Section 1

COMMUNICATION

Background

Since 1975 the Commonwealth Secretariat has held three regional seminar/workshops related to the production of low-cost science teaching equipment. These seminar/workshops attempted to break away from the 'talk shop' approach and provide the participants with laboratory/workshop sessions related to the actual problems of producing a piece of apparatus for a particular teaching activity. The recommendations from each of these meetings have emphasised the need to ensure that information on locally produced school science equipment is widely communicated.

Another area of concern has been the need for training at all levels, for those concerned with the use, design, development and production, repair and maintenance, and administration and distribution of equipment and apparatus.

Perhaps the most positive example of recommendations being listened to is the one from the third regional meeting held in Papua New Guinea. The proposal for regional co-operation is now at the point where it is quite likely that a South Pacific Science and School Equipment Centre will be established in the near future.

A number of meetings organised by other interested bodies have taken place, and are listed so that readers who may wish to obtain copies of the reports can do so directly from the sponsors.

Science and Technology

Since 1975 it is estimated that the world's scientific knowledge has roughly doubled. This is the age of the micro-chip and the micro-processor and automation. Less than ten years ago it could be said that the world was still 'dabbling in electronics'. Another era of the Industrial Revolution (which started in the 18th century) has commenced, with all the social and environmental implications experienced at that time. With this new era, not only must we re-evaluate the equipment position but we must also examine the curriculum to see if it is meeting future requirements. Experience has shown that there is a time lag between what is required and what is being provided for education.

Curriculum Development

The latter half of the 1970s has seen a continuation of the curriculum development activities which commenced during the 1960s and gained momentum in the early 1970s. Perhaps the most significant trend has been the emergence of 'technology' and the attempts to introduce technology into the school curriculum. If we examine the literature regarding science and technology we find a great reluctance to define technology. To some it is seen as the applications of science while to others it is seen as the consumer goods in the shops and market place in the same way that educational technology was, and by many still is, seen as audio-visual and programmed learning-equipment rather than as a much wider process of education. To others, technology is seen as technical and vocational education, or even given the label of engineering science. To some people in the United Kingdom (1), technology was seen as a process (and this interpretation appears to be receiving wider acceptance), that is, technology is a process which utilises scientific knowledge and human resources to achieve human purpose. If we accept that science is a body of knowledge which explains natural phenomena, then certainly technology is more than science. To those who have both a science and engineering background, technology has implicitly been a process since both technical skills and scientific knowledge are used to overcome problems, although it must be said that overcoming a problem does not necessarily imply that the method can be fully explained.

Much curriculum development work has been produced in the form of printed material. In some instances we can find three or four different textbooks and workbooks for the same curriculum, commercial organisations being ready to jump on the bandwagon without perhaps thinking of the implications for the often inadequately trained teacher in the classroom. Nevertheless, some consolidation has taken place with material being revised in the light of earlier experiences. With regard to technology, science texts contain pictures of the applications of science related to industry within the country, but this is nothing more than paying lip-service to a trend, particularly since practical activity in science lessons is still far from being universal for all children. There are always exceptions to any rule and a newly developed technology course in Papua New Guinea may be worth examining in closer detail once it has been fully established in the schools.

Curriculum and Equipment Development

Nearly all meetings on low-cost equipment have stressed the need for the equipment to be developed along with the printed material (and it has been appreciated that this may include developments by teachers and pupils in schools), but there are few signs of this having taken place. We can still see in the new material a reliance on the traditional apparatus as shown by the diagrams in the books. This is not to say that the articles illustrated are imported, since they could have been made locally, but embodied in the thinking behind the textbook is the use of traditional apparatus rather than the development of something which is related to local conditions. It is perhaps appropriate to indicate an activity which has been developed by Keith Warren during his work for UNICEF in Bangladesh (2), whereby, to relate science and technology to local conditions, such items as balances and lift pumps are manufactured by local community groups from bamboo and other available materials.

This apparatus works quite well for the level at which it is intended, and will hopefully provide a transfer of appropriate technology at a later date. By contrast we could examine the primary school kits produced by another country which, if fully developed, would leave little to be taught at secondary school. Although this may be an exaggeration it reinforces the point that whatever equipment is being developed or used it must be related to the developmental age of the children for whom it is intended. To achieve this, it is not sufficient for a curriculum development group to act in isolation from the classroom when initially developing material for a new curriculum. It is very easy to become isolated from reality when one joins a curriculum development centre (assuming that the members have had previous classroom teaching experience) or even a teacher training college as a teacher-educator. All the Commonwealth Secretariat meetings have reiterated the need for the practising teacher to be involved in the curriculum development process, a factor which needs to be appreciated as much by the Directors of Education as by the curriculum development group since secondment, or a relaxation of teaching hours, may be necessary for the teacher to be able to fully participate.

Planning and Equipment

Mention has been made of the need for giving priority to science (and technology) education within the context of national development plans. It is these plans which govern the role of education, and equally govern the role of classroom equipment. In a number of instances equipment production centres have been established in isolation from the curriculum development activities and have not formed part of an overall integrated plan for education. A production centre established to produce science equipment for secondary education (possibly because international or bi-lateral funds were offered to establish the centre) could find itself left with a stock of unsaleable items when the educational priorities change from secondary education to primary education - a level for which requirements the centre may have no expertise. Another example may be one where a country, to rationalise its limited resources for education, establishes special schools for more gifted children with a consequent reduction in the amount of equipment and apparatus needed. Again the equipment centre could be left in an undefined position. Although the actual production can be in isolation from the education, the design and development process needs to be closely integrated to be able to reflect the changing requirements.

Science and Technology Equipment

In focussing on the topic of technology we have to be careful with regard to equipment. Commercial suppliers of equipment are already turning their attention to technology. The danger here is that we may be lulled into believing that technology is equipment. With curriculum development moving towards education-for-living and environmental education, as well as continuing with the integration of the sciences etc, we must be careful not to develop equipment for current technology but allow technology (as a process) to develop the equipment needed to overcome a particular problem. If we accept this then we must accept that equipment development stems from the environment and is, therefore, best developed locally. The implications for the second generation equipment production centres during the next decade could be considerable, as it will also be for

the teacher-educators who have to train the teachers for the future generation of school children.

Naturally, it is up to each country to decide its own educational policy. The third meeting in Papua New Guinea felt that it was necessary to recommend to their governments that they should 'determine and declare an appropriate degree of priority to be accorded to science education within the national context' and to 'identify and spell out the objectives of science education in their national institutions within the context of its overall National Development Plan, and the stated objectives of its educational policy.'

Hopefully the trend will be towards education for the understanding and development of practical skills, a situation which requires both the provision of equipment in the classroom and improvisations from teachers and pupils.

Improvisation and Low-Cost Production

Improvisation and low-cost are often used synonymously but erronously. Certainly it is hoped that improvisation by a teacher is a low-cost affair but low-cost production is something quite different. If we return to the report of the second meeting held in Tanzania we find that low-cost production was defined as being as low as possible within a given situation. If saving foreign exchange is the requirement for producing equipment locally then the items may still be more expensive than the imported ones, but acceptable.

Improvisation is important since it stems from the teacher and in itself, shows to the students or pupils that alternatives are possible. In any environment one often has to improvise to overcome a problem, and one could argue that children should be educated to improvise and thereby bring about the developments needed for improvement and progress. Unfortunately, teacher training establishments still appear to avoid inculcating the idea that teachers of science should 'do' rather than 'talk'. One example of the isolation of teacher training institutions concerned one college training teachers for the first three years of secondary education. The country had a recently developed integrated science course and 75% of the schools had intimated that they wished to introduce the course. The teacher training college could see no reason for introducing integrated science into their teaching programme. One can only assume that pressures from outside would eventually bring about the necessary change, but the teacher training institutions should be abreast of any changes.

According to Hakansson (3), low-cost production is a fallacy. Even if there is an available labour force the cost of employing people and giving them a living wage is increasing worldwide. Since this is the case, then machines may be less expensive once the capital investment in procuring them has been recovered. Less men, with minimum skills, can operate machines, but mechanisation can only be justified if the production numbers are economically viable. The cost of a plastics injection moulding machine die for plastic work will be justified quicker by producing 100,000 items, than, say, 1,000 items. This may perhaps give an idea that low-cost is relative to what is acceptable and required.

Teacher Training

Independently from what is acceptable in terms of low-cost, since the decision requires a knowledge of many factors, all the meetings held by the Commonwealth Secretariat on low-cost equipment have strongly reiterated the need for teachers to be trained to improvise, and use, equipment. Information from isolated sources indicates that some changes are taking place, albeit slowly, and that in some teacher training institutions the construction of simple pieces of apparatus have become compulsory parts of the coursework. Unless one is extremely gifted, skills related to the construction of equipment have to be developed, as they do for the use of equipment. To ignore this requirement is to place the concept of science and technology education beyond the reach of future generations, a situation which no country can afford.

Conclusion

The question arises as to 'How far have we got along the path to providing equipment and appropriately trained teachers for science and technology education?' The answer to such a question cannot easily be provided from a valid data base, since 'providing equipment' and 'appropriately trained teachers' are open to interpretation and subject to the expectations of each educational system. In reality, the question is only pertinent to an individual education system and needs to be viewed in the context of the objectives of education for that particular country. What is pertinent is to look at what is going on in other countries and implement those ideas which could be useful for improving one's own system. To this end the following section provides a guide to the current position regarding educational equipment centres.

Notes

(1) Project Technology, and more recently the Schools Council Modular Courses in Technology, National Centre for School Technology, Trent Polytechnic, Nottingham, UK.

(2) A more detailed explanation of this activity is described in the UNESCO publication New Trends in School Science Equipment, UNESCO, 1982.

(3) A paper presented to the ICASE Asian Symposium on Low-Cost Equipment for Integrated Science Education at All Levels, Philippines, 1979.