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ORIGINAL ARTICLE

The development of school mathematics textbooks in China since 1950

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Abstract This paper provides an account of the development of school mathematics textbooks in China since 1950, the year following the founding of the People's Republic. This development can be divided into several major periods consisting of (a) translating and modifying textbooks from the Soviet Union, (b) writing and editing unified textbooks, and (c) developing multiple versions of textbooks under curriculum standards that emphasize students' personal development. Over the last 60 years, there have been many changes in the structure and content of developed textbooks; textbooks from each period exhibit their own characteristics which relate to specific political and cultural conditions. The debates on reform of compilation principles and of textbook structure and content still intertwine within the development of school mathematics textbooks. This development has resulted in the launching of a cross-national comparative study on mathematics textbooks in China which is intended to promote the development of mathematics textbooks considering cross-national perspectives.

Keywords Curriculum development · School mathematics textbooks · China

1 Introduction

Over the last two decades, the role and the structure of school mathematics textbooks have received increasing attention from researchers. Ball and Cohen (1996) and Johansson (2005), for instance, indicated that textbooks are an important resource in the mathematics classroom and teachers navigate instructional resources such as textbooks in order to design instruction. In addition, Cao et al. (2006) and Dede (2006) investigated and explained that mathematics textbooks convey various values. Focusing on the structure of textbooks, Nathan et al. (2002) investigated whether textbooks exhibited a symbol precedence view of mathematical development by presenting symbolic problems prior to verbal problems. Břehovský and Emanovský (2011) analyzed usage of an inductive approach in mathematics textbooks at secondary school. Wagner (2012) distinguished between closed texts and open texts in mathematics textbooks which acknowledge multiple possibilities.

There are also some studies on the role of textbooks from a particular perspective of learning. Kajander and Lovric (2009), for example, explored the potential role of mathematics textbooks in supporting misconceptions, while Shield and Dole (2013) explored how to assess the potential of mathematics textbooks to promote deep learning. Moreover, some researchers have investigated via empirical studies how teachers use mathematics textbooks in their classroom teaching (Fan et al. 2004; Nicol and Crespo 2006) and how textbooks influence teaching strategies (e.g., Fan and Kaeley 2000; Rezat 2012).

The existing studies show that researchers have not only explored the textbooks from a variety of perspectives but also obtained rich and varied results. For instance, Kim's (2012) comparison study on school mathematics textbooks between Korea and the United States revealed a significant difference in terms of the quality of non-textual elements, including accuracy, connectivity, contextuality and conciseness. Ding and Li (2010) examined the presentation of the distributive property (DP) in US and Chinese

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elementary mathematics textbooks in terms of problem contexts, typical problem types, and variability in using the DP. The authors found that the textbooks from the two nations used different ways to deal with the underlying DP principles, implicit in the US and explicit in China. Focusing on problem solving, Bao's (2004) investigation looked into the composite difficulty in mathematics textbooks, while Fan and Zhu (2007) analyzed the representation of problem-solving procedures in mathematics textbooks from China, Singapore, and the US. A wide literature search reveals that most studies on mathematics textbooks are from a perspective of teaching and/or learning (e.g., Alajmi 2012; Bierhoff 1996; Brenner et al. 1999; Caldwell and Goldin 1987; Carter et al. 1997; Chandler and Brosnan 1994; Erbas et al. 2012; Jones and Tarr 2007; Macintyre and Hamilton 2010; Manouchehri and Goodman 2000; Mesa 2004; Sood and Jitendra 2007; Stacey and Vincent 2009; Sun 2011; Toernroos 2002; Weinberg and Wiesner 2011). A smaller number of studies are based on historical (e.g., Baker et al. 2010; Legros 2012; Li et al. 2009), cultural (e.g., Haggarty and Pepin 2002; Li 2007; Rezat 2006), and political (e.g., Jacob 2001) perspectives.

This paper intends to strengthen the latter research perspectives with a focus on the development of school mathematics textbooks in China. It aims to illustrate the historical, political, social, cultural, and traditional background by examining existing studies on Chinese school mathematics textbooks.

Since the foundation of P. R. China in 1949, school mathematics textbooks have been developed continuously in search of promising theories and practices suitable for local students (Wang 2013). During the past 60 years, the reform and development of these textbooks have gone through several major periods which consist of modifying and compiling textbooks from the Soviet Union, writing and editing unified textbooks, and developing multiple versions of textbooks under the curriculum standard for the sake of students' personal development (Zhang and Zuo 2009; Zhang 2012). The structures and content of mathematics textbooks also have been improved step by step (Zhang 2012; Wang et al. 2010).

2 The period of translating and modifying the textbooks from the Soviet Union (USSR) (1952–1957)

2.1 Background

As early as September 1948, the Administrative Committee of Northeast China held an education conference, putting forward the proposal of learning from the education experience of the Soviet Union (Editorial 1984; Gu 2004; Su 1952). After the founding of new China in 1949, her entire education system imitated that of the former Soviet Union, and mathematics education was no exception. Articles on elementary mathematics and the history of mathematics written by scholars from the Soviet Union were published in almost every issue of Shuxue Tongbao (Mathematics Bulletin) from 1951 to 1957 (e.g., Andreev et al. 1954; Istomina 1953; Nagibin 1952), which clearly reflected the great influence of the Soviet Union on mathematics education in China (Wang and Dai 2004).

Along with this practice, "Arithmetic Syllabus for Elementary Schools" and "Mathematics Syllabus for Secondary Schools", which adopted many essential ideas from the former Soviet Union Syllabus, were published in 1952 and revised in 1954 and 1956 (Cai 2005; Liu 1999; Wei and Zhang 1996). These books emphasized that mathematics teaching should teach students basic mathematics knowledge and foster their skills and techniques to apply such knowledge so as to be able to solve all kinds of practical problems (Li 1985). The syllabi also mentioned that mathematics teaching should not damage the systematic nature of mathematics knowledge (Cai 2002). These ideas are consistent with the "Two Basics" principle of Chinese mathematics teaching and learning that continues to be valued today (Zhang et al. 2004).

2.2 The features of the development of school mathematics textbooks

Following the idea of "copy first and digest later", the People's Education Press (PEP) first translated the textbooks of the former Soviet Union's 10-year school systems and then edited them according to Chinese situations (Wang 2005). From 1952 to 1953, PEP revised one set of mathematics textbooks based on the former Soviet Union textbooks, with content including algebra, plane trigonometry, algorithms, and geometry. In 1955 and 1956 these textbooks were revised again according to the modified syllabus and adopted throughout China (Cheng 1955). During this period, a unified syllabus and textbooks were in place in schools all over the country.

As is well known, mathematical education in the former Soviet Union emphasized the rules and regulations of basic knowledge and the rigor of proof, including the basic training in logical reasoning (Zhang et al. 2004). These features were reflected in the set of textbooks published in 1952 as well as in the subsequent revised textbooks. For instance, this set of textbooks emphasized the systematic nature and strictness of knowledge. They narrowed the knowledge scope, but deepened mathematical theories. The geometry textbooks, for example, paid great attention to the systematic nature of geometry as a subject. While, for example, dealing with the notion of trajectory, lower

secondary school students were required to understand the definition of trajectory, know several basic trajectories well and apply them to solve construction problems; for upper secondary students, the concept of trajectory was a kind of problem proof which provided no exact solutions (Li 2008).

Nevertheless, the Chinese versions had their own features. In particular, the content was reduced significantly from what had been covered in the former Soviet Union textbooks. Analytic geometry and statistics were omitted. The duration of the curriculum was extended to 12 years in China, while the original version in the Soviet Union only spanned 10 years. In addition, the content in the Chinese textbooks was rearranged (Wei and Zhang 1996).

2.3 Open debates during this period

After implementing these textbooks in the classroom, intense debates were on-going amongst scholars and teachers, particularly with respect to the rearrangement of content in the textbooks. Some argued that much of the content of plane geometry for lower secondary school had unnecessarily been omitted (e.g., PEP 1954). Such people believed that lower secondary students were capable of learning all the plane geometry concepts (Wang 1957) so that students at the upper secondary level could move to the learning of analytical geometry which is part of university mathematics (Editorial 1957a). Against this view, some researchers remarked that the cognitions of lower secondary school students still depended on concrete objects, though their thinking might embody early abstract reasoning skills. More specifically, lower secondary school students could have only weak analytical, comprehensive, generalization and reasoning skills (Editorial 1957b). With regard to this viewpoint, students should at first experience geometry instead of learning rigorous geometry. Further, the geometry content should not be extended at the beginning stage (Zhou 1957).

Over this period, most of these arguments merely drew on field observations, practical experiences and personal beliefs rather than an investigation of the actual learning situation. Though it had its limitations, this dialogue among different opinions stimulated open discussions.

3 The first attempt and practice in compiling the textbook according to the Chinese situation (1957–1966)

3.1 Background

The debates and discussions from 1952 to 1956 revealed that the modified textbooks, while based on textbooks from the former Soviet Union, provided insufficient and superficial content. It was argued that the Chinese textbooks were not able to cater to students' needs, particularly when students went into the job field (e.g., Wei and Zhang 1996). Meanwhile, the political situation in China underwent a great change during this period of time. In 1958, it was put forward that China must cast away the influence of the former Soviet Union and implement its own way of development. The essential political movement for that period was "The Great Leap Forward" (Huang 2011). In accord with the political movement, the educational policy focused on the training of literate labourers with socialist consciousness. Therefore, from 1958, the Ministry of Education (MOE) suggested that the arithmetic then taught in lower secondary schools should be moved to primary schools. In addition, MOE organized a forum to discuss how to modify the mathematics syllabus and compile new unified textbooks according to the existent Chinese situation. A document was produced from the forum which was later approved by the Chinese government. The document detailed suggestions on the modification of the mathematics syllabus as well as the compilation of the new unified textbooks (Cai 2002).

3.2 The features of the development of mathematics textbooks

In China, political and social ideas have great influence on education development. In 1963, the PEP published "Arithmetic Syllabus for Full-Time Elementary Schools" and "Mathematics Syllabus for Full-Time Secondary Schools" according to Chinese social development, namely "The Great Leap Forward". The 1963 syllabus clearly stated three major capabilities to be cultivated, namely "accurate and rapid calculation ability", "logical reasoning ability" and "spatial visualization ability" (Wei and Zhang 1996). Given the political needs at that time, it seemed that mathematics education must provide students with basic knowledge and skills that could be transformed to practical capabilities and applications. All these reflected a different educational aim in China, compared with the Soviet Union (where, in the latter, it was rigorous proof that was the prime focus for mathematics instruction).

Furthermore, the Chinese syllabi set up the guidelines for compiling textbooks and school instruction for the succeeding years. The compilation of textbooks was required to be aligned with the guidelines. The textbooks were therefore compiled systematically around 1963 with a focus on fundamental knowledge and basic skills.

The syllabus and compiled textbooks during this period focused strongly on "Two Basics" (i.e., basic knowledge and basic skills) in mathematics instruction, which has had a significant influence on Chinese mathematics education.

The textbooks steadily strengthened the fundamental knowledge and basic training of students. The textbooks

also had many other distinctive characteristics, such as including substantive content and rigorous theories, presenting a reasonable arrangement with careful teaching guide, focusing on key concepts and important knowledge, spreading difficulty points and providing adequate exercises (Wang 2013; Zhang 2011a). These characteristics were thought to ease their use in teaching and learning. Furthermore, in order to help the students to have a solid grasp of the "Two Basics" and the three major capabilities mentioned above, the textbooks in this period emphasized the clarifying of concepts and principles, highlighting important knowledge, paying attention to students' common difficulties and providing adequate exercises. Such requirements were put into practice in classrooms and this enhanced the "Two Basics" tradition of Chinese mathematics education (Zhang et al. 2004).

3.3 Open debates during this period

After the PEP textbooks had been introduced officially into schools, the PEP asked for feedback. Most opinions focused on the depth of mathematics content. It was argued that there was too much content and it was too difficult, which put a heavy learning burden on students (e.g., Zhu 1960). The problem was that some complex but unnecessary content was brought into the textbooks while the PEP strengthened the training of basic knowledge and basic skills. In plane geometry, for instance, the texts included tasks involving construction with ruler and compasses that were believed worthless. Many classroom teachers complained that the textbooks offered many difficult and useless examples and exercises (Wei and Zhang 1996).

Some other feedback criticized the textbooks as short on presenting practical or real content, for example, bookkeeping, statistics, or three-view drawing. Following this feedback, MOE entrusted the PEP to investigate the use of textbooks in order to have better preparation for their upcoming modification.

From 1966 to 1976, China experienced a period of political unrest period called "The Cultural Revolution". The then Chinese chairman, Mao Zedong, criticized the traditional, academic and organized education system. As a result, mathematics education at that time became objectless, self-guided and without structure. During this period of time, there was no unified syllabus and there were no principles for compiling textbooks available for the whole nation. All the textbooks mentioned above were no longer used. Instead, all provinces were allowed to write their own textbooks, which eventually evolved as political documents. According to Huang (2011), mathematics textbooks at that time provided many tricky questions and overemphasized applications to manufacturing and labouring with no "systematic view", which hindered students' development. Mathematics education in China was overall destroyed. The "Two Basics" were significantly weakened and students' performance in mathematics declined dramatically (Wang and Zhang 2013).

4 Compiling the unified textbooks at the beginning of the reform and opening-up (1977–1988)

4.1 Background

After 1976, it was eventually recognized that throwing away tradition while refusing to learn from others destroyed cultural and social development thoroughly. Since then, China has implemented an "open-door" policy aimed at realising Four Modernizations in industry, agriculture, national defence, and science and technology. In order to meet the needs of these Four Modernizations, China recognized that reform in the realm of education was essential (Xu and Huang 1988). The Chinese government pointed out that textbooks should be a reflection of the culture of modern science in accordance with the Chinese situation. It was believed that teaching content in schools should emphasize modern scientific knowledge, with regard to students' learning capabilities (Chinese Literature Editorial 1990).

These ideas about modernisation permeated the construction of a new syllabus. In 1978 "Mathematics syllabus for elementary schools" and "Mathematics syllabus for secondary schools" were published and implemented nationwide. The syllabi explained the function of mathematics teaching as follows:

"The study of mathematics forms the indispensable foundation and basic tool for the study and research in modern scientific technology. It also plays a significant role in helping to build our country into a modernized socialistic superpower in agriculture, industry, national defence and scientific technology". (Leung 1987 p. 36).

During that period of time, the PEP did some investigative studies on mathematics textbooks from Japan, USA, England, France, and Germany. The essential aims were to understand how these textbooks arranged and organized basic knowledge of modern mathematics and science (Wei and Zhang 1996). Moreover, different groups of university researchers, mathematicians, and teachers were invited to be involved in the discussion of the development of the mathematics syllabus and textbooks (Wei and Zhang 1996).

4.2 The features of the development of the mathematics textbooks

The development of the mathematics textbooks directly aimed at realizing the national goal of the Four

Modernizations in this period. So the syllabus for secondary schools paid primary attention to how to change mathematics content from a modernization viewpoint. The essential principles were "condensed, incremental, and penetrative," which also provided a guideline for compiling textbooks for the time being (Zhang and Cai 1981; Zhang and Zuo 2009). In particular, "condensed" means that textbooks should select basic mathematical knowledge necessary for participation in industrial and agricultural construction as well as for the learning of modern technology. "Incremental" emphasized that the basic knowledge of calculus, statistics, and the Algebra of Logic (mathematical knowledge about computers) should be added in. Mastery of the relevant knowledge is necessary for directly engaging in construction of society and learning about modern technology. "Penetrative" suggests that the basic ideas about sets and correspondence should permeated the textbooks, which is valuable for the understanding of teaching materials and the preparation of further learning.

The textbooks published in 1978, for example, reflected these principles. The concept of functions was described using the ideas of set and correspondence with the ideas gradually being introduced step by step. In other words, at the lower secondary school level, the concept of functions is much more descriptive than had been the case previously. The related knowledge, such as correspondence, domain, range, and notion of a function $f(x)$, would be explored in depth after the basic knowledge about sets and correspondence had been taught in the 10th grade (PEP 1979). The topic of function ran through the mathematical content of upper secondary schools, becoming a characteristic of this set of textbooks (Institute of Curriculum and Textbooks 2010).

In order to meet the needs of the Four Modernizations, the syllabus for elementary schools also put forward the teaching objectives around modernization of elementary school mathematics. To summarize, the Chinese objectives in elementary school mathematics teaching were: (1) to enable pupils to understand and grasp the basic knowledge about quantitative relationships and spatial form; (2) to enable pupils to deal with the four arithmetic operations of whole numbers, decimals and fractions; to have basic understanding about some simple modern mathematical thinking, and to possess preliminary abilities of logical thinking and spatial concepts; and (3) to enable pupils to solve simple practical problems from daily life using learned knowledge. Through intuition, pupils could face some modern mathematical ideas about sets, functions, and statistics, as early as possible.

4.3 Open debates during this period

To meet the requirements of political and economic change, the newly compiled unified textbooks started to be used in schools in 1978 without sufficient investigations into whether they would be suitable for the actual teaching and learning situation. Most school teachers were at a loss about what to do when teaching the content related to newly-introduced concepts such as sets, mapping, determinants and derivatives (Zhang 2011a). Consequently the mathematics textbooks were modified completely in 1981, and some content, such as calculus and probability, was organized as an elective component which was not examined in the university entrance examination. Therefore, some teachers gave up teaching such content and put much time into training students to prepare for examinations. As Sun (2013) commented, such a usage of textbooks is mainly targeted at helping students achieve high scores in the entrance examination. Since then, the development of mathematics textbooks has always needed to deal with the challenge stimulated by the examination-oriented education that reflects the Chinese traditional education ideal (Siu 2004). In reality, passing the examinations is the most important target of mathematics education so becomes the center of all teaching activities. However, this phenomenon holds back the development of mathematics education (Sun 2013).

5 Compiling and implementing the textbooks for the compulsory 9 year education (1989–2000)

5.1 Background

With the recognition that an educated citizenry was essential to economic progress, China adopted the goal that by the year 2000 all students would complete 9 years of compulsory education (Zhu and Eula 1991). As a first step, the "People's Republic of China Compulsory Education Law" was promulgated in 1986. Both elementary schools and lower secondary schools belong to compulsory education, while the upper secondary schools provide a higher level of fundamental education. Based on the requirements of compulsory education, the "Mathematics Syllabus for Nine Years Compulsory Education" was published in 1988 and became the unified syllabus in 1992, with different textbooks being developed accordingly. In contrast with the earlier syllabus, this syllabus of mathematics education had changed in its aims, content and methods.

In order to meet the educational policy in this period, it was emphasized that the quality of education should be enhanced extensively, and a diversity of elementary school and secondary school textbooks were developed. In 1996, a new curriculum plan and syllabus for Chinese upper secondary schools were promulgated to accompany the compulsory 9 year education. Trialing of the new textbooks began in the fall of 1997 and ended in 2000. After revision, the new textbooks were put into use nationwide.

5.2 The features of the development of mathematics textbooks

5.2.1 *Establish a system of mathematics textbooks development*

Since 1989, MOE has approved that different publishing houses could compile and publish mathematics textbooks based on the unified syllabus. Different textbooks that followed their own differentiated styles could be used in schools, which indicated that the political situation of "one syllabus, one textbook" had been changed and MOE opened up as the authority for approving textbooks. During the period 1989–2000, eight sets of mathematics textbooks for junior secondary schools and three sets of mathematics textbooks for senior secondary schools were developed by different publishing houses and approved by MOE (Zhang and Zuo 2009).

To support quality in these diverse textbooks, China established a system of mathematics textbook development. Different institutions were responsible for publishing and reviewing textbooks (Zhang 2011a). The "Review Committee of National Elementary and Middle School Textbooks" was founded in September 1986 with a subcommittee responsible for reviewing mathematics textbooks. This sub-committee set the procedure for reviewing the syllabus and textbooks. It also specified the standards of reviewing the schema, content, exercises and homework, and the compilation quality of the textbooks.

5.2.2 *Change aim and content of mathematics textbooks in order to enhance the populace's cultivation*

During this period, the aims and content of mathematics textbooks was again changed. The emphasis was that "students should learn the basic algebra and geometry knowledge and skills which are necessary for every citizen to adapt to daily lives, to take part in producing activities, and to be able to do future learning" (Wei and Zhang 1996, p. 342).

Regarding this aim, geometry content, for example, was changed while the structure of Euclidean geometry was maintained. The mathematics syllabus published in 1992 stipulated that "geometry for lower secondary schools combines logicality with intuition; the teaching of geometrical properties, construction and operation promotes the development of students' abilities of logical thinking, spatial visualization and operation, and enables students to grasp basic methods in dealing with geometrical graphs" (Institute of Curriculum and Textbooks 2001, p. 617). Hence, the system of Euclidean geometry remained embodied in geometry teaching in China.

In order to cultivate students' capabilities to engage in logical reasoning, the textbooks arranged the tasks for reasoning and proof in a much more structured manner than prior to 1989. For example, the tasks for reasoning and proof in the "Triangle Unit" were divided into five steps. The "Quadrilateral Unit" began with asking students to prove propositions, which comprised many knowledge points, using a synthetic method followed by invoking their reasoning processes based on postulates, as well as finding solutions and proving theorems. The "Similar Figures Unit" required students to develop their explorative methods. As Cai (1994) has suggested, students should not only explore solutions based on prerequisites, but also discuss the postulates on the basis of solutions and figures.

Even so, the issue of how to arrange modern mathematics content in China, including topics such as calculus, probability, and statistics, is still in debate and under experiments (Zhang 2012).

5.3 Open debates during this period

Gaps between idealistic reform and realistic effects were observed. Sun and Han (1999), for example, argued that the textbooks provided only minimal application of mathematics knowledge in daily life despite a "Practical Task" unit being set up in textbooks. Furthermore, they found that most tasks included in the unit were still similar to the regular exercises, which was far away from doing mathematics in practical situations. Other debates focused on reducing the difficulty level of the courses' content in order to meet the needs of all students. Several researchers criticized such changes for going too far in reducing the content difficulty and the level of logical reasoning (e.g., Fang 2000; Zhang 2008). For example, Fang (2000) mentioned that in geometry textbooks some complex problems were already omitted, such as trajectory problems and the nine concyclic points problem. According to Fang, logical reasoning in geometry should not be weakened. Besides giving criticisms, some researchers (e.g., Deng 1997; Fang 2000; Ma 2000) also provided suggestions on how to modify textbooks concerning their structure. Liu (1999), for instance, advised that textbooks should pay attention to mathematics knowledge structure, as well as students' cognitive structure. Zhang (2010) remarked that textbooks should highlight the importance of the integration of knowledge and method. These hot debates, together with suggestions, spurred a call for a new reform.

6 The development of *Standards*-based Chinese mathematics textbooks in the twenty-first century

6.1 Background

In the twenty-first century, the Chinese government has changed education with the tasks of deepening education

reform, optimizing the education structure and pushing forward the implementation of quality education (Pan 2005). In other words, education should foster all kinds of professional talent which coincides with the needs of social development. With regard to the earlier debates about the questionable education reality, a number of investigations have been carried out to scrutinize the issues arising from mathematics teaching. This situation has initiated a new round of curriculum reform in China since 2000. MOE published *Mathematics Curriculum Standards for Compulsory Education* (*The Trial Version*) [*MCS*CE (trial)] (MOE 2001), and *Mathematics Curriculum Standards for Senior Secondary Schools (The Trial Version)* [*MCSSSS* (*trial*)] (MOE 2003), respectively. The curriculum reform aimed not only to change curriculum content, but also to renovate its principles, goals, and methods of implementation and evaluation in order to achieve an ultimate goal: promoting the general progress of all students (Ma et al. 2013).

It is the first time in China that the concept of Standards has been used. Standards are oriented to students' development and describe what students have to learn and understand in order to develop. In contrast, a syllabus has an orientation to mathematics content and describes what teachers have to teach. "The ongoing 'standards-based education reform' specifies the mathematics knowledge and ability requirements for students and advocates enhancement of students' conceptual understanding, basic skills, problem-solving simultaneously and improvement of teaching quality" (Li et al. 2009, p. 743).

6.2 The features of the development of mathematics textbooks for compulsory education

Compulsory education in China consists of nine grades. MCSCE (trial) formulates the general objectives of mathematics education including acquiring a good command of basic mathematical knowledge, being able to solve problems encountered in daily life using a mathematical approach, and possessing a creative spirit and practical abilities (MOE 2001).

The objectives aim at promoting the overall development of all students and all-round development of each student. Based on such general objectives, MCSCE (trial) stipulates that curriculum content for compulsory education should cover four domains, namely "numbers and algebra", "space and figures", "statistics and probability", and "practice and integrated applications". The content of these four domains are the outcome of supplementing, reducing, classifying, and integrating the content of the former syllabus.

MCSCE (trial) emphasizes that textbooks should stem from nature, society, phenomena in science; and practical problems. For example, concerning the content of statistics and probability, contexts of textbooks should provide real examples of modern life. Problems from newspapers and magazines, television, and other media broadcasts, as well as computer networks, can be used as teaching materials.

Textbooks compiled earlier have paid too much attention to the drilling of the "Two Basics", which restricted students' development in mathematizing abilities, and creativity and critical thinking. Based on MCSCE, textbooks provide students with learning environments that facilitate their engagement in active inquiry in mathematics. MCSCE also announces that textbooks should reflect a certain degree of mathematical values, and display the interrelationships of different content areas. Teachers should guide students to start from the knowledge and experiences they have already acquired to engage in autonomous exploration and cooperative learning, as well as to learn how to learn during the learning processes (Li et al. 2009; Zhang 2011a).

Based on MCSCE (trial), there are six sets of textbooks for primary schools with each consisting of 12 volumes, and nine sets for junior secondary schools with six volumes each. It can be seen that different textbooks authors followed different writing principles and arranged content and exercises in different ways while still adhering to the general guidelines of MCSCE (trial). Thus, different textbooks are different from each other in terms of teaching and learning philosophies embedded (Ma et al. 2013).

6.3 Open debates during this period

Different opinions have emerged regarding the structure and revision of textbook content. The hottest debate regards geometry. It was observed that the MCSCE-based textbooks excluded the word "geometry" with replacement by a vague concept of "figure". This phenomenon changes the traditional geometrical reasoning system in the old curriculum by combining plausible reasoning with deductive reasoning (Ma et al. 2013; Wang 2005). Jiang, a famous mathematician, criticized this practice and indicated that, without plane geometry in the curriculum, "students will lack scientific spirit and competencies in generalizing, summarizing, and abstracting and, thus, they will not be properly prepared for learning solid geometry and more complicated figures" (Jiang 2005). Teachers have also hotly disputed the textbook-compiling principles. The Standards proposed applying the spiral principle in developing textbooks. After using such textbooks, teachers argued that through this principle, mathematics content would be divided into isolated pieces of knowledge. Students hardly obtained a systematic view of the holistic structure of mathematics. They did not know the relation between "why" and "what" in the content (Xu 2007).

Such debates based on experiences and observations aroused a series of investigations in order to prepare for the further revision. The revised version of MCSCE promulgated by the MOE of China was published in 2012.

7 Concluding remarks

7.1 Strong influence of political and economic affairs on developing mathematics textbooks in China

Throughout the development of mathematics textbooks in China, mathematics textbooks have possessed political and economic imprints; particularly, the political situation has influenced the way in which mathematics textbooks are developed.

At the beginning of the foundation of the People's Republic of China, for example, the intimate political relationship with the former Soviet Union resulted in China's direct adoption of the Soviet Union's mathematics textbooks, including syllabus and content, without considering the educational reality in China. Immediately after the political relationship was broken, mathematics textbooks were changed thoroughly.

Since 1977, economic development became the most important and influential factor in the development of textbooks. As Rezat (2006) remarked, textbooks can be regarded as an artifact produced for certain ends and used with particular intentions. In the case of China, textbook developers had to consider how to change the mathematics content of textbooks in order to meet the Four Modernizations policy. Some modern mathematics topics, such as calculus and probability, were included in textbooks, although a large gap existed between content and readers' acceptability. The development of mathematics textbooks changed dramatically from one time to another rather than in a continuous manner.

7.2 Development of mathematics textbooks with traditional cultural imprint

The mathematics textbook is culturally formed; in other words, the mathematics textbook has a strong cultural imprint. Even if the syllabus and corresponding textbooks have been changed in the consideration of political requests, the heated debates summarized above focused on the traditional understanding of mathematics which must be systematic, logical, and well-structured. If mathematics textbooks have tangled structures, jumbled logic and divided content, they work against students' mastery of knowledge as well as the development of their capabilities (Zhang and Zuo 2009). Most debates have paid attention to content change and concerned the difficulty level of the content. The public debates often promoted the change in the development of mathematics textbooks.

7.3 Competence-oriented development of mathematics textbooks

As summarized above, in the twenty-first century the development of mathematics textbooks in China emphasized the cultivation of mathematical capabilities. The kernel capabilities, originally including operations, logical reasoning, and spatial imagination, have been extended. The newly-revised MCSCE by the MOE highlights basic capabilities, including the sense of numbers and symbols, spatial concepts, geometric intuition, consciousness of data analysis, abilities of calculation and reasoning, and the idea of modeling (MOE 2012). The new development of mathematics textbooks in China attaches importance to the different roles of mathematics textbooks in relation to teaching and learning which is emphasized by researchers (e.g., Remillard 2000; Rezat 2009; Schmidt 2012; Shield and Dole 2013; Straesser 2009).

7.4 Enhancing research-based analysis of mathematics textbooks

From reviewing the literature, it is apparent that in China there are many results or opinions about mathematics textbooks that are based on experiences or observations (e.g., Gu and Zhang 2012; Kong 2011; Wu and Qin 2013) but lack rigorous research methods (He and Gong 2012). In addition, it is important to investigate Chinese mathematics textbooks based on an international comparative study. In this way, it should be possible to have a better understanding of China's particular situation.

In recent years, some researchers have engaged in comparative studies on mathematics textbooks (e.g., Fu and Zhang 2007; Shen and Guo 2010). Furthermore, the Education Division of the National Social Science Foundation of China has funded the major project, "Cross-National Comparison of Senior High School Mathematics Textbooks". The project is led by Prof. Jianpan Wang from East China Normal University (ECNU). According to Wang (2011), the project consists of comparative studies on the organization and representation of the kernel content (e.g., Chen 2011; Li 2011; Ye 2011), comparative studies on the textbook design for the basic targets of mathematics instruction (Shao 2011; Zhang 2011b), comparative studies on the characteristics of mathematics textbooks (Bao 2011), and comparative studies on the application of modern information technology in mathematics textbooks (Xu 2011). The project began in 2010 and some of the sub-studies have achieved meaningful results. For instance, Chen and Yu (2012) developed a research framework and

selected one Chinese and one Japanese textbook in order to compare the organization and representation of probability in the books. The comparison showed that there are more knowledge points regarding probability in the Japanese textbook than those in the Chinese textbook. Focusing on the same probability content, it was clear that the degree of difficulty of this content in the Japanese textbook is higher than that in the Chinese textbook.

Xu (2012) investigated the organization and representation of inquiry content in mathematics textbooks using an analytic index framework developed by the project team. The preliminary findings indicated that German textbooks focused on designing real world problems and constructing peer/group activities; Chinese textbooks paid attention to designing open-ended questions and representing problems with interrogative sentences; UK textbooks put importance on designing team work. In short, it is important to make good use of the insights gained from comparative studies for a better preparation of the development of mathematics textbooks.

In sum, the 60-year development of Chinese mathematics textbooks has witnessed the growth of Chinese mathematics educators, from imitation in 1950s–1960s, modification in the 1970s–1980s, self-design in the 1990s–2000s, to further advance with the times in the new millennium. During these efforts, Chinese mathematics educators have experienced both successes and failures. More importantly, they have learnt, and will continue their exploration and practice process in search of promising theories and practices suitable for Chinese students' mathematics learning.

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