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A Study of Some Aspects of Mathematics Teaching in Secondary Schools in China and England

Yanyun Liu
University of Hull, UK

Ten secondary schools have been chosen to carry out this particular research in England and China. In order to make a comparison between the teaching of mathematics in England and China, the question was asked: What are the teachers' strategies? In this study will be reported the investigation of mathematics teachers' methods of mathematics teaching in China and England, more specifically what aspects of teaching they perceive to be more beneficial than others.

***Key words*:** teacher education, mathematics teaching.

Introduction

In mathematics education, the most influential research is named 'Third International Mathematics and Science Study' (TIMSS), which investigates pupils' achievement, the mathematics curricula, teaching methods, and so on. As part of TIMSS, or related to it, a number of projects have examined the teaching methods that teachers (typically) used in various countries (for example, Kaiser, 1999; Stevenson et al., 1990). Since the 1990s, researchers (Cai, 1995; Ding & Jones, 2006; Leung, 1995; Ma, 1999) have contributed to comparative studies which related to Chinese teaching in mathematics and the TIMSS. Their comparative studies have provided a more in-depth view of mathematics. They contributed several aspects, namely teaching effectiveness, an instructional model for promoting achievement of basic skills beyond their routine use, and mathematical understanding.

However, TIMMS does not help with a comparison between China and the UK, because both countries have not had opportunities to be involved at the same time. There is no evidence to show the differences in pupils' achievements. Although there are only few directly comparative studies undertaken between China and the UK, many separate comparison findings also can provide many more resources to look at the differences between the two countries: China and the UK. In addition, it is reported that England is higher in the international tables of performance in maths than it has usually been in the past (although Scotland has not done so well). Some points in this report reveal possible reasons: one was that the numeracy strategy had been introduced to pupils aged six; secondly, it depended on teachers' hard work and high standard of working; thirdly, it possibly benefitted from using computers to track students' learning (with 95% of primary pupils having computers at home and 92% of secondary pupils

connected to the internet at home). But the fact is noticeable: pupils in England have relatively small amounts of homework (news.bbc.co.uk/1/hi/education). Due to English pupils' outstanding performance in TIMMS, it is necessary to look at English teachers to find how they have done well.

Moreover, Chinese mathematics teachers are very focused on how to teach with variety n in the mathematics lesson (Gu, 1994; Gu, Huang, & Marton, 2004; Lim, 2007). For example, Chinese teachers focused on providing more examples and structured lessons, and they rearranged the contents in order to help students learn more reasonably. There are those who believe that good teachers can teach effectively and enable their students to achieve high attainment, while others do not agree that students' achievement merely relies on teachers' performance. (Haggarty, 2002; Oldknown, 2005). However, it appears that many factors interact together, including strategies of teaching and learning, the role of ICTs, curriculum and homework setting, even the role of individual motivation (Leask, 2001). Therefore, it is difficult to identify what characteristics of teaching are effective and are beneficial for pupils in learning mathematics. A comparison of differences in teaching of mathematics in China and the UK could reveal some different views of teaching and learning mathematics, which could produce some new ideas to improve my teaching in the future as well as give the same possible benefit to others.

In order to make a comparison between the teaching of mathematics in England and China, the question is asked: (a) What differences are there in the ways in which mathematics is taught in secondary schools in China and in England? (b) Mathematics teachers' views were explored in order to make a positive contribution to mathematics education in China and the UK. By means of the questionnaire, those teachers in China and the UK who participated had their teaching and learning activities and a variety of approaches to teaching in both countries contrasted and compared.

Methods

A questionnaire was given for 40 mathematics teachers in England, and was completed by 31, the response rate being 77.5% and for 110 mathematics teachers in China, completed by 101, the response rate was 92% in June 2008. Ten secondary schools were chosen to carry out this particular research in England and China. In order to gain relatively general information in a limited time, five Chinese schools were chosen, located in five different provinces from South to North, and five English schools located in Hull, East Yorkshire, North Lincolnshire, which included one single-sex school and one Catholic school.

The sample is possibly comparatively small and was necessarily a very biased sample, given the limited time and budget. Firstly, there are hundreds of schools in England, perhaps thousands, whereas there are over a million schools in China. If all mathematics teachers were to be questioned in the two countries, it would generalize the whole picture which could reveal the similarity and difference in mathematics teaching and learning in China and in England. That, however would take a long time and also require excessive funding and the support of all schools to do this research.

However, the time for this preliminary research was limited. Only a few schools were available to be researched in England and China. Although the sample chosen was not large enough to give a totally accurate depiction of teaching mathematics in China and the UK (particularly England), it was hoped that they could reveal some aspects and reflect the general picture of teaching mathematics in China and the UK.

The questionnaire was designed to cover four areas, in addition to usual personal information (teaching years): (1) issues concerning maths teachers' views of teaching approaches and generally how to use them to fit in with the pupils' learning; (2) homework setting; (3) information concerning the use of ICT in the mathematic classroom; (4) information reflecting teachers' views about teaching mathematics. Most of the questionnaire involved either four or five point Likert-scale responses to a series of statements, although teachers were also given the opportunity to provide additional information with regard to their experiences at schools. The quantitative data from the questionnaire was analysed using SPSS.

Findings from the Questionnaire for Teachers

Section A Shows the Personal Information

Table 1

Summary of Experience of Mathematics Teachers (in Number of Years) by Country

	Chinese maths teachers		*English maths teachers*	
1 year	2	(2%)	1	(3.2%)
2 – 5 years	24	(23.8%)	4	(12.9%)
6 – 10 years	18	(17.8%)	2	(6.5%)
Over 10 years	57	(56.4%)	24	(77.4%)
Total	101	(100 %)	31	(100%)

Table one shows the majority of English mathematics teachers (77.4%) and over half (56.4%) of the Chinese teachers have more teaching experience (over ten years). Although statistic results (t=1.612, df=130, t=.109>.05) shows that there is no great different in teaching experiences in both countries, the schools which have more focus on teaching experience should be more beneficial for students.

Section B-Mathematics Teaching Contents

In a particular class, table two shows the frequency of the activities used in England and China.

Table2

Percent of Activities with a Particular Class

	Once a lesson	Once a week	Once a month	Rarely or never
	China % England	China % England	China % England	China % England
Exposition by teacher	97(96%)	4(4%)	0%	0%

	30(97%)			
Discussion between the teacher and the whole class	74(73%)	27(27%)	28(90%)	3(10%)
Discussion between the teacher and a pupil	60(59%) 30(97%)	35(34%) 1(3%)	5(5%)	2(2%)
Discussion between pupils	66(65%) 22(71%)	29(28%) 9(29%)	5(5%)	2(2%)
Practical work	19(19%) 1(3%)	17(17%) 10(33%)	25(25%) 14(45%)	40(39%) 6(19%)
Problem solving	64(63%) 16(52%)	20(20%) 6(20%)	5(5%) 7(22%)	12(12%) 2(6%)
Investigation work	17(17%) 1(3%)	11(11%) 6(20%)	26(26%) 15(48%)	47(46%) 9(29%)
Practice of mathematical Skills	78(78%) 27(87%)	18(18%) 4(13%)	2(2%)	2(2%)

Table two shows mathematics teachers commonly employed exposition in every lesson. 4% of Chinese teachers did this once a week. Only one English teacher did not respond to this question. The possible reason was that the teacher thought it was a useless question or forgot to answer, or I should provide more answers to fix this question, such as, once every two lessons. In addition, teachers also focused on discussion methods in the classroom; an interesting result that we can find is that, from table 4, the percentage of "Discussion methods used once a lesson" from English teachers' answers was significantly higher than the percentage of "Discussion methods used once a lesson" from Chinese teachers' answers. In particular, English teachers much more focused on using discussion with a pupil in the classroom. Chinese mathematics teachers, however, could not provide enough chances for discussion with peers. At the same time, teachers emphasised the importance of mathematical skills. No much difference was found in practice of mathematics skills in both countries. However, there was not so much practical work, and investigation work. The percentage of never or rarely used these methods in their teaching from Chinese teachers was significantly higher than the percentage of never or rarely used these methods in their teaching from Chinese teachers. The percentage of using problem solving in every lesson from Chinese teachers was slightly higher than the percentage of using problem solving in every lesson from English teachers (63% and 52%, respectively).

Section C-Homework

Table 3

Percent of Homework Setting in Both Countries

	Every lesson	Every two lessons	Once a week	Less than once a week
England China	1(3%) 86(85%)	5(16%) 15(15%)	24(78%) 0(0%)	1(3%) 0(0%)

The majority of English maths teachers set homework once a week. The majority of Chinese maths teachers did it every lesson. Only 3% of maths teachers in England gave answers less than once a week and every lesson. The questions below examined teachers' views regarding their teaching by comparison of two statements.

Question 3.1 intended to measure their opinions and strength of those opinions regarding the two statements.

On the left is "It is important that pupils practise techniques" and on the right it is "It is important that pupils solve problems".

Table 4

The Results for Question 3.1

	Left	Near left	Middle	Near right	Right
England	2(6%)	4(13%)	17(55%)	6(20%)	2(6%)
China	3(3%)	9(9%)	29(29%)	32(31%)	28(28%)

The above table shows 55% of English mathematics teachers believed that both aspects were equal. English mathematics teachers' tendency to focus on the ability of solving problem is 7% higher than the opposite view. However, 59% of Chinese mathematics teachers had very strong points about emphasising the importance of the ability of solving problems. Quite a few Chinese teachers focused on fostering pupils' practise techniques.

Question 3.2 was intended to discover which aspect should be focused on by the teacher. To the left it read "It is important that pupils' written work is correct" and to the right "It is important for pupils to be able to discover mathematics".

Table 5

Results for Question 3.2

	Left	Near left	Middle	Near right	Right
England	3(10%)	3(10%)	15(48%)	8(26%)	2(6%)
China	4(4%)	6(6%)	44(44%)	23(23%)	23(23%)

Table five shows that approximately a half of mathematics teachers were open minded or undecided about this issue. In addition, the ability to discover mathematics was 12% higher than writing correctly in the view of English mathematics teachers. It seems that Chinese mathematics teachers emphasised more strongly the improtance of discovering mathematics.

Question 3.3 was intended to discover the view of teachers when pupils have difficulties.

The left is: "When pupils get stuck, they should ask teacher for help" and the right is "When pupils get stuck, they should work out the problem by themselves".

Table 6

Results for Question3.3

	Left	Near left	Middle	Near right	Right
England	1(3%)	4(13%)	14(45%)	8(26%)	4(13%)
China	4(4%)	7(7%)	42(41%)	24(24%)	24(24%)

The table shows 45% of English mathematics teachers believed that both sides are equally important. Those supporting fostering the ability to work out problems were more than double those with the opposite view. The tendency of Chinese mathematics teachers' view is similar to English mathematics teachers'. However, more Chinese mathematics teachers very strongly emphasised students should attempt to work out problems by themselves.

In summary, questions 3.1 to 3.3 revealed approximately half of English mathematics teachers considered the all round ability of pupils in their teaching. Approximately one third of teachers emphasised pupils' individual learning and ability development. In contrast, the views of Chinese mathematics teachers, apparently, were much more one-sided, discovery mathematics and self-study being highlighted by Chinese mathematics teachers.

Section D-The use of ICT

Table7

Percent of the Role of ICT

	Very helpful	Helpful	A little helpful	Not at all
England	9(29%)	15(48%)	7(23%)	0(0%)
China	8(8%)	63(62%)	29(29%)	1(1%)

Table seven shows the different views on using IT facilities in mathematics teaching between England and China. Although there were no opinions which indicated IT cannot contribute to mathematics teaching and learning, only 8% of Chinese mathematics teachers highlighted that IT facilities were very helpful in their teaching and learning. However, English mathematics teachers had a more positive attitude to this question.

Table 8

Frequency of Using IT Facilities in England and China

	Once a week	Twice a week	3 times a week	More than 3 times	Never
England	11(36%)	5(16%)	2(6%)	12(39%)	1(3%)
China	70(69%)	14(14%)	7(7%)	8(8%)	2(2%)

The above results show that the use of IT facilities was very popular in teaching maths in England and China. They also reveal that English mathematics teachers use IT facilities significantly more frequently than Chinese mathematics teachers.

Section E - Others

This section demonstrated more general views of teachers on maths teaching.

Question 4.1: The current curriculum is difficult to teach to and learn.

The table below shows that the majority of English mathematics teachers did not believe that the current contents of mathematics is difficult to teach and learn. However, nearly one fifth of teachers did think so. However, nearly two thirds of Chinese mathematics teachers had the opposite view. It reveals Chinese mathematics teachers

were dissatisfied with the current contents which they taught.

Table 9

Results of Question 4.1

	Strongly agree	Agree	Unsure	Disagree	Strongly disagree
England	2(6%)	4(13%)	2(6%)	16(52%)	7(23%)
China	16(16%)	51(50%)	19(19%)	15(15%)	0(0%)

Question 4.2: I think mathematics is an interesting subject.

The table below illustrates that the mathematics teachers enjoyed the subject, with only a few teachers not liking the subject. It is remarkable to see that English maths teachers had strongly agreed on this question; the ratio is nearly three times higher than the Chinese mathematics teachers (81% to 28%, respectively). It seems that this is a good message for English students, because teachers' positive attitude could impact on their students.

Table 10

Results of Question 4.2

	Strongly agree	Agree	Unsure	Disagree	Strongly disagree
England	25(81%)	5(16%)	0(0%)	0(0%)	1(3%)
China	28(28%)	57(56%)	15(15%)	1(1%)	0(0%)

Question 4.3: We would become more confident if there was more training support available.

The table below demonstrates nearly two thirds of English mathematics teachers believed that it was useful to have proper training support. However, it is remarkable that nearly one in five English teachers have a negative attitude regarding teaching training. These figures should attract some departments' attention and it is probably necessary to improve the quality of teacher training. In contrast to English mathematics teachers, it seems that Chinese mathematics teachers had more passion to accept training support from the Education department. As long as the Education Department provides useful support for teachers, it will be very helpful to improve teachers' practice in their classroom.

Table 11

Results of Question 4.3

	Strongly agree	Agree	Unsure	Disagree	Strongly disagree
England	1(3%)	16(52%)	7(23%)	6(19%)	1(3%)
China	35(35%)	53(52%)	11(11%)	2(2%)	0(0%)

Question 4.4: Students not spending sufficient time studying is the main reason for poor exam performance.

Table 12

Results of Question 4.4

	Strongly agree	Agree	Unsure	Disagree	Strongly disagree
England	10(32%)	15(48%)	3(10%)	3(10%)	0(0%)
China	10(10%)	41(40%)	31(31%)	17(17%)	2(2%)

Table12 shows 80% of English mathematics teachers believed that students did not study hard, but only half of Chinese mathematics teachers thought so. 31% of Chinese mathematics teachers and 10% of English mathematics teachers considered that there might be other reasons, and a few teachers did not think students' poor exam performance depended on students' study attitudes.

Question 4.5: In order to help students learn more effectively, it should be considered how to arrange the content more helpful to aid progressive teaching in the classroom.

Table 13

Results of Question 4.5

	Strongly agree	Agree	Unsure	Disagree	Strongly disagree
England	2(6%)	12(39%)	12(39%)	4(13%)	1(3%)
China	32(32%)	65(64%)	4(4%)	0(0%)	0(0%)

Table13 reveals that 96% of Chinese mathematics teachers and 45% of English mathematics teachers considered rearranging the content as being helpful for students' learning. 39% of English teachers and 4% of Chinese teachers were not clear about the relationship between re-arranging the content and helping students learn better. However, 16% of English teachers ignored it. Although there is no evidence to show teachers should re-arrange the content when they taught in the classroom, different students' levels and learning styles require teachers to be flexible to choose teaching strategies to match students' needs.

Conclusion

Two things are perhaps clear from this chapter. The first is that there is much that yet has to be learned which can be examined in fine detail and alongside other relevant findings in TIMMS, (e.g. Cai, 1995; Ding & Jones, 2006), those relating to teaching methods and effectiveness. The second is that the difference between teaching methods in China and the UK are much less important than a detailed understanding of what lies behind them, for example, how they can be explained.

Findings from the questionnaire for both countries' teachers, the strategies of teaching in mathematics in secondary schools in China and Britain are similar, which reinforces the conclusions of the Cockcroft report (1982) paragraph 243. Differences appeared in the frequency of use of teaching strategies in both countries (see Table 2).

In addition, this study reports that both countries' teachers emphasised the importance of the use of IT facilities in teaching and learning. However, English mathematics teachers' experiences were more flourishing and Chinese mathematics teachers possible lacked enough technical support and appropriate facilities. For the details, see Table10 and Table11. Nowadays, Western scholars greatly emphasise developing the ability of students' research and problem-solving skills. With emerging information and communication technologies (ICTs), the pressure has rapidly mounted to shift the views of people on effective teaching and learning even further (Way et al, 2003). Based on the above, it should be clear that computers were often used in

mathematics teaching and learning in England.

To conclude, the study has shown, on the one side, both ways of mathematics teaching need to be changed but, on the other side, many elements of both ways of teaching should be preserved.

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Author:

Yanyun Liu
University of Hull, UK
Email: liuyy70@yahoo.com.cn