

## A comparison of mathematics teachers' beliefs between England and China

Huiying Yu

*Faculty of Education, University of Cambridge, Cambridge, United Kingdom*

This study compares the beliefs of mathematics teachers in England and China. It explores in detail teachers' beliefs about three themes of mathematics education: mathematics teaching, the nature of mathematics, and the purposes of mathematics education. It also considers briefly whether gender or teaching experience influences these three aspects of teachers' beliefs. The research method of this study involved a questionnaire and follow-up interviews. Forty-four English mathematics teachers from 10 secondary schools in Cambridgeshire, England and 96 Chinese mathematics teachers from 10 secondary schools in Shanghai, China participated in the questionnaire survey. Furthermore, two mathematics teachers from each country were interviewed. Findings suggest that the beliefs of English teachers may generally reflect *the pragmatic understanding of theory* in mathematics teaching, while those of Chinese teachers generally reflect *the scientific understanding of theory*. With regard to the purposes of mathematics education, Chinese teachers place more emphasis on logical and rigorous reasoning than English teachers, though this study also shows that Chinese teachers agree more strongly about its application to other areas than do English teachers. On the other hand, English and Chinese teachers do not have significantly different beliefs about the nature of mathematics. And finally, gender and teaching experience do not in general affect teachers' beliefs about these three themes of mathematics education in England and China.

**Keywords:** Mathematics; Teachers; Beliefs; England; China; Comparison

### Introduction

This study makes a comparison between the beliefs of mathematics teachers in England and in China. There are a number of reasons behind this choice. First and foremost, in each country's mathematics teaching and learning, *teachers* play a crucial and special role: they mediate the teaching and learning from the past to the present or even to the future. Secondly, *teachers' beliefs* about mathematics and its teaching play a significant role in shaping the teachers' 'characteristic patterns of instructional behaviour' (Thobodmpson 1992, 130-131). In his suggestions on mathematics teaching reforms, Ernest (1989) strongly argues that mathematics teaching reform requires deeper changes in the system of beliefs held by teachers. "Teaching reforms cannot take place unless teachers' deeply held beliefs about mathematics and its teaching and learning change". (Ernest 1989, 249). Thirdly, teachers' beliefs are embedded in their cultural context and are developed over long periods of time (Perry, Wong, Howard 2006; Correa et al 2007). Correa et al (2007) argue that "teachers are a product of their culture and experience" (Correa et al 2007,

2), their beliefs are “rooted in, and constrained by, the culture of the society in which the teachers are living and working, in the culture of the education systems and traditions of the society and in their own experience as school students, teacher education students and members of school communities” (Perry, Wong, Howard 2006, 446). Thus, a cross-cultural investigation can be a critically important and valuable approach to studying teachers’ beliefs. Finally, as a mathematics teacher in China for six years, then as a postgraduate student in a British university studying mathematics education, I have personally experienced differences between English mathematics teachers, and teachers from other countries in approaches to problem solving, and in instructing classes. It is possible that these differences are a consequence of the fact that we hold different beliefs about mathematics and its teaching. It was this possibility that motivated me to carry out a comparative study of English and Chinese teachers’ beliefs. When I discuss English and Chinese teachers I am referring to teachers who are working in England and China, and not necessarily their nationalities.

This comparative study explores in depth the differences and similarities between English and Chinese mathematics teachers’ beliefs on:

- mathematics teaching
- the nature of mathematics
- the purposes of mathematics education

It considers the possibility that the Chinese approach to mathematics teaching is closely related to the *scientific understanding of theory*, while the English approach is, on the other hand, closely related to the *pragmatic understanding of theory* as suggested by Kaiser, Hino and Knipping (2006). In addition, it explores the possibility that Chinese teachers’ beliefs about the purposes of mathematics education may favour the development of students’ logical reasoning, while the English teachers’ may favour the application of mathematics. Finally, this study also considers briefly whether teaching experience or gender influence these three aspects of teachers’ beliefs between England and China. The scope of this study is the differences between secondary school mathematics teachers in Cambridgeshire, England and Shanghai, China.

## Research Methods

The research method of this study is a mix-method: questionnaire and interview. The questionnaire design was mainly referred to three references: the framework suggested by Kaiser et al (2006) to analyse mathematics education in eastern and western traditions, the classification of three views on the nature of mathematics by Ernest (1989), and the discussion of the goal of mathematics education – utility or mental training by Huckstep (2000a, 2000b). The major part of questionnaire has a total of twenty-six items on three themes: *mathematics teaching* (sixteen items), *the nature of mathematics* (six items), and *the purposes of mathematics education* (six items). Respondents to the questionnaire were asked to circle the corresponding number to indicate the extent of agreement on each statement from 1 (strongly disagree) to 5 (strongly agree). Ninety-six Chinese mathematics teachers from ten secondary schools in Shanghai and forty-four English mathematics teachers from ten secondary schools in Cambridgeshire participated in the questionnaire survey. Furthermore, two mathematics teachers from each country were interviewed to give some explanations to the questionnaire results and the information of the education context. The questionnaire data was analysed by the *independent-samples t-test* and

*two-way between-groups analysis of variance* (ANOVA) from SPSS software. Those found significant differences in the questionnaire data analysis were looked further comments from four teachers in the interview.

## Findings

Although English and Chinese teachers share similar beliefs in using real-world examples in mathematics teaching, the findings on the theme of *mathematics teaching* mostly confirmed that the beliefs of Chinese mathematics teachers are closely related to the *scientific understanding of theory*, while the beliefs of English teachers are closely related to the *pragmatic understanding of theory*. They show that Chinese teachers placed more emphasis on *the introduction of new concepts and methods, the position and function of proofs, and the role of precise language* than English teachers did. This finding is consistent with the framework of Kaiser et al (2006), which indicates that *the scientific understanding of theory* (held by Chinese teachers) leads to the ‘high importance of the introduction of new mathematics concepts and the deduction of new methods’, strong emphasis on proofs and the use of mathematically correct language (Kaiser et al 2006, 331), while *the pragmatic understanding of theory* (held by English mathematics teachers) leads to ‘a low importance of the introduction of concepts and methods, ...and often the concepts or methods are given by the teacher just as information or in the style of a recipe’ (Kaiser et al, 2006); low importance of the formal proof, and less emphasis on collectively accepted mathematics terminologies.

With regard to teachers’ beliefs about *the nature of mathematics*, no significant differences were found between English and Chinese teachers. In terms of *the purposes of mathematics education*, the possibility that Chinese teachers’ beliefs about the purposes of mathematics education place more emphasis on the development of students’ logical reasoning than English teachers is confirmed. On the other hand, this study also shows that Chinese teachers placed a stronger emphasis on learning mathematics as its application in other areas than English teachers did. This is different from the considered possibility that the beliefs of English teachers in the purpose of mathematics education may focus more on its application than Chinese teachers. This is probably due to the fact that primary and secondary school mathematics is largely regarded as a foundation for future study in Chinese education, particularly for the science subjects. (A much larger proportion of Chinese students choose to study science subjects than the humanities). Chinese teachers’ beliefs about the application of mathematics not only include the application of mathematics to the real world, but also its application in the learning of other subjects, particularly the science subjects, which are popular among Chinese students. Compared to the large proportion of Chinese students choosing science subjects for future study in Higher Education, the proportion of English students choosing science subjects is smaller. There is less possibility of applying mathematics to other areas.

Finally, in general, gender and teaching experience do not have influence on teachers’ beliefs in *mathematics teaching, the nature of mathematics* and *the purposes of mathematics education*, except that gender difference appears in teachers’ views of *the role of precise language*, and a few differences with regard to gender and teaching experience appear in the section of *the nature of mathematics* and *the purposes of mathematics education*.

## Limitations and Further Research

This research is based on data from a small sample. In particular, the number of interview participants is small. In addition, probably there are differences within each country. The generalisation of findings needs to be considered with caution. Furthermore, the data collection from questionnaire and interview, and the data analysis cannot be value-free although efforts have been made to ensure their validity and reliability. Further research could investigate whether similar findings can be obtained from a study based on a larger sample. The connection between teachers' beliefs about mathematics teaching and the goals of mathematics education also merits further study.

## References

- Correa, C. A. et al. 2007. Connected and culturally embedded beliefs: Chinese and U.S. teachers talk about how their students best learn mathematics. *Teaching and Teacher Education*: 140 - 153
- Ernest, P. 1989 The impact of Beliefs on the Teaching of Mathematics, in *Mathematics Teaching: The State of the Art* ed. P. Ernest, 249-254. London: Falmer Press.
- Huckstep, P. 2000a The utility of mathematics education: some responses to scepticism *For the Learning of Mathematics* 20(2): 8-13.
- Huckstep, P. 2000b Mathematics as a vehicle for 'mental training' in *Why learn maths?* ed. J. White & S. Bramall 85-100. London: Institute of Education
- Kaiser, G., 2. Hino and C. Knipping 2006 Proposal for a framework to analyse mathematics education in Eastern and Western traditions. In *Mathematics education in different cultural traditions: a comparative study of East Asia and the West*
- Perry, B., N. Wong and P. Howard. 2006 Comparing primary and secondary mathematics teachers' beliefs about mathematics, mathematics learning and mathematics teaching in Hong Kong and Australia. In *Mathematics education in different cultural traditions: A comparative study of East Asia and the West* eds. F. Leung; K. D. Graf and F. Lopez-Real, 435-448. New York: Springer.
- Thompson, A. G. 1992 Teachers' beliefs and conceptions: a synthesis of the research. In *Handbook of Research on Mathematics Teaching and Learning* ed. D.A. Grouws, 127-146. New York: Macmillan Publishing Company