

2010

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Recommended Citation

Ly, B. H., & Brew, C. (2010). Philosophical and Pedagogical Patterns of Beliefs among Vietnamese and Australian Mathematics Preservice Teachers: A Comparative Study. *Australian Journal of Teacher Education*, 35(2).
<http://dx.doi.org/10.14221/ajte.2010v35n2.5>

This Journal Article is posted at Research Online.
<http://ro.ecu.edu.au/ajte/vol35/iss2/5>

Philosophical and Pedagogical Patterns of Beliefs among Vietnamese and Australian Mathematics Preservice Teachers: A Comparative Study

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Abstract: Swayed by global pressures and poor international academic standing, Vietnam in 2002 initiated further school-wide curriculum change reflecting a student-centred reform agenda. Initial research on implementation is producing mixed results. One explanation is a mismatch with a Confucian Heritage Culture as a social-constructivist philosophy may counter the traditional widespread teacher-centred classrooms in Vietnam. School mathematics is often regarded as culture-independent as similar topics are taught across nations. We take as a premise that the adoption of the reform agenda is a worthwhile goal. Presented are the findings of a small scale study that set out to explore antecedent philosophical predispositions that may promote or obstruct the reform uptake among Vietnamese secondary mathematics preservice teachers. Using a mixed-method approach, and a counterpart cohort from Australia for comparison, support for constructivist and traditional mathematics teaching and learning approaches were explored in association with teacher self efficacy. The Australians were expected to reflect reasonable support for a constructivist agenda and the Vietnamese perhaps less so. For both cohorts, the quantitative data reflected strong support for a constructivist framework and a modest rejection of traditional approaches with the latter correlated with teacher self efficacy. Indeed, the Vietnamese cohort conveyed a belief more so than the Australians that mathematics is a creative discipline; likely a reflection of having studied more mathematics. Scale inter-correlations provided apparent philosophical paradoxes worthy of further study. From the qualitative data the Australians do seem to be further down the track in espousing a philosophy that incorporated a constructivist agenda. With further culturally connected professional development the Vietnamese may be better prepared conceptually to apply it.

Introduction

In the developed nations, mathematics education research and policy directions have long advocated an inquiry approach to teaching school mathematics informed by principles of learning associated with a constructivist philosophy (Maher & Alston, 1990; NCTM, 1989, 2000, 2006).

Emerging curriculum and teaching policy directions in Vietnam are consistent with this trend, prompted by the industrialisation and modernisation period embarked upon in 1991 (Nguyễn & Cao, 1999), and swayed by international studies that reveal poor academic standing (Business-in-Asia, 2009; Lê, 2006). Since 2002, the Vietnamese national curriculum has endorsed more student-centred approaches across all disciplines (MOET, 2002, 2005, 2008). To assist reform implementation, high achieving teachers and university lecturers are supported to study in countries where the curriculum has long reflected a reform-based approach, Australia being one of these (ADB, 2009). From the little research that has been conducted to date, reforms prior to 2000 in the primary sector did lead to positive changes in mathematics classrooms with students and teachers reported to be more active and creative, despite the large class sizes and general lack of resources and training (Do, 2000). Commenting more recently on the impact of the reforms, Lê (2006) indicates improved learning outcomes based on test scores in Vietnam are lower than expected.

The strategy of developing nations to rapidly promote the adoption of technologies and teaching methods initiated in western nations is aimed at gaining a more competitive edge in the global market (Thomas, 1997). Nguyen, Terlouw and Pilot (2006: 2) warn that without the implementation of “a research and testing phase” local cultural contexts may “render Western approaches ineffective and perhaps even counterproductive”. We took as a premise that the adoption of the reform agenda is a worthwhile goal and set out to explore antecedent predispositions that may promote or obstruct uptake among a cohort of Vietnamese secondary mathematics pre-service teachers. In this study the beliefs of one Vietnamese preservice cohort were compared with one Australian cohort counterpart. The aim of this study was, in part, to gather comparable data to Seaman, Szydlik, Szydlik and Beam (2005) who conducted an inter-generational study of US preservice teachers’ philosophical beliefs about the teaching and learning of mathematics (1968 vs 1998) to assess the impact of comparable reforms initiated in the 1980s. We proposed that Vietnam might represent an education generation behind Australia. State-based school curriculum across Australia (e.g. BOS, 2003; VCAA, 2006; WADE, 2002) have continued to encourage and promote inquiry-based and investigative approaches in mathematics since the late 1980s and preservice teacher training programs are required to be consistent with the State curriculum. Consequently we hypothesised that the Australian preservice mathematics teachers may hold beliefs that are more aligned with a reform agenda than their Vietnamese counterparts and that the distinction may provide a helpful point of departure for better understanding contributing factors associated with the reform uptake given their diverse cultural and educational backgrounds.

Since “legislation only sets a framework for improvement; it is teachers who must make that improvement happen” (Hargreaves & Evans, 1997: 3). Hence a reform agenda cannot be successful without teachers’ beliefs being oriented toward the reform agenda (Battista, 1994), especially preservice teacher’ beliefs (Handal & Herrington, 2003). Research on the openness toward education reform among Vietnamese school teachers is in its infancy as are cross cultural studies that compare nations during the reform process.

Mathematics Education Reform in Vietnam

Vietnam has a national curriculum associated with government prescribed textbooks, student exercise books with textbook related problems and accompanying teacher manuals (Đ. Đỗ, 2000). These resources are developed and provided by the Ministry of Education and Training (MOET). To manage the transition toward inquiry-based curricula, new materials were introduced in 2002 at grade 1 (beginning of school) and grade 6 (beginning of lower secondary school) and then for grade 2 and grade 7 in 2003 and so on, so that in 2009 the revised curriculum reached grade 12. The curriculum

document refers to teachers as supervisors who need to give instructions to students but students are to be active in the classroom, and do their own discoveries for knowledge and new information. Teaching and learning methods are also to be based on student individual abilities (MOET, 1998). All practising teachers and lecturers are required to attend professional development seminars and workshops (Đ. H. Đỗ, 2007).

As a top-down reform agenda, it is not surprising that implementation has proved to be difficult as many administrators, educators and teachers have remained resistant to change (MOET, 2008). Some parents has also provided an impediment choosing to send their children to innovative schools that abandon 'progressive methods' to return to more traditional educational methods (Nguyen et al., 2006). However as Nguyễn and Cao (1999: 131) note, pressure for curriculum change has not only come from global pressures and government initiatives, but also from the demands of other "teachers, pupils and parents who are aware of the outdated nature of the curriculum." Teachers' lack of knowledge, skills, and inadequate training about methods of the new curriculum has also contributed to the slow pace of change in the application of more effective approaches with this situation more evident in rural areas where training is less frequent (Duggan, 2001). Other barriers to curriculum reform include an overcrowded curriculum and overly academic and impractical content. Việt (2004) proposed that the new curriculum was designed by people who are not teaching, leading to a mismatch between ideology and reality. Yet the collectivist culture has been proposed to lend itself to a match with aspects of a student-centred curriculum with its inherent collaborative learning strategies (Salili, 1996). On the other-hand, the Confucian Heritage Culture (CHC), dominant in Vietnam, is also proposed to represent a mismatch due to the accepted societal power imbalance. "In the education realm this is the teacher-student dyad", associated with students being discouraged from speaking unless invited by their teacher and to refrain from questioning their teacher (Nguyễn et al., 2006: 5). Earlier, Nguyễn and Cao (1999) stated that the curriculum reform agenda curriculum was inconsistent with local needs and explained why Vietnamese teachers continued using traditional teaching methods. They propose a greater focus on the training of preservice teachers, as well as better devised in-service sessions for practicing teachers with appropriately designed teaching materials.

Influence of Mathematics Preservice Programs on Teachers' Beliefs

Research on preservice teachers' beliefs about mathematics has largely centred on those training to teach at primary level, many of whom report poor mathematics academic backgrounds and associated high levels of anxiety (Brett, Nason & Woodruff, 2002; Cohen & Green, 2002). Secondary mathematics teachers, through their specialisation, have generally been highly successful academically in mathematics, compared to their primary counterparts. If this success has come from being immersed in a traditional approach to learning mathematics - one that rewards procedural knowledge over problem solving skills – the concern is that they will model this approach as classroom teachers. Prescott and Cavanagh (2006: 430) report that limited experience of a student-centred mathematics classroom during secondary teacher training is "insufficient ingredient in ensuring that preservice teachers examine their often deeply rooted views about teaching and learning mathematics". These findings remain consistent with Raymond (1997) who reported that past school experiences of preservice teachers are strongly influential on their beliefs about mathematics as a discipline and their mathematics teaching practices, with teacher education programs only having a moderate influence.

The current study is modelled, in part, on the study by Seaman et al. (2005) who conducted an inter-generational study of elementary preservice teachers' beliefs about mathematics. These authors replicated a study by Collier (1972) using an adapted version of the mathematics beliefs questionnaire (MBQ), a 40 item instrument which measures what Collier termed the "formal-informal" dimension of

belief. The MBQ explores four philosophical themes. Two themes explore participants' perceptions about mathematics as a discipline; 1) mathematics is a rigid and prescribed discipline and; 2) mathematics is a creative discipline and requires original thinking. The other two themes explore participants' beliefs related to the teaching of mathematics: 3) mathematics is best taught by direct formal instruction, imitation of procedures and avoidance of discovery methods; 4) mathematics is best taught by investigations, encouraging students to find their own methods through experimentation. Seaman et al. (2005: 198) propose that while the MBQ was developed nearly four decades ago it remains "highly relevant to the current dialogue in mathematics education" as two of the constructs are "a reasonable measure of constructivist philosophy and ideas about instruction that follow from that philosophy."

Seaman et al. (2005: 206) compared the beliefs of their 1998 US research group with the 1968 Collier US research group and established that the 1998 cohort "held beliefs about mathematics and mathematics teaching that were significantly more informal (and thus better aligned with a constructivist philosophy) than their 1968 counterparts". This outcome was attributed to curriculum reform that was sparked by the release of *A Nation at Risk* (1983). Nonetheless both cohorts at the start of their courses believed that mathematics was a collection of rules, formulas and procedures and this perspective declined for both cohorts over the period of their respective courses providing evidence that teacher education programs can have an impact on teachers' beliefs. The authors also noted contradictory beliefs. For example, many preservice teachers supported informal teaching approaches while also reporting that mathematics was an absolute discipline. One implication from their study for practice was to provide ample opportunity for preservice teachers to discuss their beliefs both about mathematics and its teaching so as to draw out contradictions, with the aim of assisting in the "evolution of a new belief system" (Seaman et al., 2005: 206).

Contradictions in belief structures are identified by Frykholm (1999) with novice secondary mathematics teachers who were immersed in a teacher training course that embraced NCTM standards. While the large majority of participants reported that were aware of the NCTM Standards and that they valued them, in their lesson preparation they were neglected. This discrepancy was heavily influenced by the beliefs and teaching strategies of the cooperating teachers who "rarely implemented innovative strategies" and "did not discuss, emphasize, or model the NCTM Standards" (Frykholm, 1999: 92 & 93). Frykholm (1999) also surmised that some student teachers' did not view the Standards in their capacity as a philosophical framework; rather, maintained a "fairly rigid" interpretation of them. As one student said, "the Standards are a set of 'new rules' that a council of teachers think would help us keep the students engaged" (Frykholm, 1999: 89). Nevertheless, many prospective teachers wanted to know more about how to implement the Standards, and believed that the university course had focused too heavily on theory at the expense of practical advice.

The relationship between teachers' beliefs and their mathematical content knowledge is also relevant. Lester, McCormick and Kapsuz (2004) researched the link between the number of mathematics courses taken by preservice elementary teachers and their confidence and views on teaching mathematics. Perhaps not surprisingly, the more mathematics studied by participants the more likely they were to feel confident about teaching mathematics (correlation 0.5). But Lester et al. (2004: 560) also concluded that, "the mathematics specialists were more confident in their ability to do and teach mathematics, had stronger beliefs that effort makes one better able to learn mathematics, saw mathematics as more useful and centred around problem solving, and had beliefs that are more in line with the NCTM Standards" compared to the students who were not so specialist trained. Nevertheless what prospective teachers can learn from one high quality mathematics course can outweigh the influence of a number of less effective courses (Ma, 1999).

Teacher Self-efficacy and Support for an Inquiry Approach to Mathematics Teaching

Berman, McLaughlin, Bass, Pauly and Zellman (1977: 137) defined teacher self efficacy as, “the extent to which the teacher believes he or she has the capacity to affect student performance”. Bandura (1986) provided a reinterpretation of the concept to concern the development of specific beliefs regarding one’s capabilities to deal with changes. Guskey and Passaro (1994: 4) extended the concept to include beliefs about one’s capabilities to reach students, “who may be difficult or unmotivated”. Bandura (1997) later asserted that high teacher self-efficacy is associated with the capability to promote deep conceptual learning and Zimmerman (1997: 204) noted that self-efficacy influenced, “level of effort, persistence, and choice of activities”. We also have evidence from Czerniak (1990) that highly efficacious teachers are more likely to use inquiry and student-centred teaching strategies than teachers who report a low sense of efficacy. Teachers, who report low self efficacy it is proposed, rely more heavily on a more formal transmission style of teaching. Presumably their sense of inadequacy can be masked by exerting greater control in the classroom. In their review of the self efficacy literature, Tschannen-Moran, Woolfolk Hoy and Hoy (1998: 223) noted equivalent findings: “Teachers with a strong sense of self efficacy are open to new ideas and more willing to experiment”. Tschannen-Moran et al. (1998: 210) state that, “self efficacy is distinct from other concepts of self, such as self-concept, self-worth, and self esteem”, in that it is both context and subject specific, and is concerned with self-perception rather than actual level of competence. Nevertheless, a relationship between teacher self efficacy and student achievement is reported. Bandura (1997) also points to a need to develop strong efficacy beliefs among teachers early in their careers, as it becomes much harder to shift experienced teachers perceptions of personal competence without compelling evidence that will cause them to re-evaluate. Consequently when studying preservice secondary mathematics teachers’ beliefs about their pedagogical and philosophical foci, we need to also explore the role of teacher self-efficacy.

Research Questions

To what extent do the Vietnamese and Australian preservice teachers’ beliefs reflect:

- 1) support for a reform agenda in mathematics teaching and learning?
- 2) support for traditional approaches towards the learning and teaching of mathematics?
- 3) a view that traditional and reform based approaches in mathematics are not consistent with each other? i.e. Is a strong orientation towards an inquiry approach to learning and teaching mathematics associated with the rejection of traditional approaches?
- 4) they are efficacious with respect to the teaching of mathematics and;
- 5) a relationship between teacher self-efficacy and support for traditional or inquiry-based approaches to learning and teaching mathematics?

Participants

Two groups of preservice secondary mathematics teachers, one Vietnamese cohort (43 students) and one Australian cohort (28 students), both convenient samples, were invited to participate. All members of the Vietnamese cohort completed the survey (52% men; 39% women; 9% gender not identified) ranging in age from 20-25 who were in their final year of a four-year bachelor degree (2003-2007) at a relatively new metropolitan university in the Mekong Delta in the South of Vietnam. The percent of mathematics units in their degree program was 35%, 53%, 72% and 43% for the first,

second, third and last year respectively. With respect to their whole degree, only 10% is related to teaching methods which covers educational psychology, science research methodology, pedagogy and methodological teaching training. Any additional exposure to the reform agenda could have occurred during their three weeks of observing school classrooms and during a two month practicum at a local school prior to graduation. Consequently, these preservice teachers had insufficient training and modelling with respect to the reform agenda because the new curriculum was implemented after they had graduated from high school and during the teacher training program they had few teaching methods classes which informed them of the reform.

Twenty-one Australian students completed the survey (48% women; 33% men; 19% gender not identified) and they were enrolled in a one year Diploma of Education at a metropolitan University in south-eastern Australia during 2007. Six Australians were mature age, having returned to study after alternative careers with the remaining 14 comparable in age to the Vietnamese cohort. The Australians are required to train in two different specialist methods; one of these was mathematics. To be able to enrol in the mathematics method, graduates are required to have a minimum of two years of university mathematics, equivalent to 25% of a full-time load for each year. While information pertaining to the actual number of mathematics units studied by these participants was not available, several of these students had majored in Information Technology in their undergraduate years with mathematics as a minor discipline. Overall, the cohort had studied less mathematics than their Vietnamese counterparts. During the teaching Diploma they participated in 45 days of teaching practicum and 15 days of fieldwork. The mathematics method course introduces the cohort to inquiry-based principles of learning with examples of how students can rediscover mathematical relationships and requires students to read and present on current relevant research. Anecdotal feedback in class on their practicum experiences suggests they see no or few examples of inquiry-based learning.

Methods of Data Collection and Analysis

Instruments

Quantitative and qualitative data were collected through an online survey using the software program Survey Monkey during 2007. The questionnaire was translated into Vietnamese for the Vietnamese cohort and then data was translated into English by a group of Vietnamese mathematics students enrolled in a Masters of Mathematics at the participating Australian University. The Mathematics Belief Questionnaire (MBQ) validated by Seaman et al. (2005) with primary preservice teachers was used. As described earlier, the instrument measures four philosophical themes; two scales concern beliefs about the discipline of mathematics: 1) mathematics is a collection of rules and procedures (FAM – formal approach to mathematics); 2) mathematics is a creative endeavour (CAM – constructivist approach to mathematics); and two scales concern beliefs about the best way to learn mathematics 3) mathematics is best taught by direct instruction (FATM – formal approach to teaching mathematics); 4) mathematical problem-solving allows for multiple approaches (CATM – Constructivist approach to teaching mathematics). All items are worded in the positive. Wherever the word primary appeared in an item, this was replaced with secondary. Each construct is measured with ten items (Tab. 1-4). A six point scale from strongly disagree to strongly agree was adopted over the original five point scale to enhance the ability to measure greater variability of beliefs within the samples (1 = strongly disagree, 2 = moderately disagree, 3 = slightly disagree, 4 = slightly agree, 5 = moderately agree, and 6 = strongly agree). This kind of instrument allows for exploring patterns of beliefs with greater complexity, exploring the extent to which participants support both philosophical approaches and associated methods, and whether there is a relationship between their views with respect to learning and teaching within the philosophical frameworks.

The preservice teachers' self-efficacy was measured using the instrument developed by Enochs et al. (2000) that was designed to measure the extent to which with elementary teachers believe they have sufficient pedagogical skills and content knowledge to support students' learning. Four items are asked in the negative, four in the positive using a six point scale (Tab. 6). Any reference to "elementary" teaching was replaced with "secondary".

Scale internal consistency measures were determined from Cronbach Alpha scores using the combined data from both cohorts (sample size of 64). Items that did not contribute to the Alpha measures were deleted and then scale averages calculated. While an average score does inflate the influence of items that contribute the least variance to the scale, as an exploratory study, seeking patterns of influence, an average score is sufficient but remains a limitation. Kurtosis and skewness statistics for the scales were also assessed to check the appropriateness of parametric statistical testing. The mean scores for the five scales (dependent variables) and the scale inter-correlations were then compared statistically by cohort (independent variable) using MANOVA and Pearson correlations respectively.

For the purpose of exploring in more depth the participants' beliefs about mathematics, and to provide insight into patterns evident in the quantitative data, participants were invited to provide written explanations for their responses to some items from the MBQ scales. Responses to three questions are reported on in this article. From the FAM scale the following question was asked: "For question 1, regarding perceiving mathematics as a collection of rules, formulas and procedures, can you please explain the reasons for your answer (whether you agree or disagree)." The aim of this question was to draw out how the participants were beginning to reframe this commonly held belief about mathematics in the context of a reform agenda. The second question relates to items CATM26 and FATM29: "Do you think that teachers should spend class time on developing students' problem solving skills? Please explain your answer". The reason for focusing on this kind of question is because resistance to change from pre-service teachers in our experience is commonly associated with the greater time it takes to implement a problem-based learning environment. If this was a major issue it would likely be reflected in their responses. The third question was asked for similar reasons as well as to explore how the pre-service teachers were grappling with the integration of a reform strategy. "Do you think that it is difficult to use discovery methods of teaching in mathematics? Please explain your answer" (relates to items FATM27,31,38, CATM40).

Scale Internal Consistency Measures

Following some item deletions, acceptable Cronbach Alpha scores were obtained for the two scales designed to measure support for a reform agenda (CAM 0.75, CATM 0.74) (Tab. 1 & 2) and the teacher self efficacy scale (TSE 0.72) (Tab. 5). Modest Cronbach Alpha scores were obtained for the scales designed to measure support for a traditional approach to the learning and teaching of mathematics (FAM 0.60; FATM 0.68) (Tab. 3 & 4). Why some items did not contribute adequate variance to the constructs is discussed later.

The 'corrected item-total correlations' are reported for each item in decreasing order of magnitude as this reflects the extent to which the item contributes to measuring the scale (Tab. 1-5). For the CAM scale the wording of the first three items suggests that this scale is measuring the extent to which participants believe that mathematics requires original thinking, that there is inherent method flexibility in the process of problem solving and that doing mathematics develops students' creative thinking skills (Tab. 1). The remaining five items are consistent with mathematics as an art form, with varied applications and that success requires an inquiring mind (Lê, 2006).

Item number	Item	Corrected Item-total Correlation
CAM18	Mathematics requires independent and original thinking.	.72
CAM19	There are often many different ways to solve a mathematics problem	.61
CAM5	Studying mathematics helps to develop the ability to think more creatively	.55
CAM13	There are several different but logically acceptable ways to define most terms in mathematics.	.42
CAM2	The field of mathematics contains many of the finest and most elegant creations of human mind	.39
CAM7	There are several different but appropriate ways to organize the basic ideas in mathematics	.37
CAM6	The basic ingredient for success in mathematics is an inquiring nature	.36
CAM12	In mathematics, perhaps more than in other areas, one can display originality and ingenuity	.33
CAM10	Mathematics has so many applications because its model can be interpreted in so many ways.	.29
CAM15	Trial-and error and other seemingly haphazard methods are often necessary in mathematics	*

* omitted item

Table 1: Items for constructivist approach to learning mathematics scale (CAM)

For the CATM scale the wording of the first three items suggests that this scale is measuring the extent to which the participants believe that teachers need to engage students’ sense of wonder through exploratory research activities that go beyond the curriculum and that students be encouraged to develop their own mathematical ideas even if this process may involve considerable trial and error (Tab. 2). The remaining three items are consistent with the notion that this approach is good for all students and that the approach should be used frequently.

Item number	Item	Corrected Item-total Correlation
CATM35	Teachers must get students to wonder and explore issues in mathematics beyond the curriculum.	.67
CATM34	The mathematics teacher should consistently give assignments which require research and original thinking.	.48
CATM24	Each student should be encouraged to build her or his own mathematical ideas, even if her or his attempts contain much trial and error.	.41
CATM40	Students of all abilities should learn better when taught mathematics by guided discovery methods.	.42
CATM36	Mathematics teachers must frequently give students assignments which require creative or investigative work.	.41
CATM30	Teachers should frequently insist that pupils find individual methods for solving mathematical problems.	.39
CATM25	Each student should feel free to use any method to solving a mathematical problem that suits him or her best.	.35
CATM26	Teachers should provide class time for students to experiment with their own mathematical ideas.	.32
CATM33	The average mathematics student, with a little guidance, should be able to discover the basic ideas of mathematics for her or himself.	.32
CATM23	Children should be encouraged to invent their own mathematical symbolism.	*

* item omitted

Table 2: Scale items for constructivist approach to teaching mathematics (CATM)

For the FAM scale the wording of the first three items suggests that this scale is measuring the extent to which participants believe that there is little opportunity for self expression in mathematics due to the discipline representing an absolute body of knowledge with exacting language that involves the strict application of formulae to solve problems with precise outcomes. The two remaining items are consistent with this view (Tab. 3).

Item number	Item	Corrected Item-total Correlation
FAM20	The language of mathematics is so exact that there is no room for variety of expression.	.49
FAM14	Mathematics is an organized body of knowledge which stresses the use of formulas to solve problems.	.43
FAM11	Mathematicians are hired mainly to make precise measurements and calculations for scientists	.31
FAM3	The main benefit from studying mathematics is developing the ability to follow directions.	.29
FAM16	Mathematics is a rigid discipline which functions strictly according to inescapable laws.	.28
FAM8	In mathematics there is usually just one proper way to do something.	.28
FAM1	Solving a mathematics problem usually involves finding a rule or formula that applies	*
FAM9	In mathematics, perhaps more than in other fields, one can find set routines and procedures	*
FAM4	The laws and rules of mathematics severely limit the manner in which problem can be solved.	*
FAM17	Many of the important functions of the mathematician are being taken over by the new computers.	*

* items omitted

Table 3: Scale items for formal approach to learning mathematics (FAM)

For the FATM scale the wording of the first four items suggests that this scale is measuring the extent to which participants believe that teachers believe they should be central players in the content examined and methods used in the mathematics classroom (Tab. 4). Student led discoveries are considered of limited learning potential as they tend to frustrate students who do not have the ability to understand their answers. The remaining items reflect support for the view that teachers need to remain in tight control of both content and process. For the Teacher Self Efficacy Scale (TSE) all items were included (Tab. 5).

Item number	Item	Corrected Item-total Correlation
FATM22	Mathematics teachers should only set work on what has already been thoroughly discussed in class.	.64
FATM32	The mathematics teacher should provide models for problem solving and expect students to imitate them.	.50
FATM21	The mathematics teacher should always work through sample problems for students before making an assignment.	.38
FATM31	Discovery methods of mathematics teaching have limited value because students get answers without knowing where they came from.	.37
FATM27	Discovery methods of mathematics teaching tend to frustrate many students who make too many errors before making any hope for discovery.	.37
FATM29	Mathematics teachers should spend most of each class period explaining how to work specific problems.	.28
FATM28	Most mathematical exercises assigned to students should be applications of a particular rule or formula.	.24
FATM37	Students should be expected to use only those methods that their mathematics text or mathematics teacher uses.	.23
FATM38	Discovery-type lessons in mathematics have very limited value when you consider the time they take up.	*
FATM 39	All students should be required to memorize the procedures that the mathematics text uses to solve problems.	*

* items omitted

Table 4: Scale items for formal approach to teaching mathematics (FATM)

Item number	Item	Corrected Item-total Correlation
TSE8	When a student has difficulty understanding a mathematics concept, I will usually be at a loss as to how to help the student understand it better (Recode)	.57
TSE4	I will generally teach mathematics ineffectively. (Recode)	.48
TSE3	I understand mathematics concepts well enough to be effective in teaching secondary mathematics	.48
TSE5	I will find it difficult to use manipulative to explain to students why mathematics works. (Recode)	.43
TSE7	I wonder if I will have the necessary skills to teach mathematics (Recode)	.39
TSE1	I will continually find better ways to teach mathematics	.36
TSE2	When teaching mathematics, I will usually welcome student questions	.34
TSE6	I will typically be able to answer students' questions	.28

Table 5: Scale items for teaching self efficacy (TSE)

Result and Discussion

To What Extent Do the Vietnamese and Australian Preservice Secondary Teachers Support a Reform Agenda in Mathematics Teaching and Learning?

The mean scores for the CAM and CATM scales indicate that overall both cohorts believe that mathematics is a creative endeavour and that they support the practices that are associated with a reform agenda (Tab. 6). For the CAM scale only 5% of the Australians and 3% of the Vietnamese provided a score of less than 4, indicative of a perception that mathematics is not a creative discipline. For the CATM scale, 14% of the Australians and 25% of the Vietnamese provided a score of less than 4, indicative of a lack of support for reform based teaching strategies. The Vietnamese also provided a statistically higher mean score for the CAM scale compared to the Australians indicating greater

support for the view that mathematics is a creative endeavour that develops students' creative thinking skills. An individual item analysis determined the CAM scale cohort difference was due to four specific items (Tab. 7). These cohort differences are highly significant accounting for between 11-22% of the variance. One explanation could be due to the Vietnamese overall having studied more mathematics than the Australians (Lester et al., 2004).

To What Extent Do the Vietnamese and Australian Preservice Secondary Teachers' Reflect Views Consistent with Traditional Approaches towards the Learning and Teaching of Mathematics?

Both cohorts provided comparable mean scores for the FAM and FATM scales (Tab. 6). For the Australians, 71% rejected the view that mathematics is an absolute discipline (scores less than 4) and for the Vietnamese 75%. For the FATM scale, 81% of the Australians rejected traditional teaching methods and for the Vietnamese 86%.

Cohort	Index	CAM	CATM	FAM	FATM	TSE
Australian (n=21)	Mean	4.83	4.74	3.18	3.14	5.00
	SD	.72	.59	.97	.83	.60
	Skewness	-1.54	-.46	.08	.02	.18
	Kurtosis	4.66	-.71	-.33	-.74	-1.11
	% agree [#]	95%	86%	29%	19%	100%
Vietnamese (n=43)	Mean	5.29	4.62	3.12	3.02	4.65
	SD	.53	.79	0.87	.85	.80
	Skewness*	-1.19	-.30	.09	.18	-.19
	Kurtosis*	1.42	-.48	-.50	-.18	-.77
	% agree [#]	98%	75%	25%	14%	82%
	F-value	8.666	.338	.005	0.295	2.281
p-value	.005	Ns	ns	Ns	.075	

The percentage of participants whose scale scores were ≥ 4 . *Skewness and kurtosis values were within the accepted levels for being considered normally distributed for parametric statistical analysis (Jones, 1969).

Table 6: Descriptive and inferential statistics for the mean scale scores by cohort

Item	Vietnamese Mean (SD)	Australian Mean (SD)	F	Sig	Adj. R Squared
CAM5	5.77 (.52)	4.71 (1.55)	16.718	<.001	.20
CAM6	5.43 (.76)	4.45 (1.02)	18.779	<.001	.22
CAM18	5.50 (.70)	4.70 (1.45)	9.069	.004	.11
CAM19	5.84 (.48)	5.25 (1.04)	9.884	.003	.12

Table 7: Cohort comparison for individual CAM items

To What Extent Do the Vietnamese and Australian Preservice Secondary Teachers' Beliefs Reflect a View that Traditional and Reform Based Approaches in Mathematics are not Inconsistent with Each Other?

There were several expected outcomes associated with the inter-correlation analysis. 1) The CAM and FAM scales and the CATM and FATM scales would be negatively correlated. 2) The CAM and CATM scales and the FAM and FATM scales would be positively correlated. While there was a strong negative correlation for the Australians between the CAM and FAM scales (-0.57), indicating that a view of mathematics as a creative endeavour was associated with the rejection of the view that mathematics is a rigid and absolute discipline, this was not apparent for the Vietnamese cohort (-0.16) (Tab. 8). An examination of the data determined that enough Vietnamese respondents in this small sample held these two perspectives simultaneously, which minimised the correlation relationship.

Construct	Cohort	CATM	FAM	FATM	TSE
CAM	Australian	.23	-.57**	-.34	.43*
	Vietnamese	.42**	-.16	-.23	.39**
CATM	Australian		.20 [#]	.024	-.28
	Vietnamese		-.01	-.16	.07
FAM	Australian			.61**	-.69***
	Vietnamese			.20	-.19
FATM	Australian				-.50*
	Vietnamese				-.41**

* p <.05; ** p <0.01; *** p <0.001

Table 8: Scale Inter-correlations by cohort

There was also no negative correlation between the comparable CATM and FATM scales for the Australians and this was negligible for the Vietnamese. An examination of the data also indicated that there were several individuals within both cohorts who supported both teaching approaches thereby cancelling out any correlation pattern. This result may reflect a kind of transition stage, and/or an emerging new philosophy that is accommodating pedagogical strategies drawn from inquiry-based learning into an essentially formal mathematics classroom.

There was also an interesting mirroring effect with respect to the expected positive correlations across the two cohorts. While the Australians provided a strong positive correlation between the FAM and FATM scales (0.61) this was weak for the Vietnamese (0.20) but then the Vietnamese provided a moderate positive correlation between the CAM and CATM scales (0.42) and this was weak for the Australians (0.23). So while the scale means across the two cohorts are comparable (apart from CAM), we have some apparent paradoxes within the inter-correlation patterns that are not consistent across the cohorts. The Vietnamese convey a strong view that mathematics is a creative discipline (CAM), and this view is associated with support for teaching mathematics using informal strategies (CATM), but this perspective does not preclude the belief that mathematics is also a discipline with rigid boundaries (FAM). What may be relevant here is that Vietnam has been heavily influenced by the Chinese for thousands of years and imbedded within the Chinese way of life is a very stable belief system that provides for the coexistence of paradoxical value systems based on the Yin Yang principle (Faure & Fang, 2008). It is important to not extrapolate beyond the data from this small scale study, but the findings do point to needing to find a receptive professional development pathway through this aspect of the culture. Future research might explore this more explicitly with respect to which innovative strategies are initially more amenable to being integrated into the classroom.

The qualitative data provided some further insight into these findings and also reasons for why some of the items are no longer valid measures of their scale. It is important to add that the Vietnamese participants were less forthcoming than their Australian counterparts in providing rich written responses to the open-ended questions.

In response to the question: “*Solving a mathematics problem usually involves finding a rule or formula that applies, can you please explain the reasons for your answer*”, nine of the 16 Australians who provided a written response to this question conveyed sophisticated reasons for agreeing that reflect more of a constructivist approach or at least a non-procedural approach to learning mathematics. Three examples follow:

Usually the reason you are confident of an answer in maths, is that you are confident in the logic underpinning the procedure you have used to get the answer. This means there is some rule or formula that applies to the situation. However this doesn't need to be a rote-learned rule or formula, it can be something you have 'invented' for that particular problem. Mathematics is a collection of logical relationships, but that doesn't mean that having abilities in maths only requires prior-knowledge of such relationships. While having prior knowledge of the relationships often saves time in maths, the core skill is about evaluating possible relationships and if necessary, formulating your own relationships and procedures. (AUS)

Rules, formulae and procedures are only part of mathematics and only part of the process for solving mathematical problems. The major part of solving mathematical problems lies in being able to recognize concepts which are apparent or hidden in the problem and then deduce the logical connections between the concepts. The manipulation of the rules which describe the concepts and connections is the simple part; the recognition is the hard part. E.g., memorizing the formula that $C = (\pi)D$ does nothing for understanding the nature of π even though the formula is the fundamental definition of π . (AUS)

In many cases, it is very hard to find a rule, a formula or a procedure to deal with many math problems. It requires the creative application of comprehensive knowledge and skills. However, it is better if we can find out rules, formulas and specific procedures to deal with a problem. (AUS)

From among the 24 Vietnamese students who provided written comments to this question, only four reflected similar perspectives. Three examples follow:

When we study maths there are so many formulas, rules and process algorithms needed to be understood as background knowledge to solve the easy, basic problems. Then we can be more creative in solving problems; discover some new formulas. (VIET)

Of course to solve a problem we need to find out rules or formulas that apply. However, there are many problems which require students to think creatively rather than just finding formulas. (VIET)

Every science area has itself laws, rules and formulas. So if students can be seen those rules and laws they can find out the elegance of maths and will love maths. (VIET)

A view that mathematics is essentially only a collection of rules and procedures was far more prevalent in the written statements by the Vietnamese students (14 out of 24) compared to the Australian student responses (3 out of 16). Example responses from the Vietnamese students:

Strongly agree because mathematics is actually a set of formulas

Working with maths is working with formulas and procedures

In my opinion, to solve mathematics problems we have to use mathematics formulas

Because it is the basic of maths

The idea that the creative work in the discipline has essentially already occurred was also evident from one of the Vietnamese participants.

Mathematics is the result of much struggle, hard work and research. Therefore the new generation has to mainly just apply these formulas to solve maths problems. Some people like to do maths creatively; they may find out new formulas and rules, however, they may not get the expected result. It also takes much time.

Responses from the Australian students:

Many problems need to apply formulas, rules or algorithm to solve them

Mathematics concepts come from generalization of natural rules

It is the way mathematics has been taught for a very long time so it is hard to change

In response to the question: “*Do you think that teachers should spend class time on developing students’ problem solving skills?*” most participants from both cohorts were in agreement but the Australians were far more fervent and convincing that they believed in this approach. Of the 18 Australian students who responded, 16 agreed without reservation; only one student wrote that it was not necessary at secondary level. Among the 27 Vietnamese students who responded, 13 agreed without reservation, a further seven agreed but with a qualifier, and seven did not agree that it was necessary. Typical responses from the Australians who agreed without reservation follow:

Absolutely! They need to become independent thinkers, not just spoon-fed calculator operators. They need to be encouraged to consider maths applications beyond the classroom so they can apply what they are learning.

Absolutely. Problem solving usually involves a higher order of thinking and skills of analysing, trial & error, being creative and critical thinking. Can also involve group work and discussion groups - these are all great skills for students to develop.

Yes. I feel that the main benefit of learning mathematics and a great reason why employers choose people with mathematics is more for the logical though patterns they have rather than the actual mathematics. So the problem solving and logic skills are essential for mathematics students.

Yes, because in that way they get to see how maths can be used in everyday life as a tool. The new Victorian curriculum is endeavouring to develop this but not sure it will happen.

Examples of similar statements from the Vietnamese students:

Yes I think so. Because maths is not limited to just some types of problems (maths is not only what has been taught in class). If students just know about some types, they will feel confused with new types of problem. Therefore students should be taught problem solving skills.

Yes. Teachers should spend class time to develop students' problem solving skills so that students can understand knowledge deeply and then they can apply that skill to solve other mathematics problems.

I think teachers should only guide students to work out the problem and students have to solve that problem. That is the best way to learn mathematics and it helps students develop creative thinking.

It's necessary. That way, students can develop their thinking and feel excited with mathematics

For the Vietnamese students who agreed with a qualifier, lack of time was a repeating concern in relation to pressure to cover the core curriculum.

Yes they should. However they also should consider the limited classroom time so that there is still time to teach compulsory parts according to the curriculum.

Should. However, it is not easy to do because of the limited classroom time.

Should do this if enough time because through developing students' problem solving skills they can become more active in learning and improve their knowledge

Yes. But teachers may not use much classroom time because they have to follow the curriculum.

Other Vietnamese respondents suggested that setting problem solving for homework was one way to get around the problem of limited time. This response is indicative of accommodating a reform approach within the traditional teaching format as described by Do (2000) where the teacher speaks and explains concepts for over 90% of the class time and then sets considerable homework. It is at this time the students are expected to be doing most of their learning:

Teachers can use class time to develop solving problem skills for students. Also teachers can give students exercises which can help students develop solving problem skills to do at home.

Not necessary. I can give this as homework instead.

The overwhelming reason as expected for not supporting the use of class time to develop students' problem solving skills from the Vietnamese respondents was a lack of time.

Shouldn't because of limited time. If we have more time, I think we should.

No. Because of limited classroom time, teachers have to follow the curriculum

Should not. Because the class time is just enough to cover some basic maths problems

We should spend time on developing skill rather than teaching new knowledge because of limited classroom time.

I don't think so. We only need to teach new concepts, provide knowledge and guide students to some solving problem methods. Then students should practice by themselves and then develop creative thinking.

Lack of time was also the main reason given as to why discovery methods were difficult to implement in the classroom practice by the Australians, (10 of the 14 who responded to the third open-ended question) despite support for the approach. The general sense is that the use of discovery methods is a luxury and too impractical for the everyday classroom activities. One Australian suggested that, "Not all students have the mind to approach them; it can be off putting when a person is unable to work things out quickly". Further examples to illustrate their responses follow:

In a way yes. It is a fantastic way to teach students, but sometimes is just impractical. It is sometimes hard to find a way for the students to discover some things, and sometimes you simply won't have the time as you are supposed to be following the curriculum (AUS)

It can be, involving more set-up time & thought than simply opening a textbook, but it can be very rewarding for both students and teachers, providing many more opportunities and styles for learning. By discovering the validity of a formula or rule for themselves students can better incorporate new ideas into their personal learning framework - it has more context than a memorised rule that they are told to blindly accept and apply. (AUS)

Yes, I do because of the limited time of a teaching period even though the methods can improve the learning and teaching effectiveness. (AUS)

I think it has some difficulties because it is time consuming. Although the learning derived from discovery has a bigger and longer lasting impact, it will still be necessary for the students to follow it up with 'skill work' or repeated exercises to consolidate the knowledge. When I was on teaching rounds there was a lot of pressure to get through the curriculum. Finding time to undertake both discovery and consolidation of skill work was difficult. It felt like skill work was the core task and discovery methods were an ideal that were used when there was time, but often had to be dropped due to time pressures. (AUS)

For the Vietnamese, a greater diversity of obstructive factors was listed. From the 29 participants who responded to the question as to whether it was difficult to implement discovery methods in the classroom, 12 indicated it was difficult because there were too many ability levels among the students, they just did not have the attitude and skills necessary or were too lazy to think, 10 indicated it was due to lack of time, and five said it required advanced knowledge of the teachers and/or they were unprepared professionally. Several provided no reason other than it was difficult.

Example to illustrate these range of responses follow:

I think that to be effective, the discovery method of teaching require many conditions such as qualified teachers, sufficient materials, active students, adequate time. Because of the shortage of these conditions, this method has not been successful in many places in poor countries. However, this is a very important method that we need to learn and prepare to use (VIET)

I can not use discovery methods everyday because many lectures are so long that I don't have time. Besides, there are many students of different levels in a class; it is not easy to find a way to fit with all of them. (VIET)

It is not easy to apply in schools in Vietnam where the number of students in one class is big. It is difficult for students who are under the average level. (VIET)

Difficult. Because students have to face problematic situations which can not always be understood by them. (VIET)

Yes. Because of limited classroom time. But this method can help students develop creative thinking (VIET)

Vey difficult since it takes much time (VIET)

Yes because students are usually too lazy to think (VIET)

The difficulty of this method is a high requirement for advanced thinking but students have no such habit, skills and ability. Therefore the most important thing is to excite students with the discovery method to help them develop creative thinking. (VIET)

Very difficult. This method is very useful if we can use it flexibly and creatively. Then we can obtain benefits and avoid disadvantages such as not following curriculum. (VIET)

Difficult. Because it requires teachers who have strong capability and advanced knowledge to guide students. (VIET)

Five Vietnamese participants indicated it was not difficult to implement discovery methods with some of them adding that it required enthusiasm and hard work on the part of the teachers and students.

It is not difficult if we are enthusiastic and know how to apply the method effectively. I mean we should have enough knowledge to be confident in teaching (VIET)

No. Discovery methods are one of the best methods to develop thinking processes. (VIET)

No. Discovery methods can create exciting classroom atmosphere and can develop active learning attitude of students. (VIET)

One of the Vietnamese participants who affirmed that they would be including discovery methods gave important insights into how they would be implemented, reflecting an interpretation of the method back into a traditional lock step approach.

Discovery method is not difficult. Because we have questions to create mathematics problems and then guide students step by step to work it out.

To What Extent Do the Vietnamese and Australian Preservice Secondary Teachers' Believe They are Efficacious with Respect to the Teaching of Mathematics and Is There a Relationship between Teacher Self-efficacy and Support for the Various Approaches to Learning and Teaching Mathematics among these Preservice Teachers?

There were several expected correlation patterns with respect to teacher self efficacy (TSE) and the four philosophical scales. 1) A positive and negative correlation between TSE and the CAM and
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FAM scales respectively. 2) A positive and negative correlation between TSE and the TCAM and TFAM scales respectively. First, both cohorts reported a high level of teacher self efficacy (TSE) (Tab. 7) and self-efficacy was positively correlated with the CAM scale and negatively correlated with the FATM scale (Tab. 9). The findings indicate that higher self efficacy is associated with a belief that mathematics is a creative discipline and a rejection of traditional teaching methods. These findings are consistent with previous studies discussed earlier (e.g. Czerniak, 1990; Tschannen-Moran et al., 1998) and with Schuck and Pajares (2004) on the beliefs of primary preservice teachers. That is they generally hold beliefs about mathematics that preclude them from more flexible and responsive teaching methods. The results are consistent with the notion that teachers who feel less self efficacious are likely to want to create a greater sense of control and authority in the classroom among their students. Yet for both cohorts a comparable positive correlation between the CATM and TSE scales was not evident. Meaning, support for a constructivist approach to teaching was not associated positively with perceived self efficacy. In fact, the Australians provided a modest negative correlation (-.28). This finding may suggest that the experience of the Australian pre-service university program has disrupted some of the students' self-efficacy. While they may be now somewhat convinced they should adopt innovative strategies in their teaching, as yet they do not perceive they have the necessary pedagogical knowledge and skills for implementation. The lack of a comparable negative correlation between the FAM and TSE scales for the Vietnamese is interesting and likely reflects the proposed paradox referred to earlier. That is, among the Vietnamese cohort there are respondents who view the discipline of mathematics as creative as well as highly structured and precise.

Conclusion

This study has presented the beliefs of one Vietnamese and one Australian cohort of secondary mathematics preservice teachers with respect to traditional and constructivist approaches to mathematics and the relationship these beliefs have with their reported teacher self efficacy as they are about to embark on their new career. This exploratory study provides some valuable insights into plausible antecedent dispositions and potential obstacles to the uptake of the mathematics reform agenda as well as possible avenues for future research in this area.

While both cohorts were aware of their nation's respective reform agenda there was an expectation that the Vietnamese might report less support for a constructivist philosophy and pedagogy than the Australians given the earlier stage of policy driven adoption pressures as well as the influence of Vietnamese cultural factors. Compared to the quantitative data, the qualitative data are far more consistent with this expectation. The Australian participants seem far more enthusiastic and fluent in their explanations of the perceived benefits of an inquiry-based model of teaching. The quantitative findings from the MBQ data, however, tell a different story. Both the Australian and Vietnamese cohorts overall, reported that mathematics is a creative endeavour, the Vietnamese more so. Both supported in principle a teaching reform agenda and conveyed minimal support for a view that mathematics is a rigid discipline requiring traditional teaching approaches. From the qualitative data there is also agreement in the constraint attributed to a core curriculum that provides little time for discovery and inquiry-oriented approaches. The Vietnamese cohort were far more explicit in voicing concerns that these approaches require more advanced thinking skills, and some asserted that their students do not have the aptitude for engaging in these learning processes especially in light of their large classes and wide ranges in ability.

Implications include the need for excellent instructional modelling, provision of bridging opportunities to strengthen self efficacy in the use of reform approaches and guidance in ways to balance demands for curriculum coverage with goals of developing deep understanding.

It is perhaps not surprising that both cohorts have not conveyed a strong rejection of traditional approaches given that they have been successful students within traditional school environments. We know that such beliefs are developed from early schooling experiences (Brown & Borko, 1992) and are not easy to change (McLeod, 1990). Teachers tend to redefine new teaching ideas to fit within their original belief structures (Posner, Strike, Hewson & Gertzog, 1982). Further study would be required to gain a robust understanding of how the reform agenda is being interpreted in practice.

In terms of what we can learn from comparing the views of two cohorts from different educational systems we propose that there is something to consider regarding current Australian requirements for admission to teacher education for those specialising in secondary mathematics. Given that the Vietnamese cohort agreed more strongly with the view that mathematics is a creative endeavour requiring independent and original thinking than their Australian counterparts, and that they reported a stronger correlation between CAM and CATM scales; the theory and practice of a constructivist philosophy, we believe this may reflect the greater amount of mathematics they have studied. A more advanced background in mathematics for admission to Australian preservice programs is suggested. While previous research might have predicted as a consequence that there would be a correspondingly higher sense of self efficacy among the Vietnamese cohort (Lester et al., 2004), the Vietnamese cultural virtue of humility or modesty (Leung, Graf, & Lopez-Real, 2006) may explain why there is not. The self-efficacy relationships also provide a focus in preservice education on building teachers competence with a broader repertoire of flexible pedagogical practices.

The scales for measuring the formal dimension of mathematics teaching and learning clearly need revising because of the low internal consistency scores though the scales for measuring the informal dimension were reasonable despite the original instrument having been developed forty years ago. Seaman et al. (2006) drew attention to how the notion of mathematics being a set of rules, formulae and procedures remained very much a part of the belief structure among both the 1968 and 1998 cohorts in their study despite measurable shifts towards supporting more informal views. What is interesting to note particularly among the Australian comments is that this perception remains but has evolved to incorporate ideas generated from the reform agenda as well. The importance of collecting qualitative data in these kinds of studies to assist in better interpretations of the quantitative data is particularly highlighted as the contradictions in the belief structures can be better interrogated and hence provide fuel for dialogue in the preservice teacher training classrooms. We concur with Seaman et al. (2006), that if we explicitly encourage preservice teachers to explore contradictions in their beliefs, the evolution of a new belief system is more likely to occur that will support a shift towards more inquiry-based mathematics teaching. From the qualitative data the Australians do seem to be further down the track in espousing a philosophy that incorporated a constructivist agenda. With further culturally connected professional development the Vietnamese may be better prepared conceptually to apply it.

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Acknowledgements

We would like to say thank you to the Vietnamese and Australian participants involved in the study. The first author would also like to express their deepest thanks to Dr. Christine Brew for her involvement in the writing of this article.