THIRTY YEARS OF HOSHANGABAD SCIENCE TEACHING PROGRAMME

1972 - 2002

A REVIEW

HSTP Group

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PREAMBLE

In May-June of 1972, the Hoshangabad Science Teaching Programme made a modest beginning 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, Bombay and workers from two voluntary organisations Kishore Bharti and Friends Rural Centre Rasulia in the first Orientation Camp. Very soon a strong contingent of faculty members and students from Delhi University and P.G. Colleges of Madhya Pradesh also became deeply involved in the effort.

Over the thirty years a large number of people with varied backgrounds, with a wide variety of vision and perspective, with a high level of motivation and expectations have contributed in a number of ways. Hoshangabad Science Teaching Programme or HSTP or Hoshangabad Vigyan or Rasulia Vigyan (or the other names that it has come to be known by) has been an effort that has drawn attention right across the country and outside it.

HSTP has turned out to be much more than a mere effort to improve science education in 16 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 organization ‘Eklavya’ with an agenda to take innovative work beyond science and middle school only.
- It has evolved as a model for innovative quality improvement in the mainstream education system on a macro scale.
- It has set 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 grassroot 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 1000 schools spread over 15 districts across Mahakaushal, Nimad and Malwa regions of Madhya Pradesh. Involving over 2000 teachers and about 200 resource teachers, and a number of resource persons drawn from leading research and higher education institutions of the country, it directly reaches out to over a hundred thousand children annually.

The credit for nurturing, sustaining and supporting this long effort through various ups and downs squarely rests 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 strongly motivated scientists and teachers from All India Science Teachers Association (AISTA), TIFR group, IITs and a number of such institutions of advanced research and higher education. The Delhi University Science Teaching Group and the group of P.G. College Teachers from Madhya Pradesh have provided sustained academic leadership for the programme throughout and, along with Kishore Bharti group, were instrumental in formation of Eklavya. For the Eklavya group, its been a priviledge to shoulder the responsibility of coordinating such an effort, a responsibility passed on by the Kishore Bharti group in 1982 after ten years of initial path-breaking work in partnership with the Friends Rural Centre, Rasulia.

This paper attempts to document the main features of this thirty-year effort. The presentation is structured* into 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 effectiveness of HSTP.

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

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 aiming to evolve systems for introducing innovation in school system.
- **Phase III (1983-90)**: Seeding in new districts, taking it to new settings to further evolve the package across regions and prepare ground for further spread of the innovation.
- **Phase IV (1990 onwards)**: Building up towards mainstreaming the innovation in Madhya Pradesh and spreading the innovative ideas beyond.

Phase I. Ever since its inception, there have been two streams of motivation that mobilised the participating groups and organisations.

(a) Science Teaching for Rural Transformation. Kishore Bharti (KB) and Friends Rural Centre (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 contexts of rural India.

It was believed that

- A good and effective training during their early years in the method of science would help children to develop their inherent analytical power, 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 which is totally integrated with the environment may help the youth to 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).

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

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

(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 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 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 local environment and issues

- Examinations and tests consist largely of information recall questions reinforcing 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 drudgerous and devoid of perceivable meaning for students leading to loss of interest. They are totally deprived of the excitement and sense of wonder that science arouses.

That the situation is so dismal has been continuously pointed out in various documents, both official and otherwise (Ref. 1.3,1.6, 1.9, 2.6). On the other hand, the directives emerging from our National policy documents including recommendations of various Commissions and Committees, National Curriculum Frameworks, etc. have been strongly advocating to the contrary.

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

The efforts of the AISTA, the TIFR group and the HSTP group have largely followed the framework laid out in these documents. In fact it can be stressed that:

The Hoshangabad Science Teaching Programme is an effort to bridge the wide gap between the National Goals and Policy Directives on Science Education and the actual reality of Science Teaching in our Schools.

It naturally followed that rather than succumb to the temptation of opening its own school as a demonstration of innovative pedagogy, the group decided that we must face the challenge of improving science teaching in the normal government schools in rural areas. It was strongly felt that then only will we develop a replicable model that could impact the larger school system in the state and the country.

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

(1) <u>To remould school science education to fulfil universally accepted national goals and educational objectives.</u> 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 emphasized if we have to fulfil the constitutional goal of promoting scientific temper and make the child a confident self-learner for the rest of her

or his life. In addition 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 the 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 really influences how the curriculum is transacted in the classroom. The need for discovery oriented activity based pedagogy has necessitated 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 the institutions of District and State Education Department.

(4) Empowering the Teachers. The HSTP innovation has involved the teachers themselves in evolving the innovative package. Empowering the 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. HSTP group strongly believes that the effort to improve our school education system needs the involvement and commitment of the best scientists, researchers and academicians of our 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. The foresight of the Madhya Pradesh Government in this respect has been exemplary leading to innovative action.

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

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

- Methods and materials had been developed which established the village environment as a rich and versatile resource for discovering scientific phenomenon.

- The programme had demonstrated the potential of the village schoolteachers, including those without science background, for teaching science on the principles of the 'discovery approach'.

- The experiment had 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 experiment with text-books, teacher training techniques, learning methods and examination system.

At that stage new questions had 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 a dynamic leadership and to 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 will 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 organizing monthly meetings, regular collection of feedback, and kit distribution.

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

These issues were discussed in detail in 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, M.P., Smt. Vijaya Mulay, Principal, Centre for Educational Technology, NCERT, Prof. S.N.Saha, Principal, RCE, Prof. J.S.Rajput, Head Deptt. Of Science, RCE and a team from Friends Rural Centre and Kishore Bharti. (Ref. 2.7).

In the meeting Secretary Education gave his consent to initiate a District-level testing of the HSTP from July, 1978 by the Deptt. of Education. 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 academic consultants and provide support in the field as before. Prof. Rajput was requested to coordinate the process of preparation of a detailed proposal.

The proposal 'EVOLVING SYSTEMS FOR INTRODUCING INNOVATIONS IN SCHOOL EDUCATION' was submitted in February 1978 (Ref. 2.8, 2.9). Its main features were:

- The proposal was concerned with the problem of evolving systems for introducing innovations at 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 bureaucratic stranglehold and hierarchy in educational administration.

- It demanded a commitment to build fresh human resources and to reorient the existing ones 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 regional and national levels.

- In line with the recommendations of the Kothari Commission, it was imperative that the human resources available in the Universities, Colleges, Higher Secondary schools and Teacher Training Institutes are utilized 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 emphasized 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 the 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 environment-based discovery approach to science teaching in middle classes as developed in the HSTP.

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

- The Operational Group was given the responsibility for conducting of monthly meetings at block level, regular school follow-up, field-level support to the middle school teachers, and collection of feedback from the classrooms. It was constituted of 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. The RG members were to be drawn from their institutions from time to time to train school teachers, to assist in development of new learning materials, and to conduct 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 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. It would play the central role of academic co-ordination for organizing 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 HSTP was formally launched in July 1978 in all the middle schools of Hoshangabad district.

Phase III. The stage for the third phase of the HSTP was set in 1982 by the formation of a new non-government voluntary organisation – EKLAVYA, an institute for educational research and innovative action in Madhya Pradesh. The Institute was initiated with active support of the Kishore Bharti group by 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 Government of Madhya Pradesh and various departments and agencies of Government of India. The Planning Commission (Education Division) took the initiative to organize a joint meeting. The meeting was chaired by Dr.M.S.Swaminathan, Member Planning Commission. The proposal to set up such an Institute was welcomed by all and various kinds of support were committed for it (Ref. 2.11). Financial support for the first three years was shared between Department of Science & Technology and Government of Madhya Pradesh. The State Government also 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 the 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 decentralized structure with autonomy, consisting of Field-level Resource Centres to carry out innovative work, and a Co-ordination and Planning Centre for liaison and administration. Persons from universities, colleges, teacher-training institutes, schools and elsewhere with motivation 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 responsibility to improve quality and promote innovation in school education in Madhya Pradesh.

The responsibility for further consolidation and growth of the HSTP was taken up by these two organisations. The objectives laid out for this period were:

- Consolidation of the HSTP by
  - (I) revision of the Bal Vaigyanik books on basis of the feedback collected after district-level expansion of the programme;
  - (ii) preparation and official approval for administrative and academic manuals for different working aspects of the programme;

(iii) consolidation of administrative and academic coordination of the programme by formation and activation of a 'Sanchalan Samiti' (Co-ordination Committee) with the Director of Public Instruction (later upgraded to Commissioner) as its chairperson;
(iv) stabilising and strengthening the functioning of the Vigyan Ikai (Academic Cell) at the divisional headquarter in Hoshangabad and the Sangam Kendras (Co-ordination Centres) at the block headquarter higher secondary schools;
(v) seek ways to resolve crucial bottlenecks like annual replenishment of kit materials in schools, problem of removal of trained teachers through irrational transfers, etc.
(vi) develop 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.
(vii) initiate and conduct research and evaluation studies on the impact and functioning of the progamme.

- Seeding of innovative effort in other districts by initiating HSTP in selected school complexes with twin objectives of testing adaptability of HSTP package including Bal Vaigyanik books in new regions and preparing ground for further expansion by 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 Classes I to V and Social Studies for Classes VI to VIII.

- Providing further opportunities for activity and learning for children and teachers through efforts like bal melas, libraries, jathas, exhibitions, theatre workshops, publication and dissemination of a variety of periodical and occassional 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 fellowship with Eklavya, Dr. Arvind Gupte and Dr. Bharat Poorey were appointed as first Principals of 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 Teaching of Science to prepare a document as input into the deliberations for the New Education Policy. In a gathering of scientists, teachers, educationists and administrators invited from across the country, the HSTP experience was presented 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 initiated the group into seriously thinking about the dynamics of mainstreaming the innovative package of HSTP. 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 exercises of mainstreaming innovation in science teaching at various levels?
- How can problems of linkage with curricula in the lower and higher classes be established, 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 on mainstreaming, what safeguards can be built into the package to provide learning opportunities to students directly?

While debate, action and deliberation continued on all these and many other questions, the HSTP group in 1990 felt confident enough to broach the question of mainstreaming with the State and the National Government Departments of Education. A brief note outlining the proposal and a gross budget calculation was submitted (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 or so.

The proposal was jointly considered in an official meeting in Bhopal on September 17, 1990 between Secretary, Department of Education, Ministry of Human Resource Development, Government of India and Secretary, Education, Government of Madhya Pradesh. Expressing in principle support for the proposal, 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 the 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 & Mathematics, NCERT - Convenor.
- Dr. Ashok Jain, Director, National Institute of Science, Technology & Development Studies, New Delhi.
- Prof. R.H.Dave, formerly of NCERT and Director, International Institute of Education, Hamburg (Germany).
- Dr. M.C. Pant, former Prof. & Head Dept. of Science & Mathematics Education, NCERT and UNESCO Advisor on Science Education.
- Prof. B.L. Saraf, former Prof. & Head, Department of Physics, Rajasthan University, Jaipur.
- Dr. S.K. Upadhyay, Additional Director of Public Instruction, Bhopal (nominee of Govt. of M.P.).

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 the final report of the Committee could not be released, the Committee discussed its findings with the HSTP group in a meeting chaired by Secretary, School Education (Ref. 4.12).

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

(i) 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 in other similar programmes in other states.
- Kit replenishment by establishing a system of science fee collection at the school level and direct purchase there. Designing inexpensive kit boxes for direct purchase by desirous parents. Set up a model of running kit libraries from where children can borrow kit items to do experiments outside school.
- Administrative structures in Madhya Pradesh are undergoing a radical change with strengthening of village, block and district level panchayats. The school education department is also being effected. This trend towards decentralisation gives an opportunity for creating systems for community involvement in improving school education.
- Academic back-up systems like monthly meetings, school follow-up, sawaliram, Hoshangabad Vigyan bulletin have been found to be very useful by teachers. The response of children's letters to sawaliram is directly effected by the promptness in reply. Streamlining and sustaining them has been a challenge throughout.
- In light of the criticisms and feedback, the Bal Vaigyanik books needed revision. The task of producing Teacher's guides and supplementary reading material for teachers and children has to follow.

(ii) 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 quality of science teaching and the HSTP approach through press and other media as well as by organising interactions at various public levels.

(iii) 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 adequate permissions.
- Contribute to the 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 in the present continuing phase (Ref. 2.2, 3.6, 3.7, 4.20, 4.21).

2. SALIENT FEATURES OF WORK DONE BETWEEN 1972-2002.

The work done in the last thirty years of HSTP has progressed according to the evolving objectives and perspective in the four phases as described in the preceding section. The main milestones of this long journey are chronicled yearwise in the appendix (Ref. 2.1).

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

(i) Continuous development of Innovative Curricula and teaching-learning materials.

The first edition of the 'Bal Vaigyanik' set of text-cum-workbooks was evolved during the first phase of the programme. After the district level expansion, the experience and feedback gained from the teachers formed the basis for the first revision of the books during 1985-89. Presently the process of 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 have been:

- Based on enquiry-centered discovery approach, the books are in a combined format of work-cum-textbook. Each chapter is designed in a format of initiating or guiding questions, detailed guidelines for experimentation, observation or explorationn through field trips, recording and analysis of data and information, and guided discussion to arrive at conceptual understanding and further questions to explore. Problems to solve or analyse are interspersed to reinforce the understanding.
- Since the Bal Vaigyanik books emphasize training children in 'process' of science, a common criticism has been that the 'product' aspect of science was underplayed. The present revision has sought to address this criticism by including interesting related narratives in chapters taking care 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.
- 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 need. New words introduced in a chapter are listed at its 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 the

fellowships granted by UGC to Delhi University Science Teaching Group in the seventies and later to any teacher 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, easy to read and follow for the 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 of the State Text Book Standing Committee.

(ii) Teacher Training.

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

- A large majority of teachers teaching science at 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 very weak in their basic mathematical skills amking even simple measurement exercises very difficult.
- Used to simple lecturing methods, they lacked the confidence to adopt discussion based pedagogy encouraging children to ask questions.

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

- doing all the experiments, field trips and oher activities of Bal Vaigyanik, analysing, discussing, reaching conclusions and conceptual understanding expected;
- discussions about the social. philosophical, pedagogic and subject-related understandings and underpinnings, as well as the administrative structure of the programme;
- training in evaluation methods and making new questions for open-book and practical examinations;
- encouraging teachers to pursue a topic or question of their own interest outside the training schedule as well.

Each training class is normally assigned to a team of 4 to 6 resource persons with one of them co-ordinating the discussions and activities and the rest helping the trainees in their groups to perform experiments and other group-level activities. This is to ensure that most teachers get guidance for hands on experience during the orientation. The resource group to ensure a dynamic response to the needs of the trainee group follows a very rigorous schedule of preparation, feedback collection and analysis. Very often a

daily schedule of 6 hours of training time requires another 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).

(iii) 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, discuss their problems and 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 Hoshangabad region, 10 in 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 gives a feedback report. The Sangam Kendra is responsible for co-ordinating 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 the teachers, the follow-up system has been hard 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).
- An in-house bulletin of the programme, 'Hoshangabad Vigyan', serves as a medium for communicating with the teachers on various developments and debates within the programme (Ref. 3.16). It is also a platform for the teachers to express themselves and share their ideas and experiences. Normally three to four issues are brought out in a year.
- 'Sandarbh' is a bimonthly resource journal for teachers carrying articles on topics of science, social science and education (Ref. 3.17).
- '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 in turn replies to them. 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 children's questions and this would affect their status in eyes of the 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 5000 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 preparing to publish. (Ref. 3.2, 3.6, 4.21).

(iv) Resource Group Building and Mobilisation

A dedicated resource group of HSTP has been gradually built up. Its quality, motivation and commitment have been crucial to the activities of the HSTP. The resource group

now consists of about 200 trained and motivated middle and secondary school teachers and faculty members from teacher training institutions. They are supported by an involved group of about 50 scientists, academicians and research students from leading centres of research and education, including Delhi University, Tata Institute of Fundamental Research, Indian Institutes of Technology, 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). These have been actively involved in the following:

- development and improvement of Bal Vaigyanik books and teachers' guides;
- training of 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 widespread 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 good teachers and leaders of a process of educational change. Secondly these middle school teachers have been very effective in demonstrating to their other colleagues the feasibility of actually implementing these innovations in the real classroom. Meanwhile, these teachers have often been expressing their own lack of confidence because of the lack of formal training in science subjects. For this the HSTP resource group has been holding one Concept Enrichment Camp every year for the last five years for the deepening of their knowledge in specific areas and experimental skills (Ref. 3.15).

This group of resource teachers has demonstrated its capabilities by helping initiate similar efforts in other state and is an important human resource eager to contribute to any efforts at mainstreaming the gains of HSTP.

(v) Reforming Examination System and Evaluation

HSTP has emphasized the teaching of a scientific method, with experimentation serving as the core of classroom teaching. With skill and attitude development, problem solving capabilities and conceptual understanding identified as major educational goals, the evaluation system must also reflect these priorities. In fact since examinations tend to be the major determining force of what takes place in school, exam reform was an essential prerequisite for any success in innovating science teaching. The State Education Department accepted this argument and took the farsighted step of permitting development of a different model of evaluation even for the public exam at the end of Class VIII. The examination system developed, tried and tested over the last 20 years consists of:

- A large-scale examination system which focuses on situation-specific problem-solving, measurment, analytical and data-handling skills.
- Rote learning is de-emphasized by adopting the open-book approach in which children are permitted to consult their Bal Vaigyanik books and class note-books to answer the questions.

- Experimental skills are tested 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 the NCERT in its latest document *Guidelines and Syllabi for Upper Primary Stage*, November 2001, (p. 64) has also pressed for an examination system that assesses experimental skills, requiring situation/ experiment-based tests (Ref. 1.8).
- HSTP Class 8 Board examination consists of a written as well as a practical examination. The ratio of marks between written and practical is 60:40. The students have to score at least 25% separately in both of them and 33% in total for passing, a norm in line with 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, in question paper designing and evaluation methodology. 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 widely for reference, though questions from it cannot be repeated in the board test papers.
- The objective of testing for the acquisition of a scientific temper has necessarily meant the posing of 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 done after a random sampling of the answer scripts and a survey and statistical analysis of the spread of various kinds of answers across the answer scripts. This ensures that the allocation of marks can actually represent the variation amongst students and differentiate both accurately and sensitively between different levels of performances. This is also codified in the manual.
- For internal testing the teachers are encouraged to devise their own evaluations to determine effectiveness of their teaching. Class 6 and 7 year ending exams are modeled along the Class 8 pattern and in some places the Sangam Kendra co-ordinates a Block-level setting and printing of question papers.

Apart from the examinations, regular exercises of conceptual testing in identified topics are conducted. The structures of Vigyan Ikai, Sangam Kendra, monthly meetings, school follow-up and the bulletin are used to conduct such exercises across a large number of schools and share the findings. These findings are recorded as inputs for future revision exercises as well as shared with teachers in monthly meetings and thus effect their teaching practice (Ref. 4.7).

(vi) Kit Materials for Schools

HSTP has disproved the commonly held myth that experiment-based science teaching is too expensive for a poor country like ours to afford. A special science kit has been designed by putting together of inexpensive and commonly available materials, selected scientific equipment as well as specially fabricated items. A kit manual to codify its procurement and management has also been notified (Ref. 1.3, 2.2, 2.4, 2.5, 2.6, 2.7, 2.8, 3.1, 3.3, 3.6, 4.21).

- Each and every experiment mentioned in the Bal Vaigyanik books can be effectively performed by children through this kit. It consists of:
  - simple items like twine, balloons, marbles, cotton, torch bulb, electric wire, pins, etc. easily available in local markets;
  - science lab items like test tubes, boiling tubes, beaker, conical flask, 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 must 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 Rs 135 only which with 40 to 50 times magnification gives children their first glimpse of microscopic world of cells and microbes, not visible to our naked eye.

  In addition children are occassionaly asked to get items from their environment, like food items from home for testing for starch, protein and fats, or materials to fabricate their own 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 which many teachers have taken up as a challenge. A famous example is that of finding that phenolphthlein, a chemical indicator for acid- alkali, was easily available in local medical stores in form of inexpensive purgative tablets. Disposed injection bottles are very effective replacement for test tubes. It is such enterprising spirit that has made low-cost experimentation an exciting reality in many village and small town schools.

- In sharp contrast with conventional kits which are designed for a selected list of demonstration activities only, the HSTP science kit is a set of equipment and materials which allows every child in a class to participate in performing hands on experiments in groups of four children each. Thus almost all items in the kit have to be procured in multiples of number of groups in the classes

- The initial cost of this science kit for an average middle school of 120 students in three classes of 40 each is just about Rs 5000 at present prices. Kit storage in school has been a problem and the best solution so far is to add the cost of a locally made steel almirah to the initial cost. Some schools have experimented with building almirah shelves in the walls when new rooms are constructed as a cost saving. G.I. steel kit box containing all kit items for one group of children costing Rs. 1000 each have also been designed by Eklavya.

- Timely replenishment of used up kit materials is crucial to enable experimentation to take place in schools. About 20% of the kit needs to be replaced every year to make up the loss of consumable and breakable items. The annual replacement cost of this kit is about Rs1000. In the initial years the Vigyan Ikai was assigned the responsibility of kit purchase and supply. The budget for the same was to be sanctioned every year from 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 labs in high and higher secondary schools by

permitting School Principals to collect a nominal monthly science fee of Rs3 and Rs5 from students. This had 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 only per child per month to the Commissioner of Public Instruction. An order permitting all the middle schools in the entire state to collect science fees was issued from January 1996. This collection was placed in the hands of the School Head and Science Teacher giving them the responsibility of ensuring kit replenishment. Eklavya responded by making various kit items available through local shops in Block Headquarters (Ref. 3.3, 4.21). Our recent surveys in schools show that the problem of kit replenishment has been more or less resolved. A systemic solution to a problem has been successfully found (Ref. 4.18). The problem of supplying the first time kit to newly opened schools remains to be taken care of.

(vii) Academic and Administrative Structures.

The wide range of innovations implemented by HSTP also necessitated innovating the academic and administrative structures. A decentralized structure, which has been codified in an administrative manual of the programme, approved and notified by the State Government (Ref. 2.8, 2.9, 3.1). The main features of the new structures and innovations, which have emerged, are:

- Functioning of the school has been suitably modified. Making children sit in groups of four facing each rather than the traditional sitting in rows facing the teacher has radically altered the classroom architecture. This change was meant to enhance group working, child to child interaction, helping each other and sharing. It also frees the teacher for substantial intervals to circulate between the groups and act more as a facilitator in learning rather than act as the fountainhead of all knowledge. The teachers are also expected to work out systems of kit management and use. Feedback from schools tells us that putting children in positions of responsibility most successfully does this. This experience also contributes positively to their overall personality development.
- The School Heads are called upon to facilitate activity-based learning by helping teachers to 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 follow it 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.ollowing the principle of the school complex 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 Instructions.

- 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.

(viii) 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 of "Chakmak", a monthly magazine for children, as well as small booklets of interesting activities that children can do by themselves.
- Libraries are a major source of self-paced learning for children. All Eklavya Centre have active 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 sciences and other related subjects in Hindi for school age children. The Publication Programme of Eklavya aims to pitch in by launching 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. We are also seeking to spot and nurture such writers.
- Organizing various science popularization 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.

Apart from ongoing work of implementation and consolidation within the framework of the programme stated above, the following directions of work have also emerged:

(i) Spreading the Innovative Spirit – our role as a Resource Agency.

Ever since its beginning, the HSTP experience has attracted the attention of groups and agencies involved in science education, science popularisation and voluntary social action. Many sought to learn from this experience and use it in some way in their work. HSTP group has felt that 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 also. 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 to our attempt for idea-level dissemination of the 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 early nineties at Pachmarhi in teams from various states participated. Apart from exposure to various innovative programmes of Eklavya, the participants prepared translation manuscripts of Bal Vaigyanik into 10 different 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. HSTP group offered to play the role of a resource group for any such initiative. 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, district Surat, Lok Bharti, Sanosara, district Bhavnagar and Gujarat Vidyapeeth, Ahmedabad began a process of 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. HSTP group was invited to provide resource input. Over a year the ideas crystallised into a five-year project Avishika in which the three field organisations initiate the programme in 34 schools spread over the 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. Over five years a comprehensive programme was implemented which resulted in development of activity-based science textbooks for Classes 5 to 7 in Gujarati. The Gujarat State Text Board incorporated substantial proportions from these books in their new revised textbooks. 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 the formal schools of Baroda district. They sought to explore ways in which Eklavya's work in teaching science and social science in the 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* in schools organised to build up a positive pre-launch atmosphere in the schools. Eventually the programme was launched in 24 schools with permission of the State Education Department.

  In order to formally support the experiment, we helped in setting up a state committee for the Avishika programme under the Directorate of Primary

Education of Gujarat Government. 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 the SCERT and some DIETs of Gujarat visited Eklavya in this context.

- Rajasthan: In 1996, we were invited by Lok Jumbish Parishad (LJP) to help develop a science and social science package for Class 6 to Class 8. This project was seen as building up on the work done by Sandhan for the 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 the 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 people from academic and research institutions in Rajasthan, 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 who would be handling the new material. Newsletters for teachers were also produced. For the purposes of orientation, practice question papers were sent to schools. Open book examination was discussed with the teachers and their inputs incorporated into the evaluation paper for the Class 6 annual examination. Workshops were also organised for developing the science and the social science teaching package for Class 7. Chapters were prepared and revised by the large body of resource persons and the books were readied in May 1999.

  The teacher training workshop for the Class 7 curriculum was held in the Masuda DIET. One of the highlights of the training was the exercise with teachers on the open-book evaluation system. The idea was to demonstrate to them that an open-book examination did provide a serious challenge to the child even in social science. Feedback from the school visits we made showed that teachers were trying to use the discussion and activity methods in the programme. They appreciated the inclusion of Rajasthani material in the social science books in particular, as also the child-friendly language and approach. However, they had questions about Eklavya's stand on reducing the curriculum load, and this point was debated with them. Additional information sought by the teachers was circulated through the newsletters.

  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 space for innovation and improvement. One of our concerns has been to expand our educational activities into 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 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 the rural government school to the better off private school 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.

  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. A remarkable feature of the programme was that the children sat in groups for science and social science classes and this seating arrangement was followed for all other subjects. 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. Dissatisfaction with the present curricula which are based on heavy content reduced to learning by rote with little understanding, the need to try innovative alternatives was being strongly felt.
  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. The effort is being coordinated at the school level by a senior science teacher. With the school management fully supporting this effort, the initial response from the children and parents is encouraging. Other classes will be taken up in subsequent years.

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 other major innovation in society, has a set of both strengths and weaknesses. It is important for them to be spelled out so that a wider process of learning from the experiences of HSTP may proceed.

The following are among the chief **weaknesses** of the HSTP:

- The role of supplementary learning, outside the classroom, is considerable. It is in this supplementary learning that the lessons of the school are reflected upon, digested, and reinforced or challenged. Science teaching, after all, lasts for just one or two 40-minute periods every day. HSTP has been making efforts to try and enhance the supplementary learning of science among its target groups, but no clear institutional structure for this has yet been able to emerge and drive roots.
- It is very important for peer-support systems to emerge among teachers. This would spread and deepen their motivation and commitment to better science teaching. It would also lead to greater autonomy and contribute to the creativity of science teachers in designing their own solutions for their own problems. While these 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 broadbase the debate on the basic nature of science education in the local community. There continues to be a widespread adherence to the conventional view of what science and learning should be like – blind memorisation of facts, reliance on simply bookish knowledge, a reluctance to actually go and do something with one's hands and the unquestioning acceptance of dominant systems of knowledge. It is clear that much 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 which is common to all attempts at innovation: this package becomes a little out of synchronisation with the older and less progressive packages which precede it in primary school and follow it in high school. Transition pains do occur when children move into class 9^{th} and must return to the old, unchanged system of rote and blind reproduction of facts. It is clear, however, that by the time of the class 10^{th} board examination children do adapt back to the older system of examination and learning. If the benefits of the HSTP are to be sustained and carried on, it is imperative that a drastic restructuring take place of classes 9^{th} and 10^{th}, and for that matter even higher classes, so that the actual process of science is taught in them rather than the deadening memorization of meaningless facts.
- The HSTP has no system of reward or punishment. As a result it is unable to influence the school organization beyond what may be 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 that. Nor can it reward the teacher who puts in extra effort and time. Reforms in school organization which encourage the performers and discourage the non-performers are urgently called for.

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

- First and foremost of all is the fact that children greatly enjoy the activity-based model of science teaching which is the core of the HSTP. This may be seen on their faces and in their enthusiasm in any visit to a classroom where HSTP is being implemented.
- There is a quantum jump in the interaction between teachers and the 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 adds to their own satisfaction with their jobs and eventually to their commitment for better education.
- Children get the confidence to ask questions, which leads to an active process of querying that goes far beyond the limits of the syllabus and curriculum. They are encouraged to think on their own. This contributes to a central principle of the 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. This involves the skills of careful observation, measurement, the use of controls, etc. A good deal of familiarity with experimental equipment and tools is brought about by this. A shift takes place from a notion of science as a body of knowledge meant to be memorised to a notion of science as something to be practiced. It also leads to a strong emphasis on empirical verification of various propositions and the discipline required for this.
- An evaluation system has emerged which is in tune with the objectives of teaching a 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 a Board examination and at a scale of hundreds of schools.
- A body of human resources and experience has been consolidated which has represents an alternate approach to education – one which is child-centred and oriented to the learning of processes rather than dead 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.
- There have emerged systems of peer-support for teachers encouraging them to learn more and to implement what they learn in their own respective classrooms. Supported by an extensive system of regular interactions, teachers no longer feel isolated when they struggle to improve the level of teaching in their schools. At the same time they are able to share their experiences and the lessons they have drawn with their colleagues. Through the communication channels established by the HSTP there is able to occur a continual reinforcement of good ideas and a cross-checking of errors.
- Systems of academic support for teachers have been put into place. This leads to a continual process of upgradation of the teachers' own knowledge and skills. University and college teachers, including some of the finest scholars in the country and from our best institutions, 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 higher academic systems of knowledge.

- The involvement of teachers in teacher training has been at a very large scale. Every science teacher across the area covered by HSTP is supposed to go through a proper training and then participate in its monthly meetings, etc.

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 whereby multiple systems of experimentation and reform proceed along with the mainstream system of education. A gradual process of the incorporation of the 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 kind of education that maintains a pressure on the larger system to improve itself. It also allows for a continuous generation of ideas and practices for reform.

Government - NGO synergy. The government's own institutions of education and innovation have their own strengths and weaknesses. The NGO sector has the potential to supplement the efforts of the government. The HSTP experience has demonstrated that a different organizational structure from that of the government has been able to attract and involve a sizeable volume of talent and experience into engaging with the challenge of improving the performance of education. The synergy that has emerged between the government and an NGO has here led to a quality and scale of innovations that would not have been possible by either one working alone. It is important to strengthen this synergy by better 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 the support and resources which would continue to attract and retain the interest of top-quality professionals in the functioning of this joint effort.

Feasibility of large-scale innovations. 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 the teaching of a scientific temper, activity-based and child-centred learning have been brought to life in the ordinary government school. And this has happened not in just one or two model schools, but across 15 districts and hundreds of schools. The feasibility of actually implementing key principles of educational reform has 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 by interventions in just one area. There is the need for a multi-pronged strategy which simultaneously works at many different levels. With the reform of school textbooks

must go the rethinking of school curricula and syllabi. Alongside this must go the revamping of institutions of teacher training and educational research. At the same time public debates on the purpose of education and its place in society must be encouraged. The organizational model of the school must be rethought and systems of responsibility to the community set into place. Nor is it possible to do a limited reform of just two or three classes and stop there – reform must spread across the board into all school classes and even into higher education. Further, the state must exert pressure on national institutions like the NCERT and the CBSE to learn from its experiences and incorporate their 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 on together to create a fabric of a robust, effective and socially responsible system of education.

5. SOME SPECIFIC QUESTIONS REGARDING 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 is has been actually put into place within the existing organizational structure of Indian government schools, with all their problems of lack of efficiency and non-performance of teachers, etc. The HSTP strategy does not include an overhaul of the school organization and thus the implementation of HSTP broadly follows the general pattern of government schools: roughly one-third schools which function reasonably well have been able to run HSTP, too, with high levels of success; roughly one-third of the schools which have only a mediocre level of functioning have been implementing HSTP, too, in a rather lackadaisical manner; and the remaining one-third of the schools which are largely non-functional have been able to do little with HSTP.

How do the curriculum and syllabus developed under HSTP compare with those of the Madhya Pradesh SCERT and NCERT? The curricular framework for science teaching at the middle school level has been spelt only at the national level, by the NCERT (ref. 1.2, 1.5, 1.7). There is no separate curricular framework for the state. From this curricular framework a Madhya Pradesh syllabus has been created, as a listing of topics for textbook design. The curriculum, naturally, has a greater significance as the 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 implemented at the state level (ref. 3.5).

Meanwhile, a comparison between the HSTP and the conventional state science textbooks reveals an 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 topics that can be covered during an average academic year. It is to be noted that in addition to the very extensive overlap with the state syllabus, there have also additional topics in the HSTP which are of central importance to the understanding of science. These include topics like the use and comprehension of graphs.

How are the HSTP children faring in higher classes and public and competitive examinations in comparison with the normal stream? More specifically, does the perceived lack of memorization of factual details and information handicap these children at higher levels? There has been an early concern that children studying under HSTP would not be able to do well in the class 8th Board exam itself. Year after year it has emerged that students from Harda and Hoshangabad have actually done much better in science than most other districts (ref. 4.4, 4.17) Here, the science results have also been much better than the children's performances in other subjects, unlike the few other districts where good science results have come from.

In class 9th as in other subjects (ref. 3.13), science, too, sees a dip in average marks (ref. 4.16). This is a nationwide phenomenon. However, in the class 10th Board results there is little difference between HSTP students and the rest (ref. 4.5, 4.6, 4.15). However, the 10th Board exam cannot be expected to reflect the superiority of HSTP students since it is a conventional exam, based upon the reproduction of memorized information. The superiority of HSTP students is to be seen more clearly in the dozen odd Ph.D. and M.Phil. and M.Ed. dissertations which actually compared them on the basis of tests for scientific reasoning, logical thinking, etc (ref. 4.13). These broadly conclude that HSTP produces much better results than the conventional kind of schooling. The better results may be seen across various groups like SC/ST, girl-children, etc.

Competitive exams based upon logical reasoning, too, have shown HSTP children to be faring better than others. In professional examination board tests, for entrance to engineering, medical and poly-technic courses, it has been seen that HSTP districts are at the top of all primarily rural districts of the state (ref. 4.14).

There is the expectation that this programme will lead to an enhancement of the scientific temper. Having been implemented in an entire district for 20 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 notorious difficult to establish a causal relationship between such an understanding and various processes in society. The methodological problems for such a study are indeed vast. Meanwhile, it is clear that from one or two 40 minute sessions every day in middle school alone, no drastic social change is likely to ensue. The changes, if any, are likely to be fine shifts in emphasis and delicately nuanced. Accepting that much wider courses of action are called for, the HSTP team has also been supporting interventions in social science teaching and in the popular science movement.

Given the importance of community participation in the choice of what 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 would begin to crystallize. Meanwhile, the relation has still not been defined between the state as an agency for social progress and justice on the one hand and the powerful vested interests that have hitherto controlled power as well as the

emerging groups which are challenging them, on the other. 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 made and modes of dialogue are being established. At the same time HSTP has been seeking to guard against the pressure exerted by conservative forces and those who understand little about either education or the scientific method.