This chapter examines the Chinese mathematics curriculum reform. The approach adopted reflects the socio-culturally situatedness of curriculum reform, examining the cultural and pedagogical values underpinning professional practice. It will interrogate what appear to be valued by reform policies and initiatives, how these reflect, enrich or contradict local pedagogical and societal cultures, and what these mean for the successful execution of the intended curriculum in schools. It argues that the explicit articulation of values inherent in the reform process, and the subsequent negotiation of value differences and conflicts that surface, can bring about a culturally relevant and empowering reform.

Introduction

China operates the largest school Mathematics education system in the world, with more than 11 million teachers teaching more than 109 million, 60 million and 43 million students in primary, junior high and senior high schools, respectively (China Ministry of Education 2007a, 2007b) across the most populous country in the world. In China, as in many if not all other nations around the world, the quality of school Mathematics education – and the crucial relationship with the country’s economic development – is of prime interest to all levels of governance. Given the country’s stake in the global economy, and in consideration of the increasing numbers of Chinese who work and live overseas, the ongoing improvement and development of China’s school Mathematics education standard should be of interest to political, business and education stakeholders outside China as well.

China has excelled in its school Mathematics education, and this continued excellence is dialectically related to the country’s economic development (ICME11 Chinese delegation 2008; see also Kelly 2009). In the light of China and East Asian students’ consistently high performance in international comparative studies (see Mullis, Martin and Foy 2008; OECD 2004), educators and researchers in the ‘West’ have for some time been trying to make sense of how their local school Mathematics curriculum might adopt or adapt some of China’s pedagogical ideas. These efforts have been supported by the
findings of cross-cultural research such as Cai (2007), Leung (2001) and Ma (1999). The publication of the compilation *How Chinese Learn Mathematics: Perspectives from Insiders* in 2004 (Fan, Wong, Cai and Li 2004) further highlights the global academic interest in the Chinese Mathematics education system.

Yet, China’s latest (Mathematics) curriculum reform exercise has only in recent years been rolled out to all levels of primary and secondary schooling. How best can the ideals of this reform programme be realised such that students’ high performance in Mathematics is maintained? Indeed, how do practitioners and other stakeholders regard the pedagogical potentials of these reform objectives? What does this mean for the maintenance or further stimulation of excellence in school Mathematics education in China? In optimising Chinese students’ access to resources in – and entry to – foreign universities and research centres, as well as to the practices of the world business and economy activities, to what extent does the Chinese Mathematics reform feel the pressure to adopt so-called international ‘best practice’ in Mathematics pedagogy?

This chapter is concerned with evaluating the Chinese Mathematics curriculum reform in the context of the maintenance of – or further improvement to – the Mathematical performance and learning of Chinese students. This can certainly be approached through a cognition-based perspective, drawing upon established models of education or curriculum theories, as well as reference to the experiences of other education systems. For example, one might go about doing this with the perspective of numeracy, assessing the various components of the reform curriculum against the ideals encapsulated in numeracy initiatives. The approach to be adopted in this chapter, however, will reflect the socio-culturally situatedness of curriculum reform. In particular, key features in the implementation of the reform curriculum will be considered by examining the cultural and pedagogical values underpinning practice. It will interrogate what appears to be valued by reform policies and initiatives, how these reflect, enrich or contradict local pedagogical and societal cultures, and what these mean for the successful execution of the intended curriculum in schools and classrooms. The distinction between valuing as a form of ‘soft’ learning, and cognitive and affective processing as ‘hard’ learning will be made. To do this, the wider context of academic interest in China’s Mathematics education system is first offered below. A brief account of the history of school Mathematics education in China follows, as a means of situating the discussion. Various challenges to the meaningful implementation of the current curriculum reform at the societal, institutional and personal levels will be identified. Suggestions for resolving these through adopting the socio-culturally based perspective will be argued for. In particular, the discussion will exemplify how the explicit articulation of values operating in the various facets of the curriculum reform, and the subsequent negotiation of value differences and conflicts that surface, can bring about a culturally relevant and empowering reform, one
which promises to further consolidate student excellence in the discipline while being responsive to emergent trends of thinking and acting in the wider society, and one which is an expression of an educational culture that brings in ‘Western’ best practice without sacrificing the essence of local norms and practices.

Interest in the Chinese Mathematics education system

Over the last few decades, the Chinese education system has attracted an unprecedented amount of attention from educators and politicians around the world. Not only are teacher education universities in the coastal cities (such as East China Normal University in Shanghai) receiving an increasing number of visiting scholars from Western countries, institutions inland (such as Southwest University in Chongqing), which normally have few English-speaking staff members, are also host to increasing numbers of such scholars. This phenomenon may be attributed to a few factors, one of which is China’s impressive economic development since gaige kaifang (opening to the world) in 1978, and the potential leverage the nation exerts on the world economy following the global financial and economic crises in the late 2000s. Given that the quality of a nation’s formal school education impacts on the knowledge, skills and dispositions of its workforce, and how workforce quality is in turn a variable of economic strength, this aspect of China’s hard power (Nye 1990) draws attention to the features of its education system.

Another major factor for the increased interest in China’s school Mathematics education programmes is possibly the consistent phenomenon in international comparative studies such as the *Trends in International Mathematics and Science Study* (TIMSS) and the *Programme for International Student Assessment* (PISA) of East Asian nations emerging as top performers at both primary and secondary school levels (Mullis, Martin and Foy 2008, OECD 2004). Nations performing well across these studies have attracted much attention, given that TIMSS assesses student Mathematical knowledge whereas PISA examines the extent to which students are able to apply this Mathematical knowledge to novel problem-solving situations. The association of such nations as Singapore, Hong Kong, Korea and Taiwan with Confucian Heritage Cultures (CHCs) (Wong 2008) has in turn reflected the Chinese roots of most of the populations within these East Asian nations. This commonality amongst the top performing East Asian nations has then directed attention to the Chinese civilisation with its long history of valuing academic excellence.

Another factor comes about through the increased number of ethnic Chinese immigrants settling in Western countries such as the United States, Canada and Australia, and the apparent higher (Mathematics) achievement of their children in the local school systems and in Mathematics competitions. For example, for many years now, the number of ethnic Chinese students performing at the top level of the Victorian Certificate of Education
(VCE) examinations (effectively the university entry examinations for students in the State of Victoria, Australia) has been way above the demographic proportion of ethnic Chinese there. The same can be observed in the composition of many national International Mathematics Olympiad teams. In 2007, for example, the fifth-placed United States team of six competitors was made up of three ethnic Chinese members, who also won the two gold medals for their team. The team from multicultural Singapore, on the other hand, was made up of entirely ethnic Chinese members.

All these have created the perception in the Western world of a different, ‘other’ Mathematics curriculum in East Asia, but in China particularly. An understanding of the nature of this difference is important for those in Mathematics education administration and research, and for those outside these spheres of the profession as well. For the former, an informed unpacking of those aspects of China’s Mathematics education system which foster – and other aspects which constrain – the realisation of intended objectives would provide useful reflective ideas. What appear to be the causes of success in one culture need not have the same effect when applied in another culture, what with the interaction between these perceived factors of success with local pedagogical norms and community practices. Indeed, the seduction of the ‘exotic’ can sometimes prompt education systems to adopt initiatives which are unnecessarily costly and perhaps even inconsequential. As for the other stakeholders, it is in their interest that knowledge informed by culturally-sensitive perspectives serves to promote greater understandings between nations amongst their citizens, business leaders and politicians.

The current school Mathematics curriculum reform in China is part of the national curriculum reform, kecheng gaige, which was introduced to schools in the early 2000s. By 2005, all beginning students in China’s elementary and junior secondary schools were expected to follow the new curriculum (UNESCO 2007; see also the chapters in Part 1 of this volume). By 2010, the senior secondary reform curriculum is expected to be implemented in all schools across the country. As the curriculum reform approaches full implementation across all levels and all schools, this might be an ideal time to explore the extent to which aspects of the reform curriculum are being successfully implemented in schools, and to identify and understand the challenges, as a means of stimulating further reflection and discussion for finetuning the trajectory of the reform exercise.

Acknowledging the role of soft learning

An adoption of cognitive and/or affective perspectives only in reviewing the Mathematics curriculum reform in China (and elsewhere) runs the risk of robbing us of a more holistic understanding of what has worked and what has not. Many cognition-based education models originated in the ‘West’ and any argument that these can be applied to any learning environment should be challenged. For example, the direct importation of Singapore
Mathematics textbooks to some 140 schools across the USA in the late 1990s is a case in point (Chenoweth 2000, Gowen 2001), even though these textbooks were already being published in the English language. For example, there were issues relating to the use of units of measurement which are different across Singapore/Britain and the USA (Chenoweth 2000), and the contexts of many of the word problems in the textbooks were alien to American students. There is culturally-based knowledge which underlies cognitively-based pedagogical considerations such as the ways in which Mathematical concepts are introduced, and exercise problems laid out, in the Singapore textbooks. Mathematical content organisation in Singapore textbooks also assumes a level of teacher content knowledge amongst Singapore teachers which is not paralleled in America (Chenoweth 2000). Furthermore, an affective approach only would be equally unsustainable, since the level of affect need not relate to student understanding or performance. For example, below average self-efficacy means were reported by both high-performing countries such as Finland, the Netherlands, and Korea, and lower performing nations like Brazil and Thailand in PISA 2003 (Thomson et al. 2004, Figure 7.12: 187). At the same time, high-performing Asian students (from Japan, Korea, Hong Kong, and Macau) reported the four lowest Mathematics self-concept scores amongst the nations surveyed.

Thus, according to Huang (2004), ‘although many theoretical systems for discussing educational objectives . . . have been introduced into China, their direct application in educational practice is handicapped by cultural traditions’ (104). There appears to be a need to complement approaches to the analysis of curricula with a recognition that meaning- and decision-making draw upon culturally-based values as much as they do cognitively-and affectively-based knowledge. What is advocated here is that even greater insight might be gained if, instead of viewing values underpinning perspectives, decisions and actions as being separate from cognitive and affective functionings, we regard the socio-culturally based values as underpinning the cognitive and affective functionings that in turn mould perspectives, decisions and actions. That is to say, the rationalising and feeling experiences in making sense of and making decisions about phenomena are by nature culturally-situated. This kind of cultural knowing which ‘sits behind’ what the mind and heart are learning has been conceptualised as ‘soft’ learning (Seah 2009), as opposed to ‘hard’ learning with the mind and heart which are comparatively more tangible and observable. According to Seah, while hard learning might refer to the part of learning experience which draws upon an individual’s mental processing and affective response to attain varying levels of awareness and understanding, soft learning refers to the part of the learning process which draws on the individual’s experience and internalisations within the socio-cultural environment(s) he/she functions or has functioned. In particular, soft learning facilitates sense-making through such socio-cultural factors as socio-economic status; language and discourse; race and ethnicity; gender; as well as attitudes, beliefs and values.
An example might be the (hard) learning of number and computation expected of school students in many nations. Yet, the extent to which notions of number, counting and arithmetic operations are effectively acquired and understood is regulated by the soft learning which would have taken place concurrently in the minds and hearts of students. The student who has been raised in a typical ‘Western’ family will likely take it for granted that knowledge relating to the cognition of adding, subtracting, multiplying and dividing is an important life-skill. However, in a traditional indigenous community in Australia, say, the soft learning which is activated amongst students is likely to be different; counting activities, for example, have never been seen as important as one’s ability to visualise spatially one’s environment in the featureless landscape around him/her (see, for example, Kearins 1981). What then are the implications and issues of implementing such a Mathematics curriculum in communities where spatial sense and geometrical skills are more valued than number sense?

How one thinks/reasons and how one feels are guided intuitively by one’s ‘culture code’ (Rapaille 2006). Accordingly, a good way to review China’s (Mathematics) curriculum reform over the past decade or so might be to explain the values (as a manifestation of soft knowledge) that are encapsulated in and embraced by the Chinese culture. To better achieve this, it would first be necessary to relate to the long history of Mathematics education in China, in the context of the 5,000 years of history of the Chinese culture, as well as more contemporary realities of Mathematics education and schooling in the Chinese society.

Mathematics education in China

Mathematics education in China has had a long history. Arithmetic was one of the six classical arts that were already being taught in ancient China more than 2,000 years ago (Li 2008, Yao 2000). Mathematics has traditionally played an important role in the imperial courts throughout many dynasties in China. This, together with imperial China’s valuing of government officials candidates’ performance in the imperial examinations (which developed over the period 400–900 AD), had led to a societal valuing of Mathematical performance as a reflection of a family’s success, prestige and power. Details of these and other aspects of the important roles which Mathematics historically and currently plays in different levels of the Chinese society are available elsewhere (see, for example, ICME11 Chinese delegation 2008). What follows is an abbreviated account of the history of Mathematics education in China, with the aim of explicating the values that are encapsulated in and embraced by the Chinese culture, as a means of better understanding the soft knowledge relevant to this discussion.

‘Western’ Mathematics was introduced into China in about 1600 (Li 2008) through the Christian schools that were run by foreign missionaries. ‘In 1607, the first 6 volumes of Euclid’s Elements were translated into Chinese by the
Chinese mathematician Xu Guangqi and the Italian Jesuit Priest Matteo Ricci’ (Li 2008: 127). However, it was not until after imperial rule ended with the 1911 Revolution that ‘Western’ Mathematics was taught across almost all elementary schools throughout China (Zhang 2005).

The establishment of the People’s Republic of China in 1949 stimulated an overhaul of China’s education system to one which was based on the Soviet Union’s. The primary Mathematics curriculum in China at that time was characterised by content which was condensed and focused, with a valuing of logic and deduction (Zhang 2005). In the 1960s, a finetuning of the Soviet Union-based primary Mathematics curriculum led to a new valuing of practicability and applications. The emphasis of the Mathematics education system became one of learning basic knowledge and basic skills (Zhang 2005). The 1966–1976 Cultural Revolution had an impact on the development of Mathematics education in China as well. In line with the prevailing doctrine of the country, Mathematics education emphasised applications to particular areas, namely, the labour and manufacturing sectors (Zhang 2005).

Zhang (2005) observed that pedagogical exchange between the Chinese and their counterparts in the ‘West’ after 1976 had led to the introduction into China’s curriculum of such pedagogical ideas as problem-solving, standardised assessment, and Bloom’s taxonomy of educational objectives. The move in the 1990s to strengthen China through further developing technology and education had led to the valuing of ability training (Zhang 2005). At the same time, this was also a period which saw the 1992 Mathematics curriculum reinforcing China’s valuing of the ‘two basics’ (shuang ji) (that is, basic knowledge and skills) and ‘three abilities’ (that is, computation, logical thinking and spatial visualisation) in the pre-Cultural Revolution years (Wong, Han and Lee 2004). Indeed, there is ample evidence ‘on the ground’ today that Mathematics education in China still values very highly the role of foundational knowledge and skills (see also ICME11 Chinese delegation 2008).

Thus, for more than a hundred years now, the Mathematics discipline that is taught in schools has been ‘Western’ Mathematics similar to the Mathematics that was being taught in Europe or in the United States. On the other hand, traditional Chinese notions of how this ‘Western’ Mathematics is expected to be taught effectively to students (and which includes the ways in which the intended curriculum was to be written) had been infused with Russian and other Western pedagogical ideas, as well as other ideologies.

It was located within this reality that one of the most significant and comprehensive curriculum reforms in the nation began in 1999. The primary school section of this reform began its trialling process in 2001, and by 2005 all beginning students in China’s primary and junior secondary schools were placed in the new curriculum (UNESCO 2007; see also the chapters in Part 1 of this volume for an expanded discussion of this process). This comprehensive reform is characterised by a content which is essentially Westernised in its conception and articulation. The reform signalled the country’s intended move away from an education system whereby teachers impart knowledge
to students, to one which emphasises the development of lifelong learning abilities (Huang 2004), the importance of education bridging what is learnt in schools with students’ experience in society, and the importance of students assuming greater initiative and autonomy in their own learning (Wang 2005).

A more encompassing view of what constitutes assessment and a pedagogical emphasis on harnessing learning technologies (Zhang 2005) were also developed. In essence, the traditional valuing of *yingshi jiaoyu* (examination-oriented education 应试教育) was to give way to a reform discourse which emphasises *suzhi jiaoyu* (quality education 素质教育).

In the Chinese language, however, the term *suzhi in suzhi jiaoyu* takes on different meanings depending on whether it is being used as a noun or adjective. *Suzhi* (quality) is a noun in the current reform rhetoric, rather than an adjective describing the quality expected of school education. Thus, there are indicators within this latest Mathematics curriculum reform of an institutional emphasis on attending to particular groups of individuals according to their needs and capabilities (instead of providing a common education experience for all students). For example, a feature of this curriculum reform exercise had been the replacement of a unified syllabus and unified textbooks with a set of unified curriculum statements (ICME11 Chinese delegation 2008), thus laying the way for the curriculum to be realised through different textbooks (*yi gang duo ben*). Interestingly, local provinces’ valuing of efficiency (e.g. in collating and comparing student scores of local examinations) has often meant that the same textbooks are being selected in these communities, thus putting in jeopardy the intention for *ying cai shi jiao* (因材施教, teaching according to students’ capabilities). At the same time, the approval for Shanghai to structure its own school Mathematics curriculum and examinations in 1997 (Wong, Han and Lee 2004) not only represents the Chinese central government’s acknowledgement of the coastal city’s capacity and resources, but it might also be regarded as a test-case of customising curriculum innovation according to the unique resources and needs of different provinces/cities in the future.

Although ‘this process of curriculum reform is mainly inspired by Western experiences, with inputs coming from a series of study-tours to developed countries that took place prior to the reform’ (UNESCO 2007: 6–7), the Chinese government also desires a school curriculum which supports the development of a harmonious society with Chinese socialism features. Thus, the curriculum reform is intended to ‘enable, through education, new advanced cultures and concepts to spread in schools and society at large, to build among the Chinese people a co-operative and constructive partnership of democracy, equality, dialogue, consultation and mutual understanding’ (Wang 2005). There is official interest in maintaining a sense of balance between adopting foreign cultures and local experience in the structuring of pedagogical experiences for students. Thus, socio-cultural and political factors (and the values underlying these) are at work both at the intended, policy level and the implemented, articulation level.
In this context, the next sections will highlight issues related to the introduction of the Mathematics curriculum reform in China, these being high-stakes assessment, decentralisation of curriculum planning, the perceived ‘Western’ basis of the reform pedagogy, information and computer technology, rigour of reform Mathematics, and teacher professional development. The discussion will draw on understandings of the relevant soft learning, including the values that are emphasised traditionally in the Chinese Mathematics education system, as well as the values that underlie innovative pedagogical ideas.

High-stakes assessment

Examinations have traditionally occupied an important place in the Chinese (Mathematics) education system. An important factor in this discussion is the likelihood that examination performance will continue to play an important role in a child’s education in China and, in particular, in determining the next phase of his/her formal learning journey. Practically, academic performance in the university entrance examinations has been crucial in a student’s tertiary entrance process, especially with regards to prestigious universities in Beijing and other major cities. Not only is this emphasis on examinations performance a result of limited university places for the large number of senior secondary school graduates, but it is also shaped by a marketplace which is not absorbing all the university graduates every year. According to Villa (2009), ‘China will turn out 6.11 million college graduates this year [2009] who will join one million unemployed graduates from 2008 who are still looking for work’. Thus, as long as academic performance in high-stakes university entrance examinations has a bearing on a student’s future career prospects, it will be relatively more difficult for parents and educators to accept new ways of teaching and learning, unless these pedagogical initiatives promise to optimise the examinations performance of their respective children and students.

As alluded to above, this phenomenon reflects the Chinese culture’s valuing of academic performance in enhancing one’s future quality of life. The imperial China’s system of selecting officials through the examinations system has translated to a cultural valuing of examinations performance as a measure of personal and family success, prestige and wealth. China’s one-child policy in the last few decades has only reinforced this cultural value further (see Wang 2010 on the impact of this phenomenon on the parental pressures on Chinese students). Previous reform attempts to de-emphasise performance as an indicator of successful Mathematics learning have largely failed, while the examination-oriented ‘regular system’ has proven remarkably resilient, bouncing back with renewed vigour after each assault. In their actions, China’s educators remained committed to preserving examination-defined quality and left to their own devices, the features of the regular system with its links back to the imperial examination system would inevitably re-emerge (Dello-Iacovo 2009: 2).
The importance placed by the wider society on examinations performance has meant that many teachers and schools ‘teach to the test’. Anecdotal feedback from academics and teachers in China reveal that after all, a teacher’s performance and career prospects are often tied to the performance of his/her students in the high-stakes examinations, and schools with excellent student performance likewise receive more funding. Yet, in Shanghai, for example, the low proportion of Mathematics tertiary entrance examinations items that assess student applications of Mathematical concepts (despite a curriculum which promotes the place of Mathematics in one’s world) has meant that schools and their teachers do not devote as much revision time on applications-type problems. This demonstrates the need for (high stakes) examinations to reflect reform curriculum objectives, especially in cultures such as China where there is a socio-cultural perception that examinations performance is a measure of teacher/school effectiveness.

In other words, reform policies run the risk of being embraced at a tokenistic level if the society continues to value student performance in high-stakes assessments. Indeed, many members within the Mathematics education community in China believe that ‘the “exam-oriented education” has become the biggest obstacle for the development of Mathematics education in China. . . . [and it] not only impedes China’s Mathematics education but also undermines China’s future competitiveness’ (ICME11 Chinese delegation 2008: 44). Given China’s population, there may indeed be few alternative models for an examination-oriented education for a key school subject such as Mathematics. However, there might also be opportunities for the Chinese cultural valuing of examinations and performance to be capitalised upon in ways which promote the pedagogical approaches encapsulated in the reform curriculum. This certainly calls for new and creative ways of assessing student learning and assessing for teacher learning as well. Although ‘the evaluation method has not yet correspond [sic] to the curriculum reform’ (ICME11 Chinese delegation 2008: 33), charting new directions for the different modes of assessment, including the high-stakes university entrance examinations, does appear to be the next task to embark on in the rolling out of the reform curriculum (the chapter by Kang and Liu in this volume discusses some emerging initiatives to develop other forms of assessment of student work and achievement such as through the use of student portfolios).

Most significantly, the views expressed by the Chinese Mathematics education community above indicate an awareness that reforms in curriculum and pedagogical practice should be contextualised in a notion of Mathematical performance which is in itself fluid across time and space. That is to say, if the curriculum reform exercise is to be understood as supporting and maintaining student performance, then the idea of performance should take on different meanings in different periods of Chinese history, in line with changes in the social, political and economic landscapes within the nation, and in the global situation without. The barrier, however, appears to be
deep-rooted cultural valuing of performance as defined and dictated by the educational authorities. After all, throughout China’s history, the imperial court – and, to a great extent, the government too – has recruited the best brains through highly competitive selection processes, processes which are unlikely to change much in time given their efficiency in enabling the identification of capable officials. As such, performance in high-stakes assessment practices is likely to continue to dominate students’ lives, and lead to their valuing of this aspect of learning and working in the rest of their professional and personal lives.

The decentralisation of curriculum planning

A feature of the current (Mathematics) curriculum has been a tripartite education administration model. Under this organisation model, curriculum planning and the assessment of its delivery is not just the sole responsibility of the central government; the different provincial governments and school leadership teams are also expected to play active roles. As has been witnessed in other education systems (e.g. Switzerland), this organisational model not only improves the efficiency of the education service, but a greater level of direct participation by local education authorities can allow for a more effective cultural customisation of the (Mathematics) curriculum for multicultural societies such as China. With the structuring of proper guidelines, this can be an efficient model without threatening the need to maintain a unified national curriculum. Decentralisation, however, should not be an excuse for reduced central government funding (directly or otherwise). The implications of such a development would be undesirable, both for the success of the reform and for the maintenance of social harmony within the Chinese society (see Dello-Iacovo 2009), thereby eclipsing any educational benefits associated with decentralised curriculum planning.

In the area of school Mathematics education, the possibility of more customised lesson delivery afforded by the decentralised organisational model presents opportunities for the socio-cultural nature of Mathematical knowledge to be introduced more explicitly to students in a nation which has a diverse range of cultures. China’s 55 ethnic minorities, which constitute about 9.4 per cent of the country’s population, are spread out across some 64.3 per cent of land in China. A greater integration of ethnoMathematics (D’Ambrosio 1985) in the school Mathematics curriculum will not only help to realise the reform curriculum’s aims of relating what is taught at school with what is experienced outside school, but it can also unlock for students the valuing of such convictions as progress (see Bishop 1988). According to D’Ambrosio (1985), ethnoMathematics refers to ‘the Mathematics which is practised among identifiable cultural groups, such as national-tribal societies, labor groups, children of a certain age bracket, professional classes, and so on’ (45). The valuing of local, ethnic Mathematical practices in a culturally-sensitive Mathematics curriculum can instil students’ pride in their own