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A SINGULAR INITIATIVE

July 3, 2002 was a dark day in the history of education. It was on this day that the Madhya Pradesh government decided to draw the curtains on an innovative educational programme known the world over as the Hoshangabad Science Teaching Programme (HSTP). The state government's ill-conceived move did not come as a surprise to those conversant with the processes of privatisation and globalisation. Several authors have analysed the issues emanating from this malafide decision of the state government.

The HSTP initiative began as a small experiment in 1972. The legend has it that when the two voluntary organisations – Friends Rural Centre (FRC) and Kishore Bharati (KB) – approached the Madhya Pradesh government seeking permission to implement an innovative programme in state-run middle schools, the then Director of Public Instruction, Dr. B. D. Sharma, setting aside any possible objection, had famously observed, "The present state of science education in these schools is so deplorable that these novices cannot possibly make it any worse. So I see no reason to deny them permission." This tongue-in-cheek – but insightful – observation of a competent bureaucrat paved the way for a remarkable transformation in school science education.

The platform provided by these two voluntary organisations quickly drew scientists from the Tata Institute of Fundamental Research (TIFR) in Mumbai, members of the All India Science Teachers' Association (AISTA), and academic staff from Delhi University (DU). They joined hands with the teachers of 16 middle schools in the Hoshangabad district of Madhya Pradesh to embark on a journey to make education, especially science education, a meaningful and joyful experience for school children. The initiative drew countless participants as it evolved, attracting scholars, teachers and scientists from colleges, universities and research institutions across the country.

This was, perhaps, HSTP's most significant feature. It unleashed creative energy in the field of education across the country and provided a platform for its expression. It was a collective effort to improve science education in schools in which professors and students from colleges and universities, scientists and research scholars from research establishments, school teachers, artisans and craftsmen, farmers, social activists and engineers, and doctors and educationists participated.

Another significant feature of the programme was that every participant was engaged in a simultaneous process of teaching and learning. As a result, there was never a dull moment in its 30-year history. All the participants, including the students, enjoyed it. The environment it created was of shared joy that bound the participants together. This atmosphere of joy inspired people to give their best and the courage to try new and fresh ideas in education. This is why HSTP was always able to retain a measure of freshness and depth throughout its 30-year history.

One other aspect also needs to be considered. HSTP may have been fun, but it did not lack in educational rigour. The HSTP never allowed '*chalta hai*' attitude. The task on hand could be

writing a chapter, trying out an experiment, ensuring the authenticity of a diagram, teacher training, or even proofreading the *Bal Vaigyanik*. But compromises on quality were never part of the equation.

Discovery and the environment

The HSTP was a discovery- and environment-based innovation in which children interacted with their environment, conducted experiments, and formulated verifiable hypotheses. It was, perhaps, for the first time in the country that children in middle schools learnt scientific concepts by conducting experiments in groups, going on field trips, recording their observations and analysing data to derive conclusions and have fun in the process. Their teacher was their guide and companion in the process. And the children enjoyed doing all this, throwing the traditional method of rote learning out of the window.

The HSTP group emphasised the fun aspect of learning, which was later incorporated into the lexicon of the mainstream education as the 'joy of learning'. When an HSTP resource person N. Panchapakesan was asked to list the lessons from HSTP following its closure, he answered with little hesitation, "We enjoyed ourselves. The teachers enjoyed themselves. The children enjoyed themselves. What more do you want?"

But 'fun and enjoyment', apparently, wasn't considered a component of learning by the bureaucracy. Submitting a report recommending that HSTP be shut down, a senior bureaucrat of the Madhya Pradesh government dismissed the innovation as being without merit, scarcely disguising his sarcasm as he wrote, "The only argument in its favour is the 'enjoyment of children' which is an intangible and an inadequate index of

quality of learning."

Stated briefly, HSTP sought to structure the curriculum around doing science and conceptual development, rather than base it on the idea of information explosion. Children arrived at scientific laws, definitions and concepts by conducting experiments, tabulating and analysing their observations and data, and engaging in group discussions in the classroom.

The essence of the programme was to make children independent learners. To equip them for the task, it sought to familiarise them with methods and practices that would help them seek answers to new questions and problems they may confront in future.

The HSTP experiment entered its second phase in 1975, when it was scaled up to cover all the middle schools in Hoshangabad district following intensive field testing in its pilot phase in 16 middle schools.

When the state government took the ill-conceived decision to close down the programme, HSTP was operative in over 800 schools spread over 15 districts of the state. The students who had studied science using its methodology over the 30 years of its existence numbered over 250,000. More than 3,000 teachers were involved in its implementation, having undergone a series of unprecedented training programmes whose depth and rigour could only be appreciated through actual experience. Developing a core group of around 200 resource teachers who could train teachers and organise large-scale training was another of its contributions. Many of these teachers have played a leading role in conducting teacher training camps in other states.

HSTP also covered new grounds in terms of teacher

participation in every aspects of the programme. The programme has contributed significantly in understanding the potential and challenges of teacher participation.

Right from the first phase of implementation it had become clear that the teachers were at the lowest rung in the educational hierarchy. Within the classroom, they were the unquestioned fount of all knowledge, but the moment they confronted even the most insignificant authority in the educational bureaucracy they became servile and submissive. Therefore, its seemed meaningless to talk of improving education without, at the same time, according a respectful place to the teachers. Although, within the larger social fabric they appear to stand alongside the feudal class, within the school system teacher were lacking in self esteem vis-a-vis the bureaucracy. Yet, they are forced to wear the mantle of omniscient in the classroom.

These concerns shaped HSTP's engagement with the teachers. Especially, the lack of academic dialogue amongst teacher or a dialogue around issues important to their profession, prompted the HSTP group to try and create such formal fora where teacher could look at themselves has members of an academic professional group.

The programme not only uncovered the possibilities of educational change, it also indicated a direction of this change and multiple dimensions of its implementation. Probably, this was the most influential programme in contemporary scenario. its impact can be seen in all aspects of educational thought and systems.

The HSTP viewed intervention as a multi-pronged process requiring simultaneous action on many fronts. Tinkering here and there was not enough; that was clear from the outset. All

academic aspects of the teaching-learning process were addressed, beginning with the teachers actively participating in developing the teaching-learning materials. A kit for conducting experiments was put together to go with the new workbooks being prepared.

Teacher training has already been mentioned. A decentralised system of follow-up to schools was also put in place to help the teachers in the classroom and to collect feedback. In addition, an institutional framework named 'Sawaliram' was set up to address rising curiosity of children.

The examination system went through fundamental changes to free it of the tension it usually generated in the minds of the children. New ways of assessing what the children had learnt were introduced. The emphasis shifted from testing for rote learning and memory recall to assessing the development of conceptual understanding and experimental skills.

The HSTP can also be seen as the first instance of an intervention for educational change in the government school system by an agency outside the state education department. Indeed, the fresh breeze needed for shaking the system out of its inertia could have been provided only by such 'outsiders' free of the 'educational straitjacket'.

Not being tied to the hierarchy of the education department was a decided advantage. This allowed HSTP to establish an equation of equality at all levels among those interested in education and change. In the thirty year history of the HSTP, a virtual absence of formally trained educators/educationists is also a remarkable fact.

The HSTP created and consolidated a framework of decentralised structures for its implementation, breathing new

life into concepts such as the School Complex and Sangam Kendra enunciated in the 1964-66 Education Commission Report (Kothari Commission). It also helped to weaken the stranglehold of administration over the teachers while adding an academic dimension to the administrative apparatus.

The HSTP was a singular experiment in India's educational scenario and a source of inspiration for other initiatives across the country, adding new dimensions to the discourse on education. The purpose of this volume is to present its academic and administrative aspects in an organised and structured manner.

We mainly discuss three components of the HSTP in the book:

- Development of the material and its structure
- Teacher involvement: groundwork and inputs (and support)
- Examinations and student evaluation

Mateiral includes curriculum, syllabus, workbooks, kit for experiments, etc. The book seeks to trace the process of evolution of curriculum and syllabus and their periodic revision. While clarifying the rationale behind the changes and the factors influencing them, we shall also try to explain how the curriculum was translated into teaching-learning materials.

We have outlined different aspects of a typical chapter to introduce the reader to the *Bal Vaigyanik* workbooks. These aspects are discussed in detail, after which a synopsis of all the chapters from the three *Bal Vaigyanik* editions published to date is presented. To understand the evolution of chapters with the group's growing understanding of issues, biographical sketches of three chapters have been presented in some detail.

Bal Vaigyanik chapters unfold several dimensions of teaching-

learning process. Attempts were made to prepare teacher's guides to make this process accessible to teachers. A chapter described this attempt to prepare these guides and share the experiences of their uilisation.

Development of an experimental kit has been an important part of curricular development. This has been discussed breifly. One of the concerns often expressed about experiment-based learning is that the requirement of a laboratory and equipment makes it an expensive proposition. We examine the validity of this concern and discuss our attempts to make the kit more accessible and inexpensive, a process which saw contributions from scores of teachers and others.

As we have pointed out, one of the hallmarks of HSTP was its intensive engagement with teachers. One chapter narrates our experiences in this area, tracing how teacher involvement and participation grew to become the innovation's most important component.

We next discuss the issue of use of the material in actual school setting. The main source of data for this chapter is the periodic follow-up reports filed by members of the HSTP resource group and the operational group, based on their school visits. Information gathered from interviews and focused group discussions with teachers and reports submitted by some of the teachers have also been incorporated.

The final discussion in the book is devoted to the examination system – one of the most sensitive and dominant elements of our education system. Apart from giving a detailed account of the changes in evaluation and assessment introduced by the HSTP, we present an analysis of our actual field experiences of conducting examinations for middle school children.

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ACADEMIC ANTECEDENTS (Excerpts)

In February 1972, Kishore Bharati and Friends Rural Centre submitted a proposal to the Madhya Pradesh government seeking permission to conduct an experiment in science education in middle schools of Hoshangabad district. The proposal stated:

> In the last few decades revolutionary changes have taken place in the concepts of education. But these ideas have had little impact on educational programmes of our schools and colleges.
>
> The aim of education should be to acquaint the student with basic theories and common concepts rather than stuff her mind with information.
>
> The leading scientists and educationists of the country agree that the child can understand theories only through experiments and open discussion. Whatever is taught in most textbooks being used for science teaching in schools and colleges has become dated or perhaps has been proved wrong. Any innovative science teaching programme should aim at

presenting science as an exciting subject whose boundaries are constantly expanding.

The role of the teacher should be that of an observer and a guide, rather than that of a supervisor, who helps the child conduct experiments and think analytically instead of just demonstrating the experiments.

Hard curriculum and textbooks leave no scope for innovation at the school level. All the related parties in a developing science teaching programme – students, teachers, educationists and scientists – will contribute to its growth and transformation through constant feedback and classroom experience.

The physics teaching programme prepared by the physics group of the All India Science Teachers Association fulfils the above-mentioned objectives.

It is proposed that the programme of the physics group of the All India Science Teachers Association should be implemented in the primary and middle schools of the Hoshangabad district of Madhya Pradesh.

The orientation camp for 30 teachers of 15 schools should be organised in May-June 1972. During the camp the textbooks and the kit will be reassembled to make them suitable for rural schools. The physical environment of the villages will be made the basis for examples and experimental material.

The schools included in the programme should be exempted from the state syllabus and examinations.

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INNOVATIONS: TEACHERS' PARTICIPATION

Teachers played a central role in HSTP. This was expected and necessary in a discovery-based teaching-learning method because the open-ended nature of the approach meant that a chapter could follow different paths in different classrooms. One could never really predict the questions children would ask or what would happen in the classroom. So the teacher had to intervene at every step to weave children's questions into the learning process without derailing it altogether.

In traditional classrooms, the role of a teacher is limited. (S)he is at best expected to explain what is written in the textbook, supplementing the explanation with examples or analogies. Otherwise, reading out the textbook aloud is taken as teaching and dictating the answers to questions given at the end of the chapter is the ultimate purpose of such teaching.

Expecting children to do the experiments themselves, discuss their observations, derive conclusions, analyse these conclusions collectively and then explain everything in their own words is something totally off the beaten track. Even if the process proceeds along expected lines, helping them to reach

conclusions is a difficult task that requires special abilities; abilities that extend beyond the topic being taught.

It also requires patience to allow children the time to draw their own conclusions. Getting impatient and telling them the answers short circuits the process, even if it may appear the simplest way forward. The teacher must have faith in the abilities of children. Unfortunately, our educational system has little faith even in teachers and it is this distrust that leaves no space in our textbooks for teacher initiatives or innovations. The sad fact is that the system straitjackets the teachers to the extent that they end up having very little faith in their own abilities. This is not surprising because education is seen as a product by the mainstream while HSTP saw it as a process.

Teachers have often complained that if children skipped an HSTP class it created continuity problems because the discovery approach demands the active participation of children, not just reading and memorising the textbook content. In this context, it makes one wonder how did private students cope in this scenario.

The discovery approach is child-centred, as opposed to traditional teaching methods that are textbook-centred. In a traditional classroom what different children think or do is of little consequence. They may be at different levels (even that is often ignored in such classrooms) but they cannot choose to follow different paths. In a child-centred methodology, on the other hand, a single experience in the classroom can raise different kinds of questions in the minds of children, with each possibly reaching a different conclusion. At least, they may take different routes to reach, may be, the same conclusion.

That's why HSTP had high expectations of teachers. They

should know the subject well, have faith in the discovery approach and be familiar with its different aspects. They should also have faith in the children and their ability to discover things on their own and to decide what is right or wrong. They should be clear in their mind that no one, including themselves, can know everything, so they shouldn't be ashamed to admit to children that they don't know, so let's investigate.

Teachers should also understand that the textbook is not the only or ultimate source of knowledge. They should have the ability to design new activities and experiments apart from those given in the textbook. (Unfortunately, teachers are often themselves unclear about various concepts, so they are unable to apply them in new contexts.) And most important, they should be sensitive to diversity within the classroom.

Wherever possible, HSTP sought to structure the syllabus around the environment. The teachers then became responsible for relating whatever learning was taking place to the child's milieu.

This had several implications for teacher training. Apart from familiarising the teachers with the syllabus, they needed to be oriented in the discovery approach and all its aspects. The HSTP teacher training was developed keeping these two aspects in mind. In addition, four other aspects were also considered important and taken into consideration.

First was the cultural aspect. A teaching-learning process is not just studying a particular topic. It is an interaction with a world view. Ignoring this cultural aspect gives rise to the problem encounteres every day. Teachers and children learn to live with two types of knowledge. One is textbook or school learning and the other is everyday experiential or practical knowledge.

Unfortunately, mainstream education provides no space for engagement with cultural values and traditional concepts in learning. In fact, it negates their very existence. As a result, while the earth rotates on its axis in textbooks, it doesn't rotate in real life.

Second, it is commonly assumed that a one-time training of teachers is sufficient for life-long teaching. This is a wrong assumption. When teachers begin teaching in a classroom, they are confronted with many questions and problems. They have no platform to discuss these problems, so they gradually begin to take refuge between the safe covers of the textbook. It is a very easy choice for them to make in textbook-centred learning, though not a really desirable one. But making such a choice in discovery-based learning could prove disastrous.

Third, whenever anything new is attempted in the classroom, the teachers will need continuous support and consultation. Otherwise she feels isolated. Teachers are often victims of such isolation, that's why they seldom show any enthusiasm for trying out something new. When the HSTP project proposal submitted in 1972 asked for two teachers from each school, it was precisely to avoid the sense of despair caused by isolation.

Fourth, in most teacher trainings, including subject training, there is little discussion on working conditions in schools. What is the state of the school building? How many children are there in each class? Is there an almirah to store laboratory kits? Is the kit useable? What are the living conditions of teachers during the trainings? Do they get their travel and daily allowances, etc.? Such issues are never discussed in trainings, even though they have a serious impact on teaching.

It cannot be said that these things were thought out in precisely

this manner in the beginning, but what is clear is that they were part of the first training camp itself. The HSTP group saw teacher trainings as open dialogues with teachers, a two-way exchange on all these things. That's why it would be more appropriate to call them interactions rather than trainings. The interactionwas an attempt to make the teachers an integral part of all facets of the programme.

The teachers' role was never seen limited to classroom management. The idea was to make them active participants in every aspect of the programme including development of curriculum and preparing the textbooks, developing children's assessment and evaluation system etc. However, participation of teachers in the preparation of curriculum and textbooks is a complex issue. Obviously, it cannot be limited to including a couple of token teachers in creating teaching-learning materials. At the same time, it has to be recognised, to begin with, that most teachers in the present circumstances may not be able to contribute to creation of such materials. Experience shows that left to themselves, most teachers would produce materials similar to (if not worse than) what is currently in vogue. Therefore, the HSTP looked at teacher's participation in material preparation as an opportunity for teachers to learn and translate it creatively into materials.

Teacher training: the first workshop (1972)

The first HSTP training workshop began on May 22, 1972 at the Friends Rural Centre, Rasulia campus. The workshop was crucially important in the sense that it exposed the HSTP group to almost all the significant issues related to science education in a rural scenario.

There was no workbook or textbook ready for use in this

workshop ("*Lal Vaigyanik*" was published only in September 1972). So some chapters and experiments from the book published by the Physics Study Group and a few biology experiments and concepts were used. That made it a truly open workshop which defined the path ahead since the teaching-learning materials were being tested for the first time. It also set the pattern for all subsequent material development.

An article (*Science Today* in December 1977) written by HSTP group illustrates this process with several anecdotes from the workshop. Some excerpts of it are given here:

> In an orientation camp, a teacher raised a question, 'Is there variation in living things?' A biologist challenged the teacher to fetch any two identical leaves. An amusing but frustrating search ensued. Many a time the teachers thought that they had found identical leaves, only to discover small differences on closer observation. A comparison of their fingers further proved that variations were inescapable. The faculty was excited. It had material for a new chapter which the teachers promptly named '*Jeev Jagat me Vividhata*'.
>
> ...The teachers generally exhibited an implicit faith in destiny. This was an impediment in logical analysis, and had a spillover effect on the children. When presented with a specific case of two apparently identical fields giving different yields, they promptly attributed the difference to the predetermined destiny of the owners of the fields. Factors like soil types, seed rate, fertiliser use, etc., were totally ignored. This lack of rationality had serious implication on their ability to moderate discussions. A physicist, therefore, developed a unique chapter on chance and probability.
>
> ...The basic issues of discovery approach soon began surfacing. For example, discussing plant life in a biology session, a

teacher-farmer raised the question, 'How do fertilisers in soil reach the leaves?' At once, an experiment was planned. A twig was cut and placed in red ink solution. Half an hour later, the leaf veins turned red. The conclusion was obvious. But one teacher was skeptical, 'How can we be sure? Perhaps the veins turned red because we cut the twig. I have seen apples turning brown after cutting.'

Although the question appeared trivial to us, it could not be ignored. Such questions form the backbone of discovery approach, providing links to further experimentation. A heated debate followed. It was decided to modify the experiment by including a second twig placed in plain water. The concept of using 'controls' was born.

The teachers were by now thoroughly engrossed in the spirit of enquiry. 'What would happen if we use blue ink?' asked one. All faces turned to the faculty biologist. He shrugged, 'I do not know.' The teachers were flabbergasted. They asked in disbelief, 'How did you get your Ph.D. if you do not know such simple things?' It was a jolt to their value system. To them a Ph.D. signified the end point of all knowledge. Here was a chance to illustrate the open-endedness of scientific enquiry. The experiment was repeated with different inks. The selective absorption of different chemicals by plants was strikingly demonstrated. The full implication of discovery approach only then dawned upon the teachers. They began to realise that they, too, would often be forced into a spot when they would have to admit, 'I do not know, let us find out.' It was a negation of the traditional pre-eminence of teacher.

Chandrakant Dikshit,[1] a teacher from Doon School, also captures the essence and atmosphere of the first HSTP orientation camp in a report:

"The summer programme thus provided a unique confluence of rural and urban ideology, while the faculty and participants worked together, argued, shared food and relaxed together in the campus. The sole objective of these inspired souls was to explore the feasibility of an experimental, open-ended approach to the teaching of science to rural children.

"The task was arduous. Besides bearing the heat of the sun and shortage of water, it was essential to cross the administrative, psychological and cultural hurdles before any fruitful communication could be established. As it happens, at the start of the course, we were not even aware of some of the problems we had to face, and many myths that were exploded. Poor conditions under which the teachers had to work in rural schools had contributed a lot to their lack of enthusiasm for anything new; lack of faith in their competency to try out a new syllabus was only one of many reasons. They were afraid of maintaining a stock of equipment in schools which hardly had doors in classrooms to lock it up. How could a required curriculum be covered in a scheduled time when flooded seasonal rivers kept students away from classes for several days? Would the educational authorities not toss them from school to school, if they become annoyed by the problems which any untraditional approach to teaching science is bound to create?

"The schedule of work and activities were so planned as to provide ample and deliberate opportunities to participants for a free exchange of ideas and opinions with faculty members. There was a marked difference in the initial attitudes of the faculty and participants, which were based on their views on science, religious and cultural practices, and logic. This resulted in many debatable issues that cropped almost every day during academic sessions.

"At the start of the first experimental session, Shri Kulkarni[2] felt the need to emphasise the significance of experimental evidence. He quoted from one of the schools of thought (*mimamsa darshan - मीमांसा दर्शन*) to suggest that there is no proof greater than direct observation. He pointed out that in the absence of direct proof we rely on logic or reason, and guess. The evidence based on oral tradition (*shruti* evidence - *श्रुति प्रमाण*) comes in the end. Experiments provide personal experience as they are based on direct observations. Hence, by this one single reference to the *shatdarshan (षटदर्शन),* Shri Kulkarni succeeded in striking the first blow for a discovery approach to science teaching...On many other occasions, cultural and religious traditions helped a lot in the scientific explanation and interpretation of observed facts.

"References to rural environment were found equally helpful in driving home certain concepts. Bombay is the home of cricket in India, and Shri Pitre[3] had experienced no difficulty in referencing to the game while talking about the Polar Co-ordinate system for locating the position of objects. The game provides a reference point, the origin, as the position of the batsman, and a reference direction, the bowling pitch. When dealing with the topic in Rasulia, he anticipated the futility of using this example to village children. The idea of citing *गोफन* (sling for throwing stones to scare away birds) as an example to elucidate the concept occurred to him spontaneously and clicked instantly in the minds of the participants. His mention of Rectangular Co-ordinate system was then enthusiastically taken up, and many participants related it to the bigger and smaller canals in fields which cross each other at right angles.

"In one of the late night sessions under the sky, Yashpal[4] referred to the sun in a casual manner. Shastriji, one of the participants, gathered courage to ask, '*क्या आप सूरज को भगवान*

नहीं मानते?' (Do you not consider the sun a god?) Professor Yashpal elaborated on how much we owe to the sun. The light and heat we receive now (and millions of years gone by) sustains life on earth. No wonder the gratitude towards this source of life finds expression in the worship of the sun. Shastriji was thus softened, his faith in religion affirmed and attitude towards science more positive, as Professor Yashpal progressed with his talk on elementary astronomy.

"On one occasion, Dr. Anil Sadgopal was trying to classify the living world in broad categories depending upon the mode of birth. *अण्डज* (out of an egg) and *पिण्डज* (born from embryo) were two groups mentioned on the board. Some participants stated that a third category *स्वेदज* (born from perspiration) is also mentioned in mythology. In this category they included lice and fleas. Shastriji stood up to recite a couplet in which reference was made to four categories of living beings on earth: *अण्डज, पिण्डज, स्वेदज* and *उद्भिज* — the first three to cover the fauna and *उद्भिज* to cover the flora. Dr. Sadgopal had a real tough time (he almost perspired) to bring home the point that perspiration may provide the favourable environment for growth, but it is not the origin of these organisms.

"One morning when the word *तत्व* was used for elements in the Periodic Table, a participant expressed amazement at the statement that their number is as large as a hundred. He had the impression that the five elements sky, air, fire, water and earth formed the *ब्रह्माण्ड* of which the whole universe was made. I drew upon my knowledge of Sankhya Darshan (one of the six Hindu schools of thought) according to which all our interactions with the external world give rise to five basic stimuli which are experienced with the five sense organs. The *जल तत्व* exists in all objects which affect our tongue. Similarly, objects that excite our sense of smell are said to have *पृथ्वी*. It

was only after this deliberation that the word तत्व was accepted in its new usage in the Periodic Table.

"It was evident at the termination of the course that the seed of rational outlook had taken roots in the minds of our teachers."

The lessons of the first workshop

Yashpal drew attention to many key aspects of this workshop in an article he wrote:

> "1. In order to generate valid materials, a combination of working school teachers and men [sic] from universities and research scientists is ideal.
>
> "2. We have come to believe that investigatory approach to science learning is the very approach we need to follow if we want science education to take roots in a soil seeded with beliefs, myths and experience which in the traditional way of learning are never contacted, much less made use of.
>
> "3. We also find that it is very injurious in designing materials, to assume that the big city children and teachers, because of their greater exposure to gadgets and technology, are necessarily ready to receive science at higher level. On the other hand, we find that the experience of the village teachers and students is in many respects richer; only our traditional curricula do not draw upon this experience. Much of the work therefore has to be done in the environment for which the material is intended.
>
> "4. We have found that the teaching of science in the new way involves continuous confrontation with ethical and social values. In this respect, in a country like India a national effort to improve science education is much more than just science teaching; it is a major revolution in the lives of people. One

of the purposes should be to gain acceptance of the fact that the world of science does not exist apart from their daily lives and beliefs. To achieve this one does not need to disprove their 'unscientific' beliefs but to show how these beliefs could have arisen. One cannot just ignore the questions which are continuously posed by students and teachers.

"5. We have been overwhelmed with the magnitude of this task. On the other hand, if all efforts are not centralised, the problem may not be intractable.

"6. Like many other programmes we have also found that a continuous interaction with teachers and schools is needed to keep them from lapsing into traditional habits. One of the problems is that their own fund of knowledge and their daily lives do not provide most of them enough stimulation to sustain the open-ended nature of the programme."

The framework for working with teachers

Teacher interactions in HSTP were not limited to teacher training. This is clearly brought out in an observation of a teacher, R.N. Sharma, from Piparia: "In my experience no other programme has seen teachers being such active participants in every aspect – from developing curriculum to creating an evaluation system. HSTP gave teachers dignity."

Teachers were seen as equal participants, so no effort was spared to prepare them for their new role. Whether it was classroom management, evaluation of students, follow-up in schools, helping fellow teachers, developing curriculum and other educational materials, or developing kit materials, they were active participants. And every participation was taken as an opportunity for further training and orientation.

For the sake of convenience, we can club teacher development efforts into three parts:

1. Nine-weeks of in-service training conducted over three years.
2. Continuous follow-up and monthly meetings, teachers' guides, the *Hoshangabad Vigyan* bulletin.
3. Participation in other components of HSTP.

In-service training

As mentioned earlier, preparing teachers for their new role in the classroom was a major thrust area of the HSTP resource group. When the programme started, most teachers had no background in science. Most had studied up to class 10 or class 12. One or two were graduates.

This may not be a serious obstacle in a teaching methodology based on reciting the textbooks. The new approach, however, requires teachers to not just be familiar with the content in the syllabus but to understand it well.

As mentioned earlier, a teacher in the HSTP classroom was not expected to provide explanation to children's observations. Expectation, on the contrary, was that the teacher would help children to explain their observation and reach conclusions as well as decide about what is right and what is wrong.

To be able to do this, the teachers themselves need to go through the experience they are expected to guide in the classroom. They must know and anticipate what to expect: the kind of observations that could arise from experiments, possible sources of errors, alternative methods to look for answers, etc. They

must also understand the experiments and their purpose well enough to be able to suggest modifications or alternatives.

This requires in-depth understanding of the topic being investigated because conclusions drawn from experiments cannot be analysed without understanding the background and their linkages to other concepts.

It was also important that the teachers experience a democratic classroom and get a feeling of what a classroom based on learner participation, where decisions are taken on the basis of reason and evidence free from an ultimate or autocreated power looks like.

This is not an easy task, especially in a classroom adopting a methodology like the discovery approach. The teachers may know the outcome of an experiment but they cannot impose it on the children. Rather they are expected to give them the opportunity to go through the experience themselves and guide them to the conclusions through a chain of reasoning.

All this meant that the HSTP teacher training had to be structured to give teachers the opportunity to polish their experimental skills and get a more in-depth understanding of science. They also had to be convinced about the discovery approach and learn how to implement it in the classroom.

It is not clear if it was a well-thought strategy or happenned just like that, but role play was the model adopted for the orientation sessions. The interaction during a training session would be organised as if it was a school classroom. The idea was to let the teachers go through a process - performing experiments, noting down observations,explaining them, discussing and reaching a conclusion - which they are expected to lead in their own classrooms. During this process, the role played by the resource

persons gave them an idea that the teacher is a facilitator, catalyst and all questions about the content and pedagogy emerged from this concrete context. In this sense, the training was an effort to consolidate the understanding of the subject as well as give them a glimpse of the - methodology.

Going through the process helped the teachers understand and appreciate the catalysing role a teacher plays in guiding students. Also, since questions about content and methodology arise in a specific context, the training provided the opportunity to consolidate understanding of topics in the syllabus while giving the teachers a foretaste of the teaching methodology.

All teachers had to participate in training sessions spread over three years, the orientation camps being organised every summer. The first year was for the class 6 syllabus, the second year for class 7 and the third for class 8. The camps were residential and lasted for around three weeks. So every teacher went through nine weeks of in-service training. Around 3,000 teachers are estimated to have undergone this training during the lifespan of HSTP.

Teachers were not selected for the training; the schools decided who to send. The only stipulation was about the number of teachers each school should send, which was linked to the number of students in each class.

On the first day of the training, teachers were registered in appropriate classes (6, 7 or 8) divided into groups of four. Each training class had about 40 teachers and they were expected to work with their groups throughout the training. (They were expected to divide their classes into similar four member groups when they returned to school.)

The teachers spent five hours daily in the classroom. Thus they had a total of 90 hours of formal instruction time. Apart from studying the Bal Vaigyanik chapters, they were exposed to other elements of the HSTP methodology, such as evaluation, examinations, kit maintenance, follow-up and so on.

A series of training sessions

Teacher training was organised every year from the time HSTP began in 1972, barring one year. After the programme was seeded in 13 districts in 1983, with a School Complex in each district, sometimes training camp was organised twice a year. These School Complexes were spread over a very wide geographical area.

There were several reasons why large-scale training continued to be organised every year. They included expansion of HSTP to new areas, opening of new schools, promotion or transfer of trained teachers and appointment of new untrained teachers.

A rapid expansion of private schools gave rise to new problems. For example, many of these schools were not too keen to invest in in-service training of their teachers, so the teachers often spent money from their own pockets to attend the training. Another related problem was that private schools mostly do not employ/appoint teachers during the summer vacation. So there were no teachers to be sent to summer training camps.

To address these problems, two changes were made in the scheme of the training. The first change was to organise smaller training camps instead of a single large camp at the divisional level. Each such decentralised training camp catered to around

150 schools from around 2-3 blocks. The advantage was that the training didn't have to be residential. Most teachers could stay at home and come daily for the sessions. But there were several disadvantages as well. For example, there was little scope for informal interaction with teachers after the formal sessions, which was possible when the training was residential.

Another disadvantage was that the resource group had to be divided across a larger number of training camps. In the divisional training the presence of the full team of resource persons at a single venue had a special impact on the educational activities. Teachers could interact with subject experts, new volunteers and resource teachers to discuss and try out ideas on all aspects of the programme.

> Academic discussions and exchange of views were hallmarks of training camps . These camps were appropriate occasions for developing new experiments and revising the old ones as any new experiment or equipment could immediately be tested with the teachers. Kishore Panwar has given a sample of this process in an article in *Sandarbh*.
>
> The problem was to find out whether dry seeds are living or non-living. The only solution was to show that dry seeds breathe. Usually the process of respiration is inferred by carbon dioxide produced during the process. This is what was attempted during the 1988 training camp. Four or five types of seeds were placed in separate test tubes along with pink phenolphthalein indicator solution. One test tube had only indicator solution and another also had some marbles in it. After some time the indicator solution started losing its colour in the test tubes which had seeds in them. And someone said, so it is clear that seeds breathe.

> However, a teacher took another test tube and put some indicator solution in it alongwith some dry leaves and pieces of tree bark. After some time the solution lost its colour here as well. So, do dry leaves and bark also breathe? The problem was that phenolphthalein is an acid-base indicator. Dry leaves and bark etc. also increase acidity and the indicator loses its colour.
>
> Another problem was that the seeds become wet when placed in the indicator solution. So how to decide whether or not dry seeds breathe? The solution for both these problems was found in a training camp in Gujarat. In an experiment done there the indicator solutionwas placed in the test tubes and a wad of cotton was placed over it in such a way that it did not touch the solution. Seeds, dry leaves and bark etc. were placed on the cotton wad and it became clear that dry seeds also breathe.

The second change was that the training camps were organised during the school year itself. So teachers had to absent themselves from school to attend the camps, which affected teaching time in the schools. College and university resource persons also faced a similar problem, finding it difficult to take time out to attend the trainings.

So while the decentralised training did solve some problems, it gave rise to new ones. Getting resource persons and organising the daily training timetable became a complicated exercise. Tapping local colleges did not help much, so sessions on different topics had to be arranged according to the availability of subject experts rather than in the more logical conceptually graded manner.

Another casualty was interaction between teachers and resource persons. Given HSTP's climate of openness, teachers

still came up with all sorts of questions but since fewer resource persons attended the smaller camps, there was less scope for debates, discussions and trying out new experiments.

Another organisational problem was providing the kit materials. Managing kit supply at the divisional training was always a difficult task. It became even more complicated when the number of venues multiplied.

However, the block-level camps did have their positive side for teachers from private schools.

There is a reason for going into details about these problems. Such a programme requires strong structures for teacher training and continuous support. It also requires high-quality resources and creative resource persons to breathe life into these structures.

In the context of teacher training, the extent of decentralisation possible is an issue, which depends on several factors. Foremost is how successful are the attempts to involve colleges and universities. Two, how successful are the attempts to involve high/higher secondary teachers and prepare them to take up the role of resource persons. Time also is a factor as it takes time to set up these processes and structures. This can not be done by creating master trainers and key resource persons overnight. This question is particularly important in the context of an innovative programme.

Although, switching to block level training camps did have positive outcomes in terms of number of teachers, especially private school teachers, attending the trainings, the HSTP group rued the loss of the learning environment that large-scale training camps created. It means that the group considered the activities outside the formal classroom vitally important from

the point of view of the programme. This was usually the time when teachers tried out many new experiments, learned many new things, did library research, prepared wall papers, viewed films or attended lectures on various subjects.

Seen from the perspective of the resource group, large-scale workshop gave ample scope for preparation, feedback, discussions on chapters and concepts. Moreover, discussion amongst senior resource persons opened up a variety of aspects concerning the programme and science education, benefitting the volunteers and teachers alike. And it was felt that such get-togethers are essential for maintaining the rigour and intensity. Smaller camps never achieved the 'critical mass' of resource group to make these things possible.

This is why large-scale training continued to be organised occasionally at the divisional level even after the switchover to decentralised block-level training.

Whatever the case, describing the training and the preparatory process is an interesting exercise in itself because it gives insights into how seriously HSTP dealt with the issue of teacher training.

The training model

The HSTP teacher training model was based on the premise that if the teacher gets personally involved in a self-learning process during the training, she would be able to inspire the students to adopt and internalise this approach in the classroom. A person who is not a learner him/herself cannot inspire others to learn.

It's a matter of great pride that teachers who participated in HSTP accepted this fact wholeheartedly. This is clearly brought

out in the comments of teachers from Pipariya at a meeting organised on August 20, 2006, some years after the closure of HSTP. They pointed out that the learning process in children cannot be seen in isolation from their own self-learning. When asked about the learning experiences of children in HSTP, they tended to include their own personal learning experiences in their explanations, so much so that it was sometimes difficult to tell whether they were talking about the children or themselves.

Take, for example, what Shashikala Soni, a retired teacher, had to say:

> "I collected tadpoles from a nullah near the Dudhi river near Kishore Bharati for the reproduction chapter [she was probably referring to the chapter 'Life Cycle of Animals'], kept in water, they developed into frogs. Just like when I had asked children to conduct the fly experiment (life cycle of the house fly), when the fly emerged, they shrieked with joy".

It is a positive attitudinal change that the teachers visualized children's development and their own development as closely linked processes. The resource persons also learned a lot in the process. In fact, it was the excitement of learning new things that drew so many people from different institutions to the resource group.

Bharat Poorey (who was a professor in local college at the time), explains it best: "Whenever we returned home after a training session it was with a pleasurable sense of satisfaction that we had got the chance to learn something new. The training made me aware of the yawning gaps in my subject knowledge. The simple and everyday questions the teachers asked, to which I couldn't give an adequate reply, made me realise how much more I needed to learn about my subject. It was the teachers who gave me the courage to admit I did not know."

Ultimately, every person participating in this programme was simultaneously involved in teaching and learning. That is why it was a festival - a festival of learning.

The second premise of the HSTP training was that the teacher must have a deep understanding of the subject she teaches. Understanding did not mean familiarity with technical words, definitions, formulae and so on. What she needed to know was the logical structure of the subject, its linkages with other disciplines and the methods to gain insights in it.

The third premise of the HSTP training was that the teacher should believe in her own capabilities and the capabilities of children.

Teachers were expected to learn about different aspects of the methodology and its implementation. Most important, they had to understand and appreciate their new role in the classroom, the open-endedness of the teaching methodology and the excitement of discovering things for oneself.

And, of course, teachers must be good at what is to be done in the classroom.

Another important aspect of the training was to create an environment in which teachers realise that saying "I don't know" will not attract ridicule but will become a step towards learning. They should realise that it is not a crime to commit a mistake and that people here would help rather than laugh at a mistake.

This feeling was most appropriately expressed by teachers at the Pipariya meeting when they pointed out that the HSTP training demolished the deeply ingrained image of an 'omniscient' teacher. They saw this as a positive development.

HSTP gave them the courage and confidence to stand before their students and say, "I don't know. Let's try. Perhaps, we can find the answer."

Another eye-opener was that their observations from the experiments they performed during their training often did not tally with their own conceptual beliefs and understanding.

The HSTP training tried to address all such issues.

Perhaps, we can understand this better by describing what happened in an HSTP training session. But before that, let's see the kind of preparations needed for the teacher training sessions.

The resource group used to gather at the training venue three days before the training started to make the necessary preparations. There would be many jobs to be done and everyone pitched in. These included getting the accommodation for resource teachers and trainees ready, checking the lights/fans, arranging drinking water and food, getting carpets for the classrooms, organising the kit and setting up a kit room, making the three-week timetable for the training, dividing the resource group into smaller groups to take up different chapters, preparing the chapters, and so on.

The resource group did these jobs collectively, including the most routine administrative and management tasks which acquired urgency at times.

However, we'll stick to describing only the academic tasks here. In the first three days the resource group would prepare a rough framework of the chapters to be dealt with during the training, along with the kit required. The list of kit materials for each chapter would be listed and given to those in charge of the kit room so that the daily kit for each class could be arranged in

advance. If a new experiment was to be tried out, the kit room would be informed. In fact, the kit room became a kind of clearing house during the training.

Preparations for long duration experiments were also done in the first three days. For example, conducting the artificial pollination experiment in plant reproduction required selecting a farm or garden and getting the permission of the owner. In the same way, prior preparations were needed to get fertilised eggs at different developmental stages on the day the growth and development chapter was taken up.

There were experiments requiring preparation many days before they were conducted. A checklist of such experiments was prepared as a ready reference.

Unfortunately, trainee teachers could not participate in this preparatory phase because they would arrive only on the day the training began. This was a drawback, considering that they themselves were expected to undertake such preparations when they returned to their schools.

The next step was preparing for each chapter. The resource group had to perform and assess all the experiments in advance with the available kit materials. This may seem a bit excessive considering that most of the experiments have been done several times by various people to leave no lingering doubts about their 'success'. Yet this stipulation was there for two reasons. First, every training session had new resource group members who needed to be familiarised with and convinced about every dimension of each experiment. Second, experience had shown that it was imperative to check the experiment with the material available in the kit room at the moment because things may not work.

Another important aspect was deciding how to present the chapter to the trainees in the classroom. This included introducing the chapter, giving its background, anticipating the kind of questions that could arise, thinking up additional experiments, and so on. There was also the question of how to evaluate the learning outcomes once the chapter was completed.

After the resource teachers took over the responsibility of conducting the training, another step was added to the preparatory stage. A resource group member had to first sit with the resource teacher teams to discuss and finalise the training framework and schedule which was shared with a larger group.

Each day the resource group team would arrive in the classroom with the required kit materials.

Five hours per day

The average training class consisted of around 40 to 50 teachers. They would be divided into groups of four on the first day itself, with most of the work in the coming days being performed in these groups. Each teacher would get a copy of the *Bal Vaigyanik* and other materials. The report of the previous day's activities would then be read out before commencing the day's session. This became the standard practice for all training sessions.

The session would normally begin around 7-7.30 am and continue till 1-1.30 pm, with a half-hour break in between.

Just as the teachers were divided into groups, the resource group would also be divided into smaller groups of 4-5 members, with one of them coordinating and leading the session. This person would give a brief introduction of the chapter. The introduction

could take different forms. Some preferred starting with a striking, attention-catching experiment. Others preferred bringing out the prior knowledge of teachers on the topic as a starting point. Or a fundamental question could be raised about the topic, paving the way for investigation and study. Whatever the option used, the message put across to the teachers was that they may also adapt their approach to the chapter to suit the classroom situation.

The experiments would then get under way. Each group would have at least one resource person to help out, the idea being to ensure that every teacher understood how to conduct the experiments. Each group would perform the experiment, note down the observations and discuss the findings withing the group. A general classroom discussion would then follow to analyse the observations of different groups. The core thread of the discussion would usually be the questions posed in the *Bal Vaigyanik*, although all attempts would be made to keep it as open-ended as possible.

Proceeding in this manner had its pitfalls. Initially, the teachers usually think that they know all the answers, or could get the answers just by reading or listening. This is what happens most of the time in traditional teacher training. So they would hesitate or try to avoid doing the experiments. Take the example of the very first teacher training in 1972. The teachers were asked to measure the length of a table. Their immediate response was, "This is child's play. Give us something more serious to do." They began measuring only after Yashpal cajoled them, saying, "Arre yaar, just do it and see." And they were astounded when they realised they didn't really know how to measure.

As it is, teachers are reluctant to work with their hands and accept it as a way to learn. They believed that knowledge

encapsulated in books is the ideal learning source. So there is not much interest in searching for and discovering knowledge. This reluctance was most marked in teachers with a bachelor's or master's degree in science. They had no exposure to seeking knowledge in an open-ended manner, so they were totally ignorant about the process. That's why it took them some time to actually perform experiments, think for themselves, faithfully note down their observations and believe in what they actually saw.

Another problem was that they believed that all the experiments are very easy and they thought they knew all the observations. So they felt that doing the experiments was a waste of time. Take the boiling point of water as an example. Even children know that water boils at 100 C. But not once in the 30-year history of HSTP did water boil at 100 C when the teachers actually did the experiment. When after a lot of cajoling, they finally did the experiment, the excitement was palpable. Then came the attempt to try and understand why water was not 'behaving'. It was only then that they would recollect that the 'correct boiling point' of water had several provisos like its 'purity' and 'normal pressure'.

A similar kind of reaction could be noted when a magnet with north poles on both ends was placed in their hands.

Inevitably, there would be a marked change in their attitude as the training proceeded. They would begin performing the experiments, most enthusiastically, some with a bit of nudging. Once the apparatus and kit were in their hands it was difficult to stop them. New ideas would emerge, new experiments were performed. The hope was that they would let their classrooms function in the same open-ended and free manner. Unfortunately, despite creating such an exciting environment

during their training, a few teachers still went home without performing any experiments.

Apart from reluctance to do experiments, there was one other problem. As pointed out earlier, most teachers had never done experiments, or had done them a long time ago. So they did not have the skill to perform even the simplest experiments.

Moreover, whatever experiments they had done in high school or while qualifying for their degree were done with a totally different purpose in mind: usually to verify or prove something, or to arrive at an expected answer, such as the boiling point of water is 100^0C. Experience shows that the teachers had little skill in performing even the simplest of experiments. The trainings, therefore, focused on teaching them how to do experiments.

After experiments came the recording of observations which included narrating and writing them down in simple and clear language, tabulating them, drawing diagrams to illustrate them and so on.

Making diagrams was especially difficult for most teachers. They had no practice whatsoever in depicting what they saw in diagrammatic form. This proved a stumbling block, especially in biology. For example, in seed germination they would draw a real-size diagram of the seed or if they draw an enlarged diagram, it will be disproportionate. Microscopic observation was a special experience in more than one ways. It highlights one important aspect of the training. Everyone of us tends to draw something on the basis of its image imprinted in our minds rather than what we actually see. No matter which leaf it is, we tend to draw a typical a leaf.

It is here that the meaning of 'observations' gets clarified. The importance of noting observations faithfully was repeatedly stressed and was one of the important aspects of training.

The next step was even more problematic: reaching a conclusion through group discussion. This was where the trainer ideally played the role of a facilitator. The teachers were expected to collectively discuss the observations in a logical manner to reach a conclusion.

Again, this was a unfamiliar and laborious process for them. It included listening to and understanding one another's arguments and explanations, analysing them on the touchstone of logic and reason, reviewing one's own observations in the light of new observations and reasoning, modifying one's findings, and then figuring out ways to test and consolidate the conclusions that emerged. There was always the danger of taking short cuts in consolidating the collective findings, which even the resource persons tended to fall prey to.

The responsibility of moderating the group discussion was usually given to a resource person. The first step was to list the observations of all the groups on the blackboard, pinpoint out-of-the-ordinary observations, discuss them to find their underlying reasons, if necessary, repeating the experiment.

Once this process was completed, the observations could be easily explained. However, sometimes there could be more than one explanation. In such cases, each explanation was carefully scrutinised and then applied in another context to see if it answered all the questions. For example, if the explanation is correct, what would happen in such-and-such situation? Very often these would be conceptual questions or thought experiments. But they would also often be experiments that one

could carry out to confirm what happens. Before doing the experiment the observations one could expect would be listed, after which the experiment would be performed to confirm the results. In this way the class would move forward, exploring the different facets of the scientific methodology.

This part of the training was fraught with difficulties. After doing the experiments teachers expected the conclusions to be dictated to them. Or, at the very least, they expected to be told whether their conclusion was right or wrong. None of these happenned; the resource group would remain firm in its resolve: the teachers had to decide for themselves whether they were right or wrong. It was never easy to convince them of this process and they always complained about not being given the answers.

The process moved ahead in this stumbling way, one step forward, two steps backward, often unsure, deviating from course without a clear way forward. It appeared a waste of time to those habituated to treading the path fixed by the textbooks. But what was surprising was that most teachers started enjoying it and discovering things for themselves. They would totally immerse themselves in doing seemingly simple experiments that they would otherwise have considered boring.

But a balance had to be established. The resource group had to take a call on how far the teachers could pursue the 'discovery approach'. They had to assess when a dead end was being reached to prevent frustration setting in. This was often not an easy decision to make. It had to be situation specific. But it was a decision the teachers would also have to make in their classrooms, the bottom line being that as much scope as possible be given to unravel every layer of 'discovery'.

Some other processes

The teachers were periodically evaluated during the training. The purpose was not to grade them but to find out where they stood and where they needed more help. Of course, the questions posed during every session did give some indication on a daily basis. But special tests were also periodically conducted in the case of especially difficult concepts. Teachers had to answer 'mini' questions, which often proved to be 'extra long'. These questions were structured in such a way as to assess understanding of basic concepts. After each such assessment, the teachers would discuss their responses and this sometimes led to revision of parts of the chapter.

The training usually ended with a practical examination that had two objectives. One was to assess how far the teachers had developed their experimental skills. The second was to expose them to practical examinations because 40 percent of the marks allotted in the HSTP annual examination were for the practical examination.

The open-ended nature of the discovery approach often led to the teachers asking questions not directly linked to the topic under study. The fear in such cases was that the discussion could go off on a tangent and disrupt the training. Sometimes questions were also asked about HSTP and its methodology. These were usually postponed to special 'doubt clearing sessions' organised every weekend.

The way in which evaluation was done in HSTP and its purpose was quite different from the traditional examinations. That's why the training focused on familiarising the teachers with all the aspects of examination. The 'mini' questions and the

practical examination gave them a feel of the type of questions asked in an HSTP examination. But special sessions were also conducted for question paper setting. The teachers were expected to prepare questions to test conceptual understanding and assess skill development suited to an open-book examination, not an examination geared to bringing out memorised information. Each group made its set of questions, which were then discussed and assessed by the entire class. The discussions also touched upon the purpose of examinations, achieving balance in a question paper, redistribution of marks and so on.

One important daily activity in the training was reading and discussing the previous day's report. The teachers would take turns to write and present these reports, the idea being to provide feedback on the activities in each daily five-hour session. This did happen to some extent. Unanswered questions were noted down. So were comments about the way the resource person conducted the sessions, as well as comments about fellow teachers and different aspects of HSTP.

Unfortunately, the reports seldom went beyond a factual report of the previous day's happenings and saying nice things about the resource teachers. Possibly, that's the way the teachers actually felt, but the more likely explanation is that they saw criticism as being synonymous with condemnation. So they tended to refrain from criticising others. As a result, you had reports written in verse or embellished with similes, but a healthy tradition of providing critical feedback never properly developed.

Feedback sessions

The resource group would sit every evening during the trainings to collectively review the day's happenings. This was a healthy tradition. The day's class would finish by around 1 pm and the resource group would get a bit of free time till around 2 pm for lunch and some relaxation, after which they would attend the feedback session, usually scheduled for 3 pm. The sessions could be tortuous in a place like Hoshangabad, where afternoon temperatures in May-June cross 40 C. But they would take place nevertheless. Trainee teachers were welcome to these sessions.

The feedback from each class would be collected and presented by a person specially appointed for the purpose, usually a volunteer. She was expected to describe and review the day's proceedings, including the role played by the resource person. Important questions raised in class were also noted down. The report would then be discussed collectively. There were times when this reporting turned into feedback reporters vs. resource group duels but these sessions enriched the trainings. They provided a basis for the resource group to tailor the daily sessions according to requirements to further clarify difficult concepts or try out new ideas that emerged. In a way they were an extension of the daily training, where the resource group was engaged in traiing itself.

The feedback system was a mixed experience. For example, there were its 'human' aspects. Whenever a feedback reporter raised a question about the role of the resource team, the entire team tended to spring to the defence. At times there were personal insinuations. Many a time, there would be widely different assessments of the same same class or the process. Such differences also arose because the feedback reporter would have

no clue of what the resource group was looking for, and (s)he thought the role played by the resource person was devoid of any purpose. The defensive attitude of the resource persons became more pronounced after the resource teachers took over the responsibility of conducting and leading sessions. This was also related to their confidence levels.

Another problem with the feedback sessions was time over-runs. Having 6-7 to 8-10 classes during training was the norm. If a half-hour per class is taken as the average, the feedback session required 3 to 5 hours every day, which meant they went on to well past 6 pm. The resource group then had to prepare for the next day. So the resource persons ended up working 11 to 12 hours daily during the 18-day training course. In the early years no one even considered taking a day off on Sundays. That's something the teachers still remember with fondness and pride.

Training the feedback reporters was yet another challenge. Most of them were enthusiastic young volunteers who had to be instructed on what to focus on and what to ignore in the classroom. They were expected to write and present their reports in the couple of hours of free time before the feedback session began. Many times subjectivity came into play, with assessments of the same class or of various procedures ending up being different. It was heartbreaking for them when much of what they wrote was dismissed as irrelevant.

So an attempt was made to streamline the feedback system. All the reporters would meet before the session and, with the help of a moderator, select the main feedback points to be presented. While this did help, most felt the sessions had become less enjoyable. One more attempt was made. The reporters were included in the resource group. The hope was that the group would help vet the reports first before they presented in the feedback session.

From all these efforts one thing is clear: feedback was considered very important and every effort was made to ensure that it was meaningful, and organised in a positive atmosphere.

Expanding programme, evolving training

When HSTP was in 16 schools, the resource group attracted lecturers and professors from universities and colleges and scientists from various research establishments. A noteworthy feature of the training sessions in those days was the way in which topics for study and discussion would unravel layer by layer, with questions and counter questions being posed, new experiments being designed on the spot and the links between concepts being established.

The responsibility for teacher training remained with this group at the time of the district-level expansion. But some of the more enthusiastic teachers were welcomed into its fold. These resource teachers played a limited role in the training, mostly helping in the group activities. This included guiding the trainees in doing experiments, answering their questions, and encouraging them to voice their opinions in the group discussions. The responsibility for coordination continued to rest with the resource group.

Further expansion was a given objective for HSTP, and various aspects of such an expansion were discussed continuously. A new model for expansion was formulated in 1982-83 with the formation of Eklavya.

The model, which again had the School Complex concept at its core, envisaged a phase-wise expansion, the first phase being an entry into all the districts of the Hoshangabad, Ujjain and Indore education divisions. The way this would be done was to seed a

School Complex in each district and to use the resources developed in these School Complexes as a foundation for expanding to other schools in each district. So the target was to have HSTP running in all schools across 14 districts within a few years. Any subsequent expansion would also proceed in a similar manner.

A rough assessment of the practical implications of the model showed that teacher training would be the major requirement in expanding HSTP. This was a monumental task, given the large numbers involved and the short time span available. One rough estimate put the number at 20,000 teachers to be trained every year over three years in the 14 districts. This was far too big a task for the resource group to handle.

The solution lay in handing over the training to the resource teachers. How successful this transition would have been is anybody's guess, but what is clear is that a teacher training is major challenge for any educational innovation of this scale.

A pilot run was conducted in a teacher training camp organised at Indore in 1987 to judge whether the resource teachers were capable of conducting the training themselves to assess the viability of the transition model. The teachers were given the responsibility of coordinating classroom processes for the first time. Of course, an 'expert resource person' was always on hand to help out. Helping out meant the expert would discuss how to organise the classroom and its activities, think about alternative strategies and take a more active role in case of emergencies.

It is important to analyse the experiences of this and subsequent teacher training camps as this will provide insights into the process of scaling up.

One thing was evident in the performance of the resource

teachers. They were well versed in the *Bal Vaigyanik* curriculum and had internalised its philosophy. So they could teach any of its chapters in an organised and structured manner. They also had the expertise to perform every experiment and getting others to do them. They understood the safeguards to be observed while performing experiments, the expected observations to be made, sources of errors, and so on. So training teachers to teach the *Bal Vaigyanik* was not a difficult job for them.

But there was one shortcoming. Most of them taught the *Bal Vaigyanik* in a mechanical manner. They trod a beaten track: perform experiments, get everyone in the class to respond to the questions asked in the workbook, arrive at the correct answers and then go on to the next experiment. They avoided dilly-dallying, side-tracking or thinking at a tangent. Their argument was that teachers who come for training must perform all the experiments and know the answers to all questions asked in the *Bal Vaigyanik* if they are to fulfil their teaching role. So time should not be wasted in useless pursuits. In other words, there should be one-to-one correspondence between teacher training and what teachers are expected to do in the classroom.

They saw 'teaching' the *Bal Vaigyanik* (performing all the experiments and getting all the answers) as their main, if not the only, task.

If a question, which they thought was unrelated to the topic, was raised in class, and if the trainees insisted on getting an answer, they would bring in the 'expert'. The trainees were quick to catch on that the resource teachers preferred staying within the ambit of the *Bal Vaigyanik,* so they would deliberately ask such questions. Since the trainees knew that the expert was always around to take over, they tended to look to her to solve

problems that arose. Many times the resource teacher would also show such an inclination. This usually tended to upset the classroom equation by creating an unhealthy power hierarchy.

The 'staying on course' problem was often discussed in the feedback sessions. The main criticism was that the resource teachers deliberately curtailed a healthy discussion, or declared a teacher wrong even if she was proceeding on the right track, or stopped the discussion as soon as the correct answer was obtained. In a way, the problem could be seen to arise from the limited understanding of 'science' among xthe resource teachers.

We had earlier pointed out that teacher training was a continuing activity. Three HSTP activities – follow-up, monthly meetings and the *Hoshangabad Vigyan* bulletin – complemented the training to ensure continuity.

Follow-up

The system of follow-up was established in schools early in the programme. It was important for two reasons. First, the teachers often encountered many kinds of problems while teaching and required on-the-spot help. Second, follow-up provided feedback on problems in implementing the programme and its materials.

In the beginning resource persons went on regular follow-up visits to the schools. Later, higher secondary school teachers, Assistant District Inspectors of Schools and headmasters of middle schools were included in the follow-up group, which came to be known as the operational group. Later, some middle school teachers were also included to undertake follow-up and gradually they became the major constituent of the operational group.

The operational group, set up in 1977-78, was expected to perform several roles, especially follow-up and, later, teacher training. It had no formal structure and no defined criteria for inclusion of teachers. Basically, teachers who had internalised the HSTP spirit were talented and enthusiastic and could train other teachers qualified for inclusion.

HSTP had drawn inspiration from the Kothari Commission report in setting up many of its structures, including the *Sangam Kendra* and school complex. The *Sangam Kendra* centres were given the responsibility of chalking out and implementing the follow-up plan for their school complex. They were set up in every block of Hoshangabad district (and later Harda district), each linked to around 50-60 schools. In the other districts, each centre took up the responsibility of 7-8 schools.

The *Sangam Kendra* was visualised not just as an administrative unit. It had an academic function as well, with higher secondary school lecturers within the School Complex providing academic support to middle school teachers. Quite naturally, these lecturers were given the follow-up responsibility as well.

The *Sangam Kendra* also had to review and analyse the follow-up reports and prepare the agenda for the monthly meetings. This was a job that was earlier done by the Science Cell set up at the District Education Office. But the arrangement was found to be impractical, so the *Sangam Kendra* got the responsibility by default.

Unfortunately, the high school and higher secondary schools never did accept the follow-up idea whole-heartedly. Any of their faculty going twice a month on follow-up visits was seen as an extra burden and interruption. As a result follow-up was sidelined and became an irregular activity.

There was another – and stranger – problem with follow-up. HSTP saw follow-up as an academic activity to help teachers and gain academic feedback. It was distinct from inspection. But many middle school teachers began to complain that the higher secondary school lecturers who came to their schools were mostly ignorant of the needs of the HSTP classroom and curriculum. So they could not really help them out in any way when they faced problems. They also complained that some of the lecturers who came on follow-up saw their visit as a kind of school inspection, so they tended to behave officiously rather than being helpful.

These two drawbacks led to the inclusion of more and more middle school teachers in the operational group. But, here again, the experience was not too encouraging. For one, it was difficult for teachers to leave their teaching for two days every month to help out in other schools. The problem was aggravated by the chronic shortage of teachers in most schools.

That's why even though follow-up was seen as a necessary and useful activity, it was the first to falter. The system continued to deteriorate, with administrative problems – delays in getting daily and travel allowance – adding to its woes.

Another reason for the decay was lack of understanding. Follow-up was a new activity for the educational system, undertaken for the first time in the HSTP. The administration saw it as a useless and superfluous activity. The general attitude was that once teacher training was over and done with, there was no need for continuing support in the form of follow-up or monthly meetings. The argument was articulated in the form that need for continuous follow-up implies some shortcoming in the initial training. It shoudl be noted that till very recently, teacher would join the cadre after their training and would never look back.

They got no further support even if the curriculum or textbook is changed. (Neglect of this aspect in teacher support is a cause of concern.) More and more information is packed into the textbooks in the name of information explosion. Yet no attention is paid to equipping the teacher adequately for the task. This is an irony. Actually, even if the curriculum remains unchanged, teachers require continuous help and support.

As was pointed out earlier that self-learning deeply affected their enthusiasm and motivation levels. When these are absent, the teaching process is in danger of becoming mechanical.

The follow-up persons mostly never had a clear idea of what was expected of them. Attempts were made to train them in the *Bal Vaigyanik* curriculum and to familiarise them with every detail of the follow-up process. They were given supplementary tasks such as evaluating children and so on to be completed during their visit to the schools. Even proforma for follow-up report was developed but it, too, did not help significantly. Hence, in the final analysis, follow-up remained a limited exercise lacking depth.

Monthly meetings

The second platform for continuous teacher training was the monthly meetings. Every month each *Sangam Kendra* would organise a meeting of teachers in its School Complex. After the district-level expansion, 11 meetings were organised every month, their number going up to 23 when HSTP spread to other districts. Not all the teachers participated in these meetings but around 1-2 teachers from each school attended, depending on the staff situation in their schools.

The main points selected from the follow-up reports formed the discussion agenda for these meetings. They were mostly problems that remained unsolved during the follow-up visits or problems that had relevance for other schools, although they might have been resolevd during the follow-up visit. Teachers also got the opportunity to share and try out new ideas and experiments they had devised. Thus, monthly meeting was also a forum to disseminate innovations taking place at the school level.

The purpose of these meetings evolved over time but they always served as a dynamic forum for teachers and resource people to continue an interactive dialogue. In fact they could be looked upon as a strong and vibrant effort to mould the teachers into a professional academic group.

Expectedly, as the follow-up process weakened the character of the monthly meetings also changed. This was the period around 1983-84. Fewer academic discussions were taking place and a stage was reached where the only issues discussed were the problems of kit replenishment and payment of travel and daily allowances. There is no denying that these were important issues. But it became a matter of grave concern for the resource group that the problems faced by children, the questions they raised, academic stumbling blocks or other subject related topics were not figuring in the agenda.

The resource group decided to step in. It began selecting topics to include into a common agenda for all the *Sangam Kendras*, over and above the issues emerging from the follow-up reports, to stimulate discussion. These were mostly linked to the *Bal Vaigyanik* chapters. The idea was to help the teachers get a more in-depth understanding of the content and sometimes just to revisit a chapter. Different aspects of the HSTP

curriculum were also shared with the teachers. This move did breathe new life into the monthly meetings but it also led to greater centralisation in their planning as a result of which classroom issues tended to get sidelined.

A fresh attempt was made to address this problem. This effort involved organising a preparatory meeting of *Sangam Kendra* in-charges and 1-2 operational group members from each *Sangam Kendra*. Thus a group of around 30-35 teachers used to come together to chalk out an agenda and make necessary preparation for the monthly meeting to be held subsequently at the respective *Sangam Kendras*.

Helping in this preparation now became the main work of the resource group. But some resource persons continued to attend the monthly meetings, playing the same role they were playing in the decentralised teacher training camps. One positive outcome of this new form of monthly meetings was that more discussions of academic issues began taking place while space still remained for discussing local issues.

All in all, the monthly meetings did serve their purpose as a vehicle for continuous training of teachers. They were also helpful in encouraging teachers participation in different aspects of the programme. These meetings also provided a forum for teachers to voice their problems and grievances. However, the main contribution of monthly meetings was as a forum for academic exchange and peer interaction among teachers to voice their problems and grievances. They also helped encourage the teachers to get more involved in other components of HSTP.

Hoshangabad Vigyan bulletin

The third component of continuous training emerged in the form of a bulletin called *Hoshangabad Vigyan.* The magazine was visualised as an in-house journal of HSTP for exchange of ideas and information. Its publication began in 1980, three years after the district-level expansion, and continued more or less regularly.

The publication served a dual purpose. It became a notice board to carry information and notifications about HSTP. It also served as a forum for discussions on education and related matters. It also became a forum where the teachers could frankly express their opinions. The HSTP group had to make special efforts to make the latter possible.

Government employees are not usually permitted to express their views (especially critical views) in the media. That's why the Directorate of Public Instruction (DPI) had to publish a special notice permitting teachers to contribute freely without fear of retributive action.

Training of resource teachers

Orienting the teachers in a radical innovation like HSTP was a major challenge. As mentioned earlier, in the initial stages they were trained and oriented by the resource persons who came from universities, colleges and research institutions. These 'experts', with an in-depth understanding of their subject and a confidence, were capable of fostering an open environment for discussions during the training camps and monthly meetings. They would come up with new ideas and experiments on the spur of the moment or argue with logic and reason. In fact, the

format of training camps in the initial years (1972-77) was somewhat different. These sessions, apart form preparing teachers for the classroom, involved developing syllabus and textbooks, trying to evolve the examination system and so on.So there was always a healthy exchange of ideas on different aspects of the HSTP.

With the rapid expansion of HSTP the resource group soon proved to be too small for the task. That was when the idea of creating an operational group comprising school teachers was conceived.

The question often asked is: How were teachers selected for the operational group? It is difficult to give a straightforward answer because there never was any organised method or criteria for selecting them. During the teacher training camps, monthly meetings and follow-up, some teachers would be shortlisted, based on their understanding as well as their level of commitment, interest and participation. They would then be included in different forums and programme activities, such as setting and reviewing question papers, teacher training, coordinating monthly meetings, etc. Participation in these activities was the criteria of selection.

A point worth noting in this process is that whether it was teacher training or question paper setting, special attention was paid to creating an environment that encouraged participation and commitment, where the teachers could contribute to the best of their ability and hone their skills and talents. There were so many different roles, and every role given due respect, that everyone got to show his/her best.

We saw earlier the kind of problem which arose when these operational group teachers, who had earlier played a secondary

role in teacher training, were asked to take the leading role as resource teachers. The main problem being that they 'completed' the *Bal Vaigyanik* in a mechanical way. Such mechanical 'completion' of *Bal Vaigyanik* did not prepare the trainee for their expected role in the classroom. Moreover, furthe dilution inevitably occurred during classroom teaching.

This was a matter of great concern for the resource group. Training had always been seen as a way of acquainting the teachers with the basic spirit of HSTP and its methodology and the romance and joy of doing science. It was not limited to making them adept in transacting the *Bal Vaigyanik* in class. They were also encouraged to think about pedagogical issues like how children learn.

In sum, the training sought to introduce the HSTP innovation to them not as a product but as a process in which they themselves were participants. A mechanical interpretation of the *Bal Vaigyanik* could never fulfil this wider objective.

This lack of a wider perspective among the resource teachers had serious ripple effects when the trainees returned to the classroom. They, in turn, often failed to enthuse the students to change their attitude to learning.

The need to broaden the vision of the resource teachers was keenly felt. This started the process of resource teachers enrichment training. It was essential to analyse the problems and identify the shortcomings in order to plan and design this training. The main question was why were resource teachers not able to take up their new role in the right perspective?

Some resource teachers felt that one such point was when the trainees began asking all sorts of questions. Very often they did

not know the answer. So they would curtail the discussion to ensure that it did not get diffused or go "off track". The end result was that the discussions ceased to be open-ended. According to them, a simple way to resolve the problem was to list out such questions by viewing previous training reports and explain the answers to the resource teachers in advance. But that looked to be an impossible task because one cannot anticipate all such questions.

However, others felt that all such questions cannot be anticipated. In that case, every new question would put us back in the same spot. Therefore, it is better to concentrate on the process of finding answers. It was felt that the major problem the resource teachers faced was that most of them have not formally studies 'science' much and they do not have a rich repository to fall back upon. The needed enrichment in the subject content.

That's how the idea of training the resource teachers by conducting sessions with them on selected science topics gained ground. These special training camps began in 1995 and many were organised during the lifetime of HSTP. Around 100 resource teachers benefitted from them.

The idea was to develop study packages on fundamental scientific concepts. These included atoms and molecules, ionisation, electricity and electronics, basic life processes and systems, cell structure and heredity, force, pressure and so on.

Another idea mooted was to develop a correspondence course for the teachers on such topics but the idea never took off.

Challenges facing innovations

The Ganguli committee found the HSTP teacher training to

be very effective, pointing out that the training, follow-up and monthly meetings were based on sound educational principles. It interviewed many of the HSTP teachers and found that those who benefited most from the training and were the most enthusiastic were those with little formal science education. It also accepted the need for continuous training and support for teachers.

The committee expressed the view that the future success of the programme depended crucially on maintaining the quality of this professional development of teachers, at its present level.

In the Pipariya meeting referred to earlier, the teachers also commented on how successful the training methods were, although how many of them actually grasped the spirit of the programme is open to debate. Halkevir Patel, a teacher who had been with HSTP since 1972, felt that the percentage could be between 50 and 60, while another teacher Prem Shankar Bhargava felt it was around 40.

Preparing teachers for an innovation like HSTP will always be a major challenge. We have already outlined the various efforts made in HSTP in this context. The important thing is to spread its innovative spirit on a wide scale and that requires creating the proper structures and processes. The HSTP experience shows that the best way of doing this is direct interaction between the teachers and the experts. This dialogue strengthens the belief of the teachers in the innovation, and also enriches the programme.

But how far is it possible to adopt such an approach? Traditional teacher training approaches have four mediators between the planners and the teachers. HSTP began with direct dialogue between the resource group and the teachers in the initial stages

and added another link with the formation of the operational group. Even after that the resource persons continued to attend the training camps. So there was always a direct link between the teachers and the programme.

But there was one input in teacher preparation that hasn't been mentioned till now. We have talked about various aspects of innovation related to the content and methodology of science. But innovation is more than just that. Two other aspects are important. First, innovation should also focus on the essential nature of science, and, second, it should focus on education in general. Possibly, both these aspects were woven into HSTP and its different components, including teacher training. However, no organised effort was made to address them directly.

Another important aspect is about developing strong links between all participants in HSTP. Good science teaching (or good education in general) demands that these links are based on democratic principles and equality. HSTP nurtured these principles, so a culture developed (it would be wrong to say 'was developed') in which efforts to reduce inequality between students and teachers, among teachers themselves, between teachers and the resource group, between the resource group and the educational administration and between the teachers and the administration were inbuilt. This culture was so well integrated in HSTP that it defined its every interaction. The teachers felt it and reacted positively to it. Bharat Poorey describes it in these words:

> "An open environment and a chance for everyone to participate. Participation implies being able to voice one's opinions, being listened to with respect by others, having animated group discussions, and so on."

And what were the outcomes of this massive investment in teacher training and orientation? No organised study has been undertaken to assess the benefits. Whatever one can say can be said only on the basis of feelings, observations and experiences of the participants. The outcomes can be seen from different perspectives.

If seen from the angle of an understanding of science and the syllabus, then some limited studies show that the understanding of basic concepts in science was far superior among the HSTP teachers than other teachers. It also goes without saying that these teachers were better equipped when it came to experimental skills and understanding the elements of the scientific method.

As far as peer relationships were concerned, their spontaneous participation and reasoning abilities were clearly evident in monthly meetings and other forums. Whether with resource persons or administrative officials, the teachers were able to converse without fear or hesitation. Sometimes, they were said to be too outspoken, which became a reason for criticising HSTP.

When middle school teachers were first made resource teachers, other teachers reacted negatively. But eventually the ability and expertise of these resource teachers convinced them that their peers can become resource persons.

A similar stand-off existed initially between the middle school teachers and the high school teachers. As one teacher who had been with HSTP from the beginning put it, "The higher secondary school lecturers who were initially members of the operational group could not accept the fact that LDTs [lower division teachers] from middle schools could be their equals.

When LDTs were given the responsibility of conducting classes during the training and the lecturers had to assist them in the classroom, they just could not take playing this assistant's role."

The HSTP resource teachers subsequently began training teachers in other states as well.

In fact, the most significant outcome of the intensive teacher training efforts made in HSTP was the emergence of a group of professional teachers. Shashikala Soni expressed this best during the Pipariya meeting (August 2006) when she said, "HSTP created a platform for the teachers and gave them recognition. Even today, when HSTP teachers meet they are linked by a common bond." Most teachers present in the meeting agreed with her.

The evolution of such a group holds out the promise of newer possibilities in future.

17

EXAMINATIONS

One reason why the innovative science education programme running in Bombay's municipal schools was closed down was that the municipality refused to permit any changes in the Board examinations. It was clear to the teachers as well that their students would not be evaluated for the kind of things they were learning in science: the Board examinations would only ask questions about formulae and memorised information. So their students would be at a disadvantage and would suffer.

This was an important lesson from the Bombay experience. That's why when B. G. Pitre met Sudarshan Kapur and Anil Sadgopal in Rasulia with his proposal to start a science education programme in Hoshangabad, he told them that they should get permission from the government to change the examination system before implementing the innovation. This point was mentioned in the 1972 proposal although it was not emphasised strongly enough. Anil Sadgopal puts it succinctly: "Examinations throw all innovations back because they are a powerful weapon to maintain the status quo."

Changing the examination system was a major concern of HSTP from the very beginning. The basic approach was that

an examination should evaluate what children are taught or what they are expected to learn.

Like HSTP's other components, the examination system gradually evolved on the basis of field experience. So examination practice kept evolving over the innovation's 30-year lifespan, although the basic thrust remained the same.

One thing needs to be mentioned however right at the outset. The HSTP group was clear that the best examination would be one the teacher herself conducts. That is, every teacher should have the freedom to assess her students. The purpose of this examination would not be to pass or fail students, or to place them in first, second or third class. It would be to assess how much and what the students had learned till then, which topics they were now equipped to learn, where they needed more time and support, and what more they needed to experience. This topic was discussed threadbare by the resource group and the teachers during the early phase, with the resource group constantly insisting that the internal assessments should have relatively more weightage.

Board examinations during those days of HSTP were held at different stages of the school cycle in Madhya Pradesh. The first examination was held in class 5 and was conducted at the district level. Next came the upper middle school Board examination (class 8) that was held at the divisional level, followed by the class 10 and 12 Board examinations that were conducted by the state-level Board of Secondary Education.

The first batch of the HSTP students reached class 8 in 1974-75. At that time, Friends Rural Centre and Kishore Bharati

once again broached the subject of examinations with the state government. Taking an important – and bold – decision, the government permitted the two organisations to organise and conduct the class 8 examination in the 16 HSTP schools, recognising this examination as equivalent to a Board examination. In other words, the government had accorded two non-governmental organisations the status of an examination Board. This was an unprecedented step for any state government to take and its importance cannot be lost on anyone working in the field of school education.

So the class 8 Board examination in the 16 schools was conducted by Friends Rural Centre and Kishore Bharati from 1975 to 1980.

After the district-level expansion of the innovation, the HSTP group came out with a paper in 1977 describing the kind of examination system it had developed. This paper is reproduced below. I have added a few points in parentheses to clarify some aspects. The paper goes into the thinking and logic behind each element in the examination system, which we shall discuss later. The paper is by and large based on the learnings from the field experiences until 1977. During these five years many things were tried and we shall throw more light on these aspects. The third point is that the examination system was not adopted exactly in the form developed during the pilot 16-school phase. Several changes were made in the details. We shall discuss these as well. Finally, we shall go into the field experiences of implementing this examination system and the impact it had on the teaching-learning process.

THE HSTP EVALUATION – A FRAMEWORK (1977)

We have, over the last five years, gradually evolved a system of evaluation in HSTP, which we felt was best suited to our objectives. Now that the programme has been extended and others will be taking over the responsibility of evaluating these students, it is necessary that whatever till now has been in our minds, and has been applied almost intuitively, be written down.

Class 8

We shall consider first the procedure of evaluation of class 8 students and then comment on the class 6 and 7 evaluation. The major difference in these two categories [is] that the class 8 examination is done through an external board whereas the 6 and 7 class examinations are promotional, hence local in nature.

The board examination at the end of class 8 consists of three parts: internal assessment (15 percent), a written paper (45 percent) and a practical test (40 percent). To pass, a student must have a minimum 33 percent in the aggregate and 25 percent in each of the three parts.

[This division of marks was arrived at after intensive consultation with teachers. The resource group was always in favour of giving more weight to internal assessment.]

Internal Assessment: The teacher is expected to assess his students on the basis of regularity of attendance, daily performance in the classroom, record work, and performance in the monthly and bi-annual examinations.

Written Paper: This is an unlimited-time, open-book examination. The paper usually consists of ten questions

designed in such a way that it would take the average student roughly two and a half hours to complete. Students are advised to bring their record books and Bal Vaigyaniks with them and they can consult them whenever desired. They are of course not free to consult among themselves or with anyone else.

[A look at 1975-80 question papers reveals that for many years children were allowed to bring any book, not just the *Bal Vaigyanik*, although this might not have had any practical significance in the seventies, especially in rural India. Moreover, they were allowed to solve the question paper in two sittings with an interval in between, and consult each other during the interval. Evidently, they were not allowed to talk to teachers. It was, in all probability, the first example of an open-book examination, and to be allowed to talk to classmates would sound unimaginable even today.]

The question paper is usually framed by a group of persons who try and set questions extending over the whole range of the curriculum. One question is usually totally unrelated to the actual course work and designed to test the students' IQ and natural ability. The remaining are a mixture of questions of the objective type, open-ended questions, short descriptive type questions, questions requiring students to draw diagrams, question requiring simple calculations and, sometimes, questions of straight recall. The objective in framing such questions is to test various attributes of a student, namely, comprehension of concepts, logical ability, power of expression, imagination and to test him in situations close to what he has encountered in the classroom, as well as situations which are far removed.

Once the paper has been set, a preliminary allocation of marks

to each question is done, keeping in mind how difficult a question is, how long a student would take to answer it, how much written material a student has to comprehend to answer the question, how difficult and important the concept involved is, how much logical and computational ability is involved, how much imagination is required, whether the test-situation is a familiar one or whether a student is being required to apply processes that he has already learnt in situations that are totally new to him.

[However, these pre-allocated marks were not printed on the question paper.]

Amongst this set of questions, a few are singled out (two or three) as those that form the core of the programme, i.e., the students must have achieved a certain minimum amount of comprehension in their underlying concepts in order that they be promoted to the next class. Quite obviously, such questions would not be of a trivial nature. Some of the areas from which such questions would be set are measurement, units, handling of data, graphic representation and its interpretation, classification, idea of sets and sub-sets and similar basic concepts from other subjects. In the preliminary allocation of marks, such questions would be given a more weight.

[The ideas of fundamental elements, minimum expectation, etc., fossilised in the course of time. Later, these were strictly defined and included in the examination manual.]

The written test is then administered to all students. Before evaluating them, a random sample consisting of roughly 20 percent of the total number of answer books is drawn. The examiners, after having decided upon the expected answers to various questions, study this sample and grade the given

answers into various categories, ranging from excellent to poor. The distribution of such grades to each question is then noted and based on it changes are made in the pre-allocated marks to various questions along the following guidelines:

(1) No or very marginal change is made to pre-allocated marks of questions singled out as forming the core curriculum, no matter what the sample distribution is like, unless strong evidence of a badly-framed question is encountered.

(2) Amongst the rest of the questions, the weight of questions which are done very well or very badly by a majority of students is reduced and added to the weight of questions whose answers are well-distributed in the categories excellent to poor.

The rationale for doing so is that if our objective in evaluating the student is (a) to differentiate, as well as possible, between bright, good, fair and poor students, and (b) to ensure that they have learnt a basic minimum in order to proceed to the next higher class, then (1) above takes care of the latter and to achieve the former, questions in response to which the student's answers span the largest spectrum should be given greater weight, i.e., they in effect become better questions in comparison to those whose answers are uniformly good or bad and which therefore have a low power of differentiation.

[This redistribution of marks is a statistical procedure and was the cause of suspicion about the HSTP examination. This will be discussed in detail later.]

An added advantage of such a procedure is to point out questions which are ambiguously or sometimes wrongly set. (Our experience shows that every question paper contains one or two such questions). If on the basis of answers of the random sample, the examiners are convinced that a particular

question is badly or ambiguously framed and the performance of the students in the sample has been affected as a result of this, it's weight is drastically reduced, and in exceptional circumstances the question may be totally deleted. Only under such situations are the pre-allocated marks of questions of key importance, which have been singled out beforehand and drastically changed.

Having thus finally allocated marks to various questions, all the answer books are marked, including those belonging to the sample. While marking, one examiner marks a particular question of all papers instead of marking all questions of each paper.

[The idea behind one examiner marking one question in all the answer books is to do with uniformity. However, after district-level expansion, it had to be given up due to practical reasons.]

Super Marks: Since many of the questions in the paper are open-ended, there is usually more than one correct answer to each question. On the basis of their experience and the general abilities that would normally be associated with a student of class 6, 7 or 8, the examiners usually decide what kind of an answer to a particular question would deserve full marks. In the event that a student provides an exceptionally better answer than what the examiners think is the best, or shows exceptional skill or imagination far above the level of expectation, he is given super marks, over and above the full marks for that question. During our five year experience, there has been only one instance when a student, because of this provision, got more marks than the maximum possible marks; in fact it was 104 out of 100. It is very rare that a student will display extraordinary ability in all questions since different questions test diverse attributes and faculties. In any case, this

provision is meant to be used in very exceptional circumstances only, and also in questions of higher conceptual or skill value.

Practical Test: Unlike the written paper, the practical test is of fixed duration. An unlimited time test would require an impossibly large number of trained people and laboratory facilities. Such tests, therefore, normally consist of four different experiments or activities that every student has to perform in a fixed time, about fifteen minutes each. The experiments are so chosen as to test the capacity of observation, experimental finesse, ability to draw diagrams and make tables and to interpret observations and derive conclusions.

[Later on, five experiments from well-defined categories were given.]

Classes 6 and 7

The procedure outlined above, and as mentioned at the outset, is for an evaluation done by an external board of examiners. In the school tests, taken by the teacher himself at monthly, bi-annual or annual level, it is not necessary to determine the weight through this procedure, since the class teacher is aware of the relative importance of various chapters and hence can pre-allocate marks on his own. The other fact is that since random sample is required for final allocation, this would not be an appropriate method in case the actual number of answer books is small, as would be the case in many school tests.

However, if the annual examination for classes 6 and 7 is envisaged at the block level, then the procedure described above should be used.

Summary

Briefly, the HSTP examination system had many elements that were different from the traditional examinations. These were:

- Freedom to refer to note books and textbooks (open-book examination).
- Unlimited time for the written examination.
- Provision for holding a practical examination (at middle school stage).
- Group setting of question papers.
- Consciously incorporating questions outside the curriculum.
- Review and analysis of answer sheets.
- Not specifying marks allotted for each answer in the question paper.
- Redistribution of marks after the examination.
- Division of the curriculum as per examination requirements.
- Super marks.
- Two sessions to solve question papers and freedom to talk in the interval (in the initial phase).