Technical Report No. I (07-08)

Evaluating
The Homi Bhabha Curriculum for Primary Science: *In Situ*

Beena Choksi

HOMI BHABHA CENTRE FOR SCIENCE EDUCATION
TATA INSTITUTE OF FUNDAMENTAL RESEARCH
October 2007

Cover Illustration

From:
http://www.efplighting.com/?The_Chiaroscuro_Principle

Technical Report No. I (07-08)

Evaluating
The Homi Bhabha Curriculum for Primary Science: *In Situ*

Beena Choksi

Because I know that time is always time
And place is always and only place
And what is actual is actual only for one time
And only for one place

-- T.S.Elliot (in Ash Wednesday)

HOMI BHABHA CENTRE FOR SCIENCE EDUCATION
TATA INSTITUTE OF FUNDAMENTAL RESEARCH

October 2007

Acknowledgements

Grateful thanks to:

Prasanta Barua, for assistance in video recording classroom sessions.
Meena Kharatmal, for assisting in conducting classroom observations.
The administrative heads and teachers of P and Q schools, for accommodating us in their classrooms.
Chitra Natarajan for going through the report with a fine-tooth comb.
Jayashree Ramadas for her perceptive feedback.

CONTENTS

INTRODUCTION

In general, school systems in India can be distinguished in terms of their differing socio-cultural-economic background (private, partially/fully government-aided; English/vernacular medium of instruction), geographical boundaries (urban/rural/tribal schools) and/or their pedagogic practices (mainstream/alternative). About 30 schools in the country are using the Homi Bhabha Curriculum for Primary Science. Even in a small number such as this, the variation in school systems is reflected.

Seeking to move students and teachers away from rote learning (and teaching) of science, the Homi Bhabha Curriculum[1] (HBC) offers itself as an innovative curriculum reflecting the spirit of inquiry-based teaching and learning. The definition of inquiry widely quoted is:

> Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations. (National Research Council, 1996, p. 23)

The Homi Bhabha Curriculum is embedded in three kinds of books: a Textbook and a Workbook for students (for Classes 3-5), and a Teacher's Book (for Classes 1-5); all simple and attractive in appearance. The three kinds of books are known by the common rubric, Small Science[2]. A story about two curious children, Mini and Apu, and their surroundings and experiences is the theme of the textbook. The central core of the book comprises of structured inquiry-based activities and exercises on topics such as food, air, water, soil and living things.

[1] The Homi Bhabha Curriculum encompasses textbooks for Primary Science and Primary Mathematics. In this report, HBC is used to refer *only* to the primary science curriculum and specifically for Classes 3 and 4.

[2] At the time of the evaluation, the books were published in-house. Subsequently, Oxford University Press, India is responsible for promoting the series.

The topics are usually introduced anecdotally, by way of conversation between Mini and Apu and adults in their household. The activities and exercises are designed (in form and language) to illustrate the relevance of the topics in the students' everyday life. The workbook provides the space to record the results of the activities and exercises, and allows for the continuous assessment of students' work. The teacher's book serves as a manual on classroom teaching. In it the curriculum is described as developing i) curiosity and learning, ii) basic skills related with design and engineering, language and quantitative thinking, iii) experimental skills through concrete experiences, and iv) values in science.[3] The transacting of the curriculum as idealized by the curriculum developer involves the use of all three books to develop these attitudes and skills through an inquiry-based teaching and learning approach.

A small-scale evaluation was initiated in June 2005 to evaluate HBC as an innovative, inquiry-based curriculum[4]. The evaluation was carried out in two urban schools. Between June-August 2005 it was carried out in P School, which seeks to exemplify a progressive model of schooling. Between November 2005 - January 2006 it was carried out in Q School, primarily conventional in its approach to schooling. Two divisions of Class 3 (3A and 3B) in P School and one division of Class 4 in Q School were observed.

EVALUATING INQUIRY BASED SCIENCE EDUCATION

Primary schools in a large number of countries have ongoing Inquiry-Based Science Education (IBSE) projects. The practice of inquiry in schools takes different forms. Sometimes it is visible in a few episodic lessons or a short-term project; sometimes as a choice of curriculum. The inquiry may be 'open,' 'structured,' or 'guided.' Given the non-uniform ways of adopting an inquiry-based approach for teaching science, evaluating inquiry-based science education is a challenge. Yet, certain actions that the teacher and students engage in reflect an inquiry-based teaching and learning approach (Box 1). The majority of these actions are unlikely to be seen in

[3] The development of skills related to design and engineering and quantitative thinking are addressed more in some topics in the curriculum than others.

[4] The term 'inquiry' was not used with the teachers during the evaluation as it was neither explicitly used in HBC nor was a part of the discourse in either schools.

most classrooms as they require teachers to allow students a large degree of freedom to conduct inquiry independently (i.e. open inquiry). However, the purpose served by these actions is that they suggest how an inquiry-based curriculum may be transacted in a structured (or guided) manner (Windschitl, 2003).

Teachers' actions	Students' actions
➢ [5] Providing experiences, materials, sources of information for students to use directly. • Showing the use of instruments or materials that students will need in their inquiry. ➢ Asking open and person-centred questions to elicit present understandings and how students are explaining what they find. • Engaging students in suggesting how to test their ideas or answer their questions through investigation or finding evidence from secondary sources. • Where necessary, helping students with planning so that ideas are fairly tested. ➢ Listening to students' ideas and taking them seriously. ➢ Asking questions that encourage students to think about how to explain what they find. ➢ Setting up opportunities for collaborative learning and dialogic talk. • Scaffolding alternative ideas that may explain the evidence from their investigation. • Gathering information through observation, questioning and interaction, about students' developing skills and ideas.	➢ Engaging in exploration of materials, objects, events. • Working in collaborative groups, sharing ideas and constructing understanding together. • Raising questions and considering how answers may be found through investigation. ➢ Proposing possible explanations of observations. • Suggesting how ideas behind possible explanations can be tested or questions answered through investigation/active inquiry. • Planning and carrying out investigations, making observations and measurements as appropriate, or using other ways of gathering evidence, to test ideas. ➢ Keeping notes and recording results in suitable ways. ➢ Relating results to the ideas being tested or question addressed; attempting to explain results. • Communicating what they have done; listening to and sharing ideas with others. • Reflecting on the process of the inquiry and on any change in ideas.

Box 1 Summary of some key features of inquiry based teaching and learning [6]

[5] Features marked with these shaped bullets will be referred to in the section titled Inquiry in Chiaroscuro

[6] From Harlen, W. (2004). Evaluating inquiry based science developments. National Research Council.

EVALUATING INNOVATIONS

The description of the textbooks of the Homi Bhabha Curriculum in its general preface as being "full of radical unconventional ideas," aligns the curriculum with the view expressed by Bruce, Peyton and Batson (1993) about innovations: "the manifestation of a set of beliefs and values about change" embodied in "documents and practices that define and support its intended uses" (p.10). The challenge of evaluating any educational innovation lies in recognizing that the very social system that it seeks to change may change in ways unintended by the innovation; even cause alterations in the innovation itself. This is because the innovation, idealized as an agent of change is commonly developed outside the systems in which it aims to bring about change; systems which are inherently dynamic. [7] By recognizing that an innovation comes to be used differently in varying contexts, the focus of its evaluation shifts from the form conceived by its developer (its idealization), to the form it assumes through use (its realization). The evaluation of the innovation, therefore, is 'situated' in the context of use. "Situated evaluation seeks to characterize alternate realizations of the innovation and to identify new variables" (Bruce et al., 1993, p.40).

CONTEXT OF THE EVALUATION of HBC

Each school is a unique system and defies uniform use of a curriculum. Although the Homi Bhabha Curriculum is spelt out in detail and the schools that have adopted it share the common goal of changing the way primary science is taught and learnt, the curriculum is not "teacher proof."

At the time of the evaluation (2005-2006), HBC had entered the second year of implementation in both P and Q schools. One of the customary approaches to evaluating a curriculum is in terms of the stage of its implementation. Formative evaluation, with a view to improving the curriculum is best suited for a curriculum in its nascent stages of implementation. In the case of a well-established curriculum, a summative evaluation with a view to assessing the learning outcomes is viable. Both these forms of evaluation, however, are carried out on the assumption

[7] In this case, no school using the Homi Bhabha Curriculum has been involved in its development.

that the curriculum is clearly defined and stable; the focus is on *its* improvement, *its* impact. A curriculum is more than the design of a physical artifact to meet a functional specification. In transacting it, a set of social practices emerge, relations between its users are realized **(**Bruce et al., 1993). The purpose of evaluating the Homi Bhabha Curriculum was therefore to understand the *situated* process of change or the "innovation-in-use." The broad question considered in this evaluation was how institutional practices and teacher practices affect the use of an inquiry-based primary science curriculum.

DATA COLLECTION *(See Appendix A [1-5] for tools of data collection.)*

Qualitative data were collected by means of:

i. Interview of teachers prior to the observations to get to know their background, attitude towards students and learning, and initial thoughts about how to use the curriculum. (*A1*)

ii. Classroom observations (textbook and activity classes separately in the case of P school) to understand the transaction of the curriculum. (*A2 and A3*)

iii. Written feedback from the teachers after each observed class to allow them time and space away from the classroom to reflect about their classroom transaction. (*A4*)

iv. Interview of the teacher(s) after all observations were concluded to assess broadly their understanding of the curriculum.(*A5*)

In P school, classroom observations were conducted twice a week. Of the total 29 classes observed, the textbook was used in 10 and the workbook in 19 classes. Two observers (my self included) were present for 25 of the 29 observations. One workbook class and two of the textbook classes were videotaped. The twin workbook classes which were conducted in the laboratory, were either just before or immediately following the lunch break.

The school followed a fairly fluid timetable with class teachers free to sequence the subjects to be taught on a daily basis. To accommodate us for classroom observations, at least two days of the week were confirmed for teaching science. The teaching of four chapters (textbook topics) from two Units, viz., *The Living World* and *Our Food, Our Body* was observed across 29 sessions. As the choice of when and how often to teach a subject during a week lay with the class teachers, the teaching of these two topics proceeded at a pace which exceeded our planned

visits. Consequently, we were unable to observe the study of either of these two topics from start to finish.

In Q school, classroom observations were conducted once a week totalling 9 classes. I was the only observer for these 9 sessions during which I observed the teaching of two chapters from the Unit *Air*. The first class of the day was assigned to science and began at 1:00p.m. Except for one session in which the students went to the school hall adjacent to their classroom to conduct a few activities, all others were demonstrated by the teacher in the classroom.

It is important to state two caveats at the outset: i) Classroom observations conducted for this evaluation offer only a glimpse of how the curriculum is transacted through the year, 2) During the period of evaluation, practices that were visible may sometimes be only a partial approach to the curriculum and those hidden from view may occur as well, unless stated categorically.

Box 2 offers a quick look at the logistical differences between the two schools with respect to the evaluation.

Box 2 **At-a-glance differences between P School and Q School**

	P SCHOOL	***Q SCHOOL***
Location:	Central Mumbai	Satellite town of Mumbai
Class observed:	Std. 3A and 3B	Std. 4B
No. of students:	40 each	57
Gender distribution:	12/13 Girls, 27/28 Boys	28 Girls, 29 Boys
Teachers involved:	Three	One
Observation sessions:	29	9
Units addressed:	Two	One
(from the textbook)	*Living World* *Our Food, Our Body*	*Air*

The medium of instruction in both schools was English although the language spoken at home by the majority of the students and teachers was not.

P and Q SCHOOLS

P SCHOOL

It was a private school established in the central part of the city. At the time the evaluation was conducted it was no more than five years old and only a primary school for girls and boys. Students were in school from 9:00a.m. to 3:00p.m. P school has adopted some "progressive" practices such as child-appropriate furniture, unisex uniforms, a child-centred pedagogical approach, flexibility for teachers to design/modify curricula, time set aside for students and teachers to do library research, collaborative lesson planning by teachers, in-service teacher education, and parent education. The school ambience was informal and relaxed. Students were free to address teachers by their first names. The teacher population was young; for many this was their first job. The medium of instruction was English. However, the majority of the students as well as the teachers were from a community in which English is not the language spoken at home. The school administrators insisted that the teachers develop proficiency in English for themselves and in their students.

The Homi Bhabha Curriculum was transacted in P School in a manner unlike most schools. The textbook was read and discussed in Classes 3A and 3B by the class teachers Anita and Bindu respectively, each with their group of 40 students. The workbook was used in a room designed to be a laboratory, and was monitored by teacher Kalpana. Classes 3A and 3B were each divided into two groups of 20, with the twin groups of a class division visiting the laboratory consecutively. The classrooms and the lab were well-lit and spacious. The duration of a class period (using the textbook or workbook) was for 40 minutes. The teacher's book was not visible during the class sessions.

Q SCHOOL

Well established in a satellite town of Mumbai, this was a private English-medium school. Dearth of space and a large student population gave Q school little choice but to operate in two shifts. Middle and high school students attended the morning shift and the primary school students attended the afternoon shift (beginning at 1:00p.m.) For the primary school students, the school-day began with a maxim written at the top of the blackboard, such as, 'Heaven cannot be attained without good deeds,' 'Where there is smoke there is fire' and prayers.

Situated on the topmost floor, under a corrugated tin roof, the cramped classroom of Class 4 seated 57 boys and girls in pairs at uncomfortably narrow desks — to which were fastened equally uncomfortable narrow benches. The school atmosphere was formal and disciplined. Students spoke to the teachers when spoken to. The teacher's authority was paramount; sometimes palpable for the students as well. The school was largely mainstream in its ambience, practices, and role expectations of students and staff.

Yet, decisions related to unconventional practices were made, the adoption of the Homi Bhabha Curriculum being one of them. This decision had been reluctantly received by the parent community as well as the teaching staff. The primary school headmistress's confidence in the curriculum played a significant role in its gaining a foothold and being retained beyond the first year. Like P school, the majority of students and teachers in Q school were also from a community in which English was not the language spoken at home.

The transaction of HBC in Q School was, as could be expected in a conventional school. Restricting herself primarily to the classroom, Roshni, the teacher assigned to teach science to Class 4 adopted the 'chalk-and-talk' approach punctuated with demonstration of activities. At times, Roshni had to raise her voice enough to drown out the noise intruding from neighbouring classrooms. Each class period was for 35 minutes. The students recorded their observations in the workbook occasionally in class; more frequently at home. The textbook was seldom visible. There were two reasons for this, as I discovered in an informal conversation with the school's headmistress. The size of the textbook (11.5" x 8") was seen as cumbersome for students to carry and use on the narrow desks, especially in addition to the identically-sized workbook. Although — or perhaps because — it was unlike standard textbooks in its style of writing (conversational) and presentation of content (anecdotal), it was seen as too informal. The experiential component of primary school science is commonly circumscribed to demonstration of activities (by the teacher) and their observation (by the students). For Roshni, the workbook and the teacher's book seemed to suffice towards this end. She consulted the teacher's book at times while teaching; more often it was her own hand-written jottings/notes which seemed to be based on the reading of the teacher's book.

TEACHERS OF P & Q SCHOOLS

The teaching qualifications of the four teachers (three in P School and one in Q School) were varied as were their ways of transacting the Homi Bhabha Curriculum. (See Box 3 for details of the teachers in terms of their teaching and educational background.)

ANITA was the newest amongst the three in P School, but with three years of teaching experience in hand from a school known for its "experimental" status and success. She had a Bachelor's degree in Education (B.Ed.) which qualified her to teach at the middle and senior school levels. In the 3 years of being a teacher, Anita had taught science for two years--once at the primary school level and once at the middle school level. This was her fourth year of teaching, and second year of teaching science to a primary class.

The Homi Bhabha Curriculum was new to Anita. Science not being a favoured subject with Anita, she said she would opt to teach History or English if given a choice. At the time the evaluation started (June 2005) Anita was only a few weeks old in P School. In the brief time that she had interacted with her students, her assessment of them was that they were a mix of average and below average ability. The two qualities Anita identified as those that make a student a good learner were "a questioning mind" and "being an independent worker."

Box 3 Background of the teachers of P and Q Schools

	Anita	*Bindu*	*Kalpana*	*Roshni*
Teaching experience (years)	3	3	2	5
Experience teaching primary classes	1	2	2	3
Experience teaching primary science	1	--	2	3
Class being taught in 2005-06	3A	3B	3A & 3B	4B
Teaching qualification	B.Ed. (*M.A.*)	ECCE (*Certificate course*)	-- (*B.Sc*)	D.Ed (*M.Com*)

Classroom observations revealed that Anita enjoyed interacting with her students. She displayed a good sense of humour.

BINDU and *KALPANA* were in their fourth and second years respectively, of being with P School. Neither of them had professional qualifications to teach at the primary level. Bindu had been certified to teach at the pre-primary level (Nursery and Kindergarten) and at the time of the evaluation was pursuing a B.Ed degree through a correspondence course. Although it is the D.Ed (a Diploma in Education) which is designed to train teachers for the primary level, the B.Ed. degree is more sought after.[8] Of the four teachers, Kalpana was the only one who was not professionally qualified to teach at any level; she was also the only one with a Bachelor's degree in Science (B.Sc.)

Bindu began her three-year old teaching career at P School. Appointed as Class Teacher of the then Senior Kindergarten class, Bindu continued in the same capacity through the years as her students advanced; this was their fourth year together. She indicated having a strong interest in science but her confidence for teaching it as being no more than average. With the Homi Bhabha Curriculum introduced at the Class 3 level, Bindu too was using it for the first time. Given a choice, she said she would like to teach English, Math and Science.

Most of Bindu's Class 3 students had been with her from the time they first met in Senior Kindergarten. She described her students as being curious, wanting to do a variety of things and speedily, and a mixed group in terms of abilities. According to Bindu, "the ability to listen, to be curious, to find out and research" were the qualities that made a student a good learner. She was quite clear that being a good learner depended to a large extent on the teacher, who is best able to develop these qualities in her students. The atmosphere in Bindu's class was less lively, more languid. Her manner was solemn and the students seemed accustomed to it.

---

[8] The higher salary bracket associated with it and the misguided prestige of teaching "older" children who are seen as making greater demands on a teacher's intellect, are two reasons that emerge in conversation with teachers. Besides, the phenomenon of high demand-low supply of teachers characteristic of the country, compel educational institutions to circumvent the standard requirements and employ available candidates--even if overqualified--for the primary school.

For Kalpana, this was the second year that she was implementing HBC. In her view, her prime responsibility was the use of the workbook. Kalpana described her interest in science as being strong and level of confidence for teaching it as being high. She had the opportunity to interact with smaller groups of students; yet, was unable to remark on any noticeable difference among the four groups (of 20 students each) she interacted with. She described all as "inquisitive, wanting to know more and in detail, wanting to know beyond the curriculum." The qualities which according to Kalpana made a student a good learner were, "sharing thoughts, listening, observing." Kalpana's body-language and voice conveyed an authoritarian approach to teaching. It was difficult to discern the strong interest in science she had indicated as having.

ROSHNI of Q School was in her sixth year of teaching at this school. Qualified with a Diploma in Education (D.Ed), she had taught in primary level classes for five years and science as a subject for three years. She was the Class Teacher of Class 3A but as a Subject Teacher, taught Science to Class 4B. This was the second year that she was using the Homi Bhabha Curriculum, but for the first time at the Class 4 level.

Unable to pin her interest for science as being 'mild' or 'strong,' Roshni described it as lying somewhere between the two. Similarly, she gauged her confidence to teach the subject as being neither 'average' nor 'high' but wedged between the two. If given a choice, she said she would like to teach Math. Roshni's view about students and learning appeared to be achievement-oriented. The two qualities which came to her mind promptly when asked what made a student a good learner were, 'being attentive in class' and 'getting practice by doing homework.' When I probed her for another quality, she mentioned curiosity. She described the class she was teaching as being naughty, sincere, and hardworking. Although strict, occasionally even bordering on the severe, Roshni stirred interest about the subject in her students by carrying out activities specified in the curriculum.

TRANSACTING THE HOMI BHABHA CURRICULUM

The seamless use of the Textbook, the Workbook and the Teacher's Book by the teachers of the two schools was not apparent. As three distinct texts, they seemed to belie the connectedness of the curriculum across them. The perception of the textbook by the two schools differed significantly, leading in the case of Q school, to its virtual non-use. The use of the workbook varied significantly in the two schools on account of the respective school teachers giving emphasis either to (writing in) the book or the doing of the activities. Emphasis on writing appeared to have a contrary effect on the involvement with activities, and vice-versa. There was a conspicuous difference in the use of the teacher's book by the teachers of the two schools as well.

PRACTICES SURROUNDING THE TEXTBOOK

LANGUAGE DEVELOPMENT

In keeping with the school policy to improve students' (as well as their own) proficiency in the second language, English, the teachers of P School emphasized the enhancement of (general) language skills as afforded by the textbook's prose and poetry elements. In the interview prior to classroom observations, Anita spoke tentatively about using the textbook, "as an English lesson, paragraph-wise..." Bindu, on the other hand, sounded quite decided about how she planned to use the textbook: "The story as an English reader, add activities based on the content, and add questions for the purpose of comprehension." In the post-classroom observations interview, Anita and Bindu agreed upon the simple story line, the poems and the activities as the elements of the textbook which their students enjoyed. Bindu said that what her students appreciated was that "it's not like a textbook where there are only facts and information."

Q School, although sharing the second language context with P School, had not similarly considered using the textbook as a means to emphasize language development.

READING THE TEXTBOOK

Both Anita and Bindu emphasized the reading-aloud of the textbook, which either they did and/or had their students do. Anita read at an even pace and expressively. A greater number of students in her class got an opportunity to read either by being selected or by enthusiastically volunteering to. In Bindu's class there were usually two readings of the chapter. First, Bindu read aloud to the class. Her voice was characteristically undemonstrative and low; whether she was audible to all her students was doubtful. The second reading was only by those students selected by Bindu.

In Q School, neither Roshni nor her students read the textbook aloud. As a result, her students lost the opportunity to read text which addresses them actively as "young scientists," to relate their experiences to those of the story's two protagonists Mini and Apu, and to appreciate and enjoy the text's prose elements. When interviewed after all classroom observations were concluded, Roshni mentioned that rather than reading the textbook, her students liked to look at the illustrations and sometimes read the poems.

DISCUSSION ON TOPICS

The nature of discussion following a chapter in the textbook was determined to a large extent by the way the chapter was structured. The topics, introduced either by means of an anecdote involving Mini and Apu or some hands-on activity, were meant to spark the students' curiosity about its science content. However, the discussions initiated by Anita and Bindu on topics introduced anecdotally were primarily oriented to developing their students' language ability. The questions they asked were meant more to arouse their students' curiosity about the anecdote that they were about to read ("What are the differences between playing in a village and in a city?" "How many of you have climbed a tree?") and test comprehension about the characters in the anecdote, their actions and sequence of events. Questions aimed at exploring or understanding the science-related content were occasional (see Box 4).

Box 4 Questions for the chapter *Mini's Fall* in the Class 3 Textbook

Asked by Anita	*Asked by Bindu*
1. What was Mini doing on a Sunday afternoon?	1. On which part of the body does Mini feel more ticklish?
2. Why did Apu look at Mini with envy?	2. How did Apu wake up Mini?
3. Why did Mini cry?	3. Why did Apu wake up Mini?
4. What did Amma tell Mini about blood?	4. What did Apu and Mini play?
5. What would happen if we had no bones?	5. What do you do on a Sunday after lunch?

Topics that were introduced anecdotally included a small verse/poem as well, at times with a riddle posed within it. The students' enjoyment of it came from reading aloud the rhyme and guessing the answer to the riddle. In one of sessions observed, Anita and Bindu used a verse (It's hard and round, but not a stone/For in the ground, it grows on its own/Water with a pail, and it sprouts a tail/Then shoots up high, for it's alive!) isolated from the anecdote in which it featured, to initiate a discussion about the subject matter, viz. growing a plant.

Topics that were introduced by way of activities which required the students to do something specific seemed to offer the teacher a comfortable way to engage the students in a conversation with a view to delving into the subject matter. Consider a snippet (Box 5) from the exchange in the Std.3B classroom between Bindu and her students in response to the activity, *Ask your friend to open his or her mouth. Describe what you see inside*.

Box 5 Exchange between Teacher (T) and Students (S1-6) of Std. 3B

T:	What did you see?
S1:	Tongue is there. Something else is coming…
T:	Something else is *coming*? What?
S1:	Broken teeth
S2:	Teeth had so much dirt
S3:	Teeth was coming out. (*The teacher looks sceptically at the student*)
S4:	Yellow teeth

Box 5 contd. Exchange between Teacher (T) and Students (S1-6) of Std. 3B

S5:	Teeth are joined.
T:	To what?
S5:	Gums
T:	What is gums? (*Without waiting for a reply*) Colour?
S5:	Pink
S6:	I saw roots.
T:	Roots? Come and draw what you saw on the blackboard. I don't think they are roots. Let's find out…

PRACTICES SURROUNDING THE WORKBOOK

READING AND RECORDING

Grouped in three's or more around tables, Kalpana's students read aloud the exercises in the workbook and recorded their observations based on them. The importance of developing language skills, fairly strongly internalized by the students as well, was evident from the use of the workbook. They were eager to read aloud and were especially alert to unfamiliar words, seeking Kalpana's help to understand their meanings and learn their spellings. The majority of the class time was spent in students recording their observations diligently. Kalpana remained seated for the greater part of 40 minutes monitoring the students' reading and writing and "herding" them along from one exercise to the next. This gave the exercises the appearance of "tasks" which had to be executed efficiently, the final goal being "to know" (the answers). Although Kalpana's involvement in these exercises and activities was minimal and largely perfunctory, it didn't dampen the spirit of most of the students as they responded to the questions posed in them and recorded their observations in the workbook with interest.

In stark contrast, Roshni stood for the entire duration of the class, sandwiched in less than three feet of space between the blackboard and the first of seven rows of desks in front of her. The workbook was usually visible on the desks of most of Roshni's students. However, in only two of the nine classes observed, she instructed her students to record observations immediately following the activities conducted. Writing in the workbook took on the appearance of

"wrapping-up" rather hurriedly the several hands-on activities that she had conducted at length for her students. The students were not involved in an attentive reading of the workbook, independently or teacher-guided — not even while recording their observations. In two sessions, Roshni asked the students to open their books to a particular page, discussed the exercises, and instructed them to record the observations at home.

DOING ACTIVITIES and EXERCISES

The nature of involvement of the teachers as well as of the students of P and Q schools in doing the activities and exercises differed. Most of the exercises that Kalpana's students worked on were observation-centred. On occasion, they required material on which the observations were directly based, for example, activities for which students had to explicitly smell, feel, count, or look. In the absence of materials that were specified as necessary for hands-on experience, students merely recorded their observations by recalling prior experiences (the touch of a feather on different parts of the body, differentiating between kinds of grains).

The large number of students squeezed into the available classroom space did not deter Roshni from conducting activities, albeit with effort and some signs of aggravation. In the first class I observed in Q school, Roshni had her students perform activities related to the topic of air making use of minimal material (e.g. a plastic bag, a syringe), while seated at their desks. On another occasion, she had them assemble in the school hall adjacent to their classroom and allowed them to be actively involved in the doing of an activity. However, Roshni assumed charge of most activities and demonstrated them conscientiously and with interest. At times she was able to ensure that all her students were able to see what she was doing, by either holding the activity material up high or placing it atop a chair mounted on a desk. At other times, students got off their benches and stretched their bodies to get a clear view of what she was doing. She sometimes involved a couple of students to assist her in setting up the activity. Many of the students were attentive to the activities being demonstrated and some responded to Roshni's questions with enthusiasm. Roshni reminded her students on a couple of occasions that the activities that were demonstrated in the class could be done by them at home as well.

The one exercise that was unanimously enjoyed by students across both schools was that of finding similarities and differences between a pair of objects or situations.

ACTIVITY BASED DISCUSSION

In P school, the one hands-on activity that especially held scope for discussion in Kalpana's class was that of sowing seeds. And yet, there was barely any sign of it (see Appendix B). The exchange between the students and the teacher was largely defined by directions sought and instructions given about the procedure. In Q school, there was a semblance of a discussion that took place during activities. Roshni drew her students' attention to what she wanted them to observe, to understand, and welcomed examples that her students had to offer in response to her questions (see Appendix C for an example). She often used words and terms appropriate to the subject matter.

Effort to address and discuss values in science by means of workbook exercises — or independent of them, was minimal in both schools. When attempted, the tone of the discussion was more factual and information-oriented. A sense of "worth" or "appreciation" that is aimed for when talking about values was missing from the discussions.

PRACTICES SURROUNDING THE TEACHER'S BOOK

Having merely scanned the teacher's book at the end of the previous academic year, both Anita and Bindu were unable to comment on it before the evaluation began. In the written feedback (following each class that was observed), the teachers were asked how much time had they spent preparing for that class and how had they prepared for it. Anita and Bindu mentioned spending as little as a quarter of an hour to as much as a day or two preparing for some classes. However, Bindu referred only once to using the teacher's book to prepare for a topic in the textbook (*"I read the teacher's guide and got ideas for activities."*) whereas Anita made no specific mention of using it. Kalpana had said her use of the teacher's book was ongoing, at school and at home, primarily for the purpose of reference and to prepare for the classes. She found it easy to use, describing it as, "very apt, direct, to the point." Yet, in the feedback provided by Kalpana following most of her classes, she stated having spent "not much time" or "no time" preparing

for the classes; the teacher's book finding no mention at all. Classroom observations indicated that the 'teaching ideas' accompanying each lesson discussed in the teacher's book were being under-utilized

Observations of Roshni's classes revealed a fairly close reading of the teacher's book. In her written feedback following every classroom observation, she stated having spent anything from a couple of hours to a day or two preparing for her classes, by reading the teacher's book and trying out some of the activities in advance. Speaking animatedly in the interview, she described the book as being "TOO GOOD!" and as "providing a lot of knowledge." In an effort to enrich her classes, she often used the additional information and tips provided in the book.

INQUIRY IN CHIAROSCURO [9]

With the decision having been made by both schools to adopt the Homi Bhabha Curriculum, an inquiry-based curriculum which aims to engage students and teachers *together* in the learning experience, the teachers' actions were clearly an effort in that direction. Of the several teacher and student actions identified as being indicative of the inquiry-based approach to teaching and learning (Box 1, p.3), some (marked by an asterisk) were visible in P and Q schools. Student actions were defined largely by the actions of their teachers. Consequently, students in both schools explored materials and objects presented to them (or brought them to class as and when instructed), explained their observations when asked questions about them, recorded results when directed, and communicated with and listened to others when encouraged.

Although the term 'inquiry' had not been used explicitly in the Homi Bhabha Curriculum or with the teachers of either school, their understanding of the inquiry-based nature of the Homi Bhabha Curriculum and what differentiated it from other primary science curricula was addressed obliquely (see tools of data collection). The abilities the teachers listed as those which this curriculum aims to develop in students, corresponded to some of the skills and attitudes required especially in inquiry learning: observation and listening, curiosity, a hands-on practical approach to science, and independent thinking. As teachers using such a curriculum, the skills they specified as the ones they would be interested to develop were systematic research, framing relevant questions, experimental skills, a deeper understanding of the information given in the teacher's book The features of the curriculum they identified as differentiating it from other primary science curricula were its emphasis on experiments, practical work, and the need for research and observation. All the teachers were of the opinion that it would be easy to develop in their students the kind of abilities that HBC aimed for, but three of them qualified their response by adding that in order to achieve this, time, effort, and greater attention to the teacher's book are needed.

[9] The term chiaroscuro refers to the contrast between light and dark elements in a work of art. Here it is used metaphorically to depict the nature of inquiry observed in the classrooms.

The assertions made by the teachers of both schools about the abilities that the curriculum aimed to develop was not entirely embodied in their actions. Yet, their views about student as learners, their recognition of the skills that needed to be developed in students and themselves as teachers for a curriculum such as HBC, as well as the classroom transactions signalled a readiness for teachers to understand and engage their students in inquiry based science education. The combination of certain institutional practices/constraints on the one hand, and teacher practices on the other hand, accounted for the chiaroscuro effect in the nature of inquiry observed in the two schools. These two factors are considered in greater detail below.

INSTITUTIONAL PRACTICES/CONSTRAINTS

At the institutional level, overt constraints such as limited space and large class size (in the case of Q school) inhibited the teacher from setting up opportunities for collaborative learning and dialogic talk. The converse held well in P school where the teachers took advantage of the ample space and the small class size to attempt strategies for collaborative learning. However, the lacunae in their attempts will be considered in the next section.

Two other practices influenced the transaction of the curriculum. One was P school's conscious and constant effort to emphasize English proficiency in its students which diverted the teachers from a deeper engagement with the subject matter. The other was isolating the workbook from the textbook. The desire to get primary level students familiar with the idea of a laboratory as the setting for conducting experiments and hands-on activities and having got one designed specifically for this purpose, the workbook in P school was set aside for use only in the laboratory. This divided responsibility for the two books between the classroom and laboratory teachers created a patchy approach to teaching the same content. Even if the two texts were to be used apart from each other, the content across them would have to be examined and understood collaboratively by the teacher(s) in order that their students (and they themselves) have a cohesive understanding of the subject matter.

TEACHER PRACTICES

PEDAGOGICAL KNOWLEDGE — CONTENT KNOWLEDGE

In the last decade, research recommendations and reforms in the areas of teacher education and curriculum development called for students to be placed at the centre of classroom transactions, with special attention to the girl child. Schools that heeded this call sought to impress upon their teachers to organise classroom experiences that were "child-centred" and addressed the child's natural curiosity. Classrooms characterised by drill and rote learning changed to include activities involving greater participation from students. "Activity-based learning" and "hands-on learning" became the new and popular forms of pedagogy that teachers began to refer to when describing their classrooms.

In a science class, organizing classroom experiences (pedagogical knowledge) requires that in the context of hands-on activities (or projects or field visits), specific skills such as raising questions, using observation, collaborative learning and dialogic talk, developing hypotheses, predicting, planning investigations; and attitudes such as curiosity and sensitivity to the environment are attended to by the teacher. For a teacher to demonstrate these meaningfully, a deep understanding of the subject matter (content knowledge) is necessary. The single most important challenge that teachers face in transacting a curriculum is integrating pedagogical knowledge with content knowledge; "pedagogical content knowledge" (PCK), a construct developed by Lee Shulman (1987). The dominance of only pedagogical or content knowledge in the classroom misrepresents teaching and learning. Pedagogical content knowledge requires that the students' voice and role in learning is informed and ably scaffolded by teachers' content knowledge.

The purpose of asking the teachers of both schools at the end of every classroom observation how comfortable they were about the content for that day's class was to evaluate whether they reflected on their understanding and engagement with the content knowledge. By and large, the teachers of both schools seemed less reflective about it. Some of the responses were ambiguous: "I felt quite comfortable [about the content] since I did not have to explain much, except few words," "I thought I had very little matter." One of the teachers of P school, who

consistently reported feeling very comfortable about the content seemed to base her response on her students' enthusiastic involvement with the exercises rather than her own understanding of or reflection on the content: "Good, as the children could do as instructed," "Very comfortable as the children were confident about what they were writing," Excellent as it was interesting for the children."

On the other hand, in view of what was observed in Roshni's classes, her comments about her comfort about the content ranging from "quite comfortable" to "easy" to "a little difficult to understand" seemed a little more reflective. She was the only teacher to explicitly state, "first understand concepts" as among the skills a teacher using the Homi Bhabha Curriculum needs to develop/demonstrate. She also was the only teacher amongst the four who commented on what this curriculum could have emphasised more in terms of content.

A teacher's content knowledge of the subject plays a vital role in how it is taught, notwithstanding interest in the subject and confidence to teach it. Bindu and Kalpana of P school had indicated that they had a high degree of interest in science, and Kalpana had also indicated a high level of confidence to teach it. Yet, observations of their classes did not reveal competence in understanding the nature of science that matched their level of interest or confidence. School systems when assigning a subject to a teacher are often driven by practical constraints (lack of qualified teachers to teach the subject, proportionate teaching load for staff members to the extent possible). Yet, the selection of a particular teacher to teach a particular subject, carries with it an unspoken assumption for the teacher that her content knowledge (for that subject) is satisfactory. The need to think reflectively and critically not only about content knowledge but also their understanding of it is seldom given consideration by the teacher or the administrators.

The challenge of pedagogical—content knowledge is detailed below through three illustrations of it.

i. Developing curiosity through questions

Unarguably, children are curious by nature and some form of learning occurs on account of it. Teachers, by and large, are aware of this. Prior to the classroom observations, three of the four teachers had included curiosity in their list of qualities that makes a student a good learner. Following all the classroom observations, the same teachers had mentioned it as an ability that the Homi Bhabha Curriculum tries to develop in students.

The first stated goal of the Homi Bhabha Curriculum, is "the *development* of curiosity and learning" (emphasis added). In an inquiry-based approach to science, curiosity as an inherent trait is to be developed into a way of thinking; a scientific attitude. Asking students questions is a typical — but not an unambiguous — way of developing curiosity. It has the potential to tap the impulse of curiosity in students without necessarily illuminating the subject matter further; in some cases, perhaps even taking the edge off curiosity if the questions are in profusion but lack clarity or relevance. A teacher's questions, which sustain the impulse of curiosity in students and then develop the impulse into a way of thinking, are the ones that reveal the teachers' ability to draw upon content knowledge and integrate it meaningfully with pedagogical knowledge.

In one of the sessions, Anita and Bindu in their respective classrooms, invited their students to come up to the front of the room and present to the rest of the class their observations about how their plants grew. Both teachers asked a number of questions. Anita interspersed her questions with her students' presentations and nudged them to be curious (think further) about their observations (Box 6).

Box 6 Anita's questions

- Why do you think your plant is drooping?
- What has happened to your plant? Why do you think nothing has happened to it?
- What happened to the roots?
- Where did the roots grow? Which direction?
- What is it that your seeds got that these seeds didn't get?
- Did you water the plant? Did you put too much of water? What else could be the reason?

Bindu sought three details from her students presenting their observations: the name of the seeds they had sown, the number of days the shoots took to emerge, and the length of the shoots. She recorded the students' responses on the blackboard creating a data chart. She asked her first question, "*Now, each one of you look at the blackboard and tell us which seed grew the fastest?"* The question was met with a quick flurry of raised hands and correct responses. Her next set of questions were essentially a repetition of the earlier question, merely rephrased each time.(Box 7). The responses were chimed out monosyllabically, en masse.

Box 7 **Bindu 's questions**

T:	From this can you know—that all seeds have different pace to grow and it takes different time?
Students:	Yes.
T:	All seeds need the same time to grow?
Students:	Noooo…
T:	All plants grow at the same speed?
Students:	Noooo….
T:	Do they grow at different speed?
Students:	Yes.
T:	They have their own pace to grow?
Students:	Yes.
T:	Do they have their own pace to grow?
Students:	Yes.

Bindu's second question was, "*If you want to see the difference between two plants, what will you look at? If any time you want to see a plant and you want to remember it, then how will you see the plant? What will you remember of the plant?"* Using the data on the blackboard and the preceding discussion as the cue, a student said, *"In how much speed it grows."* Bindu sounded incredulous at the answer given and in a roundabout way led the students to an important understanding — though unrelated to the discussion that was underway — that plants can be differentiated on the basis of their leaves.

The students in either school were seldom observed asking questions. When they did, they were more to do with the execution of the activity rather than with the purpose of (further) inquiry. It is plausible that (to)'inquire' and 'inquiry,' on account of their overlapping meaning are confused to be identical in scope. Making a finer distinction between the two is important in

the context of teaching and learning. While questions are the principal starting point of the process of inquiry they must be seen by teachers and students only as a *part* of a process, *part* of an investigation; leading on to other elements of inquiry such as those mentioned in its definition on page 1.

ii. The use of analogy

Science teachers make use of analogies to teach subject matter that is difficult for students to comprehend. Central to achieving the goal is the right choice of the analogy. This in turn is determined largely by the purpose for which it is being used, as well as the teacher's content knowledge in making the correspondence between that which is familiar (source) with that which is not (target problem) in terms of semantics and structure (Thagard, 1992).

Anita began enthusiastically, but unfortunately on the wrong foot, when she attempted to use an analogy for a lesson on growing a seed. "I'll tell you—a seed is like a baby." The purpose of the analogy was presumably to explain how a seed grows. As Anita's explanation proceeded, it appeared that the parallel that was being drawn between a seed and a baby was to enable her students to *recall* the factors that are necessary for a seed's growth into a plant (*see Appendix D for a transcript of the detailed analogy*). The (well-intentioned) decision to use an analogy and the (inappropriate) choice of the analogy bring out the tension in this teacher's pedagogical content knowledge.

iii. Collaborative learning

The two schools differed noticeably with respect to setting up opportunities for collaborative learning. An effort in this direction was missing in Q school — partially on account of managing a large number of students in limited space, making it more conducive for the teacher to be "in-charge."

In P school, where instances of students collaborating for activities were more apparent, the advantages accruing from it were uncertain. Anita and Bindu incorporated a collaborative component in their classes occasionally by having the students report on activities in small groups, suggesting that the activity had been worked on by them in groups. For the activity of

growing a plant described earlier, the students were asked to step up to the front of the classroom in their groups and share their observations. Yet, each member of every group addressed the class about his/her individual plant. In the context of the activity, the only purpose the groups seemed to serve was that members of each group had planted the same kind of seeds. Signs of collaboration between the members of each group and/or across groups were not visible.

The seating arrangement in the laboratory in P school afforded ample opportunity for collaboration and dialogic talk amongst students and between students and teacher (Kalpana). Each batch consisting of no more than 20 students, distributed themselves in groups of 3 or more around the lab tables. The composition of the groups varied from session to session in terms of number and gender of the group members. Although the seating arrangement in the lab was conducive to intragroup and intergroup discussions, the nature of collaborative learning appeared weak and unsure.

The interaction was regulated by Kalpana who addressed the students individually rather than as a group. She seemed unmindful of the possibilities of doing and promoting inquiry in small groups or the learning advantages of collaborating as a group. Her walking to and between the groups of students to guide them in doing an activity, in their writing work or to engage them in discussion, was a rare sight. The tables came to be used by the students primarily as a surface for writing and only occasionally for conducting an activity or exploring and working with materials. Students were frequently told not to discuss amongst themselves as this was perceived as not being willing to think independently! In the first three of the 19 feedback forms that Kalpana responded to, her response to questions 4 & 5 (see Appendix A) reinforced this view of hers. She noted plainly that, "I want them to write the answers by themselves without discussion," and "I don't want to discuss the answers with them."

In the absence of adequate content knowledge, attempts at collaborative learning and dialogic talk can well remain superfluous to inquiry learning.

CONCLUSION

In the current educational scenario in India, beliefs abut students and how they learn carve the community of school teachers into three kinds. The first kind of teachers subscribe to the established beliefs and practices concerning the teacher-student relationship "based on the notion that the teacher is supreme, that he (sic) possesses knowledge, and that he knows best how to impart it. The pupil's role was to be modest, obedient and receptive" (Kumar, 2005, p.88). Clearly, an inquiry based curriculum would hold little meaning in such an atmosphere.

The second kind, with exposure to progressive ideas of education adopted by the schools they belong to (such as the three teachers of P school), is more recent and is learning to distance itself from these established beliefs. Relatively small in number and more visible in urban and semi-urban school settings, this group has been initiated by the schools they belong to, into ideas and terms such as "child as co-constructor of knowledge," "child-centred teaching," "independent thinking," "encouraging curiosity." The third (such as Roshni of Q school) is on the cusp of traditional and progressive education, falling in step with their school's regard for some established practices even while open to winds of change. These two latter kinds of teachers are able to display a level of comfort necessary to bringing in innovative curricula into their classrooms.

The design of the Homi Bhabha Curriculum, in terms of content, language and style, was successful in changing the perceptions of the teachers of P and Q schools about how primary science can be taught so that it interests students and makes student voices integral to classroom discourse. The conventional "facts-and-information" view of science presented by the teacher in a prescriptive language and received by students, began to give way to a more descriptive view of science of "think-do-draw-find out" for the teacher and students. Beginnings of change such as these are encouraging. However, the desire and decision to use an inquiry-based curriculum does not necessarily transform into the understanding that is needed for inquiry-based teaching and learning in classrooms to occur. "Change from traditional to inquiry-based science teaching may require change in teachers' understanding of how children learn and of the nature of science" (Harlen, 2004, p. 3).

The kind of learning Harlen refers cannot be neatly packaged in the texts which constitute innovative curricula. Texts are the tangible face of progressive educational ideas. The curriculum changes hands, and from the developers comes to rest in the hands of the teachers who transact it. What does not change hands as easily as the physical texts is the intangible intellectual context underlying the curriculum: theories of learning, the philosophies of education, the beliefs and values that shape the change(s) in content and pedagogy. The Teacher's Book of the Homi Bhabha Curriculum for Primary Science provides some intellectual context for its users by articulating the background for such a curriculum and the values it espouses. In its introduction, the developers of the curriculum specify that the topics "are to be studied in depth" and that the book provides "practical help and advice on how to do this" (p.1). It is doubtful whether an in-depth reading of the Teacher's Book occurs, for reasons that may be attributed to the professional habits of teachers as well as the book itself and how it is perceived. There is a growing reluctance amongst teachers to read, let alone critically, anything more than what they consider absolutely essential. In the case of HBC, reading the Textbook and Workbook is as much as the teachers spoken to during the evaluation could manage. In addition, the Teacher's Book was being read by them more as one would an instruction manual or troubleshooting manual — as and when needed.

More than half a century ago, educational theorist Dewey who was equated with the "progressive education" movement, urged that teachers and educators critically examine the principles underlying the new education. Breaking away from the mould by attempting to use something novel such as innovative curricula (at the bidding of their schools), often suffices for teachers to (unwittingly) see themselves as knowledgeable adherents of the movement for a new education — currently sweeping urban India. The overarching philosophy of an inquiry-based approach to learning science, the raison d'etre of curricular changes with respect to science teaching is entirely missed by teachers. Besides, the lack of adequate and appropriate content knowledge of the teachers further weakens inquiry teaching which demands of them the ability to think clearly on their feet, and scaffold student learning by skilfully integrating pedagogical knowledge with content knowledge.

Periodic evaluations of the Homi Bhabha Curriculum are needed in different types of school systems and settings (referred to at the start of this report), to identify variables that influence its implementation. The insights offered by the evaluations can be incorporated in designing professional development programmes which are conspicuously absent in the country for schools/teachers adopting the inquiry-based approach to science education. Change in how primary science is taught depends on the "professional development (PD) of teachers, or the provision of classroom materials, or a combination of these" (Harlen, 2004, p.2). Classroom materials in the form of innovative curricula are clearly not enough to achieve a meaningful change in science education. To ensure that classroom transactions move beyond the levels of naïve enthusiasm to purposeful conviction, programmes for the professional development of teachers is a primary concern which requires serious attention from developers of innovative curricula as well as the schools that choose to adopt them.

References

Bruce, B. C., Peyton, J. K., and Batson, T.W. (Eds.). (1993). *Network-based classrooms: Promises and realities.* New York: Cambridge University Press.

Dewey, J. (1938). *Experience and education*. New York: Macmillan

Homi Bhabha Centre for Science Education. (2007*). Small science: A series in primary science*. Mumbai, India: Oxford University Press.

Kumar, Krishna. (2005). Political agenda of education: A study of colonialist and nationalist ideas. New Delhi, India: Sage.

Harlen, W. (2004). *Evaluating inquiry-based science developments.* Washington, D.C.: National Academy of Sciences.

National Research Council. (1996). *The National Science Education Standards*. Washington,D.C.: National Academy Press.

Ramadas, J. (2005). Small Science Teacher's Book Class III. Mumbai: HBCSE

Ramadas, J. (2005). Small Science Teacher's Book Class IV. Mumbai: HBCSE

Ramadas, J. (2005). Small Science TextBook Class III. Mumbai: HBCSE

Ramadas, J. (2005). Small Science TextBook Class IV. Mumbai: HBCSE

Ramadas, J. (2005). Small Science WorkBook Class III. Mumbai: HBCSE

Ramadas, J. (2005). Small Science WorkBook Class IV. Mumbai: HBCSE

Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. Harvard Educational Review, 57, 1-22.

Thagard, P. (1992). Analogy, explanation, and education. *Journal of Research in Science Teaching, 29* (6), 537-544.

Windschitl, M. (2003) Inquiry projects in science teacher education: What can investigative experience reveal about teacher thinking and eventual classroom practice? *Science Education, 87* (1), 112-143.

APPENDIX A (1)

Teacher Interview prior to Classroom Observations

Interview No.:
Date:

Name of School:
Name of Interviewer:

1. Name of the Teacher:
2. Educational Qualifications:
3. Teaching Experience: Primary Middle Senior

   Total number of years:
   Years teaching science

4. Number of years in the current school:
5. Designation: Class Teacher/Subject Teacher/Assistant Teacher
6. The class that you are teaching currently: STD: _____ Division:
7. How would you describe your class?
8. What qualities do you think make a student a good learner?
9. If given a choice, which subjects would you like to teach?
10. How would you describe your interest in Science?
    - Mild ☐
    - Strong ☐
    - Does not interest you ☐
11. How would you describe your level of confidence for teaching science?
    - High ☐
    - Average ☐
    - Low ☐
12. Since how long have you been using the Homi Bhabha Curriculum for Primary Science in your class?
    - First Year ☐
    - Second Year ☐
    - More than 2 years ☐
13. Can you describe how and when do you use the Teacher's Book?
14. Is the Teacher's Book easy to use?
15. In what ways is the Teacher's Book difficult to use?
16. How do you plan to use the Textbook to teach?
17. How do you plan to use the Workbook to teach?

APPENDIX A (2)

Observation Schedule for a *Small Science* ActivityClass

Date:
Name of the teacher: Name of Observer:
Std: Start Time:
Division: End Time:

Number of students present: Location of class:
Girls: Boys:

Topic: (First Day/Continuation)
Stated Objective(s) of the class:

I. Classroom setting: (Seating arrangement, Position of Teacher/Teacher's Desk, Position of Blackboard, Position of Observer/s)

Classroom environment: (Lighting, Space, Ventilation, Bulletin Boards)

II. Observations made of Teacher

1. The teacher begins the class by:
   - Issuing general conduct instructions ☐
   - Providing an overview of the topic ☐
   - Arousing curiosity about the topic ☐

Comments:

2. The teacher makes clear to the students:
   - The purpose of the lesson ☐
   - The lesson's tie to preceding work ☐

Comments:

3. The teaching aids used during the class:

Blackboard	☐	Charts	☐
Reference Materials	☐	Maps	☐
Models	☐	Other	☐

Comments:

4. The nature of the activity is predominantly:

Observation-based	☐
Hands-on	☐

Brief description of activity:

5. The activity is introduced by:

Only reading it out aloud from the book	☐
Having students read it out aloud	☐
Explaining it	☐
Discussing it	☐

Comments:

6. For the activity, the students are organized in:

Pairs	☐
Small groups of 5-7	☐
Large groups	☐
One large group	☐

Comments:

7. For an Observation Activity, the teacher:

Uses the appropriate location/material	☐
Guides students effectively with respect to what has to be observed	☐
Is vague in guiding students with respect to what has to be observed	☐
Encourages students to make more observations	☐
Encourages students to observe details	☐
Encourages students to note down their observations	☐
Encourages students to draw their observations	☐
Encourages questions based on observations	☐
Observes along with the students (models it)	☐
Is patient while the students observe	☐
Lists observations on the blackboard for the whole class to see	☐
Allows for time to describe/discuss observations	☐

Comments:

8. For a Hands-on Activity, the teacher:

Reads it out aloud	☐
Has the students read it out aloud	☐
Demonstrates it	☐
Discusses it	☐
Asks students to do it and discusses it	☐

Comments:

8. The materials needed to conduct the activity are ready at the start of the class:

Yes	☐
No	☐

Comments:

9. The materials for the activity are:

As specified in the book	☐
More than those specified	☐
Less than those specified	☐
Clearly visible to all students from their position	☐
Allowed to be used by the students	☐

Comments:

10. The teacher's predominant manner of interacting with the students is:

To monitor learning	☐
To facilitate learning	☐

Comments:

11. Both boys and girls are addressed/asked questions in a uniform manner for the greater part of the class:

Yes	☐
No	☐

Comments:

12. The teacher's questions require the students to:

	Frequently	Occasionally	Rarely
Answer in yes or no	☐	☐	☐
Describe	☐	☐	☐
Give examples	☐	☐	☐
Offer alternative explanations	☐	☐	☐

Comments:

13. The teacher is able to:

	Fr	Occ	Rarely
Get students to reflect on their responses	☐	☐	☐
Provide opportunities for students to apply a concept	☐	☐	☐
Be positive and encouraging in her responses	☐	☐	☐
Encourage independent thinking	☐	☐	☐
Encourage cooperative learning	☐	☐	☐

Comments:

14. The teacher tries to arouse curiosity among students by:

	Fr	Occ	Rarely
Asking them questions	☐	☐	☐
Encouraging them to observe	☐	☐	☐
Other	☐	☐	☐

Comments:

15. The teacher deals with new or unfamiliar words by:

- Providing their meaning ☐
- Eliciting it from students by way of context ☐
- Asking students to refer to a dictionary ☐
- Ignoring them ☐

16. The teacher responds to the students' questions about the topic:

- Mostly ☐
- Sometimes ☐
- With interest ☐
- Dismissively ☐

Comments:

17. The teacher provides feedback to students on:

- Performance of the activity ☐
- Recordings in the workbook ☐

Comments:

18. The teacher appears comfortable and confident about teaching the content of the lesson:

- Yes ☐
- No ☐

Comments:

19. The language used by the teacher is:

Clear	☐
Ambiguous	☐

Comments:

20. In teaching the topic, the teacher draws attention to/emphasizes values:

Yes	☐
No	☐

Comments:

III. Observations made of Students

21. The students appear involved by way of :	Most	Some	Very few
Observing the teacher conduct the activity	☐	☐	☐
Performing the activity themselves	☐	☐	☐
Exploring materials	☐	☐	☐
Making observations	☐	☐	☐
Recording observations	☐	☐	☐
Active discussion with peers and teacher	☐	☐	☐

Comments:

22. The nature of the student's engagement during the activity encourages:

Independent thinking	☐
Co-operative learning	☐

Comments:

23. The students exhibit initiative by :	Most	Some	Very few
Asking questions	☐	☐	☐
Sharing experiences	☐	☐	☐
Providing examples	☐	☐	☐
Proposing alternative explanations	☐	☐	☐

Comments:

APPENDIX A (3)

Observation Schedule for a *Small Science* Text/Story Class)

Date:
Name of the School: Observation No.:
Name of the Teacher: Name of Observer:
Std: Start Time:
Division: End Time:
Period: Single Double
Total number of students:
Girls: Boys:
Number of students present: Location of class:
Girls: Boys:

Topic: (First Day/Continuation)
Stated Objective(s) of the class:

IV. Classroom setting: (Seating arrangement, Position of Teacher/Teacher's Desk, Position of Blackboard, Position of Observer/s)

Classroom environment: (Lighting, Space, Ventilation, Bulletin Boards)

V. Observations made of Teacher

1. The teacher begins the class by:

Issuing general conduct instructions	☐
Providing an overview of the topic	☐
Arousing curiosity about the topic	☐
Arousing curiosity about the story	☐

Comments:

17. The teacher makes clear to the students:

The purpose of the lesson	☐
The lesson's tie to preceding work	☐

Comments:

18. The teacher starts the story session by :

- Directly reading from the book ☐
- Narrating the story (without using book) ☐
- Asking students to volunteer to read ☐
- Selecting specific students to read ☐

Comments:

19. The teacher discusses the story:

- Yes ☐
- No ☐

Comments:

20. The teacher discusses the poem:

- Yes ☐
- No ☐

Comments:

21. The teacher deals with new or unfamiliar words by:

- Providing their meaning ☐
- Eliciting it from students in the context of the sentence ☐
- Asking students to refer to a dictionary ☐
- Asking students to think of the meaning ☐
- Asking for synonyms/antonyms ☐
- Ignoring the words ☐

Comments:

22. The teacher makes an effort to develop the students' language skills by:

- Asking them to answer in complete sentences ☐
- Asking them to answer questions in their own words ☐
- Making sentences with words ☐
- Emphasizing correct pronunciation ☐
- Reciting poems ☐
- Writing sentences related to the topic ☐

Comments:

23. The teaching aids used during the class:

Blackboard	☐	Charts	☐
Reference Materials	☐	Maps	☐
Models	☐	Other	☐

Comments:

24. The teacher involves both boys and girls in an uniform manner for the greater part of the class by way of:

Asking them to read aloud	☐
Questions	☐
Encouraging them to express themselves	☐

Comments:

25. The teacher uses wait time when she asks questions:

Frequently	☐
Occasionally	☐
Rarely	☐

Comments:

26. The teacher's questions require the students to:

	Frequently	Occasionally	Rarely
Answer in yes or no	☐	☐	☐
Describe (how, when, what)	☐	☐	☐
Give examples (which, what)	☐	☐	☐
Give reasons (why)	☐	☐	☐
Offer explanations other than in the text	☐	☐	☐

Comments:

27. The teacher is able to:

	Freq	Occ	Rarely
Get students to reflect on their responses	☐	☐	☐
Provide opportunities for students to apply a concept	☐	☐	☐
Be positive and encouraging in her responses	☐	☐	☐

Comments:

28. The teacher tries to arouse curiosity among students by:

	Freq	Occ	Rarely
Asking them questions	☐	☐	☐
Encouraging them to observe/recall observations	☐	☐	☐
Other	☐	☐	☐

Comments:

29. The teacher responds to the students' questions about the topic:

	Mostly	Sometimes
With interest	☐	☐
Dismissively	☐	☐

Comments:

30. The teacher teaches the science-related content of the lesson:

	Yes	No
With ease	☐	☐
With interest	☐	☐

Comments:

31. The teacher uses language to convey scientific concepts/terms:

With clarity	☐
Ambiguously	☐

Comments:

32. The teacher draws attention to/emphasizes values pertinent to the topic:

Yes	☐
No	☐

Comments:

VI. Observations made of Students.

33. The students appear involved by way of:

Listening to the teacher	☐
Taking notes	☐
Showing interest in the discussion	☐
Participating in the discussion	☐

Comments:

34. Students exhibit initiative by:

Asking questions	☐
Sharing experiences/examples	☐
Giving reasons	☐
Proposing explanations other than in the text	☐

Comments:

APPENDIX A (4)

Teacher Feedback following a Class Observation

Form No.:
Date:

Name of School:
Name of Teacher:
Std:
Division:

1. How do you feel about your today's class?
2. Was there anything in particular that you enjoyed about today's class?
3. What did the students seem to enjoy about today's class?
4. Thinking back on your class, is there anything that you wish you had done differently?
5. Is there anything you would like to change for your next class?
6. How comfortable did you feel about the content for today's class?
7. How much time did it take to prepare for it? How did you prepare for it?
8. Any other comments/reflections about your class that you would like to share:

APPENDIX A (5)

Teacher Interview after concluding all Classroom Observations

Interview No.:
Date:

Name of School:
Name of Teacher:

1. What abilities does the Homi Bhabha Curriculum(HBC) try to develop in students?
2. What skills do you think a teacher using the HBC requires to demonstrate/develop?
3. What do the students enjoy about the Textbook?
4. What do the students enjoy about learning through the Workbook?
5. In what ways is the HBC like any other primary science curriculum and in what ways is it different?
6. Is there anything for primary school science that you wish the HBC had emphasized more in its books in terms of content or method?
7. Are the experiences described in the Teacher's Book similar or different from your experiences with your students?
8. How easy or difficult do you think it is to develop in the students the abilities that HBC aims for?
9. As a teacher using the Homi Bhabha Curriculum, which skills would you be interested in developing further to teach science?
10. Overall Comments/Suggestions about HBC:
    Textbook:
    Workbook:
    Teacher's Book:

APPENDIX B

Partial Transcript of a Videotaped Class in P School

K = Kalpana (teacher)
S = A student of the class

A batch of 20 students comes in, each student with a plastic bag containing a half coconut shell, some soil, and some seeds (pulses/grains). They seat themselves around the 5 tables in the room. There is fairly loud chatter going on amongst the students.

K: First you all settle down. Still you want to talk? This class does not want to do the activity?
Students are settling down and turning around on their seats to face Kalpana. She is standing at the head of the class.
K: Okay, I want all of you all to shift to that side [*points to the table to her left*]. Okay, what are the different types of seeds? [*Hands crossed across her chest*] Will you stop talking here?
Some students can be seen opening their plastic bags; one is dipping his fingers into a mug of water to sprinkle some in the coconut shell.
K: Can you tell me the different names of the seeds you have got—one by one...yes?
S: Moong
K: Moong. Anybody else?
S: Wheat
K: Wheat
S: Chana
K Chana
S: Chauli
K: Chauli. Apart from all these?
S: Rajma
K: Rajma, Mustard
S: Ragi
K: You've got ragi? Okay, now these are—[*to a specific student*] chana—these are the different names of the...take out your coconut shells from the polythene bags—take them out. [*Some students hold up the coconut shells for the teacher to see.*]
S: We'll put mud also...
K: Please place the mud inside. Place the mud. Now, take out the seeds and place a few seeds on the top.
S: I don't have any...
K: Why? Which seeds you were supposed to bring?
Many students talking all at once. Some are naming the seeds they had to bring.
K: Place on the coconut shell. *On* the mud. Don't put it inside.
Many students are talking all at once. Someone mentions, "All the seeds." Kalpana asks the maid if there is an extra shell.
K: A few seeds.

Students check with Kalpana whether to put all the seeds, or "these many?"
K: Not so many. Few of them.
S: See, this much? See this much?
S: See this much?
K: Yes.
Students concentrate on pressing the seeds into the soil.
S: Press it inside. Press it inside.
K: Don't press it *too much* inside. Let it be a little bit on the top also.
S: Like this?
K: Yes. Now take that mud and place some water on top.
S: Water?
K: Little bit, not much.
A couple of students pick up the mug of water and pour a little water onto the soil in the shell. The maid takes the tumbler and pours it for some of the students.
S: Only this much water, no?
Many students are talking at the same time.
K: Put some water. And now place it here. Come here — those who have added the water…
S: Now what we're going to do?
For about a minute and a half the students are winding up the activity, going to the back of the class to put their coconut shell with the planted seeds on the floor. Kalpana comes to the front of the class.
K: Those who have finished, please wash your hands.

APPENDIX C

Partial Transcript of a Class Discussion in Q School

R = Roshni (teacher)
S = A student of the class

Roshni begins the session by saying that yesterday it had been difficult to get the sound of the musical notes, and that is what science was about—that experiments can fail. Adds that that is no reason to feel disappointed and attempts must be continued to be made.

R: Did you get clear idea how musical instruments are played?
S: Yes.
Roshni names the various musical instruments, explains the word vibration again, gives the example of string instruments to explain vibration.
R: We learnt that air makes sound. We will move further. For 2-3 periods it will be air, air, air—as we know, it's everywhere! Next property is [*and writes it on the board*]: Air makes bubbles.
Roshni remarks that the activity is to be done in groups but that their behaviour yesterday made her decide that she alone would do the activity. Tells students that whatever she does in class can be done by them at home if they want to experience it. She holds up a glass half filled with water.
R: Are bubbles there?
S: No
R: Water there?
S: Yes.
R: With straw I will blow air into water [*R has a small straw, a student gives her a full size straw*].
S: When you blow air, with bubbles, there is sound also.
Students watch as bubbles are formed in the glass of water
S: Air has gone into water and is trying to escape
S: When air moves in water it forms bubbles
R: What is inside bubbles?
S: Air
R: [*as she adds detergent to the water*] If I put detergent…does detergent dissolve in water?
S: Yes
Roshni blows into the water and the froth rises. She allows it to overflow from the glass and then blows on it so that bubbles begin to rise and fly in the air. Loud squeals of delight fill the classroom.
R: Did you observe—bubbles few and small in water, many and large in soapy water?
In soapy water they last longer. This is lather, foam [*gives the Marathi word for foam*]. Lather means bubbles together. Because detergent has chemicals and there is some reaction. In which other cases are there bubbles?
S: Push mug upside down in the water and tilt.
S: Jumping into swimming pool and when person tries to breathe.
S: When you gargle, bubbles are formed inside (points to the throat).
S: When you soak clothes in soap water.

S: Babies make it.
R: All babies do it. [*Asks a student to demonstrate—student forms bubbles on the lips with spit.*]
S: Shaking water bottle
S: Boiling
R: Very good. Before it starts to boil, small bubbles start coming to the top from the bottom.
S: Fish tank.
S: When fishes breathe.
S: When we are filling water.
R: Because bottle is first empty. Air tries to escape as water comes in. Speedboat—if you look behind.

APPENDIX D

Use of an Analogy in a Class in P school

The topic being discussed was 'Growing a plant.'

A: Anita (teacher)
S: A student of Std. IIIA

A: I'll tell you—a seed is like a baby. It's like my baby. What's my baby's name?
Students: "Sean."
A: When I have to put it to sleep, there are certain things which are very, very important for Sean. When I have to put him to sleep and he has to get up fresh like your plant, very important things are required. First thing...
Student says something which sounds like 'drinking.'
A: Yes, he has to have something—his stomach should be full otherwise he keeps crying. So, water. He feels very hot, he needs the fan on.
S: Air
A: Air. He also needs sunlight. He doesn't like dark rooms. He gets frightened in a dark room, so he requires sunlight.
S: Water.
A: Obviously he doesn't require soil. But he requires a bed. Like the soil is a bed for the plant, right?
S: Water, water!
A: Soil is a bed for a seed, so that is where the plant--seed goes to (gestures) sleep. And then after a few days it gets up. But there is one more thing he requires. With the fan on, he requires something. (*Arousing their curiosity*) What does he require?
Some students shout 'light' and 'air' alternately. Others say, 'food,' 'water,'
A: When the fan is on, what do you require?
Amongst many shouts, one student says 'warmth.'
A: Very good! Say it aloud for the class. Warmth. (*And writes it on the board*.) He requires something to cover himself, so, warmth as well. Very good. Give him a big hand! So, remember a baby when you remember the seed. (*Pointing to the list on the board*.) It requires a bed—soil is a bed. Sunlight—babies get frightened in the dark sometimes—small babies. Air—it requires a fan. Then, water. Obviously, the stomach has to be full. And warmth. So, a seed is also like this. So, all these things have to be present for the seed, for it to grow into a beautiful plant.