LOW-COST SCIENCE TEACHING EQUIPMENT : STRATEGIES FOR USE

All too often there is an unfortunate presumption that once the problems of production are solved, the objective of teaching and learning science using enquiry-based practical approaches will be achieved automatically. Evidence refutes that assumption; witness a reliable study that revealed a 43% non-use of available science teaching kits in one Commonwealth country over a six-month period. Recognizing this fact, participants at the seminar considered ways of ensuring that once equipment was produced it would reach the classroom and be used appropriately, imaginatively and effectively.

Why Practical Work in Science?

In the study of science, theory and practice should be seen as inseparable since science is rooted in experiment. Practical work not only helps to develop a functional understanding of scientific concepts and of scientific equipment, it also plays a role in the inculcation of scientific attitudes and practical skills. Because it can provide an immediate sense of satisfaction, self-confidence, ingenuity and dexterity, it is an invaluable source of motivation. It can contribute to a cultivation of desirable social attributes such as co-operation with others and learning from one another. It can also lead to an appreciation of the value of knowing things at the "doing" level, and cater for varied individual interests and creative imagination.

Selecting Science Equipment

Even though an understanding and appreciation of the place of practical work in school science would contribute immensely to the use of science teaching equipment, the value of practical work would be diminished if it was not preceded by a wise selection of equipment, both at the national level and at the classroom level.

At the national level, selection will relate to the policy for science and the policy for science education. Generally the former will be concerned with human resource utilization for scientific, technological, industrial, and economic development; the latter with the country's desire not only to develop scientists, technologists and technicians but also the creation of a practical scientific awareness in the population at large.

It is essential for the national policy to be embodied unambiguously in science curricula and syllabuses as well as in examinations and assessment schemes. Decisions relating to the selection of equipment to be produced or ordered, and to the style and extent of equipment usage, should be made in that context. Of course selection should also take into account the educational levels for which the equipment is destined, in particular the development of specified psychomotor capabilities and the acquisition of scientific concepts in a meaningful and directly applicable practical fashion.

It is meaningless to select equipment which is so costly that schools cannot afford it. Low-cost equipment should, therefore, be preferred and

all possible sources of such equipment should be explored. For example, local technologies which for generations have been the mainstay in societies of Commonwealth African countries should not be overlooked in the search for producers of science teaching equipment.

An important component of the wise selection of science teaching equipment is the provision of adequate specifications. In a number of cases, non-use of equipment can be attributed to lack of essential information about the equipment. Another aspect of specification is the provision of a basis on which to decide the size of an order. Yet another is an indication of which material is suitable for which parts of the country.

At the classroom level, selection must take into account the factors already mentioned above. But more specifically, the objectives of particular lessons to a given class play a paramount role. These objectives concern choices between precision of measurement (which may require expensive equipment) and an understanding of principles, which can often be achieved with low-cost apparatus. Considerations for the development of original ideas in the use of equipment should also receive attention. It is imperative that selected equipment should correspond to the physical and conceptual attributes of the learner if profitable learner participation is to be enhanced.

The Needs of Teachers

Strategies for use of science teaching equipment must take into account the many existing problems, including the shortage of suitably trained science teachers and science teaching supporting staff. Ineptitude in the use of science equipment, as well as poor pedagogical practice on the teacher's part, discourage student experimentation and engender feelings of insecurity. Combined with the pressures of time and syllabus requirements, these problems can lead to the elimination of practical classes.

It was observed that efficient and effective use of science teaching equipment depends on the teacher's attributes and capabilities. Teacher training should therefore be seen as a vital component in all processes aimed at introducing any new range of low-cost science teaching equipment. Desirable teacher characteristics in the use of science teaching equipment should be developed at the pre-service stage so that at the in-service stage teacher education can concentrate on the renewal of skills and on training in the use of newly designed equipment. Also, teacher training institutions must assist their trainees to get the most from the apparatus they are likely to find in schools. Where the majority of trainees are to be posted to rural schools with limited laboratory facilities (a common situation in developing countries) both in-service and pre-service training should reflect this consideration.

Given the current situation dominated by untrained teachers in Commonwealth Africa, massive in-service teacher education is mandatory. Training techniques, to be effective, should incorporate a thorough understanding of concepts as well as proficiency in the use of science teaching equipment. Experiences in the design and construction of simple prototypes would improve the quality of training; so would opportunities to learn to exploit the school environment and resources available in the community.

Laboratory Facilities

Poorly designed laboratories and storage rooms, as well as inadequate space and safety provisions, discourage the use of science equipment.

Vaguely written manuals and lack of clarity in instructions for the use of apparatus also create problems.

Another difficulty associated with the use of science equipment arises from insufficient maintenance and repair services. The situation arises from both non-availability of spare parts and the lack of trained support staff.

Science Teachers' Associations

Science teachers' associations, when properly run, may provide a very effective professional machinery alongside the official government services. They are capable of co-ordinating national efforts towards the implementation of a sound and meaningful science education programme in harmony with national scientific and technological goals. They can play a crucial role in the promotion of further education for teachers in the use of updated equipment. By emphasizing and rewarding imaginative locally oriented projects, they can go a long way towards the re-orientation of science teaching. They can, for example support science clubs and other ways of popularizing the use of science teaching equipment. These science clubs should endeavour to do more than demonstrate the use of equipment or the illustration of scientific principles: they should also aim at solving problems that arise out of the environment and relate to the life of the community.

Using the Media

The improvement of the quality of science education must go hand in hand with its expansion. The use of mass media for promoting effective use of low-cost science equipment is an attractive proposition because of the extent of the coverage achieved. However, the radio does not lend itself readily to promoting the use of science equipment. Television, where it exists, can certainly make valuable contributions in that field. It was suggested that both TV and radio could be very appropriate in tackling science teachers' problems in the use of equipment by broadening their information field and providing a forum for answering their questions.

A similar service can be rendered by newsletters, magazines and newspaper supplements. These can provide a medium for the professional exchange of experience in the field of design and use of appropriate science equipment. Many countries are well advanced in the practice, and useful newsletters and magazines are produced by science clubs and associations. This is an area where action by science teachers' associations can be decisive and effective.