INNOVATIONS: LAYING THE GROUND FOR TEACHERS' PARTICIPATION

Teachers played a central role in the 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 or altering its course.

In traditional classrooms, the role of a teacher is limited. (S)he is only expected to explain what is written in the textbook. At most (s)he can supplement the explanation with examples or analogies. So teaching usually means reading the textbook to the children and dictating answers to questions once the chapter is completed.

Expecting children to do experiment themselves, discuss their experimental 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, including a knowledge base that extends 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 in either children or 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 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 the HSTP saw it as a process.

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 fact, student absenteeism was always a common complaint of the HSTP teachers. In this context, it makes one wonder how a child who is considered 'studious' in mainstream education would cope if (s)he had missed an HSTP class.

The discovery approach is child-centred, as opposed to traditional teaching methods that are textbook-centred. In a traditional classroom, what children think is of little consequence. They may be at different levels (a fact generally 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. Fortunately, experience shows that most children generally tend to reach a common conclusion even if they arrive at it following different paths.

That's why the 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 children and their ability to discover things on their own and their ability to decide what is right or

wrong. They should be clear in their minds 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, the 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 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 based on a worldview. Ignoring this cultural aspect means ignoring our daily lives and surroundings. Two types of knowledge teach us about our lives and the real world. One is textbook or school learning and the other is experiential or practical knowledge. The two need to coalesce. Unfortunately, mainstream education provides no space for cultural values and traditional concepts in learning. In fact, it negates their very existence. As a result, we have the earth rotating on its axis in textbook learning even if it doesn't appear to be rotating 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, it is important to continuously support and consult with the teacher. Otherwise (s)he feels isolated. Teachers are quite familiar with such isolation that's why they seldom show any enthusiasm for trying out something new. It was for this reason that the HSTP project proposal submitted in 1972 asked for two teachers from each school – 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 – these issues are never discussed in trainings, even though they have a serious impact on teaching.

These factors were part of the HSTP agenda from the very beginning even if one isn't sure whether they were considered at the time of the first training. The HSTP group saw teacher trainings as open

dialogues with teachers, a two-way exchange of ideas and knowledge. That's why it would be more appropriate to call them interactions rather than trainings. It was through such close interactions that the HSTP sought to make the teachers an integral part all facets of the programme.

The teacher's role was never limited to the classroom. They were active participants in developing the HSTP curriculum. This went beyond the standard practice of including a couple of token teachers in textbook writing to involving all teachers in creating teaching-learning materials, developing systems to evaluate student performance and so on. Facilitating such involvement was not an easy task since the traditional system sees no creative role for most teachers beyond classroom instruction. Even when they are entrusted with the task of creating learning materials, they usually end up producing the kind of traditional materials that are the norm in classrooms.

The HSTP viewed teacher collaboration in curriculum development as a learning process for teachers, an opportunity to create something new. That's why it was always an integral part of the programme.

Teacher training: the first workshop (1972)

The first HSTP training workshop took place on May 22, 1972 at the Friends Rural Centre, Rasulia campus. It was seen as a defining workshop since all major issues relating to science education in a rural scenario came up for discussion.

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 to define the path ahead since the teaching-learning materials were being tested for the first time. It also set the pattern for all subsequent training workshops.

These first steps and the basic approach that was adopted were highlighted in an article published in 1977 (Science Today, December 1977), some excerpts of which are given below:

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

1. Chandrakant Dikshit, "Today's education for the needs of tomorrow", Physics Study Group, December 1972. Dikshit was one of the Doon School teachers who wrote *Physics through experiments*.

2. V. G. Kulkarni was a scientist from TIFR who was a key resource person of the Bombay Municipal Schools experimental programme. He later became the director of the Homi Bhabha Centre for Science Education.

3. B.G. Pitre was one of the Doon School teachers who wrote *Physics through experiments.*

4. Yashpal was a scientist at TIFR at the time and an active resource person of the Bombay Municipal Schools programme.

The learnings from the first workshop

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

Behind the terminology

Resource group: The group that gave shape to the HSTP. Its members were drawn from Kishore Bharati, Friends Rural Centre, various universities and colleges as well as research institutions. It was responsible for conducting all the teacher trainings prior to the district level expansion of the programme.

Follow-up group or executive group: The group comprising teachers from high and higher secondary schools as well as middle schools. It was responsible for conducting follow-up in schools. At the time of the district level expansion, the group was constituted as per the requirements of the expanded programme.

Resource teachers: At the time of the district level expansion, the HSTP was running in around 250 schools. It was not feasible for the resource group to conduct teacher trainings on this scale. So around 20-25 trained teachers who had fully internalized the HSTP spirit and values were selected to take over the responsibility of training and orienting other teachers. Known as resource teachers, their numbers grew to over 200 as the programme expanded. They subsequently conducted HSTP-style teacher trainings in other states and made important contributions to the programme in many other ways.

The framework for working with teachers

Teacher interactions in the HSTP were not limited to 'teacher training'. This is clearly brought out in an observation of a teacher 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. The HSTP gave teachers dignity."

Teachers were seen as equal participants so no effort was spared to prepare them for their new role. Whether in classroom management, evaluation of students, follow-up to schools, helping peer teachers, developing curriculum and other educational materials, or developing kit materials, they were active participants. In fact, they became a major resource for every training and orientation.

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

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 the 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, many teachers had no background in science. Most had studied up to Class 10 or Class 12. One or two were graduates.

The lack of formal education isn't a serious obstacle in a teaching methodology that basically requires children to read from textbooks. The discovery approach, however, requires teachers to not just be familiar with the topics in the syllabus but to understand them well.

The methodology focuses on children doing experiments themselves. This requires teachers who are familiar with the experiments and can actually perform them. That was the minimum expectation in the HSTP.

The methodology also discourages teachers from dictating observations to children. Rather they are expected to help children observe for themselves and sift out wrong observations before reaching any conclusions. To be able to do this, the teachers need to themselves 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 experiments, their background and their linkages to other concepts.

Teachers must also know how a democratic classroom functions. Only then can they ensure an open classroom based on participation of the learners that is free of constraints or the pressure of authority, where decisions are taken on the basis of reasoning and evidence.

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 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.

How much thinking went into working out a strategy for teacher training is not clear, but role play was the model adopted for the orientation sessions. The teachers played the role of students in a classroom, their interactions with the resource persons mimicking teacher-student interactions. They did everything expected of a student, performing the experiments, noting down their observations,

drawing diagrams, presenting their findings to the class, discussing them and deriving theoretical conclusions.

Going through the process helped the teachers understand and appreciate the catalyzing 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 these trainings during the lifespan of the 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.

The first day of the training was devoted to registering the teachers and dividing them into four-member groups on the basis of the class they would have to teach. 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, giving 90 hours of instruction for studying the *Bal Vaigyanik* chapters. In addition, 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 trainings were organised every year from the time the 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 two trainings were organized every year. These school complexes were spread over a very wide geographical area.

There were several reasons why large-scale trainings continued to be organized every year. They included expansion of the 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 was also occurring during this period, which 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 trainings. Also, since most private schools don’t send teachers for summer vacation trainings they faced the problem of choosing teachers for the winter trainings.

To address these problems, two changes were made in planning the training. The first change was to organize smaller training camps instead of a single large camp at the divisional level. These

decentralised trainings catered to around 150 schools from around 2-3 blocks. The advantage was that the trainings 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 interactions with teachers after the formal sessions, which was possible when the trainings were residential.

Another disadvantage was that the resource group had to be divided across a larger number of training sessions. In the divisional trainings the presence of the full complement of resource persons at a single venue had its 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 curriculum.

The second change was that the training camps were organized 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 decentralized trainings did solve some problems they gave rise to new ones. Getting resource persons and organizing 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 teacher-resource person interactions. Given the HSTP's climate of open-ness, such interactions continued to be a feature of the trainings but since fewer resource persons attended the smaller camps, there was less scope for questioning, debates, discussions and trying out new experiments.

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

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

There is a reason for going into details about these problems. The HSTP required strong infrastructure for implementation - organizing teacher training and providing back-up support for teachers in schools. It also required high-quality resources and creative resource persons to breathe life into its educational interactions.

Decentralization proved to be a limiting factor in many ways. Adequate participation of resource persons from colleges and universities could not be ensured. Putting together several teams of teacher trainers and resource persons is not a task that can be done overnight. It requires time and a process of intense interactions. Orienting high school teachers to take over the role of resource persons, which is crucial for the long-time survival of an innovative programme, also requires tremendous efforts and high-quality inputs.

The HSTP group rued the loss of the learning environment that large-scale training camps created. There were fewer learning opportunities outside the teaching sessions. 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.

The resource group felt that large-scale trainings gave more scope for preparatory, feedback and chapter-linked discussions, both formal and informal. The coming together of minds added depth to the whole process. Also, the opportunity to discuss with senior resource persons gave teachers and volunteers a better understanding of the HSTP philosophy and conceptual base. Smaller trainings could not generate 'critical mass' to foster such discussions.

This is why large-scale trainings continued to be organized occasionally at the divisional level even after the switchover to decentralized block-level trainings.

Whatever the case, describing the trainings and the preparatory process is an interesting exercise in itself because it gives insights into how seriously the 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 (s)he would be able to inspire the students to adopt and internalize this approach in the classroom. A teacher trapped in a traditional learning mould would never be able to guide students on a path of self learning.

It's a matter of great pride that teachers who participated in the HSTP accepted this fact so wholeheartedly. This is clearly brought out in the comments of teachers from Pipariya at a meeting organized on August 26, 2006, some years after the closure of the HSTP. They pointed out that the self learning process in children cannot be seen in isolation from their own self learning. When asked about the learning experiences of children in the 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 had collected tadpoles from the Dudhi river near Kishore Bharati for the reproduction chapter (she was probably referring to 'Life-cycle of animals'). They were kept in water. The children were excited to see them developing into tadpoles. Just like when I used to conduct the fly experiment and they would shriek with joy when they saw flies develop and emerge."

This link between their professional development and what children did was a positive attitudinal change for the teachers. 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), perhaps, 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 trainings 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 realize 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."

Indeed, this was what made the HSTP unique. It was a celebration of methodology, with all participants learning and teaching together.

The second premise of the HSTP training was that the teacher must understand the subject (s)he taught. Understanding did not mean familiarity with technical words, definitions, formulae and so on. What (s)he needed to know was the logic behind how concepts unfolded, their mutual links, and the methods to gain insights into them.

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

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

Of course, the teacher had to herself/himself perform whatever the children did in the classroom.

Another important aspect of the training was to create an environment in which teachers realise that saying 'I don't know' is not a shameful admission of ignorance but the first step in learning. They should realize that it is not a crime to commit a mistake and that people would not laugh but would help.

This feeling was most appropriately expressed by teachers at the Pipariya meeting when they pointed out that the HSTP trainings demolished the entrenched belief that the teacher is the 'fount of all knowledge'. They saw this as a positive development. The HSTP gave them the courage and self belief to stand before their students and say, "I don't know. Let's find out. Perhaps, we can find the answer."

Another eye-opener was that their observations from the experiments they performed during their trainings 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 happens in an HSTP classroom. But before that, let's see the kind of preparations needed for the teacher training sessions.

The resource group gathers at the training venue three days before the training starts to make the necessary preparations. There are many jobs to be done and everyone pitches in. These include getting the accommodation for resource teachers and trainees ready, checking the lights/fans, arranging drinking water and food, getting durries for the classrooms, organizing 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, with many takers for even the most routine administrative and management tasks.

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 trainings.

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 fertilized eggs at different developmental stages on the day the growth and development experiment was taken up.

The resource group would make a checklist of experiments requiring preparation many days before they were conducted.

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 were themselves 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 them may have already done the experiments several times over to leave no lingering doubts about their 'success'. Yet this stipulation was there for two reasons. First, every training session welcomed new resource group members who needed to be familiarised with and convinced about every aspect of each experiment. Second, experience has shown that experiments may need to be changed or modified according to the availability of kit materials, especially when local materials could be substituted.

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 trainings, another step was added to the preparatory stage. The resource group had to first sit with the resource teacher teams to discuss and finalize the training framework and schedule.

Each training session began with the resource group assembling 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 trainings.

The session would normally begin around 7.00-7.30am and continue till 1.00-1.30pm, with a half-hour break in between.

Just like the teachers were divided into groups, the resource group would also be divided into smaller groups of 4-6 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 previous 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 should also adapt their approach to the chapter to suit the classroom situation.

The experiments would then get under way. Each trainee 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. 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. Teachers usually think they know all the answers, or would be told the answers, or could get the answers by reading up. This is the situation in most traditional teacher trainings. So they would hesitate to do 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 realized they didn't really know how to measure.

Most were also reluctant to work with their hands because they couldn't quite accept its importance in learning. They believed that knowledge encapsulated in books is the ideal learning source. So they did not show 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.

One other problem was that they expected all the experiments to be easy and they would know all the observations. So they felt 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 the HSTP did water boil at 100°C when the teachers actually did the experiment. Their reactions

were worth noting. When they begin to understand why water does not behave in the 'right' manner, their interest and curiosity grows. It's only then that they begin to recollect that the boiling point of water depends on factors 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 stopping 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.

The environment may have generated enthusiasm, but there was one other problem. As pointed out earlier, most teachers had never done experiments, or had done them a long time ago in the past. So they did not have the skill to perform even the simplest experiments. The trainings, therefore, focused on teaching them how to do experiments.

Another point to be noted is that whatever experiments they may have done in high school or while qualifying for their degree was done with a totally different purpose in mind - usually to verify or prove something, or to arrive at an expected answer. This is seen in the example of the boiling point of water given earlier. What this example emphasizes is the importance of noting down exactly what one sees. Recording observations includes narrating and writing them down in simple and clear language, tabulating them, drawing diagrams to illustrate them and so on.

Drawing 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 had to draw a real-size diagram of the seed or draw everything in proportion in a magnified diagram. For many teachers, enlargements seen under a microscope was a new experience. They faced another problem as well. Most of us tend to present what we see (whether in a diagram or in words) in a way that is already imprinted in our minds. Suppose a leaf is placed before us. No matter which leaf it is, we tend to draw a prototypical diagram of a leaf.

It is here that the meaning of 'observations' got 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 in the 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 new and unfamiliar process for them. It included listening to and understanding one another's arguments and explanations, analyzing 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 shortcuts 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 try and find their underlying reasons, if necessary repeating the experiment to clarify them, and then sifting out those that were obviously wrong.

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 would be carefully scrutinized and then applied in another context to see if it answered all the questions posed. Like if the explanation is correct, what would happen in so-and-so 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. But 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 and they always complained about not being given the answers.

The process moved ahead in this stumbling way, one step forward, one step 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 enjoyed 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 they should give as much scope as possible to unravel every layer of ‘discovery’.

Some other processes

The teachers were periodically evaluated during the trainings. 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 a way to assess understanding of these basic concepts. After each such assessment, the teachers would discuss their responses and this sometimes led to altering parts of the chapter under study.

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% 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 the HSTP and its methodology. These were usually postponed to special 'doubt clearing sessions' organized every weekend.

The way in which evaluation was done in the HSTP was quite different from the traditional examinations. That's why the training focused on familiarizing the teachers with all its aspects. The 'mini' questions gave them their initial taste 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 to memorized 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, post-examination renormalization of marks and so on.

One important daily activity in the trainings 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 the HSTP.

Unfortunately, the feedback 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 criticizing others. As a result, you had reports written in verse or embellished with similes, but a healthy tradition of providing critical feedback never really 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 1.00pm and the teachers would get a bit of free time till around 2.00pm for lunch and some relaxation, after which they would attend the feedback session, usually scheduled for 3.00pm. 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 and many teachers would attend, even though attendance was optional.

The feedback from each class would be collected and presented by a person specially appointed for the purpose, usually a volunteer. (S)he 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.

These feedback reporter/resource group 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, the trainees being the feedback group.

The feedback system was a mixed experience. Take, for example, its 'human' aspect. Whenever a feedback reporter raised a question about the role of a resource person, the entire resource group tended to spring to the defence. The criticism and defence would get more heated in cases where the resource person had sought to take over the class, a tendency linked to their confidence level. Sometimes things could get personal. Such differences usually arose because the feedback reporter would have no clue of what the resource group was looking for, leading to irrelevant feedback on his/her role.

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 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.

Another problem was the work overload. Having 6-7 to 8-10 classes daily during trainings was the norm. As a result the feedback sessions tended to become burdensome. If a half-hour per class is taken as the average, each session required 3 to 5 hours, which meant they went on to well past 6.00pm. 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.

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 being that the group would help vet the reports first before they were presented it in the feedback session.

These attempts made one thing clear - feedback was important and every effort was made to ensure it was meaningful, purposeful and concrete.

Expanding programme, evolving training

When the 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 teachers played a limited role in the trainings, mostly helping in the classroom activities. This included guiding the trainees in doing experiments, answering their questions, and encouraging them to voice their opinions in the group discussions. The coordination responsibility continued to rest with the resource group.

Further expansion was a given objective for the HSTP so it was always on the cards. The first district-level expansion to all the schools in Hoshangabad education division occurred in 1975 and was based on the Sangam Kendra-cum-school complex concept of the Kothari Commission. 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 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 the 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 the 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 proved to be is a matter for argument, but what is clear is that a major challenge in any educational innovation of this scale is teacher training.

A study was conducted in a teacher training camp organized at Indore in 1987 to judge whether the resource teachers were capable of conducting the trainings themselves. The study sought to gauge their limitations and assess the viability of the transition model. The teachers were given the responsibility of coordinating classroom activities for the first time. Of course, a ‘resource expert’ was always on hand to help out. Helping out meant the expert would discuss how to organize 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 if we are to understand the core requirements for teacher training in an expanding scenario.

The first task was to assess the performance of the resource teachers. They were well versed in the *Bal Vaigyanik* curriculum and had internalized its philosophy. So they could teach any of its chapters

in an organized and structured manner. They were also expert in performing every experiment and getting children to do the experiments. They understood the safeguards to be observed while performing experiments, the 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, reach 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 fulfill 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 learning all the answers) as their prime concern.

If a question unrelated to the topic was raised in class, and if the trainees insisted on getting an answer, they would bring in an 'expert'. The trainees were quick to catch on that the resource teachers preferred staying within the ambit of the *Bal Vaigyanik* so they would purposely keep asking unrelated questions. Since the expert was always around to take over, the trainees tended to look to him/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 would often deliberately curtail a healthy discussion, or declare a teacher wrong even if (s)he was proceeding on the right track, or stop 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' of the 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 trainings to ensure continuity.

Follow-up

The system of follow-up to schools was established 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 discovery approach and using the kit materials developed.

In the beginning resource persons went on regular follow-up visits to the schools. Later, higher secondary school teachers, assistant district inspectors of schools (ADIS) and headmasters of middle

schools were included in the follow-up group, which came to be known as the operational group. Even later, some middle school teachers were also included to undertake follow-up.

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

The HSTP had drawn inspiration from the Kothari Commission report in setting up many of its structures, including the Sangam Kendra-cum-school complex. These centres were given the responsibility of chalking out and implementing the follow-up plan for their attached 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 visualized 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 responsibility of follow-up to schools.

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 school lecturers never did accept the follow-up idea whole-heartedly. Going twice a month on follow-up visits was seen as an imposition. As a result follow-up was sidelined and became an irregular activity.

There was another – and stranger - problem with follow-up. The 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 its full potential was never fully realized. The system continued to deteriorate, with administrative problems – delays in getting daily and travel allowance dues – adding to its woes.

Another reason for the decay was lack of academic expertise. Follow-up was a new activity for the educational system, undertaken for the first time only in the HSTP. The administration saw it as a useless and superfluous activity. The general attitude was that once teacher training is over and done with, what's the need for follow-up or monthly meetings?

The counter argument in support of follow-up was that trainings are never complete or adequate so teachers need continuous back-up. Once a teacher undergoes training (s)he gets no further support even if the curriculum or textbook is changed. (Neglect of this aspect in teacher training is a cause of concern.) More and more information keeps getting packed into textbooks in the name of the information explosion. Yet no attention is paid to equipping the teacher adequately for the task. This is the contradiction. Even if the curriculum remains unchanged, teachers require continuous help and support.

We pointed out earlier that self learning depends on 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 even made to train them in the *Bal Vaigyanik* curriculum and to familiarize them with every detail of the follow-up process. They were given tasks such as evaluating children and so on. A prototype follow-up report was even created 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 organize a meeting of teachers in its school complex. After the district level expansion, 11 meetings were organized every month, their number going up to 23 when the 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.

Initially, 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. Teachers also got the opportunity to share and try out new ideas and experiments they had devised.

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 an 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 even 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 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 to stimulate discussion. These were mostly linked to the *Bal Vaigyanik* chapters, the idea being to help the teachers get a more in-depth understanding of the content so they could contribute better when the time came to revise the chapters. 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 centralization in their planning as a result of which classroom issues tended to get sidelined.

A fresh attempt was made to decentralize the planning. The job of preparing the common agenda was given to a group of 30-35 teachers comprising Sangam Kendra in-charges and teachers from the operational group. The monthly meetings were then conducted on the basis of this common agenda.

Preparing for the monthly meetings 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 decentralized 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, acting as a forum for academic discussions and for teachers to voice their problems and grievances. They also helped encourage the teachers to get more involved in other components of the HSTP.

Hoshangabad Vigyan **bulletin**

The third component of continuous training emerged in the form of a bulletin called *Hoshangabad Vigyan.* The magazine was visualized as an in-house journal of the HSTP where the teachers could link up with each other to exchange ideas and information. Its publication began in 1980, five years after the district level expansion, and the HSTP group had to put in a lot of effort to ensure it came out regularly.

The publication served a dual purpose. It became a notice board to carry information and notifications about the HSTP. It also served as a forum for discussions on education and related matters in which teachers could freely express their views on different aspects of the HSTP. It also became a medium of creative expression in which teachers communicated new ideas about experiments and classroom teaching.

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 new innovation like the 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' had an in-depth understanding of their

subject and fostered an open environment for discussions during the training camps and monthly meetings.

They planned the academic sessions, devised new course materials, tried to evolve a more relevant evaluation system and helped develop the curriculum. Confident and capable, they would come up with new ideas and experiments on the spur of the moment or argue with logic and reason. So there was always a healthy exchange of ideas on different aspects of the HSTP.

The ratio of 'experts' to trainees was high in those days, that's why the character of teacher trainings was different in the years from 1972 to 1977.

With the rapid expansion of the 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 began gaining ground.

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 organized method or criteria for selecting them. During the teacher training camps, monthly meetings and follow-up, some teachers would be shortlisted, based on their experience and 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.

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. They got opportunities to play different roles and contribute in different ways to the many components of the HSTP.

But 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, problems arose. We had mentioned these problems earlier, the main one being that they interpreted the *Bal Vaigyanik* in a mechanical way. So the teachers they trained failed to fully absorb the HSTP spirit and get the maximum benefit from the training.

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 the HSTP and its methodology and the romance and joy of embarking on a journey of discovery. It was not limited to merely making them adept in transacting the *Bal Vaigyanik* in class. They were also encouraged to think about pedagogical issues like how children learn and how their learning can be evaluated.

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 fulfill this wider objective.

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

The need to broaden the vision of the resource teachers was keenly felt. The first step taken in this direction was to identify those points in the *Bal Vaigyanik* chapters where they tended to become more mechanical and lost sight of their catalyzing role. The resource teachers themselves felt one such point was when the trainees began asking all sorts of questions, some even tangential to the issue under discussion. Very often they did not know the answer. So they would curtail the discussion to ensure it did not get diffused or go off track. The end result naturally was that the discussions ceased to be open-ended.

One way suggested to resolving the problem was to list out such questions by reviewing previous training reports and then explaining the answers to the resource teachers in advance. But that looked to be an impossible task because one cannot anticipate all such questions. The better option was to think of ways to look for answers when things got difficult. But to move forward into unfamiliar territory requires a much deeper knowledge of the subject, which the resource teachers lacked, given their limited science background.

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 organized during the lifetime of the HSTP, with around 100 resource teachers benefiting from them.

Complete study packages on fundamental scientific concepts were prepared for the camps, which more or less constituted a formal course in studying science when taken together. The concept modules included atoms and molecules, ionization, electricity and electronics, fundamental life concepts 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.

The Ganguli committee found the HSTP teacher training to be very effective and readily accepted the total HSTP model, 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 trainings and were the most enthusiastic were those with little formal science education. It also accepted the need for continuous training and support of teachers in schools.

The committee expressed the view that the future success of the programme depended crucially on maintaining this training structure for the professional development of teachers.

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 the HSTP since 1972, felt the percentage could be between 50 to 60%, while another teacher Premshankar Bhargava felt it was around 40%.

Challenges facing innovations

Preparing teachers for an innovation like the HSTP will always be a major challenge. We have already outlined the various efforts made in the HSTP in this context. The important thing is to spread its innovative spirit on a wide scale and that requires choosing 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, which in turn benefits the programme.

But how far is it possible to adopt such an approach? Traditional teacher training approaches have four mediators between the organizers and the teachers. The 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. When we talked about innovation, the focus was on 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 the HSTP and its different components, including teacher training. So they were not looked at as something that needed to be dealt with separately, so no organized effort was made to address them directly.

Another important aspect was developing strong links between all participants in the HSTP. Good science teaching (or good education in general) demands that these links are based on democratic principles and mutual respect. The HSTP nurtured these principles so a culture developed (it would be wrong to say 'was developed') in which the distance and hierarchy between students and teachers, between teachers, between teachers and the resource group, between the resource group and the educational administration and between the teachers and the administration were mitigated. This culture was so well integrated in the 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 organized study has been undertaken to assess the benefits. Whatever can be said is on the basis of feelings, observations and experiences of the participants. These positives can be seen from different perspectives.

If seen from the angle of an understanding of science and the syllabus, then a limited study of chapters shows that understanding of basic concepts in science was far superior among 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 methodology.

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 criticizing the HSTP!

When middle school teachers were first made resource teachers other middle school teachers tried to belittle them. But they had to eventually acknowledge the ability and expertise of these resource teachers. In fact, many more middle school teachers were encouraged to become resource teachers themselves.

A similar stand-off existed initially between the middle school teachers and the high school teachers. As one teacher who had been with the 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 from middle schools (in those days they were called lower division teachers, a nomenclature that was later changed to assistant teacher) could be their equals. When LDTs were given the responsibility of conducting classes during the trainings and the lecturers had to assist them in the classroom, they just could not digest 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 the HSTP was the emergence of a class of professional teachers. Shashikala Soni expressed this best during the Pipariya meeting (August 2006) when she said, “The 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.