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A Comparison of Chinese Secondary School Mathematics In- and Pre-service teachers' beliefs about Mathematics, Mathematics Teaching and Learning

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A comparison of mathematics teachers' personal beliefs between in- and pre-service teachers for Chinese secondary schools (grades 7–12) about mathematics theories, teaching and learning has been studied. In-service teachers' beliefs are close to constructivist's aspect and pre-service teachers' beliefs are close to absolutist's views. Based on the results, we give some suggestions to both teacher education and in-service teachers' training.

Keywords: beliefs about mathematics; beliefs about mathematics learning; beliefs about mathematics teaching; Chinese mathematics teachers
ZDM Classification: B53, C29
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INTRODUCTION

As the development of cognitive psychology, there is considerable interest among researches in the study of mathematics teachers' beliefs. The mathematics teacher's

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beliefs may be defined as one's views of the nature of mathematics, its teaching and learning. During the practice of teaching, one may have a structure where the individual's beliefs are organized and interaction with each other (Jin, 2001).

Mathematics teachers' beliefs play a significant role in shaping the teachers' characteristic patterns of instructional behavior (Thompson, 1992), were closely associated with interaction patterns and classroom norms (Cho, 2000), guide their decision in the classroom and can influence many facets of classroom, including the degree of student autonomy and forms of assessment in the classroom (Correa, *et al.*, 2008; Handal, 2003a; 2003b). Teacher's beliefs affect how they perceive and act upon different messages in the textbook (Golafshani, 2004). In conclusion, teacher's beliefs have been shown to critically influence what happens in the classroom (Correa, *et al.*, 2008; Handal, 2003a; 2003b; Haser, 2006). Moreover, findings from research into pre-service teachers' beliefs claimed that these beliefs acted as a filter to new knowledge, accepting what was compatible with current beliefs (Cady, Meier & Lubinski, 2006; Perry, 2005).

It was reported that in order to implement the reform objectives and changes in mathematics instruction, teachers must possess beliefs about mathematics, its teaching and learning that significantly differ from the current school mathematics traditions (Shahvarani & Savizi, 2007). Both the secondary teachers and the pre-service teachers are the backbone of performing the new curriculum. It is important to determine their views on mathematics, its teaching and learning. By comparison of their beliefs, we can also examine teachers at different stages of their careers.

Theoretical Framework

This study wants to compare Chinese secondary school mathematics teachers' beliefs with pre-service teachers' beliefs about the nature of mathematics, its teaching and learning in two theoretical frameworks, absolutist beliefs and constructivist beliefs.

From an absolutist perspective, mathematics consists of certain and unchallengeable truths. According to this view, mathematical knowledge is made up of absolute truths, and represents the unique realm of certain knowledge, apart from logic and statements true by virtue of the meanings of terms (Ernest, 1991). In other words, all of mathematics is based on universal, absolute foundations, and, as such, it is" the paradigm of knowledge, certain, absolute, value-free and abstract, with its connections to the real world perhaps of a platonic nature (Thompson, 1992)".

From a constructivist perspective, mathematics is a human creation born of and nurtured from practical experience, always growing and changing, open to revision and challenge, and whose claims of truth depend on guessing by speculation and criticism, by

the logic of proofs and refutations. Mathematics is both demonstration and creation. Mathematical methods therefore are not perfect and cannot claim absolute truth. Mathematical methods are also space dependent because different peoples and different cultures have different ways of doing and validating their mathematical knowledge (Handal, 2003a; 2003b). In one word, Mathematics development through conjecture, proofs, and refutations, and uncertainty is accepted as inherent in the discipline (Thompson, 1992).

Absolutist perspective on mathematics teaching and learning is the strict following of a text or scheme, students should passively reception of knowledge, and they view the learner as submissive and compliant (Ernest, 1989). They emphasize a process-product and teacher centeredness model of instructions. An absolutist teaching style in mathematics education tends to rely on practices that emphasize rote learning and memorization of formulas, one-way to solve problems, and adherence to procedures and drill. Repetition is seen as one of the greatest means to skill acquisition. Teaching is therefore a matter of enunciating objectives and providing the means to reach those objectives and situated learning is given little value in instruction (Handal, 2003a; 2003b).

Constructivist views learning as active construction and problem-solving, they advocate the development of autonomy and child interests in mathematics (Ernest, 1989). Constructivist strategies advocate instruction that emphasizes problem-solving and generative learning, as well as reflective processes and exploratory learning. These strategies also recommend group learning, plenty of discussion, informal and lateral thinking, and situated learning (Handal, 2003a; 2003b).

Purpose of the study

The Purpose of the study is to investigate secondary school mathematics teachers and pre-service teachers' beliefs about the nature of mathematics, its teaching and learning. We sought to identify the beliefs that secondary school mathematics and pre-service teachers hold consistent with absolutist or constructivist views, what differentiates between them.

In sum, the study attempts to answer the following questions:

1. What did Chinese secondary school mathematics teachers and pre-service teachers believe about the nature of mathematics, its teaching and learning?
2. Did Chinese secondary school mathematics teachers' (pre-service teachers) beliefs consistent with absolutist's view or constructivist's view?
3. Were there any differences between secondary school teachers and pre-service teachers in China? If existed, what differences?

If the study solved these questions, we could give advices to the implement of the new curriculum, mathematics teacher education and in-service teachers' training.

Methodology

Instrument

In order to determine secondary mathematics teachers and pre-service teachers' beliefs about mathematics and its teaching and learning, we used a 42-item Mathematics Belief Survey. Thirteen of the items in the survey were concerned with teachers' beliefs about the nature of mathematics. While 15 of the survey items were concerned with teachers' views of mathematics learning, which involved the process of mathematics learning, the behavior and mental activities that were involved on the part of the learning mathematics and what constituted appropriate and prototypical learning activities. The rest of the items were concerned with teachers' beliefs about mathematics teaching, that is, what a teacher considered to be desirable goals of the mathematics program, his or her role in teaching, the students' role, appropriate classroom activities, desirable instructional approaches and emphases, legitimate mathematical procedures, and acceptable outcomes of instruction. The survey used a 5-scale response: strongly disagree, disagree, undecided, agree and strongly agree.

Participants

We collected data for the study from 88 secondary mathematics teachers and 197 pre-service teachers in Liaoning Province. The pre-service teachers are senior students of a normal university. All the pre-service teachers took part in education practice.

Data Analysis

The return rate was 96% and the resulting sample comprised 274 participants, which included 79 secondary school mathematics teachers and 195 pre-service teachers. In order to facilitate quantitative analyses, numerical values of 1, 2, 3, 4, and 5 were respectively assigned to the responses, strongly disagree, disagree, undecided, agree, and strong agree. For each item, the average score was respectively obtained based on the secondary teachers and pre-service teachers, an independent sample t-test was conducted to evaluate whether there was difference between secondary teachers and pre-service teachers, with significant level at 0.05 (2-tailed). For each group of teachers, the frequency for every 5-scale response to each item was obtained too. The analytical and statistical procedures of the data were carried out using a computer statistical software package SPSS 11.5. The results were shown in Tables 1, 2 and 3.

RESULTS

Beliefs about the nature of mathematics

Table 1. Teachers' beliefs about mathematics

Item No.	Strongly agree %	Agree %	Uncertain %	Disagree%	Strongly disagree %	*Mean value*	*Standard Deviation*	*p-Value*
1	18	24	26	18	14	3.14	1.29	.006
	6	25	19	28	22	2.67	1.24	
2	5	14	12	28	41	2.14	1.23	.141
	6	15	13	42	24	2.38	1.18	
3	69	19	8	3	1	4.52	0.83	.019
	82	13	3	2	0	4.75	0.63	
4	44	30	13	11	1	4.05	1.06	.001
	56	34	8	2	0	4.43	0.74	
5	5	7	12	41	34	2.07	1.10	.023
	2	3	5	48	42	1.76	0.86	
6	26	34	22	15	4	3.63	1.12	.623
	17	52	18	12	1	3.70	0.93	
7	21	49	20	7	4	3.76	0.97	.000
	51	36	10	3	0	4.35	0.76	
8	19	47	28	5	1	3.77	0.85	.332
	24	51	15	10	0	3.89	0.89	
9	53	32	12	2	1	4.33	0.90	.185
	60	34	3	0	3	4.48	0.79	
10	3	3	5	4	85	1.32	0.88	.000
	0	0	0	6	94	1.06	0.24	
11	6	8	13	31	42	2.05	1.19	.000
	0	0	2	31	67	1.35	0.53	
12	31	42	15	8	4	3.87	1.07	.002
	41	50	7	0	2	4.25	0.80	
13	38	41	9	8	3	4.03	1.04	.020
	44	47	6	3	0	4.33	0.71	

Note: For each item, the upper figure represents pre-service teachers' view, the lower represents secondary teachers.

Survey items are as follows.

1. Mathematics consists of facts and skills that need to learn by rote.
2. Mathematics is made of unquestionable certainty and infallible, there is no need to doubt.

3. Mathematics is a valuable and necessary subject.
4. Not only mathematician and scientist, but also artist and writer must understand mathematics.
5. Concepts and facts of mathematics are absolute and infallible.
6. What is most important in mathematics is instrument for other subjects.
7. Mathematics is not only created by itself, but also influenced by human needs.
8. Mathematics contains symbols and skills; it is a logically organized system.
9. Mathematics cultivates students' reasoning ability.
10. Mathematics does not play important in civilization.
11. The knowledge of mathematics is learning by rote, it gives few chances for creation.
12. Mathematics is human creation and exploration.
13. Mathematics is language.

Items with significant difference

Table1 shows that *p*-value of items 1, 3, 4, 5, 7, 10, 11, 12, and 13 obtained from *t*-test were lower than 0.05, which are significant. It seemed that more secondary teachers approved items 3, 4, 7, 12, and 13. The percentages responses of secondary teachers who disapprove items 10 and 11 were 100% and 98%, pre-service teachers were 89% and 73%.

31% secondary teachers disagree or strongly disagree with item 1, of all the secondary teachers, 50% disagree or strongly disagree with it. While 39% pre-service teachers' approved item1, 22% disapproved it.

Items without significant difference

For items 2, 8, and 9, *p*-value was upper than 0.05., which were non-significant. Of all the secondary teachers, 66% disapproved item 2, and 13% undecided on it. While 69% pre-service teachers disapproved it, 12% undecided. 75% secondary teachers thought that mathematics is made of facts and stills, which explained the external world; it is a logically organized system.

More than 80% of two groups' teachers were sure that mathematics is the instrument of other subjects and students learn reasoning from mathematics.

Summary

We could claim that secondary teachers paid more attention to the value of mathematics. They felt mathematics was rooted in human life. More secondary teachers were sure that mathematics is the creation of human mind; it plays an important role in civilization. They do not think that mathematics is boring and can't give opportunities to students' creation.

Both secondary school teachers and pre-service teachers found that mathematics is a logically organized system; students get reasoning ability from it. Meanwhile, most teachers tended to be certain that mathematics is uncertainty and doubtful.

Beliefs about mathematics learning

Table 2. Teachers' beliefs about mathematics learning

Item No.	Strongly agree%	Agree %	Uncertain %	Disagree %	Strongly disagree %	*Mean Value*	*Standard Deviation*	*p-Value*
1	13	26	39	18	4	3.25	1.03	.006
	9	21	27	33	10	2.86	1.13	
2	26	51	16	5	26	3.93	0.90	.673
	27	48	22	3	0	3.99	0.77	
3	3	8	10	33	46	1.88	1.05	.029
	0	2	9	34	55	1.59	0.76	
4	15	40	23	19	3	3.45	1.05	.005
	21	44	27	8	0	3.79	0.86	
5	7	17	14	45	16	2.54	1.16	.130
	3	8	15	66	8	2.34	0.87	
6	25	38	27	10	1	3.75	0.97	.045
	27	52	15	6	0	3.98	0.82	
7	7	6	7	22	59	1.79	1.20	.000
	2	0	0	22	76	1.32	0.72	
8	5	7	11	32	46	1.94	1.14	.003
	3	2	3	31	61	1.56	0.88	
9	21	37	26	12	5	3.58	1.08	.187
	24	32	39	5	0	3.75	0.88	
10	5	8	12	38	37	2.07	1.13	.092
	3	5	6	44	42	1.82	0.94	
11	38	38	17	5	2	4.05	0.97	.536
	30	55	12	3	0	4.11	0.75	
12	24	45	18	11	3	3.75	1.03	.354
	27	45	16	12	0	3.87	0.93	
13	8	22	17	44	10	2.74	1.13	.007
	5	8	25	40	22	2.34	1.05	
14	18	47	28	6	2	3.73	0.89	.712
	19	50	19	12	0	3.77	0.89	
15	6	14	20	44	11	2.55	1.05	.908
	2	12	38	37	11	2.57	0.92	
16	10	13	29	34	13	2.73	1.16	.003
	9	30	35	21	5	3.18	1.02	

Note: For each item, the upper figure represents pre-service teachers' view, the lower represents secondary teachers.

Survey items are as follows.

1. Teachers should explain the relationship between new contents and the former, which is most important in mathematics learning.

2. Mathematics problems can be solved in different ways.
3. Mathematics problems must be solved in ten minutes.
4. What is most important in mathematics is its application.
5. Individual study is more important than group learning.
6. It is important for the students to challenge the new problems.
7. Students must learn the content on the textbook or notebook by rote..
8. Students should learn the facts, formulas and theorems by rote, if they want to learn mathematics well.
9. Cultivate students' informal and lateral thinking ability is the key factor in learning mathematics.
10. It is a waste time of time to solve a problem in a long time.
11. Students shouldn't content with learning skills, they needs to understand the logic in math.
12. In learning mathematics, students should understand the Conceptions and truth.
13. Students can't solve problems if they don't memory the Theorems and formulas.
14. Students must learn basic facts and skills before problem-solving.
15. Students learn if they follow the teachers way of solve problems, and do similar exercises.
16. Learning mathematics requires talent.

Items with significant difference

Table 2 shows that p-value obtained from t-test of items 1, 3, 4, 6, 7, 8, 13, and 16 were lower than 0.05, which represents significant differences between two groups of teachers.

30% secondary teachers approved item 1 and 43% secondary teachers disapproved it, while 39% pre-service teachers approved it, 22% disapproved. More secondary teachers disagreed or strongly disagreed with items 3, 7, 8, and 13. For items 4 and 6, more secondary teachers represent approval. Of all the pre-service teachers, 23% thought that only talent students can learn mathematics well. 47% did not agree with it. While 39% secondary teachers agreed with it, 26% disagreed or strongly disagree with it.

Items without significant difference

There is no difference between in- and pre-service teachers on items 2, 5, 9, 10, 11, 12, 14, and 15. More than 55% two groups' teachers agreed or disagreed with items 2, 9, 11, 12, and 14, while more teachers showed disapproval with items 5, 10, and 15.

Summary

In sum, more secondary teachers encouraged students to challenge the new problems. There was great emphasis on the application of the knowledge. More secondary teachers felt inappropriate to learn by rote. Moreover, secondary teachers thought mathematics problems mustn't be solved in ten minutes. But more pre-service teachers claimed that all the students can learn mathematics well. Most of the two groups' teachers felt that students should understand the concepts, theorem and the logic. They recommended informal and lateral thinking. More pre-service and secondary teachers found that there are several ways to solve problems, but students must acquire facts and skills before solving. In additional, two groups' teachers stated some problems worth paying more time to solve.

Beliefs about mathematics teaching

Survey items are as follows.

1. It is necessary to understand the conceptions and acquire the skills in the process of teaching.
2. If a student asks a question in math, the teacher should know the answer.
3. In order to improve the instruction, teachers should pay more attention to the textbook.
4. The purpose of teaching is to help the students think mathematically and learn to solve problems.
5. Teachers task is to teach the student in a rigorous and logic way.
6. The teaching of mathematics should include students' thinking and exploration.
7. Only the teacher know whether the students answer is correct or not.
8. Students learn creation in studying mathematics.
9. Teachers should put emphasis on the process of problem-solving.
10. Teachers should encourage students to come up with their own statement.
11. It is very productive for students to work math activities and solve the problems in different ways.
12. Mathematics learning is a process that students experience mathematization.
13. Teachers should assess the students with open-ended questions, which answer is uncertain.
14. The process of learning should be a major consideration when it evaluates the students learning.
15. Mathematics teaching is a process that students own construction.

Table 3. Teachers' beliefs about mathematics teaching

Item No.	Strongly agree %	Agree %	Uncertain %	Disagree %	Strongly disagree %	*Mean value*	*Standard Deviation*	*p-Value*
1	25	41	25	6	3	3.80	0.97	.492
	24	45	27	2	2	3.89	0.85	
2	13	31	24	25	8	3.16	1.17	.241
	20	26	23	28	3	3.34	1.16	
3	47	37	10	4	3	4.23	0.95	.014
	62	30	5	3	0	4.52	0.71	
4	22	44	23	10	2	3.75	0.96	.809
	28	37	18	15	2	3.72	1.10	
5	10	33	25	25	8	3.11	1.10	.052
	9	17	27	42	5	2.82	1.05	
6	36	42	16	4	2	4.06	0.92	.535
	38	48	8	6	0	3.99	0.82	
7	5	10	6	31	48	1.91	1.16	.000
	0	0	2	36	62	1.32	0.73	
8	21	39	26	10	4	3.64	1.04	.085
	15	43	22	18	2	3.87	1.00	
9	16	29	25	28	3	3.28	1.11	.115
	15	43	22	18	2	3.51	1.04	
10	40	42	8	6	4	4.09	1.02	.003
	53	39	8	0	0	4.46	0.64	
11	26	46	17	6	5	3.83	1.03	.363
	28	42	28	2	0	3.95	0.81	
12	30	37	20	9	4	3.81	1.08	.444
	27	49	16	6	2	3.91	0.95	
13	15	29	32	20	4	3.32	1.07	.034
	9	27	28	30	6	3.01	1.09	
14	28	48	16	5	3	3.94	0.94	.247
	35	52	5	6	2	4.09	0.94	
15	24	36	24	12	5	3.63	1.11	.744
	24	33	22	18	3	3.58	1.12	

Note: For each item, the upper figure represents pre-service teachers' view, the lower represents secondary teachers.

Items with significant difference

Table 3 shows p-value of items 3, 7, 10, and 13 is less than .05. From table 3, we could also find that 92% secondary teachers approved item 3, the rest 8% were uncertain and disapproval. While 10% pre-service teachers stated uncertain and 7% disapproval. 98% secondary teachers thought only teachers knew whether the students' answer is correct or not. The pre-service teachers' approval rate is lower. Of all the secondary teachers, 92% approved item 10, 8% uncertain. While 82% per-service teachers approved, 10% disapproved.

36% secondary teachers didn't think it is necessary to evaluate students' learning by open-ended problems, while 44% per-service teachers approved, 32% uncertain, and 24% disapproved.

Items without significant difference

There are not any significant differences between two groups' teachers on items1, 2, 4, 5, 6, 8, 9, 11, 12, 14, and 15. Most of the teachers found that it is the teacher's task to teach the students in rigorous and logic way. For the rest of the items, more teachers showed approval.

Summary

We can conclude that more secondary teachers gave great value on the textbook; they advocated the students learn actively. More secondary disapproved with teachers' authority in the classroom. Both in- and pre-service teachers put great value on improvement students' thinking and problem-solving ability and emphasize the process of learning. They recommend mathematics teaching is student's construction and experience the process of *mathematization.* There was no consensus among two groups' teachers about the items that teacher must give correct answer to the students. But the positive idea is a bit more than passive idea. Most of two groups' teachers thought that it is not necessary to teach the students in a rigorous and logic way.

Conclusions and Recommendations

The study showed that secondary teachers' beliefs about mathematics, its teaching and learning are different with those of pre-service teachers.

Comparison with secondary teachers, pre-service teachers put less value on the merit of mathematics, its relationship with human life, and its role in civilization. Less pre-service teachers thought that mathematics is the creation and exploration of humankind, and they didn't think it is an interesting subject. Secondary teachers put greater value on the process of teaching and learning, gave student more chances to study the new problems, and taught students to learn to application their knowledge, as well as learning actively and value the textbook. However, secondary teachers found that only talent students can learn mathematics, they thought no need to assess the students with open-ended problems.

Overall, comparison with pre-service teachers, secondary teachers' beliefs are close to constructivist perspective. There seemed to be three reasons that have to be noted.

First, it may be related to the instructional patterns of teacher education. In traditional teacher education, mathematics lesson is only for teachers to teach, students have few

times to participate in mathematics teaching, there is little communication among students (Zhou, 2001). Moreover, it also may be related to course structure of teacher education. In Chinese normal university, the major courses are related to mathematics, and the education courses were overlooked (He, 2006). So pre-service teachers can't experience the process of creation and exploration by themselves, they can't learn actively. That is no doubt their belief systems are close to absolutists' perspective.

Second, it may be the implement of the new curriculum. The new curriculum claimed that both the teacher's direction and the students' participation were parts of mathematics teaching. It advocated generative learning and reflective process, as well as exploratory learning. These strategies also recommend group learning, plenty of discussion and situated learning. The implement of the new curriculum was an important way to change teachers' conception (Li, 2005). That was why secondary teachers' belief system close to constructivist' perspective (Cady, Meier & Lubinski, 2006; Zanzali, 2004). However, the mixed views may also occur when a reform movement was fairly new. This can also be attributed to the incomplete process of the changing in the teachers' beliefs during the short period of the reform movement (Shahvarani & Savizi, 2007; Sinkinson, 1996). It might be used to explain why secondary teachers thought only talent could learn mathematics, and it isn't necessary to assess students with open-ended problems. However, the transition of their beliefs will be likely completed in the future.

Therefore, teacher educator and in-service training must pay attention to the following facts.

Firstly, the instructional patterns of teacher education must be improved. Teacher educator should make skills more relevant to students' backgrounds and experience by anchoring learning tasks in meaningful, authentic highly visual situations, address motivation problems through passive roles, teach students how to work together to solve problems through group based, cooperative learning activities, emphasize engaging, motivational activities that require higher level skills and prerequisite lower-lever skills at the same time.

Secondly, teacher education must adjust the course structure, strengthen the proportion of educational course, and keep a balance between professional course and education course.

The main function of education course is to foster students the basic teaching ability, which help the students form belief about teaching. It is also the way that helps students to hold constructivists' beliefs. Therefore, it is necessary for teacher education work to keep the balance of professional course and education course.

Thirdly, the training time should be long enough to change teachers' belief system fundamentally.

We can see that teachers' beliefs are robust and resistant to change, the training time should be long enough, and combined with practice to change teachers' belief system fundamentally. Otherwise, teachers will make surface change to their teaching by adopting some of more easily assimilated practices into their pedagogical repertoire. Hargreaves (1995) has described these superficial changes as "safe simulations" which enable teachers to embrace new innovations without disrupting the cultural norms of the classroom and more significantly without altering their fundamental beliefs (*cf.* Yates, 2006). If teachers are helped in coping with demands brought about the new curriculum, the implementing process of the new curriculum will be effective.

REFERENCES

Cady, J.; Meier, S.; & Lubinski, C. (2006). Developing Mathematics Teachers: The Transition from Preservice to Experienced Teacher. *The Journal of Educational Research* **99(5)**, 295–305. MATHDI **2006e.**02741

Cho, Cheong-Soo (2000). *A Korean Elementary Teacher's Beliefs about Teaching and Learning and its Impact on Interactions and Norms in Mathematics Classroom.* Unpublished Doctor Dissertation. Corvallis, OR: Oregon State University.

Correa, Christopher A.; Perry, Michelle; Sims, Linda M.; Miller, Kevin F. & Fang, Ge (2008). Connected and culturally embedded beliefs: Chinese and US Teachers talk about how their students best learn mathematics. *Teaching and Teacher Education* **24(1)**, 140–153. ERIC EJ782405

Ernest, P. (1989). The Impact of Beliefs on the Teaching of Mathematics. In: P. Ernest (Ed.), *Mathematics Teaching: The State of the Art* (pp. 249–254). New York, NY: Falmer Press. MATHDI **1989g.**00248

_____ (1991). *The philosophy of mathematics education.* London: Falmer Press. MATHDI **1991c.**02843

Golafshani, N. (2004). Teachers' Conceptions of Mathematics and Their Instructional Practices. *Philosophy of Mathematics Education Journal* **10(18)**, 1–13. MTHDI **2005f.**02727

Handal, B. (2003a). Teachers' Mathematics Beliefs: A Review. *The Mathematics Educator* **13(2)**, 47–57. MTHDI **2004b.**01019

_____ (2003b). Philosophies and Pedagogies of Mathematics. *Philosophy of Mathematics Education Journal* **17(5)**, 1–9. MATHDI **2003e.**03925 Available from: http://www.people.ex.ac.uk/PErnest/pome17/handal.htm

Hargreaves, A. (1995). *Changing teachers, changing times: Teachers' work and culture in the postmodern age.* Professional Development and Practice Series. New York: Teachers College Press. ERIC ED406352

Haser, C. (2006). *Investigation of Pre-service and In-service Teachers Mathematics Related Beliefs in Turkey and the Perceived Effect of Middle School Mathematics Education Program and the School Contexts on These Beliefs.* Doctoral Dissertation. East Lansing, MI: Michigan State University. ProQuest Digital Dissertations AAT 3236322.

He, et al. (2006). *Teacher education and the development of teachers.* Beijing: China Social Sciences Press.

Jin, M. (2001). *Relationship between the Beliefs about Mathematics and Teaching-Learning and Teaching Practices of a High School.* Unpublished Doctor Dissertation. Cheongwon, Chungbuk: Korea National University of Education.

Li, M. (2005). The New Curriculum and Teachers' Conception. *Journal for research of teacher education* **17(2)**, 1–13.

Murphy, P. Karen; Delli, Lee Ann M. & Edwards, Maeghan N. (2004). The Good teacher and Good Teaching: Comparing Beliefs of Second-Grade Student, Pre-service Teachers, and In-service Teacher. *The Journal of Experimental Education* **72(2)**, 69–92. ERIC EJ744766

Perry, B.; Way, Jenni; Southwell, Beth; White, Allan & Pattison, John (2005). Mathematical Beliefs and Achievement of Pre-service Primary Teachers. In: Philip Clarkson et al. (Eds.). *Building connections: Theory, research and practice: Proceeding of the 28th Conference Mathematics Education Research Group of Australia* (MERGA 28–2005), Vol. 1 and 2. (pp. 625–632). MATHDI **2006b.**00883

Shahvarani, A. & Savizi, B. (2007). Analyzing Some Iranian-High School Teacher' Beliefs on Mathematics, Mathematics Learning and Mathematics Teaching. *Journal of Environmental & Science Education* **2(2)**, 54–59.

Sinkinson, A. (1996). The Changing Beliefs of Trainee Mathematics Teachers. *Mathematics Education Review* **3(8)**, 1–7.

Thompson, A. (1992).Teachers' Beliefs and conceptions: A Synthesis of the Research. In: Grouws, D. A. *Handbook of research on Mathematics Teaching and Learning.* New York: Macmillan, (pp. 390–419).

Yates, S. (2006). *Primary Teachers' Mathematics Beliefs, Teaching Practices and Curriculum Reform Experience.* Proceedings of Australian Association for Research in Education. http://www.aare.edu.au/06pap/yat06450.pdf.

Zanzali, Zanzali A. (2004). Implementing the Intended Mathematics Curriculum: Teachers' Beliefs about the Meaning and Relevance of Problem Solving. In: Alan Rogerson (Ed.), *The Mathematics Education into the 21st Century Project: Proceedings of the International Conference 'The Decidable and the Undecidable in Mathematics Education' held at Brno, Czech Republic* (pp. 34–37). MATHDI pre02362917

Zhou, Z. (2001). *The Investigation of Normal University teachers' Beliefs about Mathematics.* Master Thesis. Shanghai: East China Normal University.