

Professional development of science and technology teacher educators

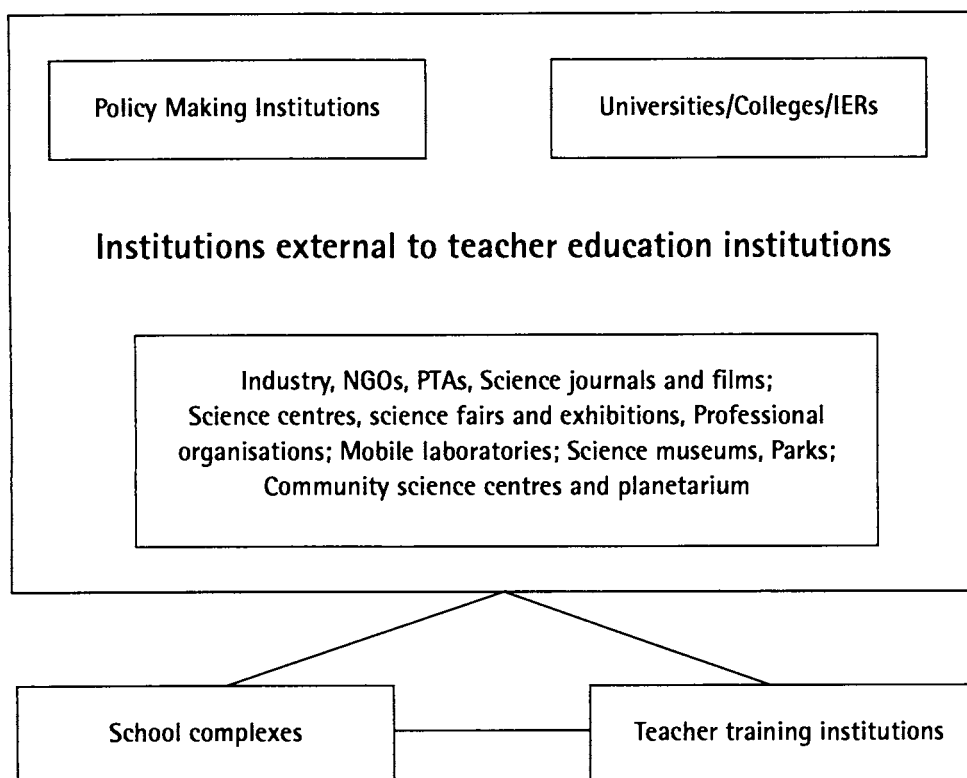
Overview

5.1

The importance of professional development of science and technology teacher educators is crucial in the context of emerging trends in science and technology education. The role of science and technology education is being increasingly recognised as a means of developing objective and rational human beings having specific competences and skills to cope with the rapid socio-economic, cultural and environmental changes brought about by the applications of science and technology for improving the quality of life.

In order to meet these emerging needs, science and technology education calls for a curriculum which will produce socially responsible, technologically and scientifically literate citizens who are able to solve problems in real-life situations, use local technologies, improvise materials and develop rational decision-making skills. The science and technology teacher educators are required to handle teacher education programmes at basic level comprising liberal education, with sound knowledge of content and professional education. To improve the quality of science and technology educators, suitable ways and means need to be devised for enabling them to keep abreast of developments and advances in the scientific and technology areas. Continuous professional development is now universally acknowledged as one of the pivots of science and technology education programmes. This further demands suitable professional development programmes for science and technology teachers as well as teacher educators in view of emerging needs and trends in science and technology education.

Professional development of science and technology teacher educators depends upon the role of institutions of teacher education and those agencies and organisations which influence them directly or indirectly. For effective professional development, it is essential to have collaboration and coordination within and between teacher education institutions, other educational agencies professional support services, and organisations and the schools. It has been envisaged that the purpose of the coordination at school level is mainly for the professional development of science and technology teachers. Figure 1 gives a comprehensive view of mutually interactive relationship between school complexes/schools, teacher-training institutes and other agencies/organisations affecting professional development of science and technology teacher educators.



5.2 Objectives

The objectives of this monograph are:

- to help science and technical level for professional development of teachers and improved science and technology teaching in schools.

5.3 Professional organisations and institutions involved in the professional development of science and technology teacher educators

A large number of professional organisations have been considered which could contribute to the professional development of science and technology teacher educators. Some of these are concerned with policy, others with professional training and/or academic growth, and still others with providing support for teacher education.

5.3.1 Organisations and institutions concerned with policy

Ministries of Education

The Ministry of Education decides on the national priorities and policies for education. Science and technology teacher educators should be aware of relevant

policies. These may be contained in a general policy document of the Ministry of Education with a section on science and technology or there may be a separate policy document. This is likely to include policy statements and guidance on:

- the type of science and technology to be taught in schools;
- the general methodology to be followed in delivering science and technology to learners;
- the assessment procedures to be followed;
- any in-service training which will be provided to teachers and others.

Department/Directorate of Education and other educational institutes, such as NCERT in India, IPSP in Pakistan, National Curriculum and Textbook Board in Bangladesh, NIE in Sri Lanka usually provide material resources to schools and advises on textbooks and other learning materials. Science and technology teacher educators should be aware of the role of these institutes and the kind of physical resources provided to schools by them. Teacher educators should have an input into various activities of these institutes.

Practices with regard to school supervision and inspection, such as its frequency, procedures and nature, are also determined by the Directorate/Department of Education. Teacher educators can help to allay teachers' understandable apprehension about the content and method of inspection by making teachers trainees aware of inspection procedures.

Curriculum development units

The importance of a well developed and managed curriculum is well recognised. The responsibility of curriculum development in various countries resides with national as well as state provincial level institutes, usually the Departments/ Directorates of Education. Tuition given by the science and technology teacher educator is more likely to be relevant and contextual if curriculum development is a collaborative effort involving teacher educators. Teacher educators should seize every opportunity to participate actively in curriculum development process.

Science and technology education can benefit from a cross-curricular approach. The curriculum guidelines provided by the curriculum development unit should encourage such an approach and facilitate its implementation.

Organisations and institutions concerned with professional training and/or academic growth

5.3.2

Universities and Institutes of Education

For their own professional and academic growth, science and technology teacher educators should co-ordinate with higher education institutions such as universities, colleges and other institutes, concerned with science and technology content and pedagogy. They should attempt to attend meetings, workshops, seminars and short courses organised by these institutions in areas which are of interest to them. Within teacher

education institutions, opportunities for participation in these seminars, workshops and courses, need to be planned for to enable all members of the science and technology education staff to participate.

In order to facilitate a cross-curricular approach in science and technology, teacher educators should urge the institutions of higher learning to provide:

- short courses which allow teacher educators to upgrade their knowledge as required. For example, technologically oriented courses by using resource personnel from industry.
- broad-based degree programmes to allow teacher trainees the opportunity to pursue integrated degrees.

In-service Education and Training (INSET) for in-service teachers as well as pre-service teacher training for teacher trainees is usually conducted by the teacher training colleges and other institutes. These institutions aim at imparting similar teacher qualifications. It is essential that the philosophy underlying them is similar. Such agencies should be in constant communication so that those completing their courses will have equal opportunities in the workplaces.

5.3.3 Support organisations and institutions

Examination agencies

If teachers are taught to follow a teaching approach which emphasises processes and problem-solving in science and technology, but the examinations test only recall of knowledge, teachers will abandon or modify their approach and adopt a didactic approach more suitable for memorising the knowledge needed for passing the examination. At the teacher training college level and within and across colleges, teacher educators in all subject areas should co-ordinate their efforts to ensure that examinations reflect the teaching approaches used.

At teacher-training institute the problem calls for co-ordination between the curriculum development unit and the examining agency. If there is no co-ordination, teachers will tend to follow the approach most suited to getting learners through the examination. Differences between examination practices and curriculum policies clearly have implications for the education of teachers.

Problems may also be caused if the examination system does not take account of learners' performance in continuous and comprehensive assessment (discussed in Monograph 4) in the award of the final grade. It will need to be made clear to teacher trainees, that continuous and comprehensive assessment in the classroom provides valuable feedback for the improvement of learning and teaching, even if it is not required for formal examination.

Professional Support Services and organisations

Science and technology teacher educators will find it helpful to be involved with relevant professional organisations, to know of their current activities and understand the issues that concern them. Such professional contacts will help the science and technology teacher educators to make teachers trainees aware of current issues and work with them so that they themselves can contribute to current debate and appropriate activities when they become teachers.

professional associations of teacher educators, Association for the Advancement of Science, Science and Technology Teacher Associations at the district, state and national level play an important role and contribute significantly, provide forum for interactions and help in disseminating new ideas, concepts, activities through journals.

Community science centres, Science Teachers' Centres, Science Resource Centres at the local school level could be of much help to a science and technology teacher educator as well as teacher involved with the activities of these organisations in discharging role as a community worker and as an interpreter of technology to the community.

Mobile science and technology laboratories could help the science and technology educators and teachers by offering them on-the-spot training and orientation even in remote areas where science laboratory facilities are inadequate. Such a facility in the form of charts, models experiments and low-cost improvisations would allow teachers of such schools to improve their teaching and also provide learning experiences to the learners.

Professional science magazines/journals containing interesting articles on science and technology can be of great help in updating the science and technology teacher educators and teachers. Mobile libraries containing books, films and other resource materials on science and technology can be of great help for the science and technology teacher educators and teachers update their knowledge.

Local industry

To ensure that science and technology is relevant and realistic, particularly in its technology aspects, teacher educators will want to draw examples from local, traditional and modern industry. Local industry is an excellent resource since it provides real contexts and genuine problems. Teacher educators should co-ordinate with local industry so that they may draw on their human and material resources. This should be a two-way flow of information and skills. If possible, science and technology teacher educators should visit various industrial plants for short periods, so as to familiarise themselves with the demands of these industries. Similarly, persons from industry must be invited to visit teacher education institutions for lectures, discussions or demonstrations some industries might provide teaching materials or equipment.

Such two way exchange of experiences will not only help science and technology teacher educators develop realistic activities, but help industry to understand how science and technology are taught in school, and thus develop confidence in their

local teaching institutions. Science and technology educators will also gain an understanding of the requirements of industry, and the kind of curriculum which will meet these requirements.

Schools

Co-ordination with schools is needed for the purpose of:

- practice teaching;
- action research;
- providing professional support for the professional development of teachers and improved science and technology teaching;
- understanding the working environment;
- acquiring first-hand experience of working with learners.

To keep up to date with current practice in schools, it is important for science and technology teacher educators to devote regular periods of time to working in the primary school, alongside science and technology teachers. Such time, is invaluable in helping teacher educators to keep their own teaching realistic.

Most teacher training colleges do not have a practice school or a demonstration school attached to the training college. As such, most of the training colleges use the neighbouring schools for the purpose of practice teaching. For arranging effective practice teaching teacher educators must have firsthand experience of working with the science and technology teachers of the neighbouring schools. They must know the strengths and weaknesses of each teacher so that their competencies may be utilised for the purpose of practice teaching of teacher trainees. This would require that teacher educators must devote time in the actual classroom teaching and helping teachers. Efforts should be made to identify enthusiastic “headteachers” to take the role of teacher educators in helping teacher trainees and other teachers in neighbouring schools.

Teacher educators must also undertake collaborative action research projects with the neighbouring schools. This will not only help them in solving problems of local schools but will also enable them to provide success stories to teacher trainees thereby making their teaching more lively and realistic. This way they will be able to train teacher trainees in techniques of action research.

Inexperienced teachers and teachers working in schools located away from cities suffer from professional isolation. In case of difficulties they hardly find anybody who could provide the required professional support. Teacher educators must realise that such teachers to be effective require continuous professional support. Similarly, when teachers are required to introduce an innovation, provision of continuous professional support is absolutely necessary for the innovation to be sustained. Teacher educators must develop mechanisms by which such support may be provided to teachers. It does not help to blame the lack of resources and constraints for not providing the support. Every effort should be made to develop mechanisms of professional support within the existing resources and constraints.

As stated in Monograph 1, teacher educators must acquaint the teacher trainees with different kinds of working environments and train them to cope with such environments. It can be possible only if the teacher educator has familiarised himself/herself with different kinds of environments and what methods/resources are useful in those environments. This would require the teacher educator work for some time in different kinds of environment to develop good understanding.

School-based orientation and enrichment to teachers could be provided by science and technology teacher educator. Teacher educators might also utilise the school clusters and school complexes as a resource base in which a centrally located institution helps and assists other schools and school science teachers in the neighbouring area/region. This strategy will provide on-the-spot remedial solutions to teaching-learning problems of the teachers on a continuous basis.

Teacher educators must also collaborate with the neighbouring schools to develop an understanding of how children learn. This would require actual teaching children at different levels. This will enable the teacher educator to provide realistic guidelines to the teacher trainees of working with children.

Co-ordination within and between teacher education institutions	5.4
--	------------

Co-ordination and collaboration between the colleges of education will provide an avenue through which teacher educators can foster their own professional growth, promote some uniformity in the quality of experiences provided for teacher trainees, and develop cross-curricular links and interdisciplinary approaches. These may be achieved through:

- Developing professional organisations for science and technology educators. These may relate to the two disciplines separately, or in any combinations as required by the specific circumstances of a country.
- Promoting regional co-ordination between such national professional organisations and associations of advancement of science and technology.
- Mounting workshops, seminars or conferences for sharing ideas on teaching approaches and resource materials, and for engaging in discussion on current issues and trends in science and technology education.
- Preparing position papers representing the consensus views of teacher educators as a means of influencing policies and decision-making with respect to teacher education.
- Making proposals for new directions in teacher education in response to prevailing social, economic or cultural influences.
- Fostering collaborative approaches to teaching, such as team teaching and team planning.
- Developing theme and project approaches to teacher education, as well as improving the delivery of the science and technology teacher education curriculum. Such approaches will benefit teacher trainees by providing them with models for cross-curricular approaches in their own classrooms.
- Exchanging human and material resources within and between colleges.

5.5 In-school activities for professional growth of science and technology teachers

Teaching science and technology in schools involves the organisation of a number of activities. These may be broadly classified as:

- those directed towards the professional growth of teachers;
- activities directed towards effective teaching and learning;
- co-curricular activities leading to promotion of science and technology amongst learners and the community.

In order to equip the teacher to organise these activities efficiently, science and technology teacher educators themselves should be fully aware of all such activities and effectively train the teachers accordingly.

5.5.1 The science and technology education co-ordinator

For effective implementation of science and technology education programmes, a staff member needs to be designated as a science and technology education co-ordinator. He/she takes on professional development programmes of teachers of his/her school or in a cluster of neighbouring schools. It could be the head-teacher, or an enthusiastic class teacher in the school with an interest in developing science and technology. If the co-ordinator is a teacher his/her teaching load may have to be marginally reduced to make room for the demands of co-ordination. The science and technology teacher educator should organise training programme for the science and technology education coordinators in such a way as to help them develop skills of coordinating activities related to the professional development of teachers and improved science and technology teaching in schools.

5.5.2 Participation in meetings/seminars/workshop

Activities which promote the professional growth of teachers normally take the form of participation by teachers in meetings, seminars, workshops and INSET courses. Such activities are usually organised by the Departments of Education, colleges or institutes education and teacher associations. Activities are also organised in schools by those teachers who have had the benefit of attending INSET programmes.

Institutes of education organise INSET courses for a variety of reasons:

- to introduce a new curriculum;
- to introduce a new teaching methodology;
- for upgrading content;
- for certification of untrained teachers;
- for introducing a new assessment or supervision system.

Depending on the nature of the INSET course, the Department of Education may specify the number of teachers from each school who will attend the course. If the course is for a limited number of teachers from a school, the science and technology education co-ordinator will be responsible for selecting those teachers who would benefit most from a course. If it is a course for content upgrading, for example, it would be inappropriate for a new science graduate to attend. On the other hand, a course leading to teacher certification would be most suitable for an uncertified teacher. To facilitate selection, the science and technology education co-ordinator will need to maintain the following record for each teacher in the schools;

- educational qualification;
- teaching experience and results produced;
- participation in science and technology education workshops, seminars and so on, with dates;
- strengths and weaknesses.

The science and technology education co-ordinator must ensure that the teacher who attends an external INSET course organises a meeting of all the school's science and technology teachers and briefs them on the course attended. This feedback will serve three purposes:

- it will help the INSET course trained teacher to consolidate what he or she learnt on the course;
- the teacher attending INSET course will have to be more attentive when on the course, knowing that he or she will have to present it himself/herself to other science and technology teachers when he/she returns to school;
- other teachers will benefit from the course.

Thus one course can benefit more than one teacher in a school. In addition, the course organisers can benefit from the teacher's report on his or her feedback to school, so that the course itself may be improved.

The focus of the teacher's feedback briefing to fellow teachers in the school should be on:

- implications for teaching and learning within the school;
- changes which could be made within the school in relation to these implications, which would make the science and technology teaching more effective.

School-based INSET programme

5.5.3

In the busy school schedule, teachers rarely have time to sit together and share experiences. In a large school, teachers may be facing some common problems which could be resolved through sharing experiences and discussion. Similarly, some teachers may have success stories and unique classroom experiences which may benefit other teachers. It is therefore always useful if the science and technology education co-ordinator can arrange for the teachers in a school to meet, possibly

after school or at a weekend, for, say, half a day each month. The object of this meeting would be predetermined through mutual consent, and known to all teachers concerned beforehand, so that everybody comes prepared. It is important for the science and technology education co-ordinator to plan the meeting, draw up a timetable, and assign responsibilities. Science and technology education teachers should be encouraged to volunteer to take up responsibilities rather than be coerced.

School-based INSET programmes, though generally short, can be useful in:

- preparing teaching-learning materials by sharing ideas;
- improving materials;
- resolving conflicts arising out of the use of resources;
- disseminating action research findings and generating ideas for action research;
- developing collaborative work amongst teachers.

A major advantage of a school-based INSET programme is that the innovations can be sustainable. Since new ideas are being generated and tried out by colleagues, the chances of successful innovation are greater. A new idea coming from a colleague is much more likely to be accepted than one imported from an outside source. Thus, school-based INSET programmes are not only useful for the professional growth of science and technology teachers, but contribute to improved teaching and learning. Alternatives to school-based programmes may be needed for smaller schools and for those where science and technology teachers are not willing to try new ideas.

5.4.4 Access to the resources

This is another important role of the science and technology education co-ordinator. In primary schools, the resources supplied by the Department/Directorate of Education are generally limited. Most of the materials required for science and technology education will be drawn from the immediate environment. The science and technology education co-ordinator will need to ensure that while the materials are safely stored, these are also easily accessible to the users. This means discussing this with the relevant teachers and identifying a place suitable for all of them. Over a period of time learners and teachers of senior classes may develop new teaching and learning materials which could be useful in junior classes. Such products should be identified, displayed and stored, and teachers encouraged to use them.

5.5.5 Extra-curricular activities

The science and technology education co-ordinator can help the teachers enabling them to organise and conduct activities such as those listed below aimed at developing the interests of learners in science and technology.

- **Science Debates and quizzes:** Science, technology and mathematics-related issues can be debated by learners. Quizzes taking the form of question and answer can be devised. As part of an INSET programme, teachers could build up a bank of topics

for debate and questions for quizzes. Careful selection of topics for debate and quiz questions within the school setting can arouse interest and encourage learners to explore the relevance of science and technology to the out-of-school environment. Topics which encourage girls to participate in science and technology should be given preference. Inter-school competitions allow science and technology teachers to exchange ideas about more effective ways they may have developed for teaching science and technology concepts and skills. Learners could also gain from sharing ideas with their peers in other schools.

- **Science Fairs, exhibitions and museums:** Periodic school fairs and exhibitions of science and technology materials made by learners and teachers can be arranged. Exhibits can form the basis for a more permanent school museum that can become a resource for future generations of learners. Labels showing the names of students and dates should be attached to exhibits to boost the morale of their creators. The items exhibited could be projects carried out by the learners. Exhibits that show links between science and technology in schools and community activities can be particularly encouraged. Schools should also be encouraged to participate in exhibitions organised by other schools and agencies. Science fairs, science exhibitions at the district, regional/state and national levels provide refreshing and motivating impact on the science and technology teachers. The visits to science and technology museums and planetaria could also be very much enlightening.
- **Science and technology clubs:** Science and technology education co-ordinators should discuss the formation of a science and technology club within a school and how this might function. Ideas from the science and technology teachers and learners can be shared and a report compiled with recommendations for teachers to implement. Science and technology clubs can be a useful way of encouraging the exchange of ideas and promoting excellence in science and technology. In such clubs learners can pursue science-related hobbies and extend the concepts that they have learnt in the class. The clubs could be organised as a junior engineers' club, a technicians' club, flying club, photographic club, maths club or general scientific club. The clubs could be named after well-known scientists or engineers, or a local traditional industrialist whose skills are widely respected. Every effort should be made to name some clubs after women who have achieved prominent positions in the field of science and technology.
- **Weekend rallies:** Science and Technology teachers can encourage informal learning by organising weekend rallies. In a relaxed atmosphere, learners can exchange ideas and work on science and technology activities. These rallies can be used to attract and encourage girls to study science and technology and to pursue related careers. They could take the form of science and technology 'clinics' where girls could meet and talk to role models and mentors. Girls could be encouraged to visit science and technology based institutions and industries and engage in hands-on-activities. These rallies serve to stimulate learners' interest and popularise science and technology in the community.
- **Science and technology news and bulletins:** A bulletin board on which learners' and science and technology teachers' work can be displayed, along with relevant news items, can be a very effective means of stimulating interest in science and technology. The content should reflect learners' activities and teachers' accomplishments. Learners can be asked to write short descriptions of their science and technology class activities for display on the board. They should also be

encouraged to read the news or bulletins during school assembly. Any science and technology-related news from the newspapers should be read and explained for the benefit of everybody.

- **Science and technology awards and souvenirs:** Awards and souvenirs for outstanding learners as well as science and technology teacher performance can also stimulate interest in science and technology. To promote science and technology amongst girls there could be awards exclusively for girls. Award winners can be identified and presentations made to them by pupils or by well-known figures from the community. Similarly, awards can be given to science and technology teachers for effective teaching and innovations in science and technology education. The community must be encouraged to promote such awards. Involving the community in the choice of award winners will develop an active interest in science and technology in the school amongst the community.