

**THIRTY YEARS OF
HOSHANGABAD SCIENCE TEACHING
PROGRAMME**

1972 - 2002

A REVIEW

HSTP Group

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May-June, 2002.

PREAMBLE

The Hoshangabad Science Teaching Programme made a modest beginning in May-June 1972, with school teachers from 16 rural middle schools of Hoshangabad district coming together with a group of science teachers from the All India Science Teachers' Association (AISTA), scientists from the Tata Institute of Fundamental Research (TIFR), Bombay, and workers from two voluntary organisations, Kishore Bharati and Friends Rural Centre (FRC), Rasulia, in the first orientation camp. Soon a strong contingent of faculty members and students from Delhi University and post-graduate colleges of Madhya Pradesh also became deeply involved in the effort.

Over the last thirty years, a large number of people from varied backgrounds have contributed in a number of ways, sustaining high levels of motivation and expectations in the programme and bringing to it a wide range of perspectives and vision. The Hoshangabad Science Teaching Programme or HSTP or Hoshangabad Vigyan or Rasulia Vigyan (or the several other names it has come to be known by) has been an effort that has drawn attention across the country and beyond.

HSTP is, today, more than a mere effort to improve science education in rural middle schools.

It embodies an effort to develop a model of school science teaching close to the ideal envisaged in our policy directives.

It is a programme that tries to address the problem of innovation and quality improvement in school science education as an integrated whole, aiming to affect all aspects of school functioning that would facilitate innovative teaching.

It generated a vision that spawned a new organisation, Eklavya, with an agenda to take innovative work beyond science and middle schools.

It has evolved as a model for innovative quality improvement in the mainstream education system on a macro scale.

It is a landmark in building an effective partnership between the state education department, its official agencies and a non-governmental voluntary organisation.

It has demonstrated the synergy possible between research and higher education academia and school science teachers in developing academically sound curricula materials based on grass-root level field experience with children.

And much more.

Today, the HSTP has evolved as a comprehensive model for implementing innovative science teaching in the mainstream education system at the upper primary stage. It covers over 1,000 schools spread across 15 districts across the Mahakaushal, Nimad and Malwa regions of Madhya Pradesh. Involving over 2,000 teachers, about 200 resource teachers and a number of resource persons drawn from leading research and higher education institutions in the country, it directly reaches out to over a hundred thousand children annually.

The credit for nurturing, sustaining and supporting this effort through its various ups and downs rests squarely with the Government of Madhya Pradesh and its School Education Department. Such an effort would not have been possible without the academic inputs provided by highly motivated scientists and teachers from AISTA, TIFR, IITs and other institutions of advanced research and higher education. The Delhi University Science Teaching Group and the Post-Graduate College Teachers Group from Madhya Pradesh have provided sustained academic leadership to the programme and, along with Kishore Bharati, were instrumental in setting up Eklavya. For the Eklavya group, it's been a privilege to shoulder the responsibility of coordinating such an effort, a responsibility passed on by Kishore Bharati in 1982 after ten years of initial path-breaking work in partnership with FRC, Rasulia.

This paper attempts to document the main features of this thirty-year effort. The presentation is structured^{*} in five sections:

1. Objectives and perspective of HSTP (as they evolved).
2. Salient features of work done between 1972-2002.
3. Strengths and weaknesses.
4. Areas of key learning.
5. Some specific questions regarding the effectiveness of HSTP.

The note is accompanied by a selected bibliography and a reference list of documents arranged under the following sub-heads:

1. Policy directives on school science education.
2. HSTP: History, perspective and objectives.
3. HSTP: Working aspects
4. HSTP: Evaluations, studies and reports.

(The listed documents are available on request from Eklavya)

1.

OBJECTIVES AND PERSPECTIVE OF HSTP (as they evolved).

From this viewpoint, the thirty years of HSTP can be divided into four distinct phases:

- Phase I (1972-77): 16-school phase of evolving a science teaching programme appropriate for rural areas.
- Phase II (1977-83): District-level expansion aimed at evolving systems for introducing the innovation in the school system.
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Phase III (1983-90): Seeding in new districts, taking it to new settings to further evolve the package across regions and prepare the ground for further spread of the innovation.

Phase IV (1990 onwards): Building up towards mainstreaming the innovation in Madhya Pradesh and spreading its innovative ideas beyond.

Phase I. Ever since its inception, HSTP has motivated and mobilised participating groups and organisations in two ways:

(a) Science teaching for rural transformation. Kishore Bharati and FRC, the two initiating voluntary organisations, looked upon an inquiry oriented environment-based science teaching in schools as an important input for social, economic and cultural transformation in rural areas. The prevailing 'irrelevant' teaching of science was based on rote learning from textbooks far removed from the contexts of rural India.

It was believed that:

Good and effective training during their early years in the method of science would help children develop their inherent analytical powers, their ability to formulate and observe problems, make logical analysis and draw conclusions from their experiences. Coupled with the teaching of science, a training programme that is totally integrated with the environment would help the youth tap resources in their own areas and contribute to the development of their immediate surroundings. (Ref. 2.4).

Valid science teaching in villages must necessarily involve 'interacting with the whole life pattern of people living therein' (Ref. 2.3).

School science teaching could provide an effective channel for work in areas like agricultural reform, development of local intermediate technology and areas of health and family welfare. It could also influence social attitudes, enabling children to begin questioning the traditional structures around them (Ref. 2.5).

Kishore Bharati realised in the early years itself that there were severe structural restraints in applying the inquiry approach to social situations, a cause for much frustration in the group (Ref. 2.16, 2.17). This motivated Kishore Bharati, and later Eklavya, to develop other programmes of educational intervention outside the HSTP framework.

(b) Reforming school science teaching.

The dismal picture of science teaching in our schools is nothing new.

It is mainly textbook-based rote learning with little emphasis on understanding concepts or the process of science. There is a tendency to introduce advanced abstract concepts in a compact manner, without sufficient preparation or adequate elaboration of the subject. Conciseness and brevity couched in scientific terminology is confused with simplicity of presentation.

It is dominated by the teacher-to-student 'chalk-and-talk' method with virtually no scope for experimentation, hands-on experience, exploration or discussion.

Textbooks have tended to become content heavy, with no scope for relating to the local environment and local issues

Examinations and tests consist largely of questions aimed at information recall, which reinforces rote learning.

The organic link between discovery, experiment, hypothesis, theory and knowledge in science is totally ignored, with theoretical descriptive texts narrating concepts with little light thrown on how they were discovered. Experiments or activities included are at best meant to be demonstrative.

Thus learning science becomes drudgery devoid of perceivable meaning for students. It leads to loss of interest and students are totally deprived of the excitement and sense of wonder that science arouses.

That the situation is dismal has been continuously pointed out in various documents, both

official and otherwise (Ref. 1.3, 1.6, 1.9, 2.6). The directives emerging from our national policy documents, including recommendations of various commissions and committees, national curriculum frameworks etc, have strongly advocated reversing this situation.

During the initial years of HSTP's development, the two major directive documents were the Kothari Commission Report (1964-66) (Ref. 1.1) and the Curriculum for the Ten-Year School, 1975 (Ref. 1.2). It is significant that later documents like the National Education Policy 1986, the resultant National Curriculum of 1988, the controversial National Curriculum of 2000 released by NCERT and the Guidelines for the Syllabus based on it, reiterate the perspective and recommendations made by the Kothari Commission with respect to science education, (Ref. 1.4, 1.5, 1.7, 1.8, 1.9)

The efforts of the HSTP group have largely followed the framework laid out in these documents. In fact it can be stressed that HSTP is an effort to bridge the wide gap between our national goals and policy directives on science education and the ground reality of science teaching in our schools.

It naturally followed that rather than opening its own school to demonstrate the innovative pedagogy, the group decided to face the challenge of improving science education in existing government schools in rural areas. It was strongly felt that only then could a replicable model be developed that could impact the larger school system in the state and country.

With these considerations in mind, the directive perspective of HSTP has been:

- 1) To remould school science education to fulfill universally accepted national goals and educational objectives. HSTP has attempted to base science education on the principles of 'learning by discovery', 'learning through activity' and 'learning from the environment' in contrast to the prevailing textbook centred 'learning by rote' method. The process of science needs to be emphasised if we have to fulfil the constitutional goal of promoting scientific temper and making the child a confident self-learner for the rest of her/his life. In addition, the science curriculum must relate closely to science and technology experiences of everyday life.
- 2) Perceiving innovation as an integrated whole. HSTP recognises that an effective innovation must take into account all factors that affect the teaching process in the classroom – curricular innovation, teacher training, kit for doing experiments, examination system, school administration, extra curricular inputs etc. Examination reform has been seen as a crucial factor that influences how a curriculum is transacted in the classroom. The need for discovery oriented, activity based pedagogy has necessitated the development of a text-cum-workbook very different from normal science textbooks.
- 3) Innovating in the mainstream system. The HSTP model has been evolved in government schools in rural and semi-urban areas in close collaboration with and involvement of institutions of the Education Department at the state and district level.
- 4) Empowering teachers. The HSTP innovation has involved the teachers as participants in evolving the innovative package. Empowering teachers – academically, administratively and intellectually - is an essential requisite for effective reforms at the classroom level.
- 5) Participation of institutions of higher education and research. The HSTP group strongly believes that any effort to improve school education needs the involvement and commitment of the best scientists, researchers and academicians in the country.
- 6) Building working partnerships. HSTP is an ideal example of close and complementary working of the State Education Department and non-governmental voluntary groups in fostering innovations. The foresight of the Madhya Pradesh government in this respect has been exemplary.

Phase II. The development of the programme in the first five years in 16 rural middle schools had shown that

It is, indeed, possible to induce the necessary conditions in government schools which enable village children to perform experiments, collect and analyse data and learn scientific principles through inquiry.

Methods and materials can be developed that establish the village environment as a rich and versatile resource for discovering scientific phenomenon.

The programme has demonstrated the potential of village schoolteachers, including those without a science background, to teach science on the principles of the 'discovery approach'.

The experiment has provided ample evidence that meaningful educational change can be introduced within the framework of the government school network through a holistic approach that gave necessary freedom and administrative backing to experimentation with text-books, teacher training techniques, learning methods and examination system.

At that stage, new questions naturally emerged:

Would it be possible to extend the experience of this nucleus programme to large school systems?

Would it be possible for the government, instead of voluntary groups, to provide dynamic leadership and create a conducive environment for orientation of teachers, effective school follow-up and continuous evolution of educational materials and methods?

How would one minimise the dilution that is normally expected in the expansion of any innovation?

Where would one find motivated and competent teacher-trainers and resource persons in sufficient numbers?

What would be the extent to which decentralisation could be introduced?

What proportion of responsibility could be effectively delegated to the district authorities and school inspectors for organising monthly meetings, regular collection of feedback and kit distribution.

Further, it was argued that the legitimate questions posed above could only be answered by facing these issues in a pilot-scale testing of the programme.

These issues were discussed at a meeting organised at the Regional College of Education, Bhopal on October 26, 1977. The meeting was chaired by Dr S.K. Mitra, Director, NCERT. Shri B.M. Date, Secretary Education, represented the Government of Madhya Pradesh. Other participants included Shri Sewaram Chaturvedi, Joint Director, Directorate of Public Instruction, MP, Smt Vijaya Mulay, Principal, Centre for Educational Technology, NCERT, Prof S.N.Saha, Principal, RCE, Prof J.S.Rajput, Head Department. Of Science, RCE and a team from FRC and Kishore Bharati. (Ref. 2.7).

In the meeting, Secretary Education gave his consent to initiate a district-level testing of HSTP by the Department of Education from July, 1978. The finances for teacher training, resource group preparation and implementing the programme in the field were committed by the department. Director, NCERT, assured full academic support and guidance for the effort and committed to finance the kit to be supplied to schools. RCE, Bhopal, came forward to support the effort through a special academic cell and the two voluntary organisations committed to play the role of academic consultants and provide support in the field. Prof Rajput was requested to coordinate the process of preparing a detailed proposal.

The proposal 'Evolving systems for introducing innovations in school education' was submitted in February 1978 (Ref. 2.8, 2.9).

The proposal was concerned with the problem of evolving systems for introducing innovations at a macro-level in large government school networks with the objective of initiating long-term changes.

It was based on the premise that the traditional 'island' or 'oasis' view of innovation is socially irrelevant and elitist. Innovation would be meaningful only when the process becomes integrated into the vast national educational apparatus for the benefit of the masses.

Given a stagnant system, it would be necessary to build special capabilities, both human and administrative, with the objective of creating effective channels for the spread

of educational change.

Development of these new strengths in the traditional system demanded a commitment from the government to a style of functioning which would be free of the bureaucratic stranglehold and hierarchy in educational administration.

It demanded a commitment to build fresh human resources and to reorient existing resources for creating a self-learning and continuously evolving base in the school system. The building of such a base within the Department of Education, Madhya Pradesh, was the focus of the Hoshangabad experiment.

The extra investment would be meaningful and justified only if the government could view such resources as catalytic nuclei for further innovation at both the regional and national levels.

In line with the recommendations of the Kothari Commission, it was imperative that the human resources available in universities, colleges, higher secondary schools and teacher training institutes are utilised to their maximum potential in any programme of improvement in school education. The proposal took a conscious step in testing the concept of the university-college-school complex as an integral part of the implementation mechanism for expanding an innovation.

The proposal emphasised the significance of involving the local people in any attempt to improve education. It suggested that increasingly greater responsibility and authority be delegated to specially constituted block-level and village-level committees for looking after the implementation of the programme. Functions such as kit distribution and maintenance, preventing teachers from reverting to old practices of lecturing and rote-learning, and ensuring that experiments and field trips continue to be the basis of learning fall within the natural domain of local committees.

All this was to be done by introducing the programme of the environment-based discovery approach to science teaching in middle classes developed in the HSTP.

The proposal envisaged creation of three important functional units – an Operational Group, a Resource Group and an Academic Cell.

The Operational Group (OG) was given the responsibility for conducting monthly meetings at the block level and regular school follow-up, providing field-level support to middle school teachers and collecting feedback from the classroom. It comprised selected higher secondary and high school teachers, school inspectors (ADIS) and middle school headmasters. They were to be specially trained for these tasks.

The Resource Group (RG) was to be drawn from human resources already existing in universities, post-graduate colleges, Colleges of Education, teacher training institutes and specialised institutes like the State Institute of Science Education across the state. RG members were to contribute from time to time in training school teachers, assisting in the development of new learning materials, and conducting evaluation. The RG was to be oriented by sharing the experience and insights of the original HSTP group that would continue to be involved as required.

The Academic Cell (AC) was envisaged as a specially constituted group of a few highly motivated individuals co-opted for full-time responsibility. Based in Hoshangabad district itself, it would be directly responsible to the District or Divisional Education Officer (DEO). It would play the central role of academic coordination for organising teacher-training, monthly meetings, school follow-up, evaluation and material development. One of its important functions will be to receive and analyse the feedback reports and initiate action accordingly.

The district level experiment was formally launched in July 1978 in all the middle schools of Hoshangabad district.

Phase III. The stage for the third phase of HSTP was set in 1982 with the formation of a new non-governmental voluntary organisation – Eklavya, an institute for educational

research and innovative action in Madhya Pradesh. The institute was set up with active support of Kishore Bharati and a founding group consisting of HSTP resource persons from various research and higher education institutions. A proposal titled ‘Evolving systems for the introduction and diffusion of educational innovations – micro-level experiments to macro-level action’ was prepared after prolonged consultations at various levels (Ref. 2.10, 2.16).

The proposal was submitted to the Government of Madhya Pradesh and various departments and agencies of the Government of India. The Planning Commission (Education Division) took the initiative to organise a joint meeting chaired by its Member, Dr M.S.Swaminathan. The proposal to set up such an institute was welcomed by all and various kinds of support were committed to it (Ref. 2.11). Financial support for the first three years was shared between Department of Science and Technology and Government of Madhya Pradesh. The state government permitted Shri S.C.Behar, a senior member of the administrative services and a member of the founding group, to become the first director of the institute in an honorary capacity.

The objectives of Eklavya included

To carry out research and field testing of innovations in both formal and non-formal education at a micro level and to explore new directions to relate their content and pedagogy to social change.

To further develop existing innovations, such as the environment-based inquiry approach of HSTP.

To identify and create mechanisms and structures for translating micro-level innovations into macro-level action programmes.

This work was to be carried out through a decentralised structure with autonomy, consisting of field-level resource centres to carry out innovative work, and a coordination and planning centre for liaison and administration. Persons from universities, colleges, teacher training institutes, schools and elsewhere, highly motivated to work for educational change at the field level, were recruited on deputation, fellowships or as full-time faculty. Special efforts were made to identify such people in the educational set-up of Madhya Pradesh.

Simultaneously, the State Council for Educational Research and Training (SCERT) was formed with the responsibility of improving the quality of school education and promoting innovations in education in Madhya Pradesh.

The responsibility for further consolidation and growth of HSTP was taken up by these two organisations. The tasks identified to be carried out during this period were:

Consolidation of the HSTP by:

- 1) revising the Bal Vaigyanik books on the basis of feedback collected during the district-level expansion of the programme;
- 2) preparing and getting official approval for administrative and academic manuals for the different working aspects of the programme;
- 3) consolidating the administrative and academic coordination of the programme by forming and activating a Sanchalan Samiti (Coordination Committee), with the Director of Public Instruction (later upgraded to Commissioner) as its chairperson;
- 4) stabilising and strengthening the functioning of the Vigyan Ikai (Academic Cell) at the divisional headquarters in Hoshangabad and the sangam kendras (cluster coordination centres) at the block headquarter higher secondary schools;
- 5) seeking ways to resolve crucial bottlenecks, such as annual replenishment of kit materials in schools, irrational transfers of trained teachers etc.
- 6) developing state and district level resource teams by identifying new motivated individuals, giving them opportunities to shoulder greater academic and administrative responsibilities in training new teachers, conducting monthly meetings and school follow-up, organising evaluations, participating in

curricular revision exercises and through exposures and interactions with teachers and educators within and outside Madhya Pradesh.

- 7) initiating and conducting research and evaluation studies on the impact and functioning of the programme.

Seeding of innovative efforts in other districts by introducing HSTP in selected school complexes with the twin objectives of testing the adaptability of the HSTP package, including the Bal Vaigyanik books, in new regions and preparing the ground for further expansion through exposure and preparation of local resource groups. The programme was gradually initiated in all the districts of Indore, Ujjain and Hoshangabad divisions (14 school complexes in 13 districts).

Development of innovative programmes in primary schools and other subjects in middle schools. Work started on preparing an integrated package for Class 1 to 5 and a Social Studies package for Class 6 to 8.

Providing further opportunities for activity and learning for children and teachers through bal melas, libraries, jathas, exhibitions, theatre workshops, publication and dissemination of a variety of periodicals and occasional reading-learning materials etc.

Upgradation of Basic Teacher Training Institutes (BTIs) to District Institutes of Education and Training (DIETs). Many faculty persons and teachers with experience of working with Eklavya and its innovative programmes were placed in DIETs. Two senior faculty members on UGC fellowships with Eklavya, Dr Arvind Gupte and Dr Bharat Poorey, were appointed as the first principals of the DIETs at Ujjain and Indore to develop them as models.

Thus this was a period of geographical expansion and consolidation for HSTP.

Phase IV. In 1985 the Department of Education, MHRD, Government of India, asked Eklavya to organise a National Consultation on the Teaching of Science to prepare a document as an input for deliberations on a New Education Policy. The HSTP experience was presented to a gathering of scientists, teachers, educationists and administrators invited from across the country as a possible model for an action programme to radically improve science education nationwide. The report and recommendations of the seminar were presented in the document 'Teaching of Science' (Ref. 1.3).

This lead the HSTP group to seriously think about the dynamics of mainstreaming the innovative package. New questions emerging in this context were:

Can the macro-level implementation of HSTP demonstrate its effectiveness in terms of pupil learning in order to be largely accepted as a desirable alternative?

What are the bottlenecks in its effective implementation and can systemic solutions to them be found?

Can we define a package of minimum essential inputs that will be needed in any exercise to mainstream an innovation in science teaching at various levels?

How can problems of linkage with curricula in the lower and higher classes be tackled, particularly in the intervening period till innovative curricula are developed for those stages also?

Given the possibility of dilution and differential levels of effective implementation, what safeguards can be built into the package to provide direct learning opportunities for students?

While the debate and deliberation continued on all these and many other questions, the HSTP group felt confident enough to broach the question of mainstreaming with the state and national government Departments of Education. A brief note outlining the proposal and a gross budget calculation was submitted in 1990 (Ref. 2.14). It was believed that the bold step of state-level expansion would also provide the impetus to resolve many of the systemic problems faced by a programme confined to a district and a few other school clusters.

The proposal was jointly considered at an official meeting in Bhopal on September 17,

1990 between the Secretary, Department of Education, Ministry of Human Resource Development, Government of India and the Secretary, Education, Government of Madhya Pradesh. Expressing support for the proposal in principle, Secretary Education, MHRD offered to provide two-thirds of the finances required from the central government. It was also decided to commission an evaluation of HSTP by a national-level expert committee as an essential input into the decision making and planning process.

The committee members were:

- Prof B. Ganguly, Head Department of Education in Science and Mathematics, NCERT - Convenor.
- Dr Ashok Jain, Director, National Institute of Science, Technology and Development Studies, New Delhi.
- Prof R.H. Dave, formerly of NCERT and Director, International Institute of Education, Hamburg (Germany).
- Dr M.C. Pant, former Professor and Head Department of Science and Mathematics Education, NCERT and UNESCO Advisor on Science Education.
- Prof B.L. Saraf, former Professor and Head, Department of Physics, Rajasthan University, Jaipur.
- Dr.S.K. Upadhyay, Additional Director of Public Instruction, Bhopal (nominee of the MP government).

The committee submitted its Final Report in March 1991 (Ref. 4.11). Recommending an "all out effort ... to introduce this HSTP model as Madhya Pradesh Science Teaching Programme (MPSTP) to all the schools of Madhya Pradesh", the committee made significant recommendations regarding various aspects of the programme, preparatory to its expansion.

Subsequently, the state government constituted a state-level evaluation committee under the chairmanship of Dr G.S. Mishra, Director, State Institute of Science Education, Jabalpur. The committee conducted extensive surveys in the field to arrive at its findings. Though its final report could not be released, the committee discussed its findings with the HSTP group at a meeting chaired by the Secretary, School Education (Ref. 4.12).

The exercise to chalk out an action plan with a detailed budget was entrusted to a committee constituted under the chairmanship of Director, SCERT. A draft plan for further discussions was prepared. Through these processes the following agenda to prepare for mainstreaming emerged:

1) Consolidation of the present programme

Resource group development by identifying new resource teachers, organising special concept enrichment trainings and participation in curriculum development, teacher training and evaluation exercises in HSTP as well as other similar programmes in other states.

Kit replenishment by establishing a system of collecting a science fee at the school level and permitting direct purchase at this level; designing inexpensive kit boxes for direct purchase by desirous parents; setting up and running kit libraries from where children can borrow kit items to do experiments outside school.

Creating systems for community involvement in improving school education. Administrative structures in Madhya Pradesh are undergoing a radical change with the strengthening of village, block and district level panchayats. The school education department is also being effected. This trend towards decentralisation gives an opportunity for moving in this direction.

Streamlining and sustaining academic back-up systems like monthly meetings, school follow-up, sawaliram, Hoshangabad Vigyan bulletin, which teachers have found very useful. This has been a continuing challenge.

Revision of Bal Vaigyanik books in light of the criticisms and feedback. The task of producing teacher's guides and supplementary reading material for teachers and children has to follow.

2) Social validation of the HSTP approach

Comparative evaluations and impact studies covering various aspects of the programme to be conducted and their findings disseminated widely.

Public advocacy of the need to improve the quality of science teaching and the HSTP approach through press and other media as well as by organising interactions at various public levels.

3) Assimilation, expansion and dissemination of the HSTP experience

Spreading and strengthening the programme by selecting an optimum spread for intensive development and further innovation by direct intervention of Eklavya in collaboration with the State Education Department.

Creating and responding to demands from schools outside the HSTP area for HSTP type teaching in their schools. A negotiation with the State Education Department would be required to encourage such initiatives by granting them the required permission.

Contributing to state and national level processes of curricular renewal by sharing our experiences with NCERT, SCERTs and other bodies initiating such efforts.

Idea level dissemination through workshops and sharing of materials with various groups. Collaborating with similar intensive programmes to innovate school science teaching in Madhya Pradesh and other states.

These objectives - within the larger objective of mainstreaming the innovation - have guided the work of the HSTP group during the current phase (Ref. 2.2, 3.6, 3.7, 4.20, 4.21).

SALIENT FEATURES OF WORK DONE BETWEEN 1972-2002.

The work done during the last thirty years of HSTP has progressed according to the evolving objectives and perspective of the four phases described in the preceding section. The major milestones of this long journey are chronicled year-wise in Appendix (Ref. 2.1).

With its perspective of addressing all possible factors influencing classroom teaching and providing children a variety of learning opportunities, the HSTP work frame is a multi-dimensional intermeshing structure. This structure is represented in the accompanying organogram. The main areas of work have been:

1) Continuous development of innovative curricula and teaching-learning materials: The first edition of the Bal Vaigyanik text-cum-workbooks was evolved during the first phase of the programme. After the district level expansion, the experience and feedback gained from teachers formed the basis for the first revision of the books during 1985-89. Presently, the third revision is nearing completion (Ref. 2.4, 2.5, 2.6, 3.2, 3.6, 3.7, 3.11, 4.11, 4.12, 4.20, 4.21). The main characteristics of these books are:

Based on the enquiry-centred, discovery approach, the books are work-cum-textbooks.

Each chapter is designed in a format comprising initiating or guiding questions, detailed guidelines for conducting experiments, observation or exploration through field trips, recording and analysis of data and information, and guided discussion to arrive at a conceptual understanding, with further questions to explore. Problems to be solved or analysed are interspersed to reinforce understanding.

Since the Bal Vaigyanik books emphasise training children in the 'process' of science, a common criticism has been that the 'product' aspect of science has been underplayed. The present revision has sought to address this criticism by including interesting narratives that are related to the concepts, taking care to ensure that they do not interfere with the discovery process in the conceptual development of the chapter. The balance attempted between product and process will now be evaluated in light of feedback generated as the revised books reach the children.

The overall conceptual structure of the curriculum is based on two principles. In Class 6, the initial emphasis is on qualitative methods of study, with repeated use of grouping and classification in different contexts. Simultaneously, specific chapters to train

children in measurements and quantitative analytical tools like graphs are introduced. This facilitates a shift to quantitative and more abstract concepts and model building by the end of Class 8. Evaluation of conceptual understanding and its feedback has been a major input in the recent revision. This is an area that needs further strengthening.

The books have a child friendly conversational style of addressing the child in preference to a serious didactic, heavy vocabulary laden style. Common terms and nomenclature familiar to children are preferred and standard vocabulary is only introduced gradually as per needs. New words introduced in a chapter are listed at the end to draw attention to them.

The experiments, activities and discussion-guiding questions have all been formulated, tested and finalised through an intensive process of trials with teachers and children in actual school situations. This process was facilitated by fellowships granted by the UGC to the Delhi University Science Teaching Group in the seventies and, later, to teachers from universities or colleges to work with the voluntary organisations in the field.

The book layout has been designed and improved to make it attractive and easy to read and follow for children. Faculty members from the Industrial Design Centre, IIT, Mumbai and National Institute of Design, Ahmedabad, have helped us in this. Karen Haydock, an independent designer, artist and scientist, has also contributed significantly to this effort.

The books are being published and marketed by the Madhya Pradesh State Text Book Corporation since 1978 after due process of whetting and approval by the State Text Book Standing Committee.

2) Teacher training: A model of training teachers was evolved during the first phase and given formal shape during the district level expansion. It took into account the fact that:

A large majority of teachers teaching science at the elementary level had never themselves studied science beyond that stage.

Even those who had been students of science did not have any training in experimentation or relating conceptual learning to it.

They were themselves unaware of the rich experience of their own environment and lacked the confidence and understanding to see it as a rich source of learning.

Most teachers were found to be weak in their basic mathematical skills making even simple measurement exercises very difficult.

Used to simple lecturing methods, they lacked the confidence to adopt discussion-based pedagogy that encourages children to ask questions.

A reorientation-cum-training addressing all these issues was developed, each of three weeks duration, for Class 6,7 and 8. It consists of:

doing all the Bal Vaigyanik experiments, field trips and other activities, analysing, discussing and reaching conclusions and the conceptual understanding expected; discussing the social, philosophical, pedagogic and subject-related understandings and underpinnings, as well as the administrative structure of the programme;

training in evaluation methods and formulating new questions for open-book and practical examinations;

encouraging teachers to pursue a topic or question of their own interest outside the training schedule.

Each training class is normally assigned to a team of 4 to 6 resource persons, with one of them coordinating the discussions and activities and the rest helping the trainees to perform experiments in their groups and in other group-level activities. This is to ensure that most teachers get guidance for hands-on experience during the orientation. To ensure a dynamic response to the needs of the trainee group, the resource group follows a very rigorous schedule of preparation, feedback collection and analysis. Very often a daily schedule of six hours of training time requires an additional input of 6 to 8 hours from the resource group. (Ref. 2.3, 2.4, 2.5, 2.6, 3.1, 3.14, 4.20, 4.21).

3) Academic support at school level: With the understanding that a one-time training would not suffice, structures were built to help resolve the academic and other problems arising at the field level, generate an atmosphere of continuing learning and enrichment and set up a vigorous process of collecting feedback and peer interaction. The system addresses the problem of academic isolation of teachers, particularly in remote rural pockets. It consists of:

Monthly meetings organised at the block headquarter sangam kendra - a higher secondary school. The teachers gather for a day to share their experiences and discuss their problems. They are also given a refresher or enrichment lesson by resource teachers. A one-day preparatory meeting of resource teams from various sangam kendras precedes the round of monthly meetings. At present, 25 monthly meetings (15 in the Hoshangabad region, 10 in the Indore-Ujjain region) and two preparatory meetings (one each in Hoshangabad and Indore) are conducted every month during the academic session (Ref. 2.2, 2.5, 2.6, 2.8, 2.9, 2.14, 3.1, 3.6, 4.11, 4.12, 4.20, 4.21).

School follow-up, in which a resource teacher visits an assigned school once a month.

The purpose of the visit is not to inspect but to offer academic support. The resource teacher also writes a feedback report. The sangam kendra is responsible for coordinating the follow-up in its block. The feedback collected is routed through the sangam kendra to the Vigyan Ikai (Academic Cell). Though found to be very useful by teachers, the follow-up system has been difficult to implement administratively (Ref. 2.2, 2.5, 2.6, 2.8, 2.9, 2.14, 3.1, 3.6, 4.11, 4.12, 4.20, 4.21).

Publication of an in-house bulletin, 'Hoshangabad Vigyan'. This bulletin serves as a medium for communicating with teachers on various developments and debates within the programme (Ref. 3.16). It is also a platform for teachers to express themselves and share their ideas and experiences. Normally, three to four issues are brought out every year.

Publication of 'Sandarbh', a bimonthly resource journal for teachers. It carries articles on various topics in science, social science and education (Ref. 3.17).

A 'Sawaliram' question-answering service. Sawaliram is a fictional character whose letters to children are carried prominently in the three Bal Vaigyanik books. Children are invited to write in their questions, comments and experiences to Sawaliram, who replies to them individually. The need for Sawaliram was felt early in the programme as teachers expressed a strong reluctance to encourage children to ask questions. They feared that they would not be able to answer many of these questions and this would compromise their status in the eyes of their students. This often leads to a discussion on the fallacy of the image of teacher or 'guru' as the 'know-all' and source of all knowledge. Establishing Sawaliram also emerged as one way of addressing children's questions. We now have over 5,000 letters from children and have got experts from various fields to answer a range of questions. In fact, there is enough material for an indigenous 'Tell me Why' type of series which Eklavya is readying for publication. (Ref. 3.2, 3.6, 4.21).

4) Resource group building and mobilisation: HSTP has built up a dedicated resource group whose quality, motivation and commitment have been crucial to its activities. The resource group consists of about 200 trained and motivated middle and secondary school teachers and faculty members from teacher training institutions. They are supported by a group of about 50 scientists, academicians and research students from leading centres of research and education, including Delhi University, TIFR, IITs, National Institute of Immunology and post-graduate colleges of Madhya Pradesh (Ref. 2.3, 2.4, 2.5, 2.6, 2.8, 2.10, 2.15, 2.16, 3.1, 3.6, 3.14, 3.15, 4.20, 4.21). They have been actively involved in:

developing and improving the Bal Vaigyanik books and teachers' guides;
training teachers and resource teachers;
conducting follow-up and monthly meetings;

preparing test papers – both written and practical - for annual evaluations; preparing evaluation guidelines; answering questions asked by children through letters to Sawaliram; conducting trainings, exposure workshops etc in other states.

The involvement of middle school teachers in the resource group has had two-fold benefits. In the first place it has reinforced their motivation to perform as teachers and leaders of a process of educational change. Secondly, they have effectively demonstrated to their colleagues the feasibility of implementing innovations in the classroom. These teachers have often expressed a lack of confidence because of the absence of formal training in science subjects. The HSTP resource group has, therefore, been holding concept enrichment camps every year for the last five years to enrich their knowledge and experimental skills (Ref. 3.13).

The resource teachers have demonstrated their capabilities by helping initiate similar efforts in other states. They will be an important human resource in any efforts at mainstreaming HSTP.

5) Reforming the examination system and evaluation: HSTP has emphasised the teaching of a scientific method, with experimentation as the core classroom activity. Since skill and attitude development, problem solving capabilities and conceptual understanding are its major educational goals, the evaluation system must also reflect these priorities. In fact, examinations tend to be the major determining factor in what takes place in school, so exam reform is an essential prerequisite for success in innovating science teaching. The State Education Department accepted this argument and took the farsighted step of permitting a different model of evaluation up to the public exam at the end of Class 8. The examination system developed, tried and tested over the last 20 years, focuses on:

situation-specific problem-solving, measurement, analytical and data-handling skills.
adopting an open-book approach in which children are permitted to consult their Bal Vaigyanik books and class note-books to answer questions, thereby de-emphasising rote learning.

testing experimental skills through a practical test in which they are asked to solve 5 or 6 simple experiment-based problems or tasks of 15 minutes duration each. It is significant to note that NCERT has also pressed for an examination system that assesses experimental skills, requiring situation/experiment-based tests in its latest document Guidelines and Syllabi for Upper Primary Stage, November 2001 (Ref. 1.8).

The Class 8 Board examination consists of a written as well as practical examination. The ratio of marks is 60:40 and students have to score at least 25% in each exam and 33% in total for passing, a norm in line with the general structure of the Board exams.

The HSTP examination has been integrated into the regular Board examinations for Class 8 and has demonstrated its viability as a public exam system. The entire process has been codified in an officially prescribed exam manual (Ref. 3.1).

This has been made possible by training teachers in developing appropriate evaluation tests and methodology and designing question papers. The papers are set and evaluated by selected groups of middle school teachers themselves. A Question Bank (Ref. 3.4) that is periodically updated is available for reference, though questions from it cannot be repeated in the Board test papers.

The objective of testing for abilities like scientific temper has necessarily meant a focus on open-ended questions. It is not advisable to set pre-determined marks and valuation standards for such questions as the range and variety of children's responses cannot be anticipated. The relative weightage of marks to individual questions is determined after a random sampling of answer scripts and a survey and statistical analysis of the spread of various kinds of answers. This ensures that the marks allocated actually represent the variation among students and accurately and sensitively differentiate between different levels of performances. This methodology is

also codified in the manual.

For internal testing, teachers are encouraged to devise their own evaluations to determine the effectiveness of their teaching. Class 6 and 7 year ending exams are modelled along the Class 8 pattern and in some places the sangam kendra coordinates the setting and printing of question papers at the block-level.

Apart from examinations, regular exercises for conceptual testing in identified topics are conducted. The Vigyan Ikai, sangam kendra, monthly meetings, school follow-up and in-house bulletin are used to conduct such exercises across a large number of schools. The findings are recorded as inputs for future revision exercises and are also shared with teachers at monthly meetings, thus aiding their teaching practice (Ref. 4.7).

6) Kit materials for schools: HSTP has disproved the commonly held myth that experiment-based science teaching is too expensive for a poor country like India. A special science kit has been designed with inexpensive and commonly available materials, selected scientific equipment and specially fabricated items. A kit manual to codify its procurement and management has also been developed (Ref. 1.3, 2.2, 2.4, 2.5, 2.6, 2.7, 2.8, 3.1, 3.3, 3.6, 4.21).

The kit enables children to perform all the experiments in the Bal Vaigyanik books. It consists of:

- simple items like twine, balloons, marbles, cotton, torch bulb, electric wire, pins, etc that are easily available in local markets;

- laboratory items like test tubes, boiling tubes, beakers, conical flasks, magnets, compass, magnifying lens, metre stick, measuring cylinders, balance with weights etc.;

- specially fabricated items like ganak (abacus), overflow can, 1 cubic centimetre plastic cubes which sink in water, blocks of different materials, cubic box of one litre capacity etc.;

- a set of chemicals in small packings of 5 to 10 grams each;

- a glass bead microscope from Dynam Engineering Corporation, Bangalore (a national award winning patented product) costing just Rs135, which gives a 40 to 50 times magnification, enabling children to get their first glimpse of the microscopic world of cells and microbes, not visible to the naked eye.

In addition children are occasionally asked to collect items from around them, such as food items from home for testing for starch, protein and fats, or materials to fabricate their own weighing balance etc.

Improving kit items with help from fabricators and suppliers in Indore, Delhi and Eklavya's own toy workshop in Harda is an ongoing activity. So is the effort to find locally available replacements – a challenge taken up by many teachers. One noteworthy example is using inexpensive purgative tablets available in local medical stores as a source of phenolphthalein, a chemical indicator for acid-alkali. Discarded injection bottles serve as a replacement for test tubes. It is this enterprising spirit that has made low-cost experimentation an exciting reality in many village and small town schools.

In sharp contrast, conventional kits are designed for a selected list of demonstration activities only. The HSTP kit allows every child in the class to participate in performing hands-on experiments in groups of four children each. So almost all items in the kit have to be procured in multiples of the number of groups in the class.

The initial cost of the science kit for an average middle school of 120 students in three classes of 40 each is about Rs 5,000 at current prices. Kit storage in the school has been a problem and the best solution so far is adding the cost of a locally made steel almirah to the capital costs. Some schools have experimented with building wall shelves when constructing new rooms as a cost saving measure. Eklavya has designed a GI sheet kit box that costs Rs1,000 and holds all the kit items for one group of children.

Timely replenishment of kit materials is crucial for experimentation to take place in

schools. About 20% of the kit needs to be replaced every year – as consumables and breakage. The annual replacement cost is about Rs1,000. Initially, the Vigyan Ikai was assigned the responsibility of purchasing and supplying kit materials. The budget was sanctioned by the Directorate of Public Instruction. For various administrative reasons this system did not work and lack of kit materials in schools became a major crisis threatening the very basis of the programme.

A long term solution to this problem was worked out with the guidance of senior officials in the Directorate. Madhya Pradesh had earlier resolved the problem of financial resources for science laboratories in high and higher secondary schools by permitting school principals to collect a nominal monthly science fee of Rs3 and Rs5 from students. This resulted in surplus collection of funds in most schools. The Sanchalan Samiti of HSTP recommended a similar arrangement for middle schools with a fee of 50 paisa per child per month. The Commissioner of Public Instruction issued an order permitting all middle schools in the entire state to collect science fees from January 1996. This collection was placed in the hands of the headmaster and science teacher, who had the responsibility of ensuring kit replenishment. Eklavya responded by making various kit items available through local shops at the block headquarters (Ref. 3.3, 4.21). Our recent surveys in schools reveal that the problem of kit replenishment has been more or less resolved (Ref. 4.18). The problem of supplying the kit to newly opened schools remains to be taken care of.

7) Academic and administrative structures: The wide range of innovations implemented by HSTP necessitated innovations in academic and administrative structures. A decentralised structure has been codified in an administrative manual, which has been approved and notified by the state government (Ref. 2.8, 2.9, 3.1). The main features of the new structures and innovations are:

The functioning of the school has been suitably modified. Children sit in groups of four rather than in the traditional rows facing the teacher. This has radically altered the classroom architecture. The change was meant to enhance group working, child-to-child interaction and sharing. It also permitted the teacher to circulate among the groups and act as a facilitator in learning rather than a fountainhead of knowledge. Teachers have also given children responsibility for kit management and our feedback shows that this experience contributes positively to their overall personality development.

The school heads are called upon to facilitate activity-based learning by helping teachers sort out their problems. One suggestion is to adjust the timetable by clubbing two periods together to give three one-hour science classes per week rather than six half-hour periods. Half-hour periods were too short for initiating an activity, completing it and following it up with discussion. Many headmasters felt that activity based classrooms are too unruly and noisy and caused 'indiscipline' in the school. Orienting the school headmasters and other officials in the block and district offices has been found to be equally necessary.

Following the principle of school complexes recommended by the Kothari Commission, block-level coordination centres were constituted in designated higher secondary schools (sangam kendras). These serve to coordinate the evaluation, training, kit distribution and other activities in each block. The sangam kendras function with the high school principal as the in-charge, assisted by a senior teacher and a specially appointed assistant teacher.

A specially created cell, the Vigyan Ikai, in the office of the District Education Officer, serves to coordinate similar activities at the district level.

A representative Sanchalan Samiti has been set up for state level monitoring and coordination under the chairpersonship of the Commissioner of Public Instruction.

The district-level expansion proposal of 1978 envisioned involvement of community in assuring quality science teaching in schools through formation of village and block-level committees (Ref. 2.7, 2.8). The materialisation of this vision has had to wait for

political decisions for creation and empowerment of such structures. The present round of administrative reforms in Madhya Pradesh have led to setting up and strengthening of Panchayati Raj structures from village to district level. The HSTP and Eklavya group is keen to seek ways of pulling up efficiency levels of school functioning. The opportunity offered by these reforms will have to be seriously explored at the field level from this perspective.

8) Extra curricular inputs: To enhance learning opportunities for children outside the classroom, various extra curricular interventions have also been put in place. These include:

Publishing Chakmak, a monthly magazine for children, as well as booklets of interesting activities that children can do by themselves.

Libraries are a major source of self-paced learning for children. All Eklavya centres run libraries for children and teachers. The libraries attempt to reach out to schools in the surrounding region by lending books in lots to groups and schools. A pressing need for a comprehensive school library programme is being realised.

There is an acute paucity of good reading material in science and other related subjects in Hindi for school-age children. Eklavya's publication programme seeks to address this need with a series of supplementary readers and activity books on various topics. Articles published in Chakmak, Sandarbh and other magazines are a possible source for such material.

Organising various science popularisation activities like jathas, bal melas, exhibitions etc and encouraging children and teachers to participate in organising them. The services of the Science Museum van of the Regional Science Centre, Bhopal have also been extensively used whenever available.

9) Spreading the innovative spirit – our role as a resource agency: The HSTP experience has attracted the attention of groups and agencies involved in science education, science popularisation and voluntary social action from the very beginning. Many sought to learn from this experience and use it in some way in their work. The HSTP group feels such interactions help strengthen efforts towards the larger goal of reforming our education system. Hence we have tried to respond to such opportunities to the best of our abilities. Such interactions have provided learning opportunities and exposure that has helped in boosting the confidence level and widening the horizon of the larger HSTP resource group. The major forms of interaction have been:

The nationwide People's Science Movement has effectively been spreading the ideas and sharing the experiences of HSTP. Our resource teachers have been participating in meetings and workshops of teachers and people's science activists in various states from time to time. Contingents of participants from various states are a regular feature of our training programmes. Interaction with other groups continues to be important in our attempt for idea-level dissemination of HSTP.

Sharing of teaching-learning materials is an important aspect of such exchanges. The All India People's Science Network, together with Eklavya, organised an exposure workshop in the early nineties at Pachmarhi in which teams from various states participated. Apart from exposure to Eklavya's innovative programmes, the participants prepared translations of Bal Vaigyanik into 10 regional languages. The respective state teams carried their scripts back with them for appropriate use. The 'Palak Niti' group has been publishing a Marathi version of 'Sandarbh'. With original writing of science articles in Marathi also, there is a regular give and take of articles between the two journals. A group from Gujarat is now preparing to bring out a Gujarati 'Sandarbh'.

One objective of idea level dissemination was that some similar intensive programmes for innovating school science teaching would emerge in other parts of the country. The HSTP group offered to play the role of a resource group for such initiatives. The following initiatives have emerged over the years:

'Adhyaita Kendri Vigyan Shikshan Karyakram' or AVISHIKA (Learner-centred Science

Teaching Programme) in Gujarat: In 1992 three Gandhian organisations, Gandhi Vidyapeeth, Vedchchi, Surat district, Lok Bharti, Sanosara, Bhavnagar district and Gujarat Vidyapeeth, Ahmedabad began thinking together on the possibility of innovating science teaching in rural schools. They were supported by Vikram A. Sarabhai Community Science Centre, Ahmedabad and the Gujarat Science Academy. The HSTP group was invited to provide the resource inputs. The ideas crystallised into a five-year project Avishika in which the three field organisations initiated the programme in 34 schools spread over three districts. The State Education Department of Gujarat supported the programme. Financial support was given under the Science Education Improvement Scheme of MHRD, Government of India. A comprehensive programme was implemented over five years which resulted in the development of activity-based science textbooks for Class 5 to 7 in Gujarati. The Gujarat State Text Board incorporated substantial portions of these books in their new revised textbooks.

Shishu Milap in Baroda: After this experiment came to an end, the challenge of pushing for quality innovations in formal schools was taken up afresh by Shishu Milap, Baroda. Shishu Milap aimed to create an innovative intervention in formal schools of Baroda district. They sought to explore ways in which Eklavya's work in teaching science and social science in middle schools could be helpful to them. We supported them in the process. A team of faculty members from M.S. University, Baroda and Shishu Milap participated in our teacher training camp in Hoshangabad while our resource persons participated in a curriculum review and development workshop in M.S. University and the bal vigyan melas organised in schools to build up a positive pre-launch atmosphere in the schools. The programme was eventually launched in 24 schools with the permission of the State Education Department.

In order to formally support the experiment, we helped in setting up a state committee for Avishika under the Directorate of Primary Education of Gujarat. As a result of this interaction, the Gujarat SCERT has shown a lot of interest in HSTP. In September 2000, a 10-member team from SCERT and some DIETs of Gujarat visited Eklavya in this context.

Lok Jumbish Parishad in Rajasthan: In 1996, we were invited by Lok Jumbish Parishad (LJP) to help develop a science and social science package for Class 6 to 8. This project was seen as building up on the work done by Sandhan for primary classes. The Education Resource Centre of Vidya Bhavan, Udaipur, became the nodal agency, especially for the science programme. We actively strove to build a Rajasthan-based resource group and network with Rajasthan-based NGOs. A large number of new resource persons from institutions of higher learning were approached and commitments obtained to these fledgling programmes in that state. The institutions included Regional Institute of Education, Ajmer, universities in Jaipur, Udaipur and Ajmer, Institute of Development Studies, Jaipur, and the Solar Observatory, Udaipur. We also attempted to interact with SCERT in Rajasthan. In fact, earlier in 1997, a team from SCERT had visited Eklavya in Madhya Pradesh.

With the help of this team of resource, books for Class 6 science and social science, adapted from the books we had developed in Madhya Pradesh, were brought out in two parts in 1998. These were introduced on an experimental basis in all 54 government schools of Pisangan block of Ajmer district. Training sessions were held for teachers and open book examinations were discussed.. Workshops were also organised for developing the science and social science teaching package for Class 7. Chapters were prepared and revised and the books were readied in May 1999. The teacher training workshop for the Class 7 curriculum was held in the Masuda DIET.

Our follow-up visits also showed that the LJP personnel in the field were very capable and handled a lot of management responsibilities, leaving us free to concentrate on the academic aspects of the programme. However they needed conceptual support

to convincingly resolve doubts raised by anxious parents and teachers. The monthly meeting system, a crucial element of instituting an innovative programme, suffered in periodicity in Rajasthan due to financial and other compulsions of the LJP.

Initiatives in urban areas: Eklavya has felt the need to develop models of better education in urban areas of Madhya Pradesh, Bhopal and Indore in particular, to extend the ambit of discussion and debate on quality education and the space for innovation and improvement. One of our concerns has been to expand our educational activities to private schools in urban areas by responding to specific demands for change from schools instead of offering a complete curricular package to them. We sought to work within the framework of the existing curriculum but to introduce several of our ideas in learning methodologies and some of the content we have developed in various subjects. We felt such an effort would show that our ideas in education were relevant across the whole range of schools from rural government schools to better-off private schools in urban areas. It would, thus, help us evolve an alternative strategy for expanding our ideas in education outside the formal system of government schools also. We also felt the impact of such work would put pressure on national level organisations such as the CBSE and NCERT to modify their approach to curriculum development.

Indore: In February 2000, we established contact with Sahodaya, an organisation of CBSE-affiliated schools in Indore. They showed interest in the HSTP and social science programmes. In the session 2000-2001, one of these schools, Vidya Sagar, took up both the programmes. The social science book was replaced in Class 6 with the Eklavya textbook. However, the science textbook was only partially replaced in the sense that chapters common to both the existing book and Bal Vaigyanik were taught by the HSTP method. The teachers were given a one-week orientation in the summer vacation and this was followed by continual follow-up visits. We supplied the kit material for science experiments. The Choithram School and a non-CBSE school affiliated to the Madhya Pradesh State Board have also joined the programme.

Mumbai: As a result of explorations undertaken by a resource person associated with Eklavya on its fellowship programme, Don Bosco school in Matunga, Mumbai has opted to introduce the activity based method in teaching of science in the primary and middle school level. Teachers were oriented by Eklavya and the methodology has been introduced in Class 6. All the science teachers in the school joined to develop worksheets for each chapter.

It is hoped that such interventions will have a considerable impact in propagating the Eklavya philosophy and work in education on a broader canvas. The extensive inputs to a large number of groups have helped to expand the space for innovative education. At another level, our advocacy has helped to bring the concepts of integration and flexible learning paces, the issue of quality in elementary education and the nature of social science education into the discourse on school level education.

3. STRENGTHS AND WEAKNESSES

The HSTP, like any major innovation in society, has a set of strengths and weaknesses. It is important for them to be spelled out so that a wider process of learning from its experiences can take place.

The following are among the chief weaknesses of HSTP:

The role of supplementary learning, outside the classroom, is considerable. It is in supplementary learning that the lessons of the school are reflected upon, digested, and reinforced or challenged. After all, science teaching lasts for just one or two 40-minute periods every day. HSTP has been making efforts to enhance supplementary learning of science among its target groups, but no clear institutional

structure for this has yet emerged and taken root.

It is important for peer-support systems to emerge among teachers. This helps spread and strengthen their motivation and commitment to better science teaching. It also leads to greater autonomy and catalyses the creativity of science teachers in designing their own solutions to problems. While peer support systems have, indeed, emerged, a much larger scale of interactions and mutual learning among teachers is desirable.

Not enough has been done to broad-base the debate on the basic nature of science education in the local community. There continues to be widespread adherence to the conventional view of what science and learning should be – blind memorisation of facts, reliance on bookish knowledge, a reluctance to do something with one's hands and an unquestioning acceptance of dominant systems of knowledge. It is clear that more effort needs to be put into encouraging reflection upon our educational system and promoting constructive criticism of its basic principles.

There is the dilemma common to all attempts at innovation: the package becomes a little out of synchronisation with older, less progressive packages which precede it in primary school and follow it in high school. Transition pains occur when children move into Class 9 and return to the older system of rote learning and blind reproduction of facts. It is clear, however, that by the time of the Class 10 Board examinations children do adapt to the older system of examination and learning. If the benefits of HSTP are to be sustained and carried forward, it is imperative that a drastic restructuring takes place in Class 9 and 10, and the higher classes too, for that matter, so that the actual process of science is taught rather than the deadening memorisation of meaningless facts.

HSTP has no system of reward or punishment. As a result it is unable to influence the school organisation beyond what is possible through moral pressure or the inspiration and excitement of learning new things. If a teacher is unwilling to teach there is little that HSTP can do about it. Nor can it reward a teacher who puts in extra effort and time. Reforms in school organisation that encourage performers and discourage non-performers are urgently called for.

Among the chief strengths of the HSTP the following may be counted:

First and foremost is the fact that children greatly enjoy the activity-based model of science teaching that is the core of HSTP. Any visitor to a classroom where HSTP is being implemented can see this excitement on their faces and their obvious enthusiasm.

There is a quantum jump in the interaction between teachers and children and among the children themselves. This adds considerably to the degree and quality of learning taking place. Teachers find the classroom much more interesting and this heightens their satisfaction with their jobs and, eventually, their commitment to better education.

Children gain the confidence to ask questions, which leads to an active process of querying that goes beyond the limits of the syllabus and curriculum. They are encouraged to think on their own. This contributes to a central principle of scientific temper – independence of thought and a critical approach to any claim based on the authority of the claimant alone.

Children learn the basic premise of science teaching – experimental skills. These include skills of observation, measurement, using controls etc. They gain a fair degree of familiarity with experimental equipment and tools. A shift also takes place from the notion of science as a body of knowledge that is to be memorised to of science as something to be practiced. It leads to a strong emphasis on empirical verification of various propositions and the discipline required for doing this.

An evaluation system has emerged that is in tune with the objectives of internalising scientific temper. It bypasses the usual kind of testing of rote-based learning to focus

on the learning of actual scientific skills as applied to various everyday situations. This has been demonstrated to function even at the level of the Board examination and at a scale of several hundred schools.

A body of human resources and experience has been consolidated that represents an alternate approach to education – one that is child-centred and oriented to the learning of processes rather than information. This, in itself, becomes a key resource for the ongoing improvement of the programme as well as for attempting reforms of the educational system at large.

Systems of peer-support for teachers have emerged. They encourage and motivate teachers to learn more and to implement what they learn in their classrooms. Supported by an extensive system of regular interactions, teachers no longer feel isolated when they struggle to improve teaching in their schools. At the same time, they are able to share their experiences and the lessons they have learned with their colleagues. The communication channels established by HSTP permit a continual reinforcement of progressive ideas and filtering out of errors through cross checking.

Systems of academic support for teachers have been put into place. This enables continual upgradation of their knowledge and skills. University and college teachers, including some of the finest scholars from the most prestigious institutions in the country, have been interacting with school teachers on a regular basis. As such, HSTP represents an important step forward in bridging the gap between the school and systems of higher academic knowledge.

The involvement of teachers in teacher training has occurred on a very large scale. Every science teacher in the area covered by HSTP is supposed to go through a regular training and orientation course and then participate in monthly meetings and other follow-up activities.

4. AREAS OF KEY LEARNING

Importance of plurality: The HSTP experience has demonstrated the advantages of a pluralistic strategy in educational change. The space allowed by the Madhya Pradesh government to develop an alternate conception of science teaching has yielded rich dividends. This indicates the workability of a system in which multiple approaches to experimentation and reform proceed along with the mainstream system of education. A gradual process of incorporation of such innovations into the mainstream can go hand-in-hand with the seeding of new innovations and experiments. It is the existence of counterpoints to the conventional system of education that maintains a pressure on the system to improve itself. It also allows for a continuous generation of ideas and practices for reform.

Government-NGO synergy: Government institutions of education and innovation have their strengths and weaknesses. The NGO sector has the potential to supplement the efforts of the government. The HSTP experience has demonstrated that an organisational structure different from that of the government can attract and involve a sizeable volume of talent and experience in the challenge of improving education. The synergy that has emerged between the government and an NGO has led to a quality and scale of innovation that would not have been possible if either had worked alone. It is important to strengthen this synergy by further integrating the functioning of both institutions. At the same time, it is necessary to protect and strengthen the characteristics of each. For this, it is imperative that the government provide support and resources to attract and retain the interest of top-quality professionals in the functioning of such a joint effort.

Feasibility of innovations at the macro level: The HSTP experience has demonstrated that it is possible to bring the lofty vision of educational policy statements into reality at the grassroots level. The principles of teaching scientific temper, activity-based and child-

centred learning have been brought to life in ordinary government schools. And this has happened not just in one or two model schools, but across 15 districts and hundreds of schools. The feasibility of actually implementing key principles of educational reform has thus been established and the myth that no change is possible has been demolished.

Multi-pronged strategy: It has also become clear that educational change cannot proceed through interventions in just one area. There is need for a multi-pronged strategy that works simultaneously at many levels. The reform of school textbooks must go with rethinking about the school curricula and syllabi. Institutions of teacher training and educational research must be revamped, at the same time. Public debates on the purpose of education and its place in society must be encouraged. The organisational model of the school must be reconsidered and systems of responsibility for the community set in place. It is also not possible to do limited reform in just two or three classes and stop there – reform must spread across the board to all classes and even into higher education. Further, the state should exert pressure on national institutions like NCERT and CBSE to learn from their experiences and incorporate the lessons at the national level. It is clear that educational change is a complex and multi-dimensional process. Many simultaneous threads of innovations and reform must go together to create a fabric of a robust, effective and socially responsible system of education.

5. SOME SPECIFIC QUESTIONS REGARDING THE EFFECTIVENESS OF HSTP

Is inquiry-oriented, activity-based learning, as adopted in HSTP, actually feasible in Indian situations?

20 years of a macro-level intervention by HSTP has clearly demonstrated the feasibility of implementing inquiry-oriented and activity based learning in the average Indian school. This has actually been put in place within the existing organisational structure of Indian government schools, with all their problems of lack of efficiency, non-performance of teachers etc. The HSTP strategy does not include an overhaul of the school organisation, so the implementation of HSTP broadly follows the general pattern of government schools: roughly one-third of the schools that function reasonably well have been able to run HSTP with high levels of success; roughly one-third of the schools that have a mediocre level of functioning have been implementing HSTP in a rather lackadaisical manner; and the remaining one-third of schools that are largely non-functional have been able to do little with HSTP.

How do the curriculum and syllabus developed under HSTP compare with that of the Madhya Pradesh SCERT and NCERT?

The curricular framework for science teaching at the middle school level has been spelt out only at the national level by NCERT (ref. 1.2, 1.5, 1.7). There is no separate curricular framework for the state. A Madhya Pradesh syllabus has been created from this curricular framework, as a listing of topics for textbook design. The curriculum, naturally, has greater significance as a statement of what middle school science teaching should seek to do. The HSTP textbooks are actually closer to the national science curriculum than the syllabi and textbooks of the state (ref. 3.5).

A comparison between HSTP and conventional state science textbooks reveals 85-90% commonality (ref. 3.8, 3.9, 3.10) between them. This belies the earlier fear that an activity-based approach to science teaching would necessarily lead to a serious reduction in the number and range of topics that can be covered during an average academic year. It is to be noted that in addition to the extensive overlap with the state syllabus, HSTP has additional topics that are of central importance to the understanding of science. These include topics like the use and comprehension of graphs.

How are HSTP children faring in higher classes and public and competitive examinations in comparison to children from the normal stream? More specifically, does the perceived lack of memorisation of factual details and information handicap these children at higher levels?

There has been concern that children studying under HSTP do not do well in the Class 8 Board exam. However, it has emerged that students from Harda and Hoshangabad have actually done much better in science than most other districts over the years (ref. 4.4, 4.17). The science results have also been better than the performance in other subjects, which is not the case with the few other districts with good science results.

Class 9 sees a dip in average marks in science as in other subjects (ref. 3.13, 4.16). This is a nationwide phenomenon. However, the Class 10 Board results show little difference between HSTP students and others (ref. 4.5, 4.6, 4.15). Anyway, the Class 10 Board exam cannot be expected to reflect the superiority of HSTP students since it is a conventional exam, based on reproduction of memorised information. The superiority of HSTP students is seen more clearly in the dozen-odd PhD, MPhil and MEd. dissertations that have actually compared students on the basis of tests for scientific reasoning, logical thinking etc (ref. 4.13). These broadly conclude that HSTP produces better results than conventional schooling. The better results can be seen across various groups like SC/ST, girl-children etc.

Competitive exams based on logical reasoning have also shown HSTP children faring better than others. Comparisons reveal that HSTP districts are at the top of all primarily rural districts of the state in professional examination board entrance tests for engineering, medical and polytechnic courses (ref. 4.14).

There is the expectation that this programme will lead to an enhancement of scientific temper. Having been implemented in an entire district for 30 years, is there any social impact visible due to HSTP?

While various studies have established that HSTP children have a better grasp of science, it is difficult to establish a causal relationship between such enhanced understanding and various processes in society. The methodological problems in undertaking such a study are, indeed, vast. It is clear that no drastic social change is likely to ensue as a result of one or two 40 minute science sessions every day in middle school alone. The changes, if any, are likely to be delicately nuanced, fine shifts in emphasis. Accepting that much wider courses of action are called for, the HSTP team has also been supporting interventions in social science teaching and the popular science movement.

Given the importance of community participation in the choice of the kind of education the community's children get, how is a reconciliation to be sought between the often contradictory positions of older and emerging power blocs and the recommendations of a professional group of educational experts?

The structure of community participation is still in a fluid state in Madhya Pradesh. It is expected that with the passing and implementation of the proposed Jan Shiksha Adhiniyam the structure will begin to crystallise.

Meanwhile, the relationship between the state as an agency for social progress and justice, powerful vested interests that have hitherto controlled power, and emerging groups that are challenging them has still not been defined.

In this dynamic scenario, HSTP has been expanding its systems of consultation with various sections and interest groups in the local community. Several new initiatives of reaching out to the community have been undertaken and modes of dialogue are being established. At the same time, HSTP has been seeking to guard against pressures exerted by conservative forces and those who understand little about either education or the scientific method.