

MONOGRAPH 5

Co-ordinating science and technology education

5.1 Overview

The current trend towards the provision of a broader general education in schools implies the need for a more cross-curricular approach to education at all levels. In science and technology education, calls for curricula which will produce socially responsible, technologically and scientifically literate citizens, also point in the direction of an interdisciplinary approach.

Such an approach can best be achieved in the context of co-ordination between all levels of education, and between educational institutions and all those external bodies which have an impact on them.

The usual structure of university degree programmes makes it unlikely that there would be many teacher educators with competent in both science and technology. However, the contents of these disciplines lend themselves ideally to cross-curricular links. Additionally, many organisations external to, but which impact on teacher education, are involved in activities that are relevant to both these subjects.

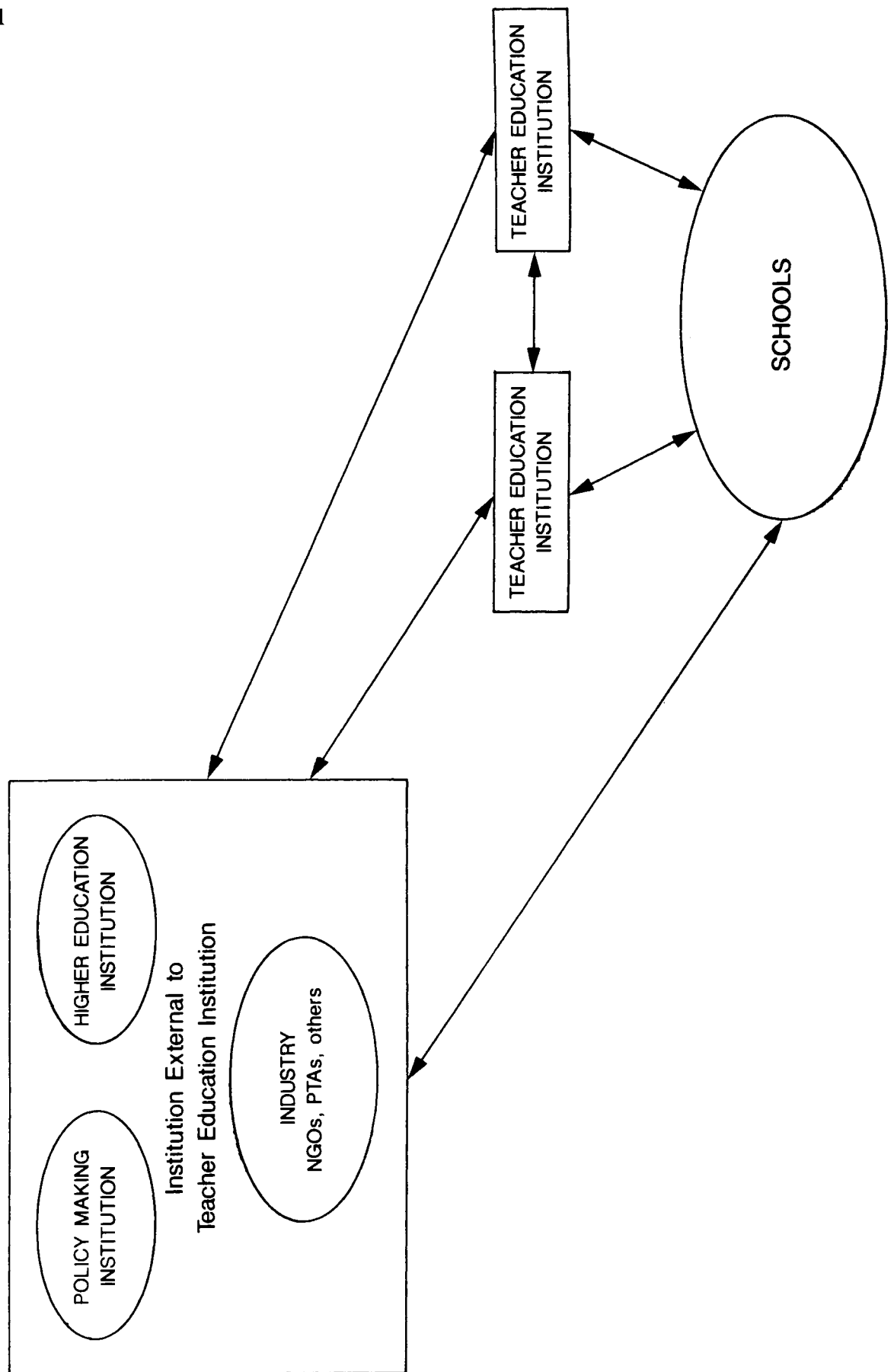
Co-ordination is considered here at three levels:

- Between institutions of teacher education and those agencies and organisations which influence them, either directly through the making of policy, or through the professional development of teacher educators; or less directly through their influence on the social, economic or cultural climate in which teacher education takes place.
- Within and between teacher education institutions themselves.
- Within and between schools.

This view of co-ordination envisages a set of mutually interactive relationships occurring within and across all three levels (see Figure 1).

Figure 1

LEVELS OF CO-ORDINATION IN
SCIENCE AND TECHNOLOGY EDUCATION



5.2 Objectives

The objectives of this monograph are:

- to inform science and technology teacher educators about those organisations, their policies and practices which must be considered in the education of teachers;
- to enable science and technology teacher educators to identify those agencies which can influence science and technology in their own contexts;
- to provide guidance on how science and technology teacher educators can influence co-ordination at all levels.

5.3 Co-ordination with institutions and organisations external to the teacher education institutions

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 children;
- the assessment procedures to be followed;
- any in-service training which will be provided to teachers and others.

The Ministry of Education usually manages the appointment and placement of teachers, provides material resources to schools, supervises schools, and advises on textbooks and other learning materials. Science and technology teacher educators should be aware of their Ministry's policies and placement practices, of the kind of physical resources provided to schools for science and technology, and the policy with regard to their maintenance and replenishment. Teacher educators should have an input into the formulation of these policies

and practices. Ministries of Education also decide on staff development policies, another area with which the teacher educator must be familiar.

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

Curriculum development units

The importance of a well developed and managed curriculum is well recognised. The responsibility for this task resides with a curriculum development unit, which usually comes under the aegis of the Ministry 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.

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

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

Higher institutions

For their own professional and academic growth, science and technology teacher educators should co-ordinate with higher education institutions 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.

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

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

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 staff to participate.

INSET agencies

In-Service Education and Training (INSET) is usually conducted by the Ministries of Education, whereas pre-service teacher training is organised in colleges and universities. Where both are avenues to gaining the same teacher qualifications, it is important that the philosophy underlying them is similar. Both sets of agencies should be in constant communication, so that those completing their courses will have equal opportunities in the workplace.

5.3.3 Support organisations and institutions

Examination and assessment agencies

If teachers have been 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 college level, 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 the school level, the problem calls for co-ordination between the curriculum unit and the examining agency. If there is no co-ordination, teachers will tend to follow the approach most suited to getting pupils through the examination. Differences between examination and curriculum policies and practices clearly have implications for the education of teachers.

Problems may also be caused if the examination system does not take account of pupils' performance in continuous assessment in the award of the final grade. It will need to be made clear to student teachers, that continuous assessment in the classroom provides valuable feedback for the improvement of learning and teaching, even if it is not required for formal examination.

Professional 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 pre-service teachers aware of current issues and work with them so that they

themselves can contribute to current debate and appropriate activities when they become teachers.

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 might visit teacher education institutions for lectures, discussions or demonstrations or firms might provide teaching materials or equipment.

Such co-ordination 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;
- understanding the working environment;
- acquiring first-hand experience of working with children.

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.

Teacher educators might also promote science and technology in the primary school by encouraging principals to adopt flexible time tabling arrangements, for example, block time tables, which allow class teachers flexibility across subject areas.

5.4 Co-ordination within and between teacher education institutions

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 the specific circumstances of different countries dictate.
- Promoting regional co-ordination between such national professional organisations.
- 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 and both nationally and regionally.

5.5 Co-ordination of in-school activities

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 students and the community.

5.5.1 The science and technology co-ordinator

For effective implementation of science and technology education programmes, a staff member needs to be designated as an science and technology co-ordinator. It could be the head-teacher, or an enthusiastic class teacher in the school with an interest in developing science and technology. Their teaching load may have to be marginally reduced to make room for the demands of co-ordination.

5.5.2 Co-ordination of activities for the professional growth of teachers

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 Ministry of Education, colleges of education and teacher associations. Activities are also organised in schools by those teachers who have had the benefit of attending INSET programmes.

Ministries 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 Ministry 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 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 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 teacher to consolidate what he or she learned on the course;
- the teacher will have to be more attentive when on the course, knowing that he or she will have to present it themselves when they return 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 providers 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 school should be:

- 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 and teaching more effective.

5.5.3 School-based INSET for professional growth and effective teaching and learning

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 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 pre-determined through mutual consent, and known to all teachers concerned beforehand, so that everybody comes prepared. It is important for the co-ordinator to plan the meeting, draw up a timetable, and assign responsibilities. 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 amongst colleagues, the chances of successful innovation are greater. A new idea coming from a colleague is much more likely to be accepted than one imposed from an outside source. Thus, school-based INSET programmes are not only useful for the professional growth of teachers, but contribute to improved teaching and learning. Alternatives to school-based programmes may be needed for smaller schools and for those where teachers are not willing to try new ideas.

5.5.4 Co-ordination of resources

This is another important role of the co-ordinator. In primary schools, the resources supplied by the Ministry of Education are generally limited. Most of the materials required for science and technology education will be drawn from the immediate environment. The co-ordinator will need to ensure that while the materials are safely stored, they 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 students and teachers of senior classes may develop 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 Co-ordination of extra-curricular activities

The science and technology co-ordinator can encourage activities such as those listed below, aimed at developing the interests of children in science and technology. These will also need proper co-ordination.

- **Debates and quizzes.** Science, technology and mathematics-related issues can be debated by pupils. 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 children 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 teachers to exchange

ideas about more effective ways they may have developed for teaching science and technology concepts and skills. Students could also gain from sharing ideas with their peers in other schools.

- **Fairs, exhibitions and museums.** Periodic school fairs and exhibitions of science and technology materials made by pupils 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 students. 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 pupils. 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 and technology clubs.** Science and technology co-ordinators should discuss the formation of a science and technology club within a school and how this might function. Ideas from the teachers and students 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 students can pursue science-related hobbies and extend the concepts that they have learned in class. It could be 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.

- **Weekend rallies.** Teachers can encourage informal learning by organising weekend rallies. In a relaxed atmosphere, pupils 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 pupils' interest and popularise science and technology in the community.

- **Science and technology news and bulletins.** A bulletin board on which children's and 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 children's activities and teachers' accomplishments. Children 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 pupil 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 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.