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Examination of Mathematics Intended Curriculum in China From an International Perspective*

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This study aimed to examine and track the transformations in the mathematics intended curriculum during the latest reform in China from a neutral and objective perspective. Following the document analysis used in TIMSS (the Third International Mathematics and Science Study), the results indicated that a more modern system of mathematics knowledge had been constructed after the reform and the curriculum standard emphasized more on its facilitating role. Compared to TIMSS top-achieving countries and regions, it found that the pattern of topics in curriculum guide in China exhibited a similar coherent pattern to those high achieving countries but more concentrated. Moreover, the decentralization in the curriculum standard was unable to figure out the pattern of topics on the intended curriculum level. Lastly, the influence of decentralization in the curriculum standard was discussed.

Keywords: intended curriculum, mathematics, curriculum guide, curriculum standard

Introduction

Advances in information technology have lives changed dramatically. To prepare next generation for the future in the new millennium, countries had paid close attention to their own curriculums at the end of last century. In 1980s and earlier, education reform was witnessed in many countries (Lewin, 1985; Wang, 2010). The TIMSS (the Third International Mathematics and Science Study) revealed that 25 countries out of 36 had initiated national mathematics curriculum reforms in the early 1990s (Schmidt, Mcknight, Valverde, Houang, & Wiley, 1997). Reform efforts have produced a renewed interest in focusing on content standards—the intended curriculum. China has begun its latest curriculum reform in basic education since 2001. Shanghai, one of the four municipalities directly under the central government who using the same curriculum standard as the rest of regions in China, took part in the PISA (Program for International Student Assessment) in 2009 and ranked first in mathematics in the all the participating countries and regions (OECD (Organization for Economic Co-operation and Development), 2011). Its outstanding performance in PISA attracts more and more

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interests in Chinese intended curriculum.

Researches on Intended Curriculum

The intended curriculum, an important concept in the tri-partite model of curriculum, has been employed in many studies of the IEA (International Association for the Evaluation of Educational Achievement). In this model, curriculum is divided into three layers: the intended, implemented and attained. The intended curriculum defines what a system expects students to learn (Schmidt et al., 1997). The study of intended curriculum would have far-reaching implications, because only by setting up ambitious curriculum intentions will students have the opportunity to attain high levels of achievement (Valverde, Bianchi, Wolfe, Schmidt, & Houang, 2002). The analysis of the materials about the intended curriculum, such as policy documents, curriculum guides/standards, syllabi, textbooks and related materials would provide a glimpse of curriculum intention. These materials published by the local or central government reflect the aims, intentions and viewpoints of the policy-makers officially and directly. The textbook, interpreted by the authors, maybe considered as a partial and indirect manifestation of the potential intended curriculum. It may be appropriately viewed as the bridge between the curriculum intention and implementation and was leveled out from intended curriculum to become a single level named potential implemented curriculum (Schmidt et al., 1997).

In 1988, the Education Reform Act required a national curriculum and assessment system to make sure that all the students could be examined at the end of four key stages in England. The National Curriculum Assessment has functioned in England for more than 20 years and provided the government and public great information about the curriculum standards (Whetton, 2009). Researchers in the United States have also dug deeply in the curriculum in the past 30 years. The standard-based reform was fostered when the demand of higher quality public education became apparent (Smith, 1990). Ball and Cohen (1996) found that changes in mathematics teaching mainly depended on revision of curriculum materials. Researchers specialized in curriculum and policy-makers concerned about the US curriculum standards compared to other top-achievement countries' curriculum standard. Through exploring the TIMSS data, Schmidt, Wang, and McKnight (2005) found that the content topics in TIMSS top-achievement countries and regions showed a coherent pattern sharply contrasting with the pattern of laundry lists of topics with longer stay in more grades, but lack of coherence both in American's national and state content standards. Still, a large number of researchers and organizations concentrated on the quality of state standards as well (Clements, 2007; Porter, Polikoff, & Smithson, 2009). Their researches got the similar conclusions.

The Latest Curriculum Reform in China

Background

As we know, China mainland rarely took part in the international mathematics assessment except Beijing in 1989 IAEP (International Assessment of Educational Progress) and Shanghai in 2009 PISA. In 1989 IAEP, on non-routine problem-solving, students from eight countries performed better than Chinese students did, though they were on the top of overall performance in all the countries (Fan & Zhu, 2004). However, in 2009 PISA, Chinese students performed best no matter in overall performance or high level of proficiency in all the participating countries and regions (OECD, 2009). The latest curriculum reform was carried out between the two assessments, which brought changes into every aspect of curriculum.

Although there have been regular curriculum reform efforts in China, little has been known to the outside world. Only very few essays briefly introduce the latest curriculum reform in recent years (Huang, 2004; Hu, 2008; Wei, 2009; Xu, 2009; Li & Ni, 2011; Ni, Q. Li, X. Li, & Zhang, 2011). Since the reform and opening-up policy carried out in 1978, the connection between China and the rest of the world is much closer and inseparable in every aspect. Since 1990s, the rapid development of economics and the popularization of information technology have influenced the education policies in every nation in the world (Dale, 1999; Huang, 2004; Singh, 2004; Liu, 2009; Zhong, 2008; Teodoro & Estrela, 2010). China is a nation with more than 5,000-year history. The increasing demand of balancing the globalization and traditions drove education policy-makers to concern about how the curriculums could achieve the sustainable development for the young. It was in this backdrop that China began to prepare for the latest curriculum reform.

The Preparation for the Latest Curriculum Reform

In 1996, Ministry of Education conducted a survey in nine provinces as the beginning of the preparation for the latest curriculum reform. Nearly, 16,000 students in grades 1-9 and about 2,000 teachers, principals and communities were investigated. It revealed several urgent problems. Taking elementary school mathematics for example, about 57% of principals and 46% of teachers reflected that there were too many required topics. Nearly 60% of principals and 40% teachers agreed that some topics, too difficult and obsolete, were inappropriate for students' development. Still 30% of principals and 50% of teachers complained about the insufficient teaching time for required contents. Especially up to 48% of principals reported that for the lack of teaching time, teachers failed to achieve the requirements in the curriculum guide and were hard to finish all the contents in textbooks.

Since 1998, in preparation for curriculum reform, researches about curriculum quality have been conducted at different levels, from school, district to the central. The decision of deepening educational reform and all-round pushing quality education issued in 1999, required reform of the curriculum organization, construction and content to establish a new basic education curriculum system and encouraged the three-class (the central, local and school levels) curriculum mode. By April 2000, the drafts of "National Curriculum Standards" of all subjects in basic education had been completed by the collaboration of experts in curriculum and education practitioners. In the following four months, opinions were solicited from different sectors of community (Zhong, 2008; Zhu, 2002).

Through years of preparation, the latest national curriculum reform in China started as the publication of the "Guideline for Curriculum Reform in Basic Education" (draft) by Ministry of Education in June, 2001, which has brought substantial changes to every school, teacher and student (Xu, 2009). The "National Curriculum Standards" (draft) for all subjects came into effect in 38 trial areas in September, 2001. The percentage of students who were taught by "National Curriculum Standards" was between 10%-15% in 2002 and expanded to 35% one year later. It was not until 2005 that all the students in the beginning grade in elementary, middle and high schools were taught according to the new curriculum standards and used counterpart textbooks.

The Mathematics Intended Curriculum for Elementary School

In each curriculum reform, the intended curriculum always attracted most attention, because any minor change would cause series of transformations in the whole curriculum system. The mathematics curriculum guide used before this reform, over-emphasizing on the knowledge, called two basics (basic knowledge and basic skill) in Chinese leading teachers to excessively focus on the content which resulted in refined lectures and repeated practice in instruction (Zhang, Li, & Tang, 2004; Ni, Q. Li, X. Li, & Zhang, 2011). Proficiently in mastering of the two basics, students dealt with word problems accurately and efficiently and were more likely to solve problems by abstract strategies (Cai & Hwang, 2002; Cai & Cifarelli, 2004; Cai & Lester, 2005). What is more, the mathematics education before the latest reform was criticized as examination-oriented emphasizing abstract knowledge, teaching according to the examination requirement and ignoring students' attitude and emotion. It resulted in rote-memorization and drilled mechanically in teaching and learning. Students were labeled with "high score low ability" those who scoring high in tests cannot generalize the particular knowledge beyond the classroom into real life. What is even worse, the passive attitude, even phobia and disgust towards mathematics was fostered among students due to the boring assessment. Such outcome was completely antithetical to the original goal of curriculum designers.

In order to increase students' interests and develop their positive attitude and value toward subjects, the "Guideline for Curriculum Reform in Basic Education" (draft) clearly required changes in the curriculum from over-heavily weighted on pure subject-based knowledge to more comprehensive and application of knowledge (Ministry of Education). The new intended curriculum should explicate objectives operationally, regulate contents and outline principals for curriculum implementation, acquirement and evaluation generally (Huang, 2004). After the reform, the name of intended curriculum—"National Curriculum Standard" replaced curriculum guide in Chinese in all subjects. The mathematics "National Curriculum Standard" is not only the fundamental standard specifying topics to be taught, directing the textbook compilation and examination, but also the basic criterion for curriculum implementation and evaluation (Yu, 2007). Emphasis was laid on the minimum requirements of the subject knowledge, performance expectation, emotion, attitude and value towards subjects instead of two basics emphasized before (Huang, 2004). Through the reform, a brand new three-dimension mathematic knowledge system was constructed. By constructing such a multi-faceted system, the mathematics "National Curriculum Standard" aimed to establish the role of students as the positive active participants, a departure from mechanistic rote learning before, and to develop their capacities in communication, acquiring new knowledge and solving problems instead of becoming passive receptionists. Therefore, an active interaction and equal-dialogue relationship between teachers and students could be established eventually which was thought as the realization of quality education (Cui, 2009).

The Purpose of the Study

In 2010, State Council issued the "Outline for Medium and Long-Term Development and Reform of Education", which proposed the scheme of education development in the next decade. It has been 11 years since the latest curriculum reform. Now in China, "National Curriculum Standard" of all subjects have been revised and published in February, 2012. It should be admitted that the reform in curriculum is a sustained topic and how to improve the curriculum quality is under the spotlight. There were kinds of studies about the efficiency of the reform on mathematics. However, none of them focused on the intended curriculum. They paid more attention to teacher instruction and students' achievement and mentioned it in a descriptive way as their study background (Li & Ni, 2011; Ni, Q., Li, X., Li, & Zhang, 2011). In fact, setting up a high quality intended curriculum, especially under the centralized curriculum system in China, is the primary and vital step in the whole process.

Since the mathematics "National Curriculum Standard" carried out, there has been a debate about the efficiency of the reform. Based on the TIMSS framework, this study tried to examine and track the transformations in the mathematics intended curriculum during the latest reform from a neutral and objective perspective. Under the guidance of the new ideal of this curriculum reform, exporters had renewed the knowledge system of mathematics thoroughly. What the changes are in the mathematics intended curriculum for elementary school during the reform is the first problem the study try to answer. On accounting of its increasing importance in the world, China began to focus on the “World-Class Content Standard” to prepare the young for a better future life. Compared to those top-achieving countries in TIMSS, what the characteristics of intended curriculum for elementary school are that in China both before and after the latest reform is another question the study concerned.

What should be clarified is that the textbook was not included as the intended curriculum in the study. Because it was not until the latest curriculum reform, any individual or institute has been authorized to compile, publish and distribute textbooks nationally or locally after approval by the central or the local levels. The textbook was not authoritative, as before any more. The work of textbook compilation has been highly valued in China. PEP (People’s Education Press) was the only organization in the whole country responsible for the compilation of textbook for basic education before 1988. Since then, the Ministry of Education began the trial on textbook diversification. A very small number of provinces and cities, such as Shanghai were authorized to compile their own textbooks. Though there were numerous trials on the diversification of textbooks, still most teachers and students in China uniformly used the textbooks published by PEP. However, after the latest reform, the Examining and Approving Office of Teaching Material of Basic Education under the Ministry of Education (2001) reported that there were six series of mathematics textbooks allowed to be published in national wide, while great amount of textbooks were used locally. Facing the same curriculum standard, different compilers may have various interpretations and arrangements. It can no longer reflect the intention of intended curriculum designers as directly as before.

Method

Two graduate students took part in the coding work. They firstly attended one-day training to learn the document analysis, which firstly used in TIMSS (Robitaille, 1993; Schmidt et al., 1997). This method divided the document into units with six types (introduction to guide, policy, objective, content, pedagogy and other), and then further divided each unit into blocks with seven types (official policies, objective, content element, pedagogical suggestions, examples, assessment suggestions and other). In TIMSS, each block was labeled according to the TIMSS mathematics framework. However, in present study, only the block of content element was required to be labeled.

Then, they were required to code the curriculum guide published in 1992 for trial. After that, an expert in mathematics education and an elementary school math teacher reviewed their coding results. Lastly, all the disagreements were eliminated through the discussion among the four-person group to make sure the two coders could finish the coding under the same criterion. The inter-rater reliability was 0.985.

Lastly, two coders began the coding work officially. Both the Mathematics Curriculum Guide (revised in 2000) and “Mathematics Curriculum Standard” (published after the reform) that used for elementary school were analyzed. Coder A was responsible for dividing the structure of curriculum guide and labeling the curriculum standard structure while code B for labeling the curriculum guide and dividing the structure of curriculum standard. Moreover, in analyzing curriculum standard, the coders found that a considerable number of blocks about the suggestion for textbook compilation are not listed in the TIMSS analysis framework.

Therefore, the block of suggestion for textbook compilation was separated as a new block in the study.

Results

Documents' Structure

The result of unit structure is presented in Table 1. There were seven units in the curriculum guide and five in curriculum standard, respectively. Neither of the documents had the policy unit. There were two content units in the curriculum guide, because two schooling tracks (five-/six- year elementary school) coexisting in China and topics were designed for the two tracks, respectively. For the usage of grade band instead of grade level, all the grades in the primary school were divided into two grade bands: grades 1-3 and 4-6 (5, for five-year track) in curriculum standard. Both tracks were included in the grade bands. Thus, there was only one content unit. In order to make the comparison between curriculum guide and curriculum standard, only the content unit of six-year track in curriculum guide was analyzed further. There was no obvious change in the structure of units after reform. However, the space distributed to each type of units varied. The curriculum standard devoted space to the pedagogy unit at the cost of reducing space of the content unit. The percentage of pages occupied by the rest types of units increased as well.

Table 1
Unit Structures of Curriculum Guide and Curriculum Standard

Unit type	Curriculum guide		Curriculum standard	
	N	Pages occupied (%)	*N*	Pages occupied (%)
Introduction to guide	1	2.1	1	8.2
Policy unit	0	0	0	0
Objective unit	1	4.2	1	6.6
Content unit	2	77.1	1	32.8
Pedagogy unit	2	14.6	1	47.5
Other unit	1	2.1	1	4.9
Total	7	100	5	100

The result of block structure is displayed in Table 2. Neither curriculum guide nor standard provided space for official policies. Objectives and content elements were dominant in curriculum guide, which occupied more than 95% blocks. Nevertheless, there were substantial adjustments in curriculum standard. Two types of blocks, examples and the suggestion for textbook compilation appeared for the first time. Though decreased about 10%, the content element was still the main part, while the percentage of the block of objective declines dramatically from 42.6% to 17.4%. Compared to the curriculum guide, the total percentage of objective and content element was cut into 58.7%, the sum of percentages of pedagogical suggestion, assessment suggestions and suggestions for textbook compilation were increased from less than 5% in the curriculum guide to nearly 40% and the proportion of examples was above 20%.

There were some moderations in the curriculum standard. Firstly, in the curriculum guide, the statements of content and expectation performance listed separately at block level. In each grade, the guide specified the topics firstly, and then the expectation performance for those contents, while the curriculum standard stated content and its expectation performance simultaneously. Secondly, it was not until the latest curriculum reform in 2001, the emotion, attitude and values began to be as important as contents and performance expectation. However, the curriculum guide revised in 2000 began to pay attention to this dimension by adding a new block at the end of each grade that was unavailable in the Curriculum Guide published in 1990. In the Curriculum Standard, the mathematics was divided into four areas: number and algebra, space and shape, statistics and probability and practical activity in first grade band or comprehensive application in the second grade band. The forth area is the third-dimension that clearly required to provide opportunities for students to communicate and cooperate with others to experience the mathematics, gain confidence through solving problems by comprehensive application mathematics and realize the importance of mathematics in real life.

Table 2
Block Structures of Curriculum Guide and Curriculum Standard

Block type	Curriculum guide (%)	Curriculum standard (%)
Official policies	0	0
Objective	42.6	17.4
Content element	52.5	41.3
Pedagogical suggestions	4.3	5.9
Examples	0.0	21.7
Assessment suggestions	0.6	4.0
Suggestion for textbook compilation	0	7.8
Other blocks	0.6	1.9

Curriculum Content

All the topics in the curriculum guide and standard were coded according to the content dimension of TIMSS mathematics framework. The result is showed in Figure 1. The topics required by grade band instead of grade in the curriculum guide meant that they could be taught at any grade in the same grade band and connections between specific topics and grades and duration of topics were no longer required. Therefore, it cannot be determined that how those topics distribute among grades and is impossible to make the comparison of the two documents directly. After aggregating topics in six grades in the curriculum guide into two grade bands, it found both the numbers of topics required in two grade bands increased from 11 and 25 in curriculum guide to 17 and 28 in curriculum standard respectively. There were six new topics added in the standard (estimating quantity and size, measurement estimation and errors, coordinate geometry, patterns relations and functions, uncertainty and probability, and map and direction), while rounding and significant figures and abacus computation were deleted. Moreover, the word problem was no longer listed as a single topic and was required in the curriculum standard with other topics simultaneously. There were moderations of the left topics after the reform. The topic of decimal fractions, transformations and data representation and analysis were begun to be required in the first grade band, while constructions using straightedge and compass were only required in the second grade band.

After aggregating topics in six grades of TIMSS top-achieving countries and regions into two grade bands, it found that the numbers of topics required in two grade bands in TIMSS countries and regions (15 and 25, respectively) were fewer than the numbers required in the curriculum standard, respectively. All the results about top-achieving countries and regions can be found in another article published in 2005 (Schmidt et al., 2005). Except for rounding and significant figures, the rest topics covered by those countries in two grade bands were all required in the curriculum standard. Topics of properties of whole number operations, relationships of common and decimal fraction and equation and formulas were required by TIMSS top-achieving countries and regions in the first grade band but only required in the second grade band in the curriculum standard in China. However, the requirements of topics of measurement, estimation and errors, three-dimension geometry and transformation were on the opposite. Compared the intended curriculum in those TIMSS countries and regions with curriculum guide, it revealed that there was a larger number of topics required by TIMSS top-achieving countries and regions in each grade except grade four. In the curriculum guide, the number of topics during grades 1-3 stayed at seven and increased to around 15 during grades 4-6. Those TIMSS countries and regions increased their number of topics gradually in each grade. Moreover, except for topics of estimating quantity and size, coordinate measurement estimating and errors and geometry, the rest topics required by those TIMSS countries and regions were all required by the curriculum guide.

Topic	Curriculum Guide						Curriculum Standard		Curriculum Guide	
	G1	G2	G3	G4	G5	G6	G1-3	G4-6	G1-3	G4-6
Whole Number: Meaning	●	●		●			●	●	●	●
Whole Number: Operations	●	●	●	●			●	●	●	●
Whole Number: Properties of Operations				●				●		●
Common Fractions			●		●	●	●	●	●	●
Decimal Fractions				●	●		●	●		●
Relationships of Common and Decimal Fractions					●	●		●		●
Percentages						●		●		●
Properties of Common and Decimal Fractions					●	●		●		●
Negative Numbers, Integers and Their Properties				●				●		●
Number Theory					●			●		●
Estimating Quantity and Size							●	●		
Rounding and Significant Figures				●	●					●
Estimating Computations	●	●	●	●	●	●	●	●	●	●
Units	●	●	●	●	●		●	●	●	●
Perimeter, Area and Volume			●	●	●	●	●	●	●	●
Measurement Estimation and Errors							●	●		
Two-dimensional Geometry: Coordinate Geometry								●		
Two-dimensional Geometry: Basics		●		●			●	●	●	●
Two-dimensional Geometry: Polygons and Circles	●		●	●	●	●	●	●	●	●
Three-dimensional Geometry	●				●	●	●	●	●	●
Transformations[a]					●	●	●	●		●
Constructions Using Straightedge and Compass		●		●		●		●	●	●
Proportionality Concepts						●		●		●
Proportionality Problems						●		●		●
Patterns, Relations and Functions							●	●		
Equations and Formulas				●	●			●		●
Data Representation and Analysis				●	●	●	●	●		●
Uncertainty and Probability							●	●		
Other Content _ Abacus Computation				●						●
Other Content _ Word Problem	●	●	●	●	●	●			●	●
Other Content _ Map And Direction							●	●		
Number of topics	7	7	7	16	15	14	17	28	11	25

Figure 1. Topic distributions of intended curriculum in China. *Note.* [a]: The topic of transformations was selective content in curriculum guide.

The Pattern of Topic Coverage

The topics in the guide and curriculum standard were rearranged according to the pattern of TIMSS major top-achieving countries and regions (topics intended by at least four out of six top-achieving countries) which was summarized by Schmidt et al. (2005). The result is visible in Figure 2. The curriculum guide exhibited a similar pattern of topic coverage to TIMSS top-achieving countries and regions in that topics moved from the elementary to the advanced as grade increased. However, comparatively speaking, on the one hand, topics covered by the curriculum guide did not show the same continuity as in TIMSS top-achieving countries and regions. For example, whole number meaning, introduced during grades 1-2 and stopped at grade 3, was reintroduced at grade 4. Common fraction showed such discontinuity as well. On the other hand, the pattern of topics in the curriculum guide was more concentrated. In 21 topics covered by both TIMSS countries and regions, and China, the durations of 15 topics in TIMSS countries and regions were longer than the ones in China. It is a pity that no comparison of intended curriculum is available between TIMSS countries and regions, and China after the latest reform.

Topic	Curriculum Guide						Curriculum Standard	
	G1	G2	G3	G4	G5	G6	G1-3	G4-6
Whole Number: Meaning	●	●		●			●	●
Whole Number: Operations	●	●	●	●			●	●
Units	●	●	●	●	●		●	●
Common Fractions			●		●	●	●	●
Equations and Formulas				●	●			●
Data Representation and Analysis				●	●	●	●	●
Two-dimensional Geometry: Basics		●		●			●	●
Two-dimensional Geometry: Polygons and Circles	●		●	●	●	●	●	●
Perimeter, Area and Volume			●	●	●	●	●	●
Rounding and Significant Figures				●	●			
Estimating Computations	●	●	●	●	●	●	●	●
Whole Number: Properties of Operations				●				●
Estimating Quantity and Size							●	●
Decimal Fractions				●	●		●	●
Relationships of Common and Decimal Fractions					●	●		●
Properties of Common and Decimal Fractions					●	●		●
Percentages						●		●
Proportionality Concepts						●		●
Proportionality Problems						●		●
Two-dimensional Geometry: Coordinate Geometry								●
Transformations[a]					●	●	●	●
Negative Numbers, Integers and Their Properties				●				●
Number Theory					●			●
Estimation and Errors							●	●
Constructions Using Straightedge and Compass		●		●		●		●
Three-dimensional Geometry	●				●	●	●	●
Patterns, Relations and Functions							●	●
Uncertainty and Probability							●	●
Other Content _ Abacus Computation				●				
Other Content _ Word Problem	●	●	●	●	●	●		
Other Content _ Map And Direction							●	●

Figure 2. Topic patterns of intended curriculum in China. *Note.* [a]: the topic of transformations was selective content in curriculum guide.

Discussions and Conclusions

The intended curriculum, in context of centralized curriculum system in China, plays an important role in deciding curriculum quality. A scientific designed intended curriculum could improve the teaching and learning efficiently.

The Function of Intended Curriculum

Through analyzing TIMSS countries' and regions' curriculum guides, it found that those guides shape curriculum with different strategies. Some countries' guides, such as Greece, Hong Kong and Japan, were more prescriptive focus on stating policies, formal objectives for instructions and so on, while others like Australia, the Russian Federation and Singapore more facilitating usually emphasize suggestions for instructions and assessments and providing examples. In different types of units, the policy, objective and content units were considered more directive and prescriptive to present the curriculum, while pedagogy units represented more facilitative ways to setting out curriculum (Schmidt et al., 1997).

The results showed that there was no unit or block designed for statement of policy in curriculum guide or curriculum standard in China. In fact, when the curriculum guide or curriculum standard issued, it always being accompanied by a policy document named a curriculum plan, which elaborated the policies about curriculum and instruction in detail for all the subjects, such as which subjects should be taught in each grade and the teaching time assigned for every subject per week (Zhu, 2002). Therefore, the curriculum guide or standard did not have to repeat them again. The space devoted to objective and content unit halved in curriculum standard from more than 80% in curriculum guide while considerable increasing space for pedagogy from 14.6% to 47.5% indicated substantial strategy innovation in designing intended curriculum. In this reform, curriculum designers strengthened the facilitating role of curriculum standard instead of the prescriptive function.

At the block level, by analogue, official policies, objective and content element represented a prescriptive approach while pedagogical suggestions, examples, assessment suggestions and suggestions for textbook compilation facilitated the implementation of the curriculum. Considering the block size may vary substantially, it would be hard to explore implications about the curriculum intention further. However, the differences in the block structure between curriculum guide and standard did indicate transformation of the intended curriculum.

Through comparing to the curriculum guide at the block level, it found that the curriculum standard began to pay attention to its facilitation for teachers as well as at the unit level. For the content element was the main component, the curriculum guide was more directive and prescriptive. Teachers were clearly required what should be taught at each grade and what the performance expectation of each topic was. Though there were some suggestions for pedagogy and assessment, all of them were very general and more like the basic principles that teacher should follow. There was no example block providing detailed information to help teacher understand how to implement curriculum. Facing such a curriculum guide, the only thing that teachers could do was trying to interpreter the guideline and follow it required. After the reform, in the curriculum standard, there was more emphasis on facilitating teaching. The percentage of suggestion block for pedagogy and assessment was increased and there was a considerable percentage of example block. It provided numerous examples even in the suggestions for pedagogy and assessment to illustrate how to implement the curriculum and evaluate it in detail. Compared to the curriculum guide, the curriculum standard was more instructive and operable.

The Construction of Mathematics Knowledge System

Reviewing the system of mathematics knowledge, it found that through the reform, the curriculum standard has broadened the range of mathematics knowledge, which now represents as a significant increase in the number of topics required to be taught in each grade band and replaced outdated contents by fresh knowledge. The deletion of abacus calculation and supplement of estimation computation were the results of the development of modern technology (Dale, 1999; Singh, 2004; Teodoro & Estrela, 2010). The fast advance in the computation has liberated human being from complex and boring computation. There is no need to require students to do the complicated computation any more. With the prevalence of computer and calculator, abacus, the traditional calculating tool in China had completed its historic mission. On the contrary, the capacity of estimation was more important than ever before for it allows one to response to computation demand quickly in real life. Through endeavors, a modern mathematics knowledge system has been set up. However, the topic of rounding and significant figures has been deleted in the curriculum standard, which connects with common fraction and decimal fraction tightly. We checked three different versions of mathematics textbook for elementary school by random. All of them introduce this topic. There was no reason we could find by now for the deletion of the topic. Lastly, generally speaking, the mathematics contents intended for elementary school were similar no matter in TIMSS top-achieving countries and regions or in China.

The Decentralization in the Intended Curriculum

In contrast with the coherent pattern of TIMSS top-achieving countries and regions, the curriculum guide exhibited high degree of agreement with it but more concentrated. Considering all the topics in the curriculum standard required by grade band, curriculum standard is not amenable to be analyzed using present methodology. The decentralization of topic arrangement to textbooks and teachers provides much more freedom for textbook compilation and curriculum implementation. However, Schmidt et al. (2005) found that coherence and rigor were some of the most critical defining elements of high-quality content standard. In order to improve the math achievement in US, researchers suggested a coherent national curriculum that makes inherent logical structure of the discipline more visible to textbook compilers, teachers and students (Schmidt et al., 2005; Clements, 2007; Porter, Polikoff, & Smithson, 2009). In China, the policy-makers just gave up such opportunity and distributed it to the textbook compilers and teachers. Facing the topic requirement by the grade band, different textbooks may have different interpretations. With the modification of teachers in teaching, students may receive knowledge of mathematics arranged in diverse patterns. As for Shanghai, under guidance of the same curriculum standard, its outstanding performance in PISA makes us believe that the textbook used and teachers must have arranged the topics in a coherent and rigor pattern.

The decentralization of curriculum system is an important characteristic of the reform. The power of curriculum decision-making is distributed into the central, local and school levels. Each level has its own special role and plays an important part in the curriculum management instead of a pure implementer. Nonetheless, the decentralization in the topic requirement in the intended curriculum may bring risks into the curriculum system. Mathematics is a discipline with a rigorous logic structure. If the arrangement of topics could be required uniquely on the intended curriculum level in a coherent pattern, risks can be reduced remarkably and the high curriculum quality could be guaranteed from the top of curriculum system. In practice, we have noticed that some teachers complained about poor arrangements of topics in textbooks after the reform. Usually, individual teacher has little chance to decide which textbook to be used in his/her own classroom. Considering the diversity of textbooks now in China, how to recognize and evaluate the coherence and rigor pattern of topics represented in textbooks became one of the most pivotal, if not the single most critical concern during both the stages of textbook examination and approval and of the selection of textbook in local education authority. In brief, the decentralization in the intended curriculum is a double-edged sword. It provides liberty for textbook compilers and teachers to explore all kinds of pattern of topics to improve teaching effect as well as increases the risks that may cause failures in teaching and learning, due to the improper arrangement of discipline knowledge.

Through present study, it found that China has set up a modern multi-faceted mathematics intended curriculum that values understanding of mathematics contents, acquiring ability and culturing attitude and emotion simultaneously. Whether it is well understood and implemented by teachers needs further researches. In fact, China has kept improving mathematics intended curriculum in recent 20 years. We do not encourage simple imitation from others, because every country has its own different and special factors determining curriculum quality. Based on the reflections from the results of this study and the practice, the influence of decentralization in the intended curriculum needs full attention and deeper researches.

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