5
<i>Alpha</i>	0.717	.633

<b><i>Source of Mathematical Knowledge</i></b>	Pilot	Final
Mathematical concepts are not created, but discovered	0.651	0.589
Mathematical concepts existed even before the existence of human beings	0.641	0.717
My role is to encourage interaction between my pupils and me	- 0.592	n/a
<i>Percentage of Variance</i>	3.59	4.5
<i>Alpha</i>	0.482	0.322

<i>Stability of Mathematical Knowledge</i>	Pilot	Final
Today's mathematical concepts are no different from those of long ago	- 0.764	-0.757
Basic mathematical facts will always remain exactly the same	- 0.624	-0.595
<i>Percentage of Variance</i>	3.53	4.4
<i>Alpha</i>	0.654	0.376

Table 1 Item Loadings of the 'Classroom Authority' belief; the 'Source of Mathematical Knowledge' belief; and the 'Stability of Mathematical Knowledge' belief as yielded by the exploratory factor analysis

### Classroom Authority

The final *Classroom Authority* scale appears to be concerned with the notion of *obedience* i.e. 'My role is to ensure that my pupils are obedient' and 'Learners should be obedient to their teacher'. This aspect of mathematics learning and teaching only emerged in the interviews with the Thai teachers, and was not evident in the Western-culturally dominant literatures.

Given how both items had negative loadings, no reverse of scores or meaning is needed. Subsequently, teachers who scored very lowly on the two items comprising this scale ('1' being 'Strongly Agree') could be perceived as *traditional* teachers, upholding the very deep-rooted social value which says juniors should respect and be obedient to their seniors.

On the other hand, teachers who scored very highly on this scale ('5' being 'Strongly Disagree') could be considered as *constructivist* teachers, meaning that they prefer to create a learning environment where pupils should be free to challenge their teachers' teaching and free to be intellectually argumentative to their fellow pupils and teachers. This type of teachers thus chooses to ignore the status quo and work towards eliminating classroom hierarchy to provide an environment conducive to effective learning.

### Source of Mathematical Knowledge

Drawing from the wordings of the two items above (i.e. 'Mathematical concepts existed even before the existence of human beings' and 'Mathematical concepts are not created, but discovered'), the *Source of Mathematical Knowledge* scale appears to be concerned with the nature of mathematical knowledge acquisition.

Teachers who scored very lowly ('1' being 'Strongly Agree') on the scale could be described as *Platonist*, subscribing to the view that mathematical knowledge has always been out there waiting to be discovered, and that they were never created. These teachers might thus adopt the didactic approach to teaching and learning, in that they expect their pupils to simply discover mathematical facts and rules from their teachers, through listening and taking notes, without a great deal of teacher-pupil or pupil-pupil interaction, if any. Simply put, knowledge is to be transmitted from teachers to learners.

On the other hand, teachers who scored very highly on the scale ('5' being 'Strongly Disagree') could be described as *constructivist* teachers, subscribing to the view that mathematical knowledge is created – either by individuals on their own (von Glasersfeld's (2002) 'Radical Constructivism') or through a process of social interactions (Ernest's (1999) 'Social Constructivism').



Teachers with this view might be more likely to encourage their pupils *to construct* their own knowledge based on their prior experience, while social constructivist teachers would emphasise on interactions between teacher and pupil and collaboration among pupils.

### Stability of Mathematical Knowledge

Given the wordings of the two items above (*'Today's mathematical concepts are no different from those of long ago'* and *'Basic mathematical facts will always remain exactly the same'*), this scale appears to be concerned with the permanence or stability of mathematical knowledge.

Given how both items had negative loadings, no reverse of scores or meaning is needed. Subsequently, teachers who scored very lowly ('1' being 'Strongly Agree') could be described as *absolutist*, who likely believes that mathematical knowledge is permanent and fixed.

Subsequently, they might be more likely to encourage their pupils to memorise facts and formula, treating them as immutable. On the other hand, teachers who scored very highly on this scale ('5' being 'Strongly Disagree') could be perceived as *fallibilist*, subscribing to the view that mathematical knowledge is evolving and "eternally open to revision, both in terms of its proofs and its concepts" (Ernest, 2004, p. 12). Therefore, teachers with this view might be more likely to encourage their pupils to be critical of any given facts and emphasise the role of reasoning.

### Data Analysis

#### Mann-Whitney U Test

In order to answer the first research question concerning the extent to which urban and rural Thai mathematics teachers share their beliefs on classroom authority, the source and stability of mathematical knowledge, the Mann-Whitney *U* Test was undertaken to test the null hypothesis, which states that there is no difference in the way the Thai mathematics teachers in the very high and very low socio-economic settings view a certain dependent variable (belief), versus the alternative hypothesis, which is that there is a difference. If the significance (*p*) value of these tests is below a conventional significance level of .05, then the null hypothesis would be rejected, implying that there is, in fact, a significant difference in the way the Thai teachers of different socio-economic settings respond to that particular dependent variable. Black (1999) explains that:

Conceptually, the issue being addressed is whether the two samples come from the same population, thus, the question asked is: are the two underlying population distributions the same? As usual, it is unlikely that they are identical and [Mann-Whitney *U* Test] is asking whether they are close enough to be considered the same or so different as to be considered two different distributions (p. 570).

While Pallant (2006) adds that,

Instead of comparing means of the two groups, as in the case of the t-test, the Mann-Whitney *U* test actually compares medians. It converts the scores on the [...] variable to ranks, across the two groups. It then evaluates whether the ranks for the two groups differ significantly (p. 291).

Spearman’s rho

In order to answer the second and final research question on the extent to which Thai mathematics teachers’ beliefs concerning classroom authority, and the source and stability of mathematical knowledge related across the two socio-economic settings, *Spearman’s rho* tests were performed to test the null hypothesis, which states that the examined variables are independent, versus the alternative hypothesis; i.e. variables are not independent. If the significance (*p*) value of these tests is below a conventional significance level of .05, then it can be concluded that there is, in fact, a significant relationship between the examined variables.

Sarantakos (2005) defines Spearman’s *rho* as being “a product-moment, non-parametric correlation coefficient which deals with ranks (not magnitudes), and measures the strength of the linear association between variables” (p. 379). It does this by “ranking people on each variable and then comparing people’s relative position on the two variables” (De Vaus, 2002, p. 187). Spearman’s *rho* produces “a result between -1 (for a perfect negative correlation: as the independent variable increases, the dependent variable decreases) and +1 (a perfect positive correlation: both rise or fall together)” (Buckingham & Saunders, 2004, p. 216).

**Results and Discussion**

*Comparison by Socio-economic Cohort of Province of Teaching*

	All		Very High Socio-economic Cohort		Very Low Socio-economic Cohort		U	sig
	Mean	SD	Mean	SD	Mean	SD		
1. Classroom Authority	3.11	.94	3.23	.95	3.00	.91	59554.50	<b>.001</b>
2. Source of Mathematical Knowledge	2.29	.74	2.37	.75	2.22	.74	62007.50	<b>.011</b>
3. Stability of Mathematical Knowledge	3.07	.85	3.14	.84	3.00	.86	63188.50	<b>.032</b>

Table 2 Mean scores and standard deviations of each factor for all teachers, as compared by socio-economic cohort of province of teaching. Significant probabilities are in bold.

Classroom Authority

As Table 2 shows, the highest significant socio-economic difference ( $U = 59554.50, p = .001$ ) was found in the Classroom Authority belief. Teachers in the very high socio-economic cohort ( $M = 3.23, SD = .95$ ) appeared to hold a significantly stronger belief than their counterparts in the very low socio-economic cohort ( $M = 3.00, SD = .91$ ) by rejecting the authoritarian classroom management style, implying that they might be more likely to create a classroom environment where pupils are encouraged to be intellectually argumentative and critical of their teachers’ teaching.

As it has been previously discussed, the expectation that pupils should be obedient to their teacher is common in Thai classrooms. This is, as Hofstede (2007) argues, due to the notion of *power distance*, or the extent to which less powerful members of society accept and expect that

power is distributed unequally. Using his Power Distance Index (PDI), Hofstede (2007) was able to measure such concept as manifested in different societies globally, where the bigger the index, the higher the level of acceptance and expectation of such inequality. Thailand, according to his study, scores 67 out of 100, while the US and the UK, for example, score only 40 and 35 respectively. Since teachers in Thailand are regarded as highly as parents, and Thai children are expected to be obedient to their parents as a way to pay back a moral debt to their raising them up (Mulder, 2000), Thai pupils are thus expected to be obedient to their teachers too.

Taking into account of this socio-cultural value as manifest in Thai society, the significant difference in the way teachers in the two cohorts view the Classroom Authority belief might not be that surprising. Komin (1991) explains that rural Thais (i.e. those who live in the very low socioeconomic cohort) are more likely to keep certain traditional socio-cultural values and are less likely to change, while their more liberal urban counterparts (i.e. those who live in the very high socio-economic cohort and who are arguably more exposed to Western values through media, such as Hollywood films that often depict non-hierarchical society), are less likely to hold on to traditional socio-cultural values. Komin's (1991) thesis corroborates that of Willits et al. (1977, p.682) who argue that urban people "tend to be more accepting of nontraditional ideas than their [rural] counterparts [due to the former's] exposure to a wider range of differing circumstances".

However, the findings of the current study is inconsistent with that of Arredondo and Rucinski's (1996) study of 126 teachers and principals from primary and secondary schools in Chile, which found no significant difference in the way private school teachers (i.e. those teaching in the high socio-economic setting) and their state school counterparts (i.e. those teaching in the low socio-economic setting) responded to the *Don't criticise authority* scale. In general, they all appeared to believe that pupils should be able to criticise their teachers' teaching openly.

Martin & Yin's (1999) study of 145 secondary school teachers in the USA also reported no significant difference in the way urban and rural teachers responded to the *Behaviour Management* scale, which was taken from Martin, Yin & Baldwin's (1998) 'Attitudes and Beliefs on Classroom Control Inventory', comprising survey items, such as: 'I believe teachers should require student compliance' and 'respect for law and order'. Regardless of the socio-economic context of the school they taught in, the teachers had neither particularly controlling nor non-controlling view towards their classroom management approach.

While none of the these studies offered any explanation for their reported non-significant differences, it might be useful to note that the finding of Martin & Yin (1999) was unexpected to their authors, whose literature reviews predicted a significant difference in the way rural and urban teachers think about classroom authority. More specifically, drawing from the studies of Herzog and Pittman (1995) and Roweton & Bare (1990), Martin & Yin (1999) pointed out that unlike urban schools,

[R]ural schools [...] are typically characterised not only by a strong sense of community within the school itself, but also by a sense of being a part of the larger community and an extension of the family (p. 101).

Subsequently, they argued that "these environmental variations would lead to different [views about classroom dynamics] in these two settings" (Martin & Yin, 1999, p. 102).

Source of Mathematical Knowledge

An additional significant difference ( $U = 62007.50$ ,  $p = .011$ ) was reported in the way teachers in the two socio-economic settings viewed the Source of Mathematical Knowledge belief. While teachers in both cohorts appeared to be Platonist-oriented, subscribing to the view that mathematical knowledge has always been out there and waiting to be discovered, implying that mathematical knowledge is to be transmitted from external authorities (e.g. teachers and textbooks) to the learners; teachers in the very low socio-economic cohort ( $M = 2.22$ ,  $SD = .74$ ) appeared to be significantly more convicted in that belief than their counterparts in the very high socio-economic cohort ( $M = 2.37$ ,  $SD = .75$ ).

While the reported significant socio-economic difference is consistent with the finding of Arredondo and Rucinski's (1996) study of 126 teachers and principals from elementary and secondary schools in Chile, their finding concluded that private school teachers appeared to have a significantly stronger belief that knowledge resides in external authorities than their state school counterparts, when responding to the *Depend on authority* scale.

Using the *Source* scale, which comprises such items as: 'Whatever the teacher says in science class is true', Conley et al.'s (2004) study of 187 5th-grade students from low and average socio-economic backgrounds in the US, as measured by whether one received free or discounted school lunch, found that students of the low socio-economic background appeared to hold a significantly stronger belief that external authorities are the main source of knowledge than students of the average socio-economic background.

While Arredondo and Rucinski (1996) did not offer any explanation for their reported significant socio-economic difference, Conley et al. (2004), drawing from Pintrich (2002), attributed their reported difference to the "possible mechanisms for class effects" (Conley et al., 2004, p. 200), where the nature of interactions with people and institutions in different contexts might result in different knowledge representations and ways of thinking that could create group differences in epistemological thinking.

Similar to the Chinese society, where "students are expected to show respect for, and be obedient, to elders and authority figures [and where] it is assumed that authority figures or experts hand down knowledge" (Chan, 2004, p. 7), the structure of Thai society is also hierarchical (Mulder, 1997; Hofstede, 2007). And since Komin (1991), as previously discussed, found that rural Thais (i.e. those who live in the very low socio-economic cohort) are more likely to keep certain traditional cultural ties and less likely to change, when compared to their more liberal urban counterparts (i.e. those who live in the very high socio-economic cohort), it becomes apparent why rural Thai teachers might be significantly more convicted than urban teachers in viewing knowledge as objective reality, waiting to be handed down from teachers to learners.

Stability of Mathematical Knowledge

There appeared to be a significant difference ( $U = 63188.50$ ,  $p = .032$ ) in the way teachers in the two cohorts viewed the Stability of Mathematical Knowledge belief. While teachers in both cohorts did not appear to have a fully formed view about the stability of mathematical knowledge, teachers in the very high socio-economic cohort ( $M = 3.14$ ,  $SD = .84$ ) seemed to have a slightly and significantly stronger belief that mathematical knowledge are constantly evolving than their counterparts in the very low socio-economic cohort ( $M = 3.00$ ,  $SD = .86$ ).

The reported significant socio-economic difference is consistent with the finding of

Conley et al.'s (2004) study of 187 5th-grade students of low and average socio-economic backgrounds in the US, which concluded that students from the low socio-economic background appeared to hold a significantly stronger belief that knowledge is permanent than their counterparts of average socio-economic background, when asked to respond to the *Development* scale, comprising items such as: 'Some ideas in science today are different than what scientists used to think' and 'The ideas in science books sometimes change'.

The findings of the above studies are however, inconsistent with that of Arredondo and Rucinski's (1996) study of 126 teachers and principals from primary and secondary schools in Chile, which found no significant difference in the way private and state school teachers responded to the *Knowledge is certain* scale. Regardless of their school's socio-economic setting, the teachers appeared to subscribe to the view that knowledge is fixed.

Similarly, Tang's (2010, p.94) study of 1,204 secondary school students in China also found no significant difference in the way rural and urban students responded to the *Stability of Maths Knowledge* scale, which ranges from "certain knowledge to changing knowledge" and comprised items, such as 'Math knowledge is not a fixed, but continuously evolving culture'.

While Arredondo and Rucinski (1996) and Tang (2010) did not offer any explanation for their reported non-significant differences, Conley et al. (2004) attributed that finding to contextual factors. For example, they argued that factors such as the nature of learning activities can shape one's belief concerning the stability of knowledge. They gave an example of hands-on classrooms, which often create

[S]ome doubts about the certainty of knowledge, given the high potential for different students to generate different results from their hands-on experiments. Performing their own experiments and observations, as well as sharing differing results might have helped students understand that answers to questions [...] are subject to revision and change (p. 199).

Further, this arguably implies that teachers' view about the stability of knowledge might be influenced by the kind of learning activities they themselves were exposed to during their schooling.

*Correlations Between the Two Beliefs Concerning the Nature of Mathematical Knowledge, and the Classroom Authority Belief*

<i>Spearman's rho</i>	
	<b>Classroom Authority</b>
<b>Source of Mathematical Knowledge</b>	$r_s = .085, p = .020$
<b>Stability of Mathematical Knowledge</b>	$r_s = .165, p = .000$

Table 3 Correlations and their associated probabilities calculated between the two beliefs concerning the nature of mathematical knowledge, and the Classroom Authority belief.

Regarding the positive correlation with the Classroom Authority belief, it appears that the stronger the belief that mathematical knowledge is a human's creation, and hence derived by learners' own effort and learning process, the stronger the belief that pupils should not need to be obedient to their teachers, and hence should instead be encouraged to be intellectually argumentative with them, and vice versa. This correlation makes sense in that if knowledge is created by humans, then learners should be encouraged to construct their own knowledge, and one way to make that happen is to create a learning environment where teachers should not be viewed as the sole authority of knowledge to be obeyed, but a learning environment where learners are encouraged to question their authority or teaching.

Regarding the positive correlation with the Classroom Authority belief, it appeared that the stronger the belief that mathematical knowledge is permanent and fixed, the stronger the belief that pupils should be obedient to their teachers. Alternatively, this can also be viewed as the stronger the belief that pupils should be obedient to their teachers and should not question their teaching, the stronger the belief that mathematical knowledge is permanent and fixed. The relationship between these two beliefs reflects that of the Source of Mathematical Knowledge and the Stability of Mathematical Knowledge beliefs, where the hierarchical structure of Thai society and its associated socio-cultural values, means young Thai children, generation after generation, are taught by their parents to *cheu fang khoon-kru* (*cheu* = believe in; *fang* = listen to; *khooon kru* = teachers). Such Thai mentality that teachers are the knowledgeable authority to be obeyed, respected and trusted would also likely result in another mentality that their teaching is always correct, and hence the transmitted knowledge would likely remain fixed and absolute.

## Conclusion

Drawing from the finding of the first research question, there appears to be a dissonance between the constructivist principles underlying Thailand's educational reform on the one hand, and teachers' epistemological and pedagogical beliefs on the other. More specifically, Thai teachers' beliefs concerning the Source of Mathematical Knowledge and Classroom Authority do not appear to be conducive to creating a constructivist classroom environment where pupils themselves actively construct their own knowledge and are encouraged to be openly critical of their teachers' teaching. This might also explain why their Stability of Mathematical Knowledge belief is not fully fallibilist, for in a socio-cultural context, like Thai society, where teachers are regarded as the supreme source of knowledge, their teaching and hence the transmitted knowledge, would also be perceived as absolute truth and fixed. Subsequently, these three beliefs should be addressed together.

Once again, both teacher educators and professional development administrators could make it more explicit to pre-service and in-service teachers respectively of how some of the Thai socio-cultural values could hinder teaching and learning. They could also be assessed, through reviewing lesson plans or classroom observations, to see whether they have done enough to encourage their pupils to construct their own knowledge through, for example, trial-and-error approach, and reasoning. More specifically, they could encourage their pupils to come up with different ways of solving a mathematical problem, perhaps through group-then-whole class discussion, so they could see that there is no one absolute answer. Also, through the process of reviewing different potential solutions together, pupils could be encouraged to judge which solutions are more efficient and why; giving them the autonomy to assess other students' ideas and choose their own favourite method. In brief, not only would the problems with the Source of

Mathematical Knowledge, the Classroom Authority, and the Stability of Mathematical Knowledge beliefs get addressed, but other aspects of mathematics teaching and learning, such as pupil autonomy and collaboration would be addressed here too.

What is interesting is that the three largest significant differences between teachers' examined beliefs in the two socio-economic cohorts happened to be the Classroom Authority, the Source of Mathematical Knowledge, and the Stability of Mathematical Knowledge beliefs with the mean differences of 0.23, 0.15 and 0.14 respectively on the 5-point Likert scale. Teachers in the very low socio-economic cohort appeared to espouse the three beliefs in a more traditional, Platonist and absolutist manner respectively than their counterparts in the very high socio-economic cohort (*refer to previous section on Stability of Mathematical Knowledge*), and such difference can be explained using Komin's (1991) thesis that rural people tend to hold on to traditional values more firmly than their urban counterparts who are more exposed to a diversity of socio-cultural heritages. Had teachers in one socio-economic cohort appeared to espouse the beliefs that are more perfectly in line with the reform, while teachers in the other cohort failed far behind, a recommended policy would have been to encourage teachers from the latter group to spend a few years teaching in the former group to observe and espouse the belief system of their counterparts.

However, the mean socio-economic differences of the three problematic beliefs, whilst statistically significant, are of small size and are equally not perfect. It would thus be more productive to tackle them – that is reducing the gap between what is endorsed in the reform and what Thai teachers currently view these three beliefs – nationally through the above policy recommendations.

This study has some limitations. Firstly, all the interpretations found in this study are, to an extent, subjective. For example, while the interview and observation data were analysed systematically using the coding and constant comparative methods, the final decisions of which aspects of the data were to be coded, and then which codes were to be retained, were all made by the researcher alone.

Finally, translating survey items from one language to another can be challenging. Drawing from their experience of translating survey items from English to Korean, Shin & Koh (2007), for example, pointed out that:

Because the school cultures and classroom settings were different in the two countries, some of the questions in the survey questionnaire might not have exactly made sense to the Korean teachers. For example, the item, "students should choose the learning topics and tasks" may be interpreted for Korean teachers as the learning topics for students' independent study at home, not topics for school learning" (pp. 305-306).

This thus highlights potential misinterpretation by the survey participants, even when accuracy-checking strategies, such as back translating, have been employed. Drawing from the finding of the first research question, whereby significant socio-economic differences were found in the three examined beliefs, it might thus be of interest for future studies to adopt a largely qualitative research design to examine more closely what are intrinsically different about these two socio-economic settings that have caused such significant discrepancies.

Beyond building on the findings of this study, other research opportunities also exist. For example, Thailand's Basic Education Curriculum has, for over a decade, been promoting

constructivist approach to teaching and learning. Yet international comparisons of mathematics achievements, such as the Third International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA) have shown that East Asian students of the traditional pedagogical influence consistently outperform their Western counterparts of the constructivist pedagogical heritage. To help avoid adopting a particular pedagogical model uncritically, the direction of future research might thus include attempting to establish which of the Thai mathematics teachers' epistemological and pedagogical beliefs, if any, are significantly correlated with students' high mathematics test scores, and whether those beliefs are traditional or constructivist in nature. The research finding could potentially lead to a *pragmatist* view of education reform, where certain traditional and constructivist pedagogical beliefs and practices, that are shown to significantly correlate with high mathematics test scores, are equally embraced.

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## RELATIONSHIP BETWEEN CLASSROOM AUTHORITY AND EPISTEMOLOGICAL BELIEFS

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