

# **A Review of China's Elementary Mathematics Education**

Linrong Zhang

Department of Education  
Taishan College  
Tai' An, ShanDong  
People's Republic of China

## **Abstract**

This paper provides an introduction and analysis of the undergoing curriculum reform in China's elementary mathematics education. To compare with the past, the history of China's elementary mathematics education is first briefly reviewed. Then, the content and characteristics of the newly issued curriculum standards are explained and analyzed in details. The curriculum reform is expected to bring a promising future to China's elementary mathematics education.

China's mathematics education has its own unique history, cultural context and national characteristics. Studying the past, present and future of China's mathematics education, especially for elementary classes, we can learn from the past's successes and mistakes, find solutions to existing problems, and prepare for the future.

## **I. A Brief history of China's Elementary Mathematics Education**

Mathematics education in ancient China was quite developed. During the period of the Sui Dynasty (A.D. 581-618), in the mathematics school of the Imperial College, the highest educational institute at that time, there were two court academicians, two

assistants, and 80 students. In the Tang and Song Dynasties, the size of the mathematics school was further enlarged, reaching 200 students at peak time. Later, however, from the Ming Dynasty to the Qing Dynasty, mathematics education declined because the Imperial examination emphasized writing essays more (Zhang Diaozhou, 2003).

In the Qing Dynasty, China's traditional arithmetic education relied solely on individual endeavors, in which the government played little role. After 1840, foreign missionaries taught western mathematics in Christian schools although the teaching level was not necessarily high. In 1862, the Astronomy and Mathematics Institute was established in the nation's capital and modern mathematics education began. In 1898, the Capital College was founded, where mathematics courses were formally offered. Until 1906, the algebra textbook still used the traditional page layout in which the text reads vertically from top to bottom and horizontally from right to left. The constants and variables were denoted by Chinese characters instead of Roman letters. After the 1911 Revolution, which overthrew the Qing Dynasty, elementary mathematics was offered in almost all schools, building upon the western mathematical system. In the 30 years from 1919 to 1949, China's mathematics education was mainly modeled on that in Europe and the United States of America. The textbooks were from Great Britain and the USA, too. The teaching methods were the traditional ones though, in which the teacher teaches and the student listens, without much interaction between them (Zhang Diaozhou, 2003).

After the People's Republic of China was established in 1949, the entire educational system imitated that in the Soviet Union. In the 1950's, elementary mathematics education in China had the following characteristics: content was condensed and concentrated and the system rigorously emphasized logic and deduction. The philosophy of teaching centered around three elements: teachers, curriculum and teaching methodology. There were five essential links in teaching: organizing the classroom, introducing the new content, teaching the new content, consolidating it through practice and assigning homework.

In 1963, China reflected on its educational system and issued new guidelines, based on the former Soviet Union's educational system while considering practical conditions in China. The new ideas stressed basic knowledge and basic skills, and aimed to develop students' abilities of basic computation, spatial imagination, logic and analysis. Emphasis was on careful teaching of the essentials and allowing students to learn through intensive practice. Classroom teaching still comprised five links, but added enlightening students, animating the classroom atmosphere and activating students' thinking. Elementary mathematics education rose to a new height at that time.

The ten-year Cultural Revolution from 1966 to 1976 destroyed normal education and teaching activities. Mathematics education was no exception. The curriculum of elementary mathematics then lacked a systematic view, with too much emphasis on applications to manufacturing and laboring. Students learned mathematical knowledge only in pieces. As a result, education quality dropped severely.

After 1976, elementary mathematics education quickly returned to the pre-1963 track. The teaching quality improved greatly. In 1977, the national college entrance examination system was restored, and students showed unprecedented enthusiasm to learning. Elementary mathematical education entered a new era through exchange with western countries. New educational methodologies were introduced from overseas: the practice of "standardized tests" was adopted for the Chinese college entrance examination; Benjamin S. Bloom's taxonomy of educational objectives was popularized and adapted to the idea that passing exams was the main goal of students in China; the "problem solving" slogan proposed for American mathematics education in 1980 spread through all China too. George Polya's theory on problem-solving teaching became Chinese mathematics teachers' most studied material.

Elementary mathematics education in China took the decade of the 1980s to recover from past damages. The examination system, consisting of the college entrance examination and various other exams, permeated policy making, teaching content and testing methods with unprecedented depth. However, the examination system was a double-edged sword:

exams can stimulate enthusiasm among students, and drive them to improve problem solving abilities through intensive training; however, the excess competition aroused by exams caused many problems, too.

In 1986, the "Compulsory Educational Act" was issued and nine years of elementary and secondary education became mandatory. After 1990, the whole nation made education a top priority, promoting the reform and development of the education system. Since the 1990's, under the strategic plan of reviving the nation through technology and education, "ability training" has been advocated, propelling the reform and development of elementary education to a new level. Every subject, including mathematics, was reformed to meet the demands of ability training. New curriculum guidelines were adopted for elementary mathematical education. The idea of general mathematical education was gradually accepted; the college entrance exam policy was revised; computer technology was integrated into teaching; and students were permitted to use calculators in their exams.

## **II. China's current unprecedented curriculum reform**

The current reform for promoting ability training is the eighth elementary curriculum reform since the establishment of the People's Republic of China. The scope, intensity, and speed of this reform have no precedent. The "Mathematics Curriculum Standards for Full-time Compulsory Education" (hereafter abbreviated to Mathematics Curriculum Standards) were first written in 1999 and underwent many revisions before they were announced in March 2001 (Ministry of Education of China, 2001). In the fall of 2001, the teaching material that was compiled according to the Mathematics Curriculum Standards was tried in 38 experimental districts with 470,000 students. By the end of 2003, the nation had 1,642 experimental districts, and 35 million students were using the new teaching material. In the fall of 2005, all first graders in China will begin to use it.

The Mathematics Curriculum Standards include four parts: the preface, the curriculum goal, the content standard and suggestions for use of the standards.

### (1) Preface

- a. Purpose: Mathematics curriculum should emphasize basic concepts, generalization of knowledge and future development. Elementary mathematics education is for every student, not only the elite. Every student should learn useful mathematics; every student should acquire necessary basic concepts; different students develop differently in mathematics.
- b. Design: Compulsory education is divided into three phases: the first is for Grades 1 to 3; the second is for Grades 4 to 6; the third is for Grades 7 to 9. For each phase, objectives for knowledge and skills, mathematical thinking, problem solving, and learning attitudes are elaborated in the Standards.

### (2) Curriculum Goals

The Mathematics Curriculum Standards set overall goals and goals for each phase of compulsory education. The overall goals are: Through study, students can acquire essential mathematical knowledge and necessary skills so that they will be prepared for future life development; students learn to apply mathematical thinking to everyday life and the study of other subjects; students learn the value of mathematics and feel the close relationship between mathematics, nature and human society; students develop their creativity, practical abilities, and personalities through mathematics learning.

### (3) Guidelines on content

For each phase, content guidelines are established for "number and algebra," "space and graph," "statistics and probability," and "practice and applications." The content of "number and algebra" includes numbers and arithmetic, equations and inequalities, and functions. The content of "space and graph" includes the shape, size, spatial positions and transformations of all planar or solid geometric objects. The content of "statistics and probability" includes studying real life data and their randomness. "Practice and applications" mainly helps students to synthesize and utilize their knowledge and experience. Through self-exploration and cooperation, students are expected to solve

challenging and comprehensive problems with applications close to real life scenarios, develop their problem solving abilities, deepen their understanding of the content covered in "number and algebra," "space and graph," and "statistics and probability," and so appreciate the relationship of all aspects of mathematics.

#### (4) Suggestion on teaching practice

In order to guarantee its successful implementation, Mathematics Curriculum Standards give suggestions in teaching, appraisal, compilation of teaching material, and development and use of curriculum resources.

The Mathematics Curriculum Standards have the following characteristics:

1. The transformation of the function of education. Mathematics Curriculum Standards strive to embody "knowledge and skills," "process and methods," and "emotional development and values" as the function of education. The emphasis of education shifts from indoctrinating knowledge to developing learning ability.
2. Breaking the old course system. Some old, complex, difficult, and eccentric course contents are replaced by carefully selected basic knowledge and ability training that can prepare students for their life-long learning. The textbook gets closer to students' everyday life experience, the development of modern society, and new achievements of science and technology.
3. The emphasis on bettering methods of both teaching and learning. Mathematics teaching is an interactive process between teachers and students, through which both parties communicate and improve together. Mathematics teaching should start from students' life experience and preexisting knowledge, create lively and interesting scenarios, and guide students to observe, experiment, conjecture, deduce and communicate. Through mathematical activities, students master basic knowledge and skills, learn to observe phenomena and analyze them, and motivate themselves to

learn. Students are the masters of mathematical learning, while teachers are the organizers, guides and collaborators.

4. The emphasis on comprehensive appraisal of students' learning. The Mathematics Curriculum Standards emphasize that to assess students' learning, teachers should pay attention to students' development and gather information on all aspects of students' learning: not only their proficiency but also the emotions, attitudes and personalities displayed during their learning. Appraisal emphasizes students' performance in mathematical tasks and activities, especially students' abilities of problem solving, innovation and application of knowledge.
5. The emphasis of using new technologies. The Mathematics Curriculum Standards request students to use calculators for complex computations from the beginning of the second education phase, so that they can put more energy into exploratory and creative mathematical activities. Students are encouraged to use calculators and computers as tools to learn new knowledge and solve general practical problems. Students' learning experience can be enriched by various teaching aids, enhancing interaction between students and teachers and providing animated display of the teaching content.

The change of curriculum content mainly lies in the strengthening of some aspects and the reduction of others. The emphasis is put on enabling students to abstract mathematical models from practical problems, explore the fundamental laws behind them, and acknowledge the diversity of ways of solving problems. Requirements of complexity and speed of computation are reduced. For example, students are not required to master the mixed arithmetic of fractions and decimal numbers before the seventh grade.

Teachers and students embraced the curriculum reform. In a poll conducted by the Ministry of Education of China, more than 90% of teachers expressed their understanding and support, and over 95% of students indicated that they enjoyed mathematics classes

more than before. The new curriculum reform is being extended to the whole country by the Ministry of Education.

### **III. The future of mathematics education in China**

Elementary mathematics education in China has a strong cultural tradition, and has accumulated rich experience through the past several decades. It is expected that it will have even greater success. At the same time there are still many problems to solve.

Along with the development of modern science and technology, the value and use of mathematics will receive more attention from the public; the digitized society demands a high quality of mathematical education. In addition to nine years of compulsory education, most Chinese will study four more years in high school. After that, approximately 20% or more of the eligible age group will enroll in universities. And almost all departments in universities offer courses in mathematics. However, with the increasing population of students, the number of students who experience difficulties in mathematical learning will increase. If the differences of students' ability are not properly dealt with, it is very possible that the "equally poor" effect that happened in other countries could also take place in China.

The reform of elementary mathematics education promises future's remarkable achievements, but only with years or decades of effort. With the past characteristic of solid and rigorous training, future emphasis will also be placed on the development of students' creativity and ability to solve practical problems. Curriculum design will be centered on helping students to live to their potential. Through mathematics learning, students will improve both academically and personally.

New education models will continue to emerge. Students will play the central role in their mathematics learning and the role of teachers will be redefined. In future classes, the "five links" teaching model will lose the popularity it once had. There were two major kinds of teaching models: one emphasized training through large volume and high

intensity of practice on problem solving, the other emphasized classroom teaching with small steps, more quizzes, and detailed explanation of teaching materials. Both of them will fade away. Students will have more interests in learning through self-motivated exploration, communication, collaboration, and creative thinking. As a result, Chinese students will extend their advantages in solving textbook problems to better mathematical modeling of practical problems. The role of the teachers will be more that of leader, guide, collaborator and participant instead of center. However, the teachers' role of director in mathematics teaching will not change.

Modern technologies will be extensively adopted in mathematics teaching and learning; in the near future, teachers will use computers as they formerly used blackboards and chalk. Mathematics education software will be popular among teachers. The majority of them will be able to develop their own teaching aids. Mathematics education will enter a new digitized era.

Elementary mathematics education in China will form its own style and model with a clearer scientific definition, through more practice and experiments. Research on mathematics education will shift its emphasis from solving mathematical problems to comprehensive study of the fundamental principles of mathematical education. Success of Chinese mathematical education will draw international attention, hence more collaboration and communication between Chinese educators and educators overseas. It is hoped that the young generation of Chinese mathematics teachers will make their due contribution to mathematics education not only in China but also internationally.

**References:**

1. Zhang Dianzhou (2003). Introduction to the theory of Mathematics education, 1<sup>st</sup> edition . Higher Education Publishing House of China, April 2003.
2. Ministry of Education of China (2001). *Mathematics Curriculum Standards for Full-time Compulsory Education*.

**Biography:**

Linrong Zhang is an associated professor in the Department of Education in Taishan College, China. Her research interests are in the mathematics education for elementary and middle school students.