CHAPTER 68

INTRODUCTION TO THE INDIA SECTION

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Two factors need to be kept in mind as one reads the chapters in the India section in this volume. First, that India is a country of diversity and large numbers, and second, that education in India has witnessed major initiatives in the last decade. In 2010-2011, over 15 million students were in Class X (i.e., Grade 10), which is the year of completion of secondary school. About 8 million young Indians from this age cohort were not in school (corresponding to a Gross Enrollment ratio of 65%). In the same year, there were over 19.5 million children in Class VIII, which is the year of completion of the compulsory stage of schooling. The number is much larger because of the higher Gross Enrollment Ratio of 85% (Ministry of Human Resource Development, 2012).

These numbers are likely to have increased in the last two years due to strong legislative action in 2010 by the central (federal) government in the form of the Right to Education Act (frequently referred to as the "RTE" Act). The Act makes it mandatory on the part of the Government to provide school education to every child from the age of 6 to 14, amounting to eight years of school education. It specifies certain parameters of quality for school education which include adopting the National

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Curriculum Framework as broadly defining the curricular aspect of quality education.

The framers of the constitution of independent India had, in 1950, expected school education to become universal within a decade. It is nearly 60 years later that the Government enacted legislation to realize this stubbornly elusive goal. Implementing the RTE Act requires navigation of the complex federal governance structure in India. There are 28 states in India, many with a separate dominant language, representing a diversity of cultures. All the states have their own elected legislatures and governments. In the mid-1970s, education, which till then was the domain of the state governments, was made a "concurrent subject", that is, a joint domain of responsibility and action by the Central and State governments. In recent decades, the central government has played an increasingly pro-active role, using its leverage to align the policies of the state governments with those of the Center.

The Central Government called for the creation of a new National Curriculum Framework in 2005, often referred to as "NCF 2005". The relation of the NCF 2005 to the history of education policy making in India, and its perspective on mathematics education are discussed in detail in Khan (this volume). Nearly every chapter in this section takes account of the background of the new curriculum framework and locates the discussion in the context of educational reform that the NCF 2005 represents. The creation of NCF 2005 was a mammoth exercise carried out by the National Council of Educational Research and Training (NCERT), drawing on the educational expertise available in the country. There were 21 focus groups composed of experts drawn from institutions across the country that formulated policies and guidelines on various aspects of school education – one of the focus groups was on the teaching of mathematics in school. The reports of these groups formed the input for new framework. NCF 2005 gave primacy to placing the child at the center, to moving away from rote learning and stereotypical assessment, to linking school learning with the child's lived experience, and to building a democratic ethos. All the documents that comprise the NCF 2005 are available on the webpages of the NCERT: http://www.ncert.nic.in.

Although the NCF 2005 is the primary policy document for the school curriculum at the national level, its direct impact is limited to schools that are regulated by the central government. These are the schools affiliated to the Central Board of Secondary Education, which follow the textbooks published by the NCERT. In order to impact the curricula and textbooks in the various states of India, the effect of NCF 2005 must percolate through the complex federal structure, a process that is still underway. Each state has its own regulatory body in the form of a secondary education board. Table 68.1 gives an idea of the relative sizes of some of the

Table 68.1. Number of Students (in Millions) Who Appeared for the 2012 Class X Examination of Various School Boards

School Board	*Number of Students Who Appeared for Class X Exam in 2012 (in millions)*
Central Board of Secondary Education (country wide)	1.18
Council for the Indian School Certificate Examinations (country wide)	0.13
National Institute of Open Schooling (country wide)	0.53
Maharastra State Secondary Education Board	1.35
Tamil Nadu State Secondary Education Board	1.05
Gujarat State Secondary Education Board	0.93

Source: Compiled from various news reports announcing the results of the school board examinations.

major school boards in the country. The first three school boards in the table operate across the country, while the others operate within their respective states.

The vast majority of schools located in rural areas and schools catering to low socio-economic groups are affiliated to the state boards. In these schools, the medium of education is typically the language of the state. For example, for the states in the last three rows of Table 68.1, the languages are Marathi, Tamil and Gujarati respectively. In contrast, the schools affiliated to the Council for the Indian School Certificate Examinations are typically urban, English medium schools that cater to middle or higher income families. Differences in the availability of resources, distance from urban centers, access to and aspiration for the English language, and position in the social, especially caste hierarchy, are some of the critical factors in determining the outcome of education in India. An indicator of the range of differences is the stark contrast between the performance of the country's top education and research institutions in science and technology and the poor quality of education in the vast majority of its institutions. These factors need to be kept in the background while discussing problems of mathematics education in the Indian context. The larger context of education and its relation to mathematics education have also been discussed in several articles in a recent volume (Ramanujam & Subramaniam, 2012).

The chapters related to India in the sourcebook deal with the issues of K-12 mathematics education, or from primary to senior secondary stages, as they are called in India. The opening chapter by Farida Khan discusses

the perspective on mathematics education in NCF 2005. She sets this in the context of how earlier policy documents viewed the place of mathematics in the school curriculum. Although many of the recommendations of NCF 2005 echo those made in earlier policy documents, she notes that there is a shift from viewing mathematics as a static, unquestionable body of knowledge to emphasizing mathematics as a way of thinking and reasoning. The curriculum framework and the textbooks that followed did bring in a focus on the learner that is new in the Indian context. She cautions, however that the resources that a majority of schools are currently able to muster may prove inadequate to realize the vision of mathematics education that is envisioned in NCF 2005.

Amitabha Mukherjee and Vijaya Varma describe an important effort aimed at reforming the primary mathematics curriculum. The effort is one among several efforts outside the formal education sector that were led by non-profit voluntary organizations (commonly referred to as "NGOs" or "Non-Governmental Organizations"). The significance of the School Mathematics Project lies in the fact that it was an effort initiated by University professors of science to address problems in primary mathematics education, but one in which primary teachers played a central role. The Project had an impact beyond its field of work in influencing first, the curriculum and textbooks of the Delhi state and later, the post NCF 2005 national curriculum and textbooks of the NCERT. The chapter thus documents an important episode in the history of reform efforts in primary mathematics education in India.

The work of Usha Menon is another example of the voluntary efforts to improve primary mathematics education, one that is informed by the perspective of Realistic Mathematics Education. The chapter explores the nuances of early number learning focusing on the ordinal and cardinal meanings of number. It analyses the role of pedagogical supports, especially the 100-bead string and the empty number line in developing number sense among young children. The author attempts to develop empirical indicators of number sense in terms of the diversity of solution strategies that children use in solving problems. In relating theory to practice, the author draws on her own extensive teaching experience and her interactions with teachers.

Jayasree Subramanian, Mohammed Umar and Sunil Verma summarize some interventions aimed at developing new approaches to the teaching of core topics in middle school mathematics. The authors set this in the context of the work of the NGO Eklavya, which is widely known for its seminal contributions to innovations in science and social science education at the school level. Efforts at innovating curricular approaches are set against the often harsh realities of Indian schools, especially those that serve students from poor families. The authors raise sharp questions

about whose interests the current curriculum really serves and if the curriculum can be re-visioned to make it more relevant to the lives of children from less affluent backgrounds.

Rakhi Banerjee draws on her previous research on approaches to teaching beginning algebra and analyzes the impact of the new curricula and textbooks on classroom teaching at the middle school level. Although the textbooks adopt a more student-friendly approach to introduce symbolic algebra than earlier textbooks, she argues that they do not prepare students adequately nor take advantage of their knowledge of arithmetic. She makes a case for the textbook approaches to be better informed by the vast literature on algebra education, and to focus on algebraic thinking as a central goal of algebra education.

The chapter by Ruchi Kumar, Subramaniam and Shweta Naik provides a brief overview of issues related to the development of in-service mathematics teachers in India. The authors' focus is workshops for mathematics teachers, which is the main mode of in-service teacher development in India. They suggest a broad framework consisting of goals, principles and themes for analyzing the design and enactment aspects of a workshop, and illustrate its application through the analysis of the components of a workshop and its enactment. Their analysis reveals how the agencies of the teacher and the teacher educators shape the interaction in the light of the goals and the principles.

Assessment of mathematical learning is one of the areas that is recognized as needing urgent and comprehensive reform. The two chapters on assessment address this problem from two different perspectives. The chapter by Aaloka Kahnere, Anupriya Gupta and Maulik Shah discuss insights about student errors gained from large scale diagnostic tests conducted across many states in India. The large scale data allows them to draw what may prove to be robust insights about Indian students' mathematical conceptions. They also draw on interviews of groups of students conducted in a classroom setting and recorded on video, to probe misconceptions in greater detail.

Shailesh Shirali's chapter on assessment discusses test items from high stakes examinations such as the public "board" exams at the end of Class 10 and 12, and the highly competitive entrance examinations to prestigious higher education institutes. Such examinations cast a long shadow on education, and drive the major effort and spending by families on education. Shirali sketches some of the damaging effects of a competitive, high stakes examination culture. He calls for research on innovations in assessment including the use of technology and investigative projects in mathematics, remarking that there is better acceptance of the latter in science than in mathematics education.

Jonaki Ghosh explores the use of technological tools such as computer algebra systems, dynamic geometry, spreadsheets and graphics calculators for teaching mathematics to higher secondary school students. Drawing on her own experience of teaching secondary school students over several years using a project based approach combined with technological tools, she describes several examples of investigative projects. The chapter highlights the mathematical ideas that have engaged students as they worked on the projects. Ghosh locates her work in the context of the challenges in using technology for teaching mathematics in the mostly resource-poor schools in India.

The last two chapters illuminate mathematics education and school mathematics from a historical perspective. The chapter by Senthil Babu explores the curriculum of indigenous schools in South India in the pre-British period. Based on a study of manuscripts that functioned as arithmetic manuals in the *tiṇṇai* or veranda schools, he argues that memory played a basic role in learning and in the organization of knowledge. The manuals contained arithmetic tables of various kinds which were committed to memory and recalled in the context of solving a problem. The numbers, units and problem contexts show the rich links that the elementary mathematics curriculum had with practical problems in a local context.

Unlike Babu's study of a local, vernacular form of mathematics close to the domain of application, the chapter by Raja Sridharan and Subramaniam is closer the grand narrative of the history of Indian mathematics. Marking a departure from the domains of astronomy, geometry and algebra, they discuss the mathematics of combinatorial problems associated with prosody and music. The discussion is located in the context of contemporary Indian music and Sanskrit prosody. They explore the occurrence in Indian mathematical texts of binary arithmetic, of "Fibonacci numbers", of factorial and other representations for positive integers. They argue that the mathematics explored in this chapter has relevance at the school level in terms of the novel ideas and surprising connections.

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