

STUDY OF CHANGE IN PRIMARY MATHEMATICS TEXTBOOKS AT GRADE 3 IN DELHI GOVERNMENT/MUNICIPAL SCHOOLS

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The paper presents a comparative study of three grade 3 mathematics textbooks produced by NCERT and SCERT Delhi, and used successively by all government and municipal corporation schools in Delhi in the period 2001-2006. The main part of the work is analysis of the textbooks along a set of pre-determined pedagogic parameters. Field studies included examining the lesson planning processes of pre-service teacher trainees, observation of classroom transactions, and children's responses. The basic questions addressed are: What are the pedagogic principles underlying each of the three textbooks? Do textbooks influence pedagogical practices in classrooms?

OBJECTIVES AND SIGNIFICANCE OF THE STUDY

Textbooks are perhaps the only materials for learning available in most Indian schools. Most textbooks are prepared by the government at the centre or in the states. Their content has raised pedagogic and curricular concerns to such an extent that the Central Advisory Board of Education constituted a committee in 2005 for evolving regulatory mechanisms for textbooks (Hasan 2005). The Yash Pal committee set up by the Ministry of Human Resource Development in 1992 recognised that both the packed content and dense nature of textbook writing add to mental burden of children (Yash Pal 1993). While some examples of effective textbooks for children do exist (see, e.g., Eklavya 1999), they have by and large not been mainstreamed for the larger system. However, since 2000, governmental textbook agencies have been actively engaged in addressing some of the issues related to textbooks. NCERT, in 2000, prepared a fresh mathematics textbook for Grade 3, referred to in this paper as Book [A]. SCERT, Delhi, brought out two textbooks for Grade 3 mathematics, prepared by two different sets of author teams. Book [B] was published in 2003 and Book [C] in 2005.

This paper presents a comparative study of the three Grade 3 mathematics textbooks produced by NCERT (Book [A]) and SCERT (Books [B] and [C]), and used successively by all government and municipal corporation schools in Delhi during the period 2001-2006. The main part of the work is analysis of the textbooks along a set of pedagogic parameters. Field study included examining the lesson planning processes of pre-service teacher trainees, observation of classroom transactions and children's responses. Views of in-service teachers on the textbooks were collected during the course of in-service training for primary school teachers held during 2002 to 2005. The basic questions addressed are: what are the pedagogic principles underlying each of the three textbooks? Do textbooks influence pedagogical practices in classrooms?

(i) Specific objectives of the study

- To examine the three efforts at textbook construction undertaken by NCERT and SCERT Delhi between 2000 and 2005
- To abstract pedagogic principles used in the three textbooks
- To present a glimpse of classroom planning and transactional experiences of the textbooks
- To collate and present views regarding mathematics textbooks among practitioners.

(ii) Significance of the Study

Around 300,000 children use the Grade 3 mathematics textbooks every year in Delhi. Most of these students come from lower socio-economic strata and tend to be first generation learners. According to the National Institute of Educational Planning and Administration (NIEPA), the dropout rate among them is around 40% after Grade 5 (Mehra, 2003). Analyses of CBSE results by the Directorate of Education, Government of Delhi (Kumar, 2003) show that around 60% of children from government schools fail in Mathematics at Grade 10 in CBSE. Given the primacy of textbooks as learning tools, their construction has research implications for improved mathematics teaching learning in schools. Grade 3 is particularly important since the NIEPA report shows that children start dropping out of primary school at this grade. A survey of out-of-school children conducted in Delhi (Kumar 2002) shows that the most cited reason by parents for taking their children out of school is that the children have not learnt very much in their three years of schooling.

UNDERLYING THEORETICAL FRAMEWORK

The study is based on the theoretical framework broadly termed the constructivist approach. Studies by Piaget, Inhelder and Szaminska (1960), Piaget (1972), Sinclair and Kamii (1970), Vygotsky, Bruner and co-workers (1965 and 1993), Carpenter and Moser (1984), Kieren (1971), Saljo and Wyndham (1997), Gough (2006), Zack and Graves (2001), Leung (2001) and AAAS (2000) have been drawn upon for the determination of the matrix along which the textbooks were studied and for drawing up a list of assumptions, listed below, about how children learn mathematics.

Assumptions on how children learn mathematics

- Children think differently from adults.
- Manipulative experiences are crucial in the processes of mathematics learning at the primary level. Children love playing with materials and under some conditions they are ready to go on answering questions and playing. The performance of hands-on tasks facilitates the acquisition of concepts.
- Children at Grade 3 grasp and enjoy working with non-number concepts. These include shapes, patterns, measurement and data handling.
- Well before children are ready to manipulate numbers and to understand their somewhat abstract meanings, they learn the counting sequence. However, to be able to count out a number of objects, they have to establish one-one correspondence between the given set and the counting numbers. It cannot be assumed that Grade 3 children are already able to do this.
- The optimal sequence for learning mathematical ideas proceeds through the stages of enactive, iconic and symbolic representations.

- Mathematical concepts are perhaps best acquired when organised spirally, as typically it requires many repeated visits to a concept for its internalisation. Through these repetitions children observe and experience something new and different each time. Providing opportunities to children for repeated visits of concepts could be an important strategy for teaching mathematics.
- Learning mathematics needs a firm sense of the underlying abstraction but also a good stock of visual images. Children need mediational representational structures that transcend immediate imagery. They begin by constructing an embodiment of concept, and build a concrete form of operational definition that 'stands for' the concept.
- Operations introduced contextually followed by the development of language and symbolic notation, with the standard algorithm coming at the end, is an effective sequence of mathematics teaching.
- Children learn mathematics effectively through co-operative activities and discussion that may come from diverse levels of understanding. While learning in a group, children move to a cooperative stance. By posing questions and evaluating worthiness, they can conclude that there are several correct ways of finding a solution.
- It cannot be assumed that children in Grade 3 in government and municipal corporation schools have grasped place value. Further, it cannot be assumed that children in Grade 3 in government and municipal corporation schools are able to read independently.
- Including open-ended questions, for which sometimes there are no definitive answers, is important for generating and sustaining children's curiosity in mathematics.
- Children lose interest in mathematics as soon as they feel that there can be only one answer and begin to fear that they will not be able to arrive at that one answer. This fear is greatest at this age-stage and acts as a barrier to processes of mathematics learning.

RESEARCH DESIGN AND PROCEDURE

Textual review, study of assumptions underlying organisation of materials of the topics covered in the textbooks forms the core method of study. Grade 3 has been chosen due to the developmental significance for learning in children in this age group. Topics presented in each of the textbooks were listed and examined with respect to pedagogic principles which were identified along the following parameters: positioning of concepts, development of concepts, seriation, opportunities for re-visiting provided later in the textbook, opportunities for hands-on activities, co-operative learning, open-endedness, contextuality, interactivity of the visuals, visualising proof, development of language and symbolic notation, mediation between visual, language and symbol based on children's experiences, positioning and treatment of standard algorithm, computational skills, estimation, element of challenge, problem solving, reasoning, use of art forms and aesthetics, opportunities for children's imagination, static and moving elements. These were organised in a colour-coded grid to arrive at a comprehensive picture of each textbook.

Field study was based on organising and observing the use of the textbooks in Grade 3 in schools, as part of the pre-service ETE programme at IASE, Jamia Millia Islamia. The ETE course includes a school experience programme, in which teacher trainees are assigned to primary schools, where

they are supervised by teacher educators during the teaching-learning process. Before going to schools the trainees are grouped and each group is assigned to a teacher educator. Teacher trainees are asked to prepare lesson plans; these plans, after the approval of the teacher educator, are used in the classroom with children of Grade 1-5 at selected MCD schools.

Since Grade 3 was chosen for reasons mentioned earlier, the field study comprised of observing the manner in which the Grade 3 textbooks were being used by pre-service teachers in MCD schools, and the way they were received by children of Grade 3 in those schools. The study is based on this process in the years 2001, 2005 and 2006. For each year, 10 pre-service teachers enrolled in ETE at IASE and around 200 children studying in six MCD primary schools of Delhi, taught by these pre-service teachers, formed the sample. Interaction with the teachers and children of Grade 3 and observations during the preparation and delivery of lessons was the basis of collection of the data. Children's responses were gauged through their articulations about mathematics and their classroom performance. The study relies on the work of supervision done between 2001 and 2006 by one of the authors of this paper (AS), who has been a teacher educator at IASE for over a decade. The Book [C] author team was led by one of the authors (AM), while both Book [B] and [C] were prepared under the overall co-ordination of the third author (JR). During this period, all the authors were also involved in in-service teacher training programmes for primary school teachers. The views of teachers regarding the textbooks collated come from the interactions with teachers during the training.

The field data were analysed qualitatively along a set of parameters as listed here: analyses of the lesson plans, feedback from teacher trainees, diversity and open-endedness of children's responses, visible involvement and interest of children in the classroom, questions and comments posed by children, children's performance, usage of visuals in the classroom.


FINDINGS

- There has been a distinct change in the pedagogic approach in all Grade 3 mathematics textbooks since 2000.
- Each textbook applies selected pedagogic principles of mathematics teaching learning in varying degrees.
- No textbook utilises all principles and perspectives identified in the study.
- Book [C] uses the most pedagogic parameters, followed by Book [B] and then Book [A].
- The textbook that best matched the perspectives identified for mathematics teaching learning in the study was Book [C].
- Teacher trainees found lesson planning most rewarding for Book [C].
- Pedagogic practices of teacher trainees altered substantially in the case of Book [C].
- Children requested that they should do more mathematics where they were taught from Book [C]. This response did not accompany classes taught from Books A and B.
- In-service teachers found Book [A] to be of too high a standard for Grade 3. They reported that Book [B] was too lengthy and all exercises could not be performed. Book [C] was viewed as too

easy. Children could learn some of the topics by themselves, even without a teacher. This must mean that the standard was too low, they stated. The organisation of the contents page of Book [C] was found to be cumbersome.

Overall, among the three textbooks under review, Book [C], the SCERT book of 2005, appeared to have adhered most closely to contemporary understanding of how children learn mathematics at the primary stage. Book [B] does it to some extent but not consistently across all topics. Book [A] does so only for isolated topics. These results pertaining to classroom practices have to be viewed with caution because of the small sample size. Nevertheless, there seem to be some clear implications for future textbook writers.

Abbreviations

CBSE	Central Board of Secondary Education
ETE	Elementary Teacher Education (a 2-year diploma Programme) 
IASE	Institute of Advanced Studies in Education, Jamia Millia Islamia
MCD	Municipal Corporation of Delhi
NCERT	National Council of Educational Research and Training
SCERT	State Council of Educational Research and Training

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