Country Reports

China - Shanghai

1.1 Relevant Policy

Shanghai has had particular success in ensuring depth of success in mathematics across the whole student population, not only among the most talented.[1] The small gap between the highest and lowest performers and the importance given to equality as well as quality has been identified as a key factor behind the city's success by the Shanghai PISA centre.[2]

Centralisation of education and training policies means that specifics about Shanghai are difficult to source; the level of centralisation can mean that teachers and training institutions do not have the room to try new or innovative approaches to learning. The success of Chinese students in mathematics may further appear counter-intuitive, as conditions in Chinese schools are in many ways not those considered ideal for learning by proponents of mainstream educational theory.[3] Classrooms are crowded, classes are large, teachers are dominant and students tend to be passive, following a rote learning approach not usually thought to support effective learning in maths.[4] Some observers have detected in this view a Western-centric approach to education and have found other factors that underlie the country's success, explored further under Practice and Pedagogy below.[5]

Vocational teacher training is limited; where it does exist, it tends to be in philosophies and theories, rather than in practical areas,[6] which means that there is limited opportunity for vocational teachers and trainers to integrate maths education into their vocational curriculum.

1.2 Institutions and Courses

General System

The education system in China consists of six years of primary and six years of secondary education; the latter is divided into three years of lower secondary and three of upper secondary.[7] Lower secondary education takes place in a single stream, at the end of which (at age 15) students take an entrance exam for upper secondary.[8] Depending on the results of this exam, the student may enter either an academic or vocational upper secondary school, or leave full-time education.[9]

The Chinese curriculum has three elements: a basic curriculum of compulsory courses in Maths, Chinese, English, Science and Humanities, taken by all students; an 'enrichment' curriculum of optional courses, which differ from school to school but may include sport, music, art and calligraphy; and an enquiry-based curriculum of research activities to encourage critical thinking, creativity, group activities and competitions.[10] Maths is studied daily and is compulsory until the age of 18.[11] At the secondary level, the curriculum is similar to that used in England for students of higher ability, but with a higher level of difficulty and greater complexity.[12]

All Shanghai schools use one core curriculum document, the *Shanghai City Primary and Secondary Mathematics Curriculum Standard*, which is divided into five key stages: primary grades 1-2, primary grades 3-5, middle school grades 6-7, middle school grades 8-9, and high school grades 10-11.[13] At each stage, the content is divided into basic and extension; the latter covers the same content as the basic material but in greater breadth and depth.[14] The Standard

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[1] http://www.nationalnumeracy.org.uk/resources/79/index.html
[2] http://www.nationalnumeracy.org.uk/resources/79/index.html
[3] http://www.merga.net.au/documents/MERJ_19_1_Lim.pdf
[4] http://www.merga.net.au/documents/MERJ_19_1_Lim.pdf
[5] http://www.merga.net.au/documents/MERJ_19_1_Lim.pdf
[6] Chen S., Kompf M. (2012). Critical Issues in the Future of Learning and Teaching: Chinese Scholars on Western Ideas about Thinking, Leadership, Reform and Development in Education. Rotterdam: Sense Publishers
[7] http://www.ncee.org/programs-affiliates/center-on-international-education-benchmarking/top-performing-countries/shanghai-china/shanghai-china-instructional-systems/
[8] http://www.ncee.org/programs-affiliates/center-on-international-education-benchmarking/top-performing-countries/shanghai-china/shanghai-china-instructional-systems/
[9] http://www.ncee.org/programs-affiliates/center-on-international-education-benchmarking/top-performing-countries/shanghai-china/shanghai-china-instructional-systems/
[10] http://www.nationalnumeracy.org.uk/resources/79/index.html
[11] http://www.nationalnumeracy.org.uk/resources/79/index.html
[12] http://www.nationalnumeracy.org.uk/resources/79/index.html
[13] http://www.merga.net.au/documents/MERJ_19_1_Lim.pdf
[14] http://www.merga.net.au/documents/MERJ_19_1_Lim.pdf

details the required content for each topic and gives suggestions for teaching activities, with encouragement to teach the extended content through creative activities including investigative projects, puzzles and games, and the history of mathematics.[15]

Vocational Courses

In recent years, the opportunity to progress from vocational secondary institutions into higher education has improved significantly.[16] Secondary vocational graduates are now permitted to take the National College Entrance Examination (NCEE - China's standardised university entrance exam) immediately, whereas before they had been required to wait several years; there are also, increasingly, opportunities to enter higher vocational institutions.[17] Maths is a compulsory subject in the NCEE.[18]

1.3 Practice and Pedagogy

Despite the positive lens through which achievement in maths is viewed in Shanghai, many of the Chinese papers related to maths teaching in vocational institutions are negative about inputs and outcomes; this is possibly related to the lack of papers available specifically about Shanghai, as research papers in this area tend to have a broader focus on China. In common with other countries reviewed for this study, barriers to the provision of maths education in vocational learning are thought to include poor teacher training, a poor mathematical foundation (vocational students tend to average 70 points out of an available 150 in their maths exams), lack of enthusiasm for learning and a fear of maths.[19]

Professor Weiping Shi of East China Normal University in Shanghai has pointed out that students in vocational institutions habitually describe mathematics, Chinese language and foreign languages as their 'most hated' subjects in school.[20] Often, these subjects bring back memories of underperformance and humiliation during their compulsory education years.[21] According to Professor Shi, current efforts to strengthen literacy and numeracy in vocational schools in order to provide a better foundation for extending learning risk further disengaging vocational learners if they are not implemented correctly.[22]

Teachers are not required to follow the Curriculum Standard strictly, and are encouraged to explore further mathematical content as they see fit.[23] A 2007 observational and interview study found the following six key factors behind the impressive results seen in mathematics education in Shanghai (note that this study was based on a small number of schools, so findings should be treated with caution):[24]

- Teaching with variation: maths teachers in Shanghai tend to use at least three different examples, with different connotations or difficulty levels, for each concept; they also teach multiple methods to solve the same type of problem.
- An emphasis on precise mathematical language: teachers were observed to demand that students express their answers to problems as succinctly as possible and using language close to that employed in the text books.
- An emphasis on logical reasoning, mathematical thinking and proofing during teaching: high-level thinking questions like *'why?', 'how?'* and *'what if?'* were observed to be common in Shanghai maths classrooms, promoting verbal interaction between teacher and students and among the students. This approach is included in the *Shanghai City Primary and Secondary Mathematics Curriculum Standard* as an objective for middle and high school maths. Contrary to the image of 'rote learning', the study found evidence that Shanghai maths teachers see the inculcation of an ability to think for oneself as a key feature of successful maths teaching.
- Strong discipline and an emphasis on order in the classroom: this was observed to be a common feature in Chinese classrooms, often ascribed to the country's Confucian heritage.
- Strong rapport between teacher and student: the study observed a positive and encouraging relationship between teachers and students, and strong coherence between the teachers' pedagogical philosophy and students' beliefs about the importance of mathematics as a subject and the best ways to develop mathematical competence.
- A strong culture of collaboration among maths teachers: maths teaching in Shanghai is characterised by continuous engagement by teachers in collaborative peer-led professional development through lesson study and teaching

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[15] http://www.merga.net.au/documents/MERJ_19_1_Lim.pdf
[16] http://www.qualificationsrecognition.ie/china-SchoolEducation.html
[17] http://www.qualificationsrecognition.ie/china-SchoolEducation.html
[18] http://www.qualificationsrecognition.ie/china-SchoolEducation.html
[19] http://www.ier-institute.org/2070-1918/lnit16/v16/129.pdf
[20] http://www.inap.uni-bremen.de/dl/pres11/keynotes/Weiping%20Shi-Issues%20and%20Problems%20in%20Current%20Development%20of%20TVET%20in%20China%20(20110526-SHI).pdf
[21] http://www.inap.uni-bremen.de/dl/pres11/keynotes/Weiping%20Shi-Issues%20and%20Problems%20in%20Current%20Development%20of%20TVET%20in%20China%20(20110526-SHI).pdf
[22] http://www.inap.uni-bremen.de/dl/pres11/keynotes/Weiping%20Shi-Issues%20and%20Problems%20in%20Current%20Development%20of%20TVET%20in%20China%20(20110526-SHI).pdf
[23] http://www.merga.net.au/documents/MERJ_19_1_Lim.pdf
[24] http://www.merga.net.au/documents/MERJ_19_1_Lim.pdf

research groups. The schools observed had all set aside one afternoon per week for maths teachers to meet and discuss lesson plans, and teachers commonly sat in on each others' lessons to observe and exchange comments. Staff room facilities were also organised in such a way as to maximise interaction between teachers teaching the same grade level.

One study suggests that teachers follow traditional approaches to teaching and learning, whereby students absorb knowledge passively. The theoretical approach itself to the learning of maths in vocational contexts is not widely critiqued within the local context, however: a further critique in the same paper, for example, argues that practical learning is given course time at the expense of theoretical learning, such as mathematics.[25] Experimental teaching in vocational maths has been limited in China, due to the limited available credit hours; one study points to around 30% of teaching being experimental, defined as learners being able to undertake practical mathematical experiments.[26]

Shi recommends that literacy and numeracy will be best promoted within vocational education by integrating the relevant content with job skills and life skills, and making the process of learning more enjoyable for students.[27] Recommendations for the further development of vocational mathematics, according to one paper, include:[28]

- Developing learners' interest in maths through the use of science, the internet and multimedia.
- Enhancing learners' self-confidence through positive feedback.
- Incorporating real-life stories to break up the teaching of mathematical principals.
- Integrating real-world examples in the teaching of maths, e.g. teaching functional relationships through the example of video games sales.

1.4 Key Points of Learning

We found limited evidence of vocational mathematics curricula in Shanghai; what little evidence exists points to a highly theoretical approach to the learning of maths in vocational institutions. This fits with the point outlined above that Shanghai's approach to the teaching of maths runs counter to the popular conceptions of successful approaches to teaching maths in vocational contexts. Reasons for this may include the different cultural context for the application of appropriate pedagogies or the lack of traditionally disengaged groups in the system.

Several aspects of the Shanghai model nevertheless constitute interesting ideas for the UK. Maths is studied on a daily basis and is compulsory until the age of 18.

[25] http://www.atlantis-press.com/php/download_paper.php?id=12088
[26] http://www.atlantis-press.com/php/download_paper.php?id=12088
[27] http://www.inap.uni-bremen.de/dl/pres11/keynotes/Weiping%20Shi-Issues%20and%20Problems%20in%20Current%20Development%20of%20TVET%20in%20China%20(20110526-SHI).pdf
[28] http://www.ier-institute.org/2070-1918/Init16/v16/129.pdf