The Homi Bhabha Curriculum in Primary Mathematics: Background and Overview

K. Subramaniam
HBCSE, Mumbai

Introduction

In comparison to what was envisaged in policy documents of the Indian government, school education in India is lacking in terms of both availability and quality. Many factors contribute to this situation. Some factors have to do with poor infrastructure - availability of schools, teachers and learning equipment. Other factors include a paucity of good in-service teacher training programs, teacher support and well-designed curricula. All of these are links in the chain and need to be strengthened. Making available well-designed, culturally appropriate curricular materials is one of the inputs necessary, though not sufficient, to improve school education. A recognition of this need led to the launching of the Homi Bhabha Curriculum project in primary science and mathematics.

In India, apart from the State and Central Government bodies, there have only been a few initiatives in curriculum development for schools. After more than a decade, the National Council for Educational Research and Training is co-ordinating the process of the development of a new curriculum. There has been, in recent years, an appreciation of the need for more decentralisation in curriculum development. (The National Curriculum Framework talks of 'co-ordinated decentralisation'.[1]) Some new textbooks and other curricular material for the primary school have been developed by Non-Governmental Organisations involved in education and District Primary Education Projects (DPEP). New textbooks have also been produced by commercial publishers from time to time which cater to a limited number of schools. In what could be a changing context, the Homi Bhabha Curriculum aims to offer a wholesome curriculum in primary mathematics with broad learning objectives and an effective and contemporary pedagogy.

Background

Some of the earlier projects carried out by the centre have provided inputs for the development of the mathematics curriculum. We summarize these below.

Remedial Education Project in mathematics for low performers

The centre conducted remedial courses in mathematics for low-achieving students of high school and middle school for a few years. One of the insights gained through these programs, was that primary education plays a crucial role in subjects like mathematics. Mathematics is a hierarchical subject and many difficulties that children face in high

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[1] NCERT (2000) The National Curriculum Framework for School Education, National Council for Educational Research and Training, New Delhi.

school and middle school can be traced to a weak foundation in primary school mathematics. The remedial project showed us the importance of both cognitive and emotive factors. We also realised that mathematics is seen by most students as merely a set of procedures and very little attention is paid to conceptual understanding. For many students, especially those studying in the English medium, language presents formidable difficulties in learning mathematics. Even for those studying in their mother tongues, the language of mathematics textbooks is often too formal and forbidding.

Field projects in tribal and rural areas

These field projects included teacher training, school visits and classroom observations. One of the things that we learned through these programs is that teachers find activity based learning and the mathematics laboratory to be of value. It is possible (and desirable) for classroom organisation to be more flexible in rural areas. We also learned the importance of teachers experiencing mathematics in a different way. They need to make sense of mathematics and not view it as merely a collection of procedures.

Mathematics through activities, puzzles and games

The centre has a mathematics laboratory with several activities, games and puzzles aimed at primary, middle and high school students. These have been used in student enrichment workshops, exhibitions and teacher training programs and are very popular with students and teachers and have high cultural acceptance. These activities create a positive attitude to mathematics among students, teachers and the community besides facilitating mathematical learning.

Broad guidelines for curriculum development

Some of the broad guidelines accepted by the mathematics curriculum development project were,

- The curriculum should have wide relevance and should be of use in urban and rural schools.
- It must place the needs of the disadvantaged students in the forefront, without compromising on content.
- It must reflect the insights gained by research and field studies conducted by the centre and by the wider community of mathematics education researchers.
- The curriculum materials must be attractive to children and teacher friendly.
- Feasiblity of implementation should be an important goal – the curriculum must not collapse under conditions which are far from ideal.

Methodology

Study of research literature in mathematics eduction, standards and a variety of textbooks

There is considerable literature published on the learning of primary mathematics. Many difficulties and hurdles that children face have been identified and some of them well characterised in the neo-Piagetian and other cognitive studies of mathematics learning. We have attempted to apply, or at least, take account of these research findings while

designing instruction on difficult topics like word problems, fractions and multiplicative (proportional) relationships.

Standards documents vary widely in their emphasis, despite there being a more or less uniform set of topics in the primary mathematics curricula found across the world. Culture and context tend to shape the standards documents more than established pedagogical insights, even if the documents claim support from research in pedagogy.

There is a great amount of literature produced and available on issues about curriculum and standards, especially in the US and the UK. This literature has been useful in pointing out critical factors affecting learning that we might have not otherwise paid attention to. To mention an example, the TIMMS video study showed the importance of developing instructional practices through attending to detailed and incremental refinements. We realised how important it is to document, communicate and discuss teaching at a micro-level. However, on the whole, many debates over issues in education are steeped in strong educational and cultural traditions. So one must be wary of transferring issues which are central to a debate in developed countries to the situation in countries like India.

Classroom trials

The curriculum materials were developed through extensive classroom trials conducted both during the regular school term and in the vacation period. We thought it important to set clear learning objectives and try to attain these through actual teaching. It was essential to have the personal involvement of the development team in teaching and for them to strive to ensure successful learning. During the regular school months, we taught in schools where most pupils were first generation learners. The vacation programs were particularly useful and would have two or three batches of students attending the program concurrently. Students with a range of abilities participated in these programs. Much attention was paid to low achieving students and this shaped the classroom ambience in desirable ways. Highly skilled teachers were part of the development team and the teaching was shared between the teachers and other members of the development team.

The classroom trials are an important strength of our approach to developing the curriculum. Through the trials we were able to develop lessons more gradually. We could fill in gaps and sequence the lessons better. Another input from the classroom trials was increased sensitivity to the role of language in aiding or hindering mathematical learning. To take a simple example, in the local language, which is often not the medium of instruction, children refer to the second hand of a clock as the ‘third’ hand! When these children hear the teacher pointing to the ‘third’ hand and saying ‘second hand’, one must expect some confusion. One needs to be careful when teaching children how to read clocks.

Design of study material

The text-cum-workbooks meant to be used by students were designed in close collaboration with graphic designers. The presentation of difficult ideas or concepts in print is aided greatly by illustrations and pictures. However keeping the visual flow simple and easy to absorb is always a challenge. Layout and design are therefore very important elements in communicating the content to be learned.

Teacher training

The curriculum development group conducts training programs for large groups of teachers of primary mathematics, where ideas on specific instruction practices are shared. The training is often centred around the curriculum of the state board and not around the Homi Bhabha Curriculum. Neverthless, these programs allow us to integrate many ideas developed for the Homi Bhabha Curriculum with current teaching practices. Special training programs are conducted for teachers who wish to teach the Homi Bhabha Curriculum.

Features of the Homi Bhabha Primary Maths Curriculum

Expanded learning outcomes

Traditional curricula in Indian schools emphasize the learning of mathematics as a collection of procedures. We have explicitly retained a broad set of learning outcomes in view while designing the curriculum. These outcomes include, besides factual and procedural knowledge, conceptual understanding, problem solving ability, making connections, language and communication, and disposition and beliefs. An example from the text-cum-workbook for class 3, which illustrates the approach to conceptual understanding and to communicating mathematical ideas is found in figure 1.

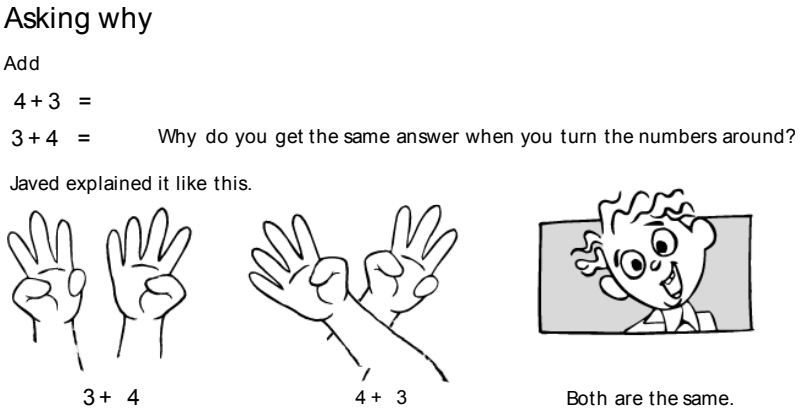

Figure 1

Scaffolding for concept learning and number skills

Children improve their number and operational sense by actively using and playing with numbers over a period of time. We have facilitated this process by providing a concrete scaffolding to some of the basic number operations. For example, children practice mental addition and subtraction on a number building. Activities, puzzles and games are presented which require them to move up and down the number building. In the process of carrying out these tasks, they strengthen their number sense. Another such example is multiplication on a 10×10 array of dots. The dot grid, besides providing a concrete visual representation for the multiplication operation, is useful to understand multiplication by zero and one and the commutative and distributive properties.

Activities and connections

The curriculum emphasizes connections both within mathematics and between mathematics and the real world. While dealing with the topic of measurement, for example, there is a strong emphasis on actually making measurements using simple, low cost, easy-to-make measuring instruments. We use empty wrappers in which articles are sold as an aid to learning about the units of measurement. Many numbers are printed on these wrappers and it is interesting for children to find out what these numbers mean. Games and activities can also be done centred around empty wrappers, cartons, etc.

Language and word problems

One of the major areas of difficulty for children is word problems. We found that part of the difficulty that children had with word problems had to do with language. When we presented some unfamiliar but simple word problems to children in Hindi rather than in English, their performance showed a significant improvement. This was observed only when written problems were presented in Hindi, and not when problems presented in English were orally translated into Hindi. This suggested to us that a bilingual approach may be useful in developing the understanding of word problems, an approach which is now incorporated into the curriculum.

The difficulty with word problems did not entirely have to do with language, but also with logic. For example, problems like 'I had some mangoes and my uncle gave me 17 more, and now I have 36. How many did I have in the beginning?', were more difficult than straight forward addition and subtraction problems, whether they were presented in Hindi or in English. To help in solving such problems, we have used a diagrammatic representation of the problem situation to mediate between language and mathematical symbols. This gives the children another handle to try and grasp what is being asked in the word problem.

Presentation

The learning material, as we mentioned earlier, is designed carefullly to ensure that the layout is attractive and communicative. We have also been careful to ensure that the right implicit messages are carried, especially relating to gender. There are as many girls present as there are boys, and girls are shown doing important tasks.

The Homi Bhabha Curriculum in primary mathematics is disseminated through text-cum-workbooks for students, and teachers' books and other material for teachers. This material is being developed at the centre. Some of the published material is listed as references.

References

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