

Preface

The major characteristics of traditional Chinese mathematics are its emphasis on algorithms and the application of mathematics in solving practical problems; mathematics theories are embodied in the combination of these. In contrast, ancient Greek mathematics is an established axiomatic system consisting of a series of theorems derived from given axioms (or postulates) and definitions through deductive reasoning. Chinese education and cultural tradition place much emphasis on the humanities and social sciences, and science and technology are relatively less emphasized. In terms of classroom teaching, concise exposition, ample practice and careful reflection are stressed, and for a long time this has been considered by some as a traditional and conservative teaching method. The literature has pointed out a number of shortcomings in Chinese classroom teaching, such as a uniformed didactic approach, teacher-dominated instruction and passive student reception, and large class sizes. On this phenomenon, Biggs¹ and other western scholars put forward the famous “Chinese Learners’ Paradox”, that Chinese learners, despite learning mathematics in a seemingly unsatisfactory environment, performed better than their western counterparts in international studies of mathematics achievement.

Since the 1980s, phenomenal changes have taken place in China’s society and economy. Faced with the new challenges of the time and new problems in classroom teaching arising out of curriculum reforms, the Ministry of Education conducted a survey from June 1996 to 1997 on the implementation status of the compulsory national curriculum, including the mathematics curriculum. The survey results showed that, despite significant achievements such as students’ acquisition of solid foundations of basic knowledge and basic skills, major problems have remained in the implementation of the curriculum, for example, the contents being too complex, difficult, distorted and obsolete; students suffering from the pressures of memorization and rote learning; teachers’ time taken up setting excessive

¹ Biggs, J.B. & Watkins, D.A. (2001). Insight into teaching the Chinese Learner. In D.A. Watkins & J.B. Biggs, *Teaching the Chinese Learner: Psychological and pedagogical perspectives*: 277–300.

practice exercises; and over-emphasis on achievement scores in the assessment of student learning. Under this traditional and unified evaluation system, substantial numbers of students have been subjected to immense pressure in learning mathematics, which has had the negative impact of lowering their confidence greatly, even leading to a hatred of mathematics and its learning.

Under the influence of the worldwide trend of curriculum reform in mathematics, China launched a new round of reforms at the basic education stage, based on relevant research. At the level of design and implementation, it aimed to develop a new system of Chinese mathematics education based on an orientation towards student development, with a curriculum structure emphasizing student choice. The curriculum is organized around the major theme of unifying various mathematics contents, with an integrative and modular structure, thus extending the traditional stress on basic knowledge, basic skills and basic ability.

The mathematics curriculum reform since the beginning of the twenty-first century has been based on student-centred approaches, with emphasis on mathematics application and the development of students' abilities. Different aspects of mathematics education, including the curriculum standards, teaching materials and teaching practice, as well as examination and evaluation, have undergone different degrees of changes, some of which were very radical ones. With changes, there have been controversies as well, and amid these changes and controversies, Shanghai's participation in PISA for the first time in 2009 and its first-place rankings in mathematics, science and reading caught attention around the world. Shanghai students' superior performances came as a surprise because developing students' mathematics literacy has not been a traditional strength of education in China. Yet the PISA results have shown that the education system in Shanghai is able to inculcate students who can perform so well in PISA, which focuses on assessing mathematics literacy and applications. The latest release of the PISA 2015 assessment results, in December 2016, gives a slightly more balanced picture. Whereas Shanghai was the only participating city in mainland China in PISA 2009 and 2012, three additional Chinese provinces, namely Beijing, Jiangsu and Guangdong, also participated in PISA 2015. In addition, some changes were made in the PISA 2015 assessment, including the introduction of computer tests and assessment of capabilities in cooperative problem solving. So it could be argued that the results of PISA 2015 reflect more accurately the performance of students in the more developed regions in mainland China.

The PISA results have invoked much reflection nationally, as well having aroused interest in the mathematics education community internationally. After more than a decade of curriculum reform, what changes in mathematics education have occurred in China? Are the "two basics" still the only concern? Are there any special characteristics of Chinese mathematics education which have led to the outstanding performances of Chinese students in PISA? What are the characteristics of students' mathematics learning and teachers' instructional practices and professional development in China? What are the main problems faced by the education system in the country?

Such international attention on mathematics education in China has prompted us to carry out an in-depth study into the current status of mathematics education in China since the beginning of the twenty-first century, including its strengths and weaknesses. At a meeting in Beijing Normal University in March 2014, a group of mathematics educators expressed a common interest in conducting a study of different aspects of mathematics education in China. In June of the same year, Prof. Paul Cobb of Vanderbilt University and Prof. David Clarke of Melbourne University visited Beijing Normal University, and they also expressed support for such a project. In July 2014, during the Fourteenth Session of the National Institute of Mathematical Education, scholars in mathematics education from both home and abroad were consulted on what aspects of mathematics education in China are deemed to be of interest to the international community. Views and opinions about the project were also collected from various stake holders through interviews and questionnaires. Through these efforts, the preliminary framework of the book was determined.

This book aims at summarizing different aspects of the status and achievements of mathematics education in China from the perspective of the “insiders” in order to share with the international mathematics education community our experiences and the lessons learned. At the same time, it is hoped that mathematics instruction in China will also be enhanced and improved through our work in the project. The book consists of twenty-three chapters organized around six parts, covering almost all aspects of mathematics education in China. The six parts include: an overview of mathematics education in China which introduces the traditions, the examination system, the curriculum reform and family education; mathematics curriculum and teaching materials, covering the curriculum and teaching materials at primary and secondary school levels and the characteristic features of the mathematics teaching materials in the new century; classroom instructional practices, including different types of mathematics teaching, their characteristics, task design, mathematics teaching objectives and the integration of information technology into mathematics education; professional development of teachers, which covers pre-service education, school-based professional development of in-service teachers, teachers’ beliefs about mathematics teaching and teachers’ knowledge in teaching. In addition, the book also includes topics on learning and evaluation in mathematics education.

This book is the result of a concerted effort of authors including university professors who have been engaged in research in mathematics education for a long time; young scholars who research in specific areas of mathematics education; and experienced researchers, curriculum developers and textbook writers. The editors and authors have different areas of expertise. Frederick Leung and Yiming Cao have long been interested in comparative studies of mathematics education and the influence of culture on mathematics teaching and learning; Dai Qin, Liu Jian, Zhu Yan and Wang Lidong have been engaged in research on mathematics curriculum reform and educational policy; Lv Shihu, Li Haidong and Ye Beibei are experts in the study of the mathematics curriculum and textbooks; the main research interests of Wang Guangming, Hu Dianshun and Shao Zhenhong’s have been on mathematics classroom practices; Guo Yufeng has been engaged in research on

students' mathematics learning; Cai Jinfa, Yang Xinrong, He Xiaoya and Han Jiwei have been involved in research on mathematics teachers' professional development; and Tu Rongbao, Ning Lianhua and Zhang Chunli have rich research experience in the evaluation of mathematics education. The authors work in teacher education institutions, comprehensive universities, secondary schools and publishing houses from virtually all parts of China, including the University of Hong Kong, Beijing Normal University, East China Normal University, Northeast Normal University, Nanjing Normal University, South China Normal University, Southwestern University, Inner Mongolia Normal University, Northwest Normal University, the High School Affiliated to Renmin University of China, Beijing Jingshan Middle School and the People's Education Press. This representative group of scholars is best qualified to produce a comprehensive picture of different aspects of mathematics education research and practices in China since the twenty-first century.

The book has pulled together the commitments and efforts of different authors, taking more than two years to complete, from the design of the framework in 2014, to reviews of the abstracts of the chapters by the editors, peer reviews of all the chapters, final reviews by the editors, and proof reading of the final Chinese and English versions, to its completion in 2017. Making use of attendance at mathematics education conferences, the editorial team met numerous times in Chongqing, Wuhan, Beijing and other places, in order to ensure the quality of the book.

We are also indebted to other scholars in mathematics education at home and abroad for their help and support in the preparation of the book. Professor David Clarke of the University of Melbourne, Prof. Paul Cobb of Vanderbilt University, Dr. Zsolt Lavicza of the University of Cambridge and others have rendered insightful comments and suggestions. Li Haidong, Director of the People's Education Press, has invested great effort in the production of the book, and Dr. Li Xinlian has helped prepare the manuscripts in her capacity as project assistant. To all of these people, we express our thanks and appreciation.

Research and practice in mathematics education in China have attracted and will continue to attract the attention of researchers and practitioners at home and abroad. We sincerely hope that this book will enhance the development of research and practice in mathematics education in this country, as well as promote cooperation and interchange of ideas between China and the rest of the world.

Prof. Yiming Cao
School of Mathematical Sciences
Beijing Normal University

Prof. Frederick K.S. Leung
Kintoy Professor in Mathematics Education,
The University of Hong Kong
Southwest University

The 21st Century Mathematics Education in China

Cao, Y.; Leung, F.K.S. (Eds.)

2018, XI, 493 p. 71 illus., Hardcover

ISBN: 978-3-662-55779-2