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ABSTRACT
This report summarizes the proceedings of a 1976 meeting held in Singapore concerning the current trends and problems in science and technology education in Asia. Two themes are examined: (1) interrelationships between science and technology education, and (2) community-based science and technology education. The overall purpose of the meeting was to identify problems which needed further study and research and to make recommendations for cooperative action programs for science and technology education in Asia. (MH)

Trends and Problems in Science and Technology Education in Asia

Report of a Regional Meeting
Singapore. 20–26 July 1976

Bangkok

SINGAPORE NATIONAL COMMISSION FOR UNESCO
UNESCO REGIONAL OFFICE FOR EDUCATION IN ASIA

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CONTENTS

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I. INTRODUCTION

Background

A Regional Meeting on the Trends and Problems in Science and Technology Education in Asia was organized in pursuance of Resolution 1.23 adopted by the Unesco General Conference at its Eighteenth Session, within the framework of Unesco's programme of education for science and technology. Convened at the invitation of Unesco, it was held at Singapore on 20-26 July 1976 with the Government of Singapore acting as generous host.

The reform and development of science and technology education have become a major policy concern in almost all of the Member States in Asia. In the last decade or so, a variety of programmes have been developed and launched in an attempt to improve the quality of science and technology education and extend its reach to the rapidly broadening population in schools. Some of these attempts aim at refining and improving the existing programmes and structures, while others stem from far-reaching and fundamental changes being brought about in the education systems. In either case, the direction of national endeavours is clearly towards making education in science and technology relevant and authentic to national problems and realities. A considerable body of experiences has been generated in the process; also, many new problems have emerged. The Regional Meeting was intended to promote the exchange of experiences that the countries have gained and to suggest the directions in which further development of science and technology education in the Asian region might be explored.

Objectives

The Meeting was to review the current trends and problems in science and technology education in Asia and examine in particular two themes: interrelationships between science and technology education, and community-based science and technology education. In the light of the Meeting's review and analysis it was to identify problems which needed further study and research and to make recommendations for co-operative action programmes for science and technology education in Asia. (Meeting Agenda at Annex 2).

For the purpose of this Meeting, 'science and technology education' refers to the first two levels of education, for both in-school and out-of-school populations. The tertiary or higher level of education was not included in the Meeting's terms of reference.

Participation

In preparation for the Meeting, all Member States in the Asia and Oceania region were requested to send in reports on the situation of science and technology education in their countries. Seventeen Member States responded by sending in their country reports. The country reports were generally in two parts, one in which an overview of the present situation of science education and technology education in the country was presented, and a second part in which specific projects and programmes underway were described. The participants from 15 of these Member States were able to attend the Meeting in their individual capacities. Organizations of the U.N. system, intergovernmental organizations, and other organizations also sent their representatives and observers. (List of Participants at Annex 1 and List of Documents at Annex 3).

Organization

The Meeting was held on the premises of the Regional English Language Centre in Singapore, and the inaugural ceremony took place on the morning of 20 July 1976. After a statement of welcome by the Director of the Unesco Regional Office for Education in Asia, the Meeting was inaugurated by H. E. Mr. Chai Chong Yii, Senior Minister of State for Education, Government of Singapore.

In his inaugural address Mr. Chai Chong Yii referred to science and technology education as 'building blocks in the acquisition of technology skills and development of economy'. In today's world, modernization generally involves some degree of industrialization, the key to which is the application of science and technology. Receptivity to industrial technology depends to a large extent upon education.

He referred to the measures that the Government of Singapore has initiated for investment in science and technology education in order to develop the potential of the young people of the country to play their role in the economic and civic life of the community. (Inaugural Address at Appendix II).

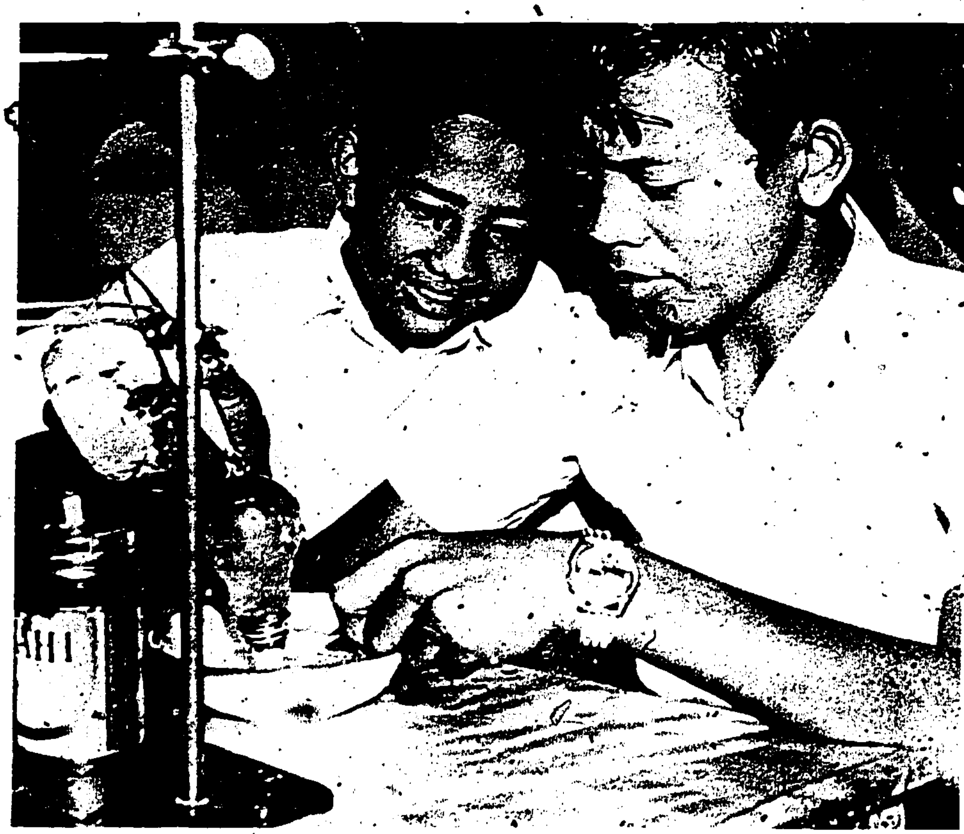
Following the inaugural, the Meeting assembled in the first plenary session to elect its office bearers and constitute the Bureau of the Meeting. The following Officers of the Meeting were elected unanimously: Chairman: Mr. Lim Jit Poh (Singapore); Vice-Chairmen: Mr. Mohammad Nadir Atash (Afghanistan), Prof. P. Fensham (Australia), Mr. Kum Boo (Malaysia), and U Tha Nyunt (Burma); Rapporteurs: Prof. A. N. Bose (India), Dr. Nida Sapianchai (Thailand), and Miss Raquel Valle (Philippines).

The first three plenary sessions were devoted to presentations by participants on current trends in science and technology education in their countries. Thereafter the Meeting formed itself into two Working Groups, each of which discussed and examined the other agenda items. The reports of the Working Groups were presented to plenary sessions and discussed in detail on 23 and 24 July 1976. In the final plenary session held on 26 July, the Meeting considered and adopted this final report for transmission to Unesco.

Acknowledgement

The Meeting recorded its deep appreciation and gratitude to the Government of Singapore, its Ministry of Education, and the Singapore National Commission for Unesco for acting as host and for all the courtesies and consideration extended to the participants. Appreciation was expressed of the programme of visits organized by the Singapore National Commission to enable the participants to observe the working of some of the centralized workshops of Singapore. The participants requested that their thanks and appreciation be also conveyed to the teachers and organizers in the centralized workshops who helped the participants so generously during their visit.

The Meeting recorded its thanks to Unesco for making it possible for the participants to get together to exchange their experiences and ideas, and to the Unesco Regional Office for Education in Asia for the efficient organization of the Meeting. Recording its appreciation of the documentation assembled for the Meeting, the participants recommended that it be published in a suitable form for distribution to the Member States.



2. CURRENT STATUS OF AND EMERGING TRENDS IN SCIENCE AND TECHNOLOGY EDUCATION IN ASIA

The Member States invited to the present Regional Meeting had sent in written reports in advance describing the current status and some of the emerging trends of science and technology education in their countries.[1] These reports were supplemented by oral presentations by the participants at the Meeting. Each presentation was followed by a question-answer discussion in which specific points were clarified or elucidated. In terms of the remit of the Meeting, the country reports and oral presentations dealt with science and technology education with reference to the first two levels of education only. It was also clearly noticeable that the discussions treated 'technology education' in its pre-vocational aspects and as a part of general education rather than with reference to the vocational-technical training system.[2]

Planning of science education

Science education has become a major concern in almost all the Member States, and high priority has been accorded to its expansion and qualitative improvement. Scarce resources have been committed to this in the belief that this investment would yield dividends in the national development programmes. Increasingly, recognition is now gaining ground that special attention needs to be given to science for its role in all spheres of everyday life, and as an integral part of everyone's basic education.

In quantitative terms, the expansion rate of science education has been well ahead of the expansion rate of total enrolments in schools. In all countries of the region, primary science in one form or another is one of the core subjects for compulsory study. Science is continued as a compulsory offering at the junior secondary stage, and its importance is enhanced by a strong trend discernible in a number of countries towards unifying what are variously known as 'primary' and 'junior secondary' (or 'middle') stages. At the upper secondary stage, science subjects are offered generally as electives, and efforts are directed to increasing the number of seats in science courses. In some countries, where science subjects are required for compulsory study, the allocation of time for science has been significantly increased.

1. The reports will be published in the next issue of the Bulletin of the Unesco Regional Office for Education in Asia, Bangkok.

2. In this report the term 'Science-technology' has been used to identify the references in the Meeting's discussions to science and technology as an integrated set of learning experiences which is also a part of general education.

Prior to the 1960s (when the upsurge of interest in science education occurred), the typical arrangement in almost all of the developing countries in Asia was for science to be dealt with by a syllabus committee. More often than not, there were different committees - and sometimes even different organizations - to formulate the syllabuses for primary and secondary education.

By far the most significant recent change in the developing countries of the region has taken the form of establishing a separate institution for curriculum development in science education. In addition to curricular development, some of these institutes also assume the responsibility for planning and implementing science education in the schools. In some countries, the institutes or centres are concerned only with science education, whereas in others, science education is a part of the comprehensive responsibility of the institute for curriculum development. This institutionalization of curriculum development work in science education has, in some countries, now resulted in a co-operative association of expertise from various bodies within and outside the educational system in developing new science education curricula.

From the above account, it will be noted that the planning of science education, and the organizational mechanisms relating thereto, have focused almost exclusively on in-school science. International assistance (in which UNDP and Unicef working with Unesco have played a significant role) has also tended to concentrate in this area.

Next is the conscious linkage between education reforms and the planning of science education. In very recent years, a number of countries have promulgated educational reform policies which aim at a fundamental and radical re-orientation of their education systems. The planning of science education in these has been closely articulated with overall educational reforms.

A beginning has been made towards providing science education to those who are not in educational institutions and many of whom have had no opportunity for formal education. This generally takes the form of community development services by the schools. Then there are the extension programmes in agriculture, and other fields, which also help to disseminate science information. What is being done is no more than a beginning, however; systematic planning efforts have yet to evolve to make scientific knowledge, skills and attitudes available to the vast number of young people who are outside the reach of school systems.

Strategies in science education [illegible]

All countries in Asia, without exception, [illegible] focal point of their programmes for the [illegible] was in one way inevitable [illegible] curriculum [illegible] on in education [illegible] that the science education programmes [illegible] structure of the education system [illegible]

In many countries, the initial efforts in science curriculum development until the late 1960s tended to be 'adoption' or 'adaptation' of science curricula designed in developed countries. A major shift has appeared now towards a progressive development of indigenous curriculum programmes based on experiences gained in earlier projects. This is reflected in the new instructional materials which incorporate more local examples and are increasingly oriented to the new social demands made on the education system. Greater effort is in evidence to relate the new materials to the national environment of the child. In developing learning/teaching materials, the use of the learners' environment - both natural and man-made - and locally available resources are being used to provide first-hand science experiences, particularly at the basic level. Nepal for example, through its primary supervisors and using centrally developed curriculum guidelines, has developed lesson plans using this approach. Also discernible in a few countries is a trend towards giving greater freedom to teachers to design learning/teaching sequences within certain general guidelines, to meet the individual and local needs of their students. This trend, though not yet general, may become so in the coming years.

Although a traditional approach to teaching science as a body of facts (knowledge) is still prevalent, and in some countries, with heavy emphasis on teaching 'pure' science principles first and foremost, there is now a noticeable shift in a number of countries, particularly in their new programmes. This shift is from the closely-directed learning of established facts to conceptual understanding and to applications of acquired knowledge and skills to life problems. There is greater stress on first-hand experiences by pupils and their active involvement in the learning process through enquiry and discovery, and on the application of science while incorporating elements of technology.

The level in the education system at which the new science curricula were introduced differs from country to country. In some countries the second level of education was taken up first, in view of resource constraints, the numbers involved and—in some cases—the belief that improvement of secondary-school science will bring an immediate return in improved science teaching at the university level as well as in the preparation of science teachers for the school system. The extension to primary-school science was here rather slow and, when it did occur, the effects of the styles of curriculum development at the second level were all too obvious. In other countries, the strategy of beginning at the top and moving downwards was changed entirely and the focus shifted to curriculum development for a basic cycle of education. By far the largest proportion of pupils are those who will terminate their formal schooling at the end of the basic cycle comprising from four to [illegible] years, depending on the circumstances. The exposure to science learning experiences that they get in the basic cycle is all that they are likely to [illegible] world of work and living. The central problems of curriculum [illegible] cation concerning relevance [illegible] to be encountered in their most challenging [illegible] science education in the basic cycle of education [illegible] as a watered-down version of the secondary school [illegible].

Arising out of this, there is a perceptible tendency towards a unified or integrated approach to the content within the various branches of science at the basic cycle. In some Member States, attempts have also been made to integrate science with areas of social studies and the humanities. In the Sri Lanka Primary School Curriculum, for instance, the total real-life situation of the child is the major source of learning. The most recent plans for curriculum change in several other countries are also in this direction. The enchancement of the scientific outlook of rural learners and the development of an international viewpoint appear in the curriculum plans of some countries.

The science curriculum programmes have been developed as 'packages' of instructional materials, textbooks and guides, along with the in-service training of teachers. The difficult problem of the material base (supplies and equipment) for the programmes was not long in making itself felt as a constraint. In response, many countries in Asia have established centres for designing and developing equipment suited to local conditions and using local raw materials. When science education programmes encounter the compulsions of mass education, the problem of material base will be magnified manifold. Clearly, innovative approaches are called for. In some countries, the thinking is moving towards evolving science education programmes, particularly at the basic level, which should be capable of providing valid learning experience without being dependent on traditional equipment. The linking of science education with work experience, the interlocking of cognitive knowledge and practical application, and the use of environmental and community resources are obviously important elements in this approach.

Member States of the region are moving in the direction of making their education systems, at least at the first level, available and relevant to the entire society. This new concept of basic functional education has emphasis on health and nutrition, development of employable skills and rural transformation. Science as an integral part of this education has its focus on preparing the learner to deal with real problems, particularly those of poverty and deprivation. Other aspects involve problems of the impact of technology on the physical, cultural and socio-economic environments. In particular, much of science learning is closely linked with problems of environmental conservation. Out-of-school programmes associated with work experience have also contributed to learning in these areas. Other out-of-school science programmes in the form of such activities or establishments as science clubs, science fairs, science centres and zoological parks have been started in many Member States, but most of them appear to cater for urban in-school population and often take place or are used outside the regular school hours. Special programmes for gifted children have also been started in some countries.

<u>Implementation strategies</u>

[illegible] quite vigorously [illegible] Member States, [illegible] shortfalls. There are a number of [illegible] being a fragmented rather than a systematic approach to changes in science curriculum due to:

- the piecemeal nature of efforts which do not closely link curriculum development to national policy and do not have some assurance of continuing and adequate support;
- the lack of systematic efforts to link and co-ordinate science education with changes in teacher education, material production and instructional and management systems;
- the insufficient mobilization of needed resources and the under-utilization of available (non-traditional) resources;
- in the context of a centralized system of curriculum development, inadequate communication and co-ordination at the level of schools and teachers.

While in some countries the Curriculum Development Centres have been used for the preparation of textbooks and other related instructional materials and training programmes and are thus closely involved in the implementation of the curriculum, in others the agencies responsible for developing the instructional materials needed for the implementation of the curriculum are different from those responsible for developing it. Similarly, the examination systems (and this applies particularly to terminal examinations at the second level) have sometimes remained unchanged and ill-suited to the needs of the new curricula.

The way that a curriculum is developed determines in a very substantial degree the conditions of its implementation. The new programmes of science education including instructional materials were developed centrally in nearly all cases. This did help in concentrating scarce resources of expertise and ensuring qualitative standards, but it also created a gap between those who developed the curricula and the classroom teachers who are responsible for carrying out the curricula in learning/teaching situations. Implicit in every curriculum, and more so in science, are certain learning/teaching strategies and, to the extent that those who are to practise these are unaware of or uninvolved in them, the gap is widened. Partial attempts have been made to bridge this gap by associating selected teachers in curriculum activities.

Since the new programmes of science education have only recently entered the implementation phase in most Asian countries, the experience of implementation is not quite as extensive as that of curriculum development. Some indications are available about the directions in which solutions are being sought to the basic problems of finding a balance between centralized and decentralized curriculum development and implementation. In terms of curriculum development, this involves again the linking of science education to the immediate environment and real life problems. [illegible] are being made to decentralize the development of curricular materials relating to certain topics while retaining [illegible] centrally. In Singapore, for example, curriculum development and tryout are done by the teachers so that the processes of development and implementation go forward almost together.

Then again, in countries where science education curricula are centrally developed, there is a distinct trend towards the decentralized management of implementation, as shown by the establishment of regional or district centres.

There is a growing awareness that the pre-service teacher education programmes have not come up to the challenges of the new school curricula and need to be revised. Most of the Member States have started work in this direction. Charges in the preparation of teachers have however hardly been of a magnitude and depth to match the changes which the science programmes have tried to initiate. Innovations have been made in a few courses, but innovations of the programme itself have not emerged. It is recognized that, using the traditional modalities it is very difficult to train all the teachers simultaneously.

In order to accelerate the rate of science education improvement, almost all the countries have organized massive in-service training programmes linked with the curriculum change. The strategy mostly used is to train the key personnel or master teachers, who in turn provide in-service training to teachers. This method, due to lack of resources in some cases, might require a decade to train all the teachers. In order to meet the ever-increasing demand of in-service training programmes, decentralized resource centres are being established in some countries. Multi-media self instructional modules for the purpose of upgrading teachers are also being developed.

Despite the quite extensive in-service training programmes, a recurrent theme in the Meeting referred to the lack of comprehensive education of teachers, particularly at the primary level, to cope with the changes sought to be introduced by science education programmes. Generally the in-service training programmes are designed to help the teachers in handling the specific changes being introduced by a particular curriculum project or to use the instructional materials developed in it. All of the countries have felt that new mechanisms are needed for rapid large-scale retraining of teachers to accelerate the rate of science education improvement.

There is a growing recognition that conventional schools are only one important institution in society with a stake in the provision of equality of educational opportunity. Alternative structures, orientations and resources are being increasingly explored. Maximum utilization of under-utilized and unutilized resources in the community is becoming a major effort in some of the programmes.

An increasing use of multi-media packages of educational technology along with conventional instructional materials is being attempted. Individualized instruction and the use of self-learning kits and modules are being tried out. New instructional resources like kits, scientific educational toys and games for enriching science learning are being developed.

A progressive development of new management systems for the effective implementation of science programmes has been attempted in many countries by instituting special supervisory cadres.

Evaluation

Although experimental tryout of new curricular materials, microtesting and using formative evaluation to revise the materials before introducing a new science curriculum have been reported by some countries, a systematic built-in curriculum evaluation has not yet been put into use as an integral part of the curriculum development process. Curriculum analysis and curriculum evaluation for the training of curriculum developers has not yet been used on any significant scale. More often than not, policy changes which change the curriculum result from political changes rather than from curriculum evaluation.

With regard to procedures for the assessment of pupils, many Member States have abolished public examinations up to the lower secondary level. Even where some sort of centralized examination up to this stage is retained, it is to be used for diagnostic purposes rather than selection. As a result, more use of internal assessment on a continuing basis is being made for assessing pupils' progress at the lower secondary stage. At the second level as a whole, however, the examination systems appear to have, in a number of countries, a very strong and directive influence on the curriculum.

Planning of technology education

In most of the countries of the region, technical and technological education is a separate training system from the general education, and no major efforts to integrate these within general education are yet under way.

Recognizing that education, to be relevant to national developmental efforts, has to prepare the learner for the world of work where science and technology are becoming critical factors, there is a growing concern in many of the Member States to make work experience an integral part of the general education programme for the development of desired attitudes and skills. Attempts are being made to develop work-oriented curricula and, in some countries, this includes technological learning experiences of a pre-vocational character.

In primary education, arts and crafts or practical arts are included in the curriculum. In some countries there is no fixed syllabus for these subjects and they are either taught as part of co-curricular activities or incidentally as part of other subjects.

At the lower secondary stage, crafts or industrial arts are taught in the majority of Member States, either as a compulsory or as an optional subject and are intended to cultivate positive attitudes towards manual work, develop basic practical skills and provide a pre-vocational bias to the general education programme. Some countries are, however, moving towards providing a more integrated general and technology education programme for the first and second levels of education. Shortage of qualified teachers and equipment for technical subjects has generally been the main problem in providing such programmes. Efforts are being made to find a solution by imaginative use of community human resources such as artisans or skilled workers.

At the secondary level, and particularly the higher secondary stage, special industrial, vocational or technical schools provide technical education where about 70% of the instructional time is devoted to vocational or technical subjects and about 30% to general education. The tendency is quite evident that those who are not able to do well in courses in an academic general education programme are diverted to the vocational and technical streams at the secondary stage.

Although at present certain institutes are identified with certain types of education, there is a trend towards making the distinction less sharp between general and technical education by the conversion of more general secondary schools into vocational schools, by incorporating instruction in technology in new science programmes, by making work experience more oriented towards technology, or by establishing 'comprehensive' secondary schools.

Different administrative arrangements exist for planning and implementing technology education. In some countries this is done through special departments in the Ministry of Education, in others through Ministries such as those of Industry, Agriculture, Forestry, Fisheries or Labour. In order to facilitate an integrated development of science and technology teaching, sections dealing with science, and technical and vocational areas, are at times being established under the 'umbrella' of a Science Education Bureau.

As regards curriculum development and production of instructional materials, unlike science education, no institutional arrangements have yet been evolved for technology education. However, where work-experience, pre-vocational and vocational subjects are being made an integral part of the general education curricula, the Curriculum Development Centres become responsible for the development of the curriculum for these subjects also.

As there has been little significant revision in technology subjects in recent years, the advances in these fields are hardly reflected in the curricular programmes. One cannot but note that the kind of upsurge which has marked science education is not reflected in technology education at the school level. This is certainly not because there are no major areas of concern to national policies; there are such policy concerns, e.g. pre-vocational education, intermediate technology on the development of employable skills - particularly in rural areas. Possibly the growth points which lie on the line where science and technology meet have not been explored sufficiently to provide the leavening for education.

So far, technical education has been urban-biased. There is need for developing technology education which should deal with the rural areas and their modernization, and how appropriate technology can be transferred to these areas. Sri Lanka, India and Nepal have taken positive steps toward orienting some technology education in the direction of rural areas.

Implementation strategies

The major problems in implementing the technology education programmes, as seen by the participants of the Meeting, appear to be:

- The inadequacy of the curriculum, which is still geared to the needs of the earlier strategies of development rather than the needs of the present and the expanding future;
- The absence of appropriate instructional materials;
- Shortages of physical work facilities, equipment and raw materials;
- The shortage of a qualified and trained teaching force.

Efforts are now being made in many countries to counteract these problems. A growing interest is in evidence in revising the technology curricula with a view to linking them more closely with the general education programme and postponing the stage of specialization as much as possible.

The Curriculum Development Centres are now getting more involved in developing new instructional materials for technical and vocational subjects. Places for more pupils are being made available in the vocational and technical schools. Trade-type courses normally conducted at the technical institutes are being conducted at selected senior secondary schools. National vocational preparation programmes for out-of-school youth are being developed through youth centres and other similar arrangements.

In a few countries, experiments are underway for using a project approach in agro-technical studies in school programmes. The use of community resources and facilities is being encouraged for the technical and vocational components of general education, and to meet the shortage of equipment, materials and skilled training personnel. This has been possible by revising the curricula to provide for practical training in village or local crafts. Part-time technical-vocational education courses for school leavers are also being organized in some countries. The resources of regular schools after school-hours and those available in the community are also being used for this purpose.

The teachers of technical and vocational subjects are usually not primarily trained as teachers; they are generally technical college/institute graduates. In some countries they are technicians recruited from industry, and are then given a year's training in secondary teachers' colleges. The supply of well prepared and qualified technical teachers is a major problem in all the developing countries of the Asian region, as the existing mechanisms for pre-service training are proving quite inadequate.

Evaluation

Although the use of experimental try-out and evaluation (both formative and summative) has been reported in the cases of some new science curriculum projects, no such activity has been reported in the area of technology education. With regard to pupils' evaluation, the traditional approach appears to be prevalent. As there is an increasing concern for the development of desired attitudes and practical skills in the technology education programmes, however, new testing procedures are being tried out in a few countries. Pilot projects underway are testing the feasibility of using local committees to assess certain practical work undertaken by secondary students as part of their course studies in general education. A movement away from a strong centralized examination system is also emerging in a number of countries.

Concluding observations

Technology education as a part of the formal education system is passing through an uneasy period of transition in the developing region of Asia. In the earlier decades, such education was intended primarily to develop specific skills required for the lower and middle ranges of occupation in the economy, and was typically imparted in post-primary institutions, parallel to grades V/VI - IX/X of the general schools. Vocational schools at this level are now fast declining. In some countries, technology education has moved up to secondary grades, parallel to grades X-XII of general schools; in other countries, such institutions are at post-secondary level. Training for the lower ranges of skilled occupation has been taken over by apprenticeship schemes, on-the-job training and trade schools. The school systems would be the poorer if education were to be disconnected from the kind of practical learning experiences which technical/vocational schools provide, despite their somewhat narrow concentration on specific skills training. The response of the school systems in some countries was to develop 'comprehensive' secondary schools which brought together technical/vocational courses and general academic courses under a single school, which incidentally provided opportunities for students to change courses or even streams. It is hoped thus to remove one of the crippling handicaps of the usual technical/vocational schools; namely, that they have tended to be the last-resort choice of pupils and were 'dead ends' from which there was no outlet for moving up to post-secondary education, not even to technical colleges. The 'comprehensive' school has not been established long enough on the Asian soil to assess its merits, but there is some indication to show that the job market preferences are not entirely in favour of the graduate from the technical/vocational stream of a comprehensive high school.

Another response in some countries in Asia arises from the awareness that training in skills which can be applied polyvalently, rather than in only a narrow range of jobs, is essential if education is to create a wide base of skills for the communities. This is resulting in the movement towards integrating general and work education as the foundation for more specialized training - which may take place in an institution but more often on the job.

3. PROBLEMS OF SCIENCE-TECHNOLOGY EDUCATION IN ASIA

Socio-economic context and educational priorities

The socio-economic and geographical environments in the countries in the vast region of Asia have significant differences. Nevertheless, there is discernible a remarkable degree of consistency in the patterns of development adopted by many developing Asian countries in the late 1950s and the 1960s. The general strategy was to try to keep the GNP ahead, in real terms, of population growth. To achieve this, the main effort was directed towards the modern sector, which invariably coincided with the urban sector. It was assumed that the traditional and poor sector (in the main, rural and agricultural) would receive the benefits of growth by a 'trickling down' process.

The last two decades of development in the region, however, have indicated that high rates of economic growth, or even relatively high per-capita incomes, have not necessarily led to significant socio-economic progress for the poor 80% of the population, and certainly not to the poorest 30-40% of the population. The very real problems of the poorest sections in the countries have increased rather than eased.

A most significant development in the late 1960s and early 1970s arose from the fact that the assumptions underlying the modern sector approach have been seriously questioned. Increasingly, the countries are now adopting development strategies which articulate social dimensions, focusing on disadvantaged populations.

Education strategies over the same years, while producing dramatic results in terms of enrolment increases, did not achieve all that was expected. Large numbers of drop-outs, an increasing number of illiterates, a vast number of children from disadvantaged populations without access to education, irrelevance of what was delivered in the education system, educated unemployed – all pointed to serious shortfalls in what the education systems were supposed to be doing. While it is admitted that several of these shortfalls may be beyond the control of the educational planners, their incidence nonetheless drew attention to the mismatch in various sectors of socio-economic development.

The new emerging socio-economic perceptions are born of the recognition that the equitable distribution of developmental benefits is not an automatic consequence of growth and that the development strategy has to be consciously directed towards the distribution aspects of growth, as well as towards growth itself. One consequence of this change would be the creation of productive employment, particularly in the traditional (rural, agricultural) sector. This broadening of development objectives would imply far-reaching changes in educational policies and practices - especially if education is now to contribute to the rural and other disadvantaged sectors of the country. One consequence of this change in educational policies is the recognition of the necessity for mass education - particularly for those who have remained outside the orbit of the modern sector growth. It follows from a broad-based policy of this kind that all sections of the population must receive education and training to the extent that economic and social development demands, and that there would be a wide variety of populations to be served requiring an equally wide variety of educational 'inputs' organized in different forms to meet their diversified needs.

Science and technology education, being integral components of education, would need to be sensitive to, and reflect, this fundamentally different direction that education is taking, in keeping with the new strategies for socio-economic development in evidence in the Asian region.

This new emphasis raises some new problems for science and technology education. In many cases, the recent effort in science education has been to improve teaching in this subject-area as a means of preparing science specialists for the modern sector. Even with new curricula, the experience of students or pupils in science education has been heavily factual and many of them emerge from school with a sense of failure in these subjects. This type of science teaching has also been quite unrelated to technology education at the school level. Technology education tended to be formalized and restricted to the development of some selected skills under rather contrived conditions in schools. Parental attitudes to these two subjects have also discriminated between them. Science education has been acceptable as it is identified with the academic pathway to possible employment, while technology education has been less favoured.

If this larger developmental framework is accepted, the matter of the kinds of science and technology that are relevant and appropriate to the needs of mass education would have to be thought through. Are these needs being met even marginally by existing science and technology education programmes? Would they be met if these programmes in a modified form were only to be expanded downward to cover the school-going population? Any answers to these questions must necessarily be seen in relation to both the school-going population and those who are not in school. Such answers would conceivably imply consideration of fundamental questions of inter-relationships such as learning-and-work; learning-and-immediate environment; learning-and-production; school-and-community.

The developmental framework also highlights the issue relating to the inter-relationship between science education and technology education. Such inter-relationship implies more than just emphasizing the applied aspect of science education while retaining its essentially cognitive style of learning, or just incorporating more science elements in technical courses. Basically, acceptance of the inter-relationship might call for a different approach to the teaching of science, an approach in which an understanding of science is built up by its application to concrete problems.

A consideration of the above issues raises the question: what kind of planning mechanism is needed for developing science and technology education programmes?

The problems of implementation are bound to be increased manifold in the context of mass education. The point of break-through may well lie in the science and technology programmes themselves, in the way they are able to release productive potentialities of the schools, of their communities and of the learners and the teachers.

Against the backdrop of the above general issues, the following specific problems of great significance to science-technology education were discussed by the Meeting. To ensure a realistic and practical perspective for discussion, the Meeting focussed on a variety of wide-ranging problems at the classroom level, such as the following:

- Implementation - rather than the development of ideas or programmes - is a major source of problems. So many worthwhile ideas, texts and materials for science education have been developed in recent years but are not reaching the children in schools.

- There is need to improve the integration between science and technology education, which are often taught as divorced from each other. Only in this way can 'technical and vocational' education become more than just the acquisition of traditional skills. If science education can contribute to an enlargement of technology education, however, there is hope that children (and through them their parents) will not only acquire appreciation, skills and knowledge about technical and vocational possibilities, but will also acquire real problem-solving potential.

- The teachers and children lack detailed instructions on how to do practical work with the resources which they have. For most people, these resources will for many years be the village resources. Teachers and children need very clear instructions on how the village outside the school room can become the 'laboratory' and provide the materials required. Since in many Asian schools there are no immediate prospects of constructing and equipping special science rooms, open space or the crowded floors must become laboratories. The shortage of teachers will continue in many areas and teachers will often have to teach several classes at the same time. Teachers will often need the techniques of multigrade teaching. Furthermore, the teachers are often unskilled in building their own equipment. Both teachers and children will have to 'learn by doing'.

- Primary school children cannot read scientific or technical information, so other means of communication need to be explored such as self-constructed toys, models, comics or photographs.

Curriculum development

What criteria may be used to decide whether science education makes a direct contribution to improving the social conditions and potential of the disadvantaged sections of communities?

The last decade has seen considerable activity in the revision and development of science-technology curricula in Asian schools. The view was expressed that in spite of these developments, the curricula have not become relevant to the needs of children or the community. They have only a few topics that are of real use for life, particularly in the context of mass school populations of heterogeneous composition. To meet these new needs, the Meeting thought, new techniques of curriculum development are needed which in turn may suggest the use of new techniques and media of presentation and communication.

As the curricula are already becoming overcrowded, there is a danger that, with every revision brought about under the pressure of expanding knowledge, they may become unmanageable. It is therefore important that with the current curricula the most effective materials be extracted from the mass of less relevant materials in which they are imbedded: it is important to remove the 'dead wood' from the curricula.

The overcrowded curricula have added additional constraints on teachers and converted the act of learning for the learner into a blind race to cover the course for examination purposes.

The need for the inclusion of locally specific, real-life situations in curricula calls for the appropriate decentralization of certain aspects of curriculum development. This has been achieved in varying degrees by Member States. Any degree of decentralization raises a variety of important problems of planning, implementation and evaluation, such as the ease of mobilization of experts and material resources, and the sustaining of national standards.

New techniques of identification, selection, analysis and synthesis will have to be developed if curricula that unite science and technology are to be drawn from real-life situations rather than solely from the disciplines.

Teachers are largely untrained in critical competencies such as practical work, management, content and skills for promoting self-learning. The numbers involved are so large that their retraining within a reasonable period of time is not feasible with the conventional methods of in-service education. These constraints have to be taken into account in the planning and development of curricula that have a reasonable chance of implementation. This may involve the development of new techniques such as communication going more directly to children while still being administrable through the education system.

Alternative and optimal strategies for the provision of the extensive facilities necessary for adequate experience of technology education within general education would need to be developed. Central facilities serving several schools and the use of local craft places are alternatives that have been used with success in several places and should be tried elsewhere.

It was noted that most educational effort towards practical science education falls short of reaching the children; that is, it stops at conferences, A-V centres, educational research institutions or in cupboards of unused apparatus. A critical appraisal of the failure of recent well-intentioned projects is needed if the mistakes are not to be repeated.

Training of teachers

Training programmes for teachers have not kept pace with changes in the school science-technology curricula, either in quantitative or qualitative terms. Changes in pre-service education reflecting the competencies implicit in the changes in curricula and practical school conditions are required. Similarly, in-service education designs have to meet the massive quantitative targets quickly, particularly at the primary level. Techniques and methods for the enhancement of the competencies of teachers must now take account of the very large numbers of teachers who have to be reached and the relatively short time available within which to reach them. In this effort, a pre-requisite for success is the effective reorientation of teacher educators. This should include their active involvement in school curriculum planning and development processes. This involvement will also contribute to more realistic curriculum designs by taking account of the resources and other constraints.

Further emphasis on new competencies in science-technology education in an already overcrowded teacher education syllabus does however raise problems of curriculum development and management of training time for pre-service teacher education.

Utilization of resources

Shortage in finance, material and human resources is a persistent problem to contend with. The Meeting felt that, of the overall resources available for education, a more equitable proportion than is given at present should be allocated to the disadvantaged areas within each country.

In order to obtain maximum benefits from the available resources, the total allocation profile for science and technology education needs re-examination to establish priorities in the areas of curriculum development, teacher training, administration and management, facilities and materials.

Emphasis has to be shifted from merely acquiring hardware (expensive equipment) to the production of software (teachers' guides, handbooks, manuals, worksheets) which will help learners and teachers to improvise the much-needed teaching/learning materials, and to utilize the environment and local resources for science-technology education.

The dearth of financial and material resources is further aggravated by the lack of adequately trained teachers and resource persons to implement science and technology education programmes. To overcome this shortage, the Meeting made the following suggestions:

- the use of mobile units for reaching remote areas to provide, especially at the senior secondary stage, the science and technology experiences requiring costly equipment, as well as on-the-spot retraining for teachers;
- the production of self-learning kits, correspondence-cum-contact courses and guidebooks for teachers;
- more effective use of educational radio and T.V., and other mass media;
- improvization of equipment by using low-cost local materials and use of the environment as a learning laboratory;
- the use of pre-service programmes for the production of equipment;
- designing of equipment specifications which will reduce cost (e.g., a cheap low-powered microscope is often sufficient instead of an expensive high-powered one);
- using multi-purpose science-technology rooms instead of individual laboratories or workshops;
- the design and production of simple equipment and kits by students as part of their work experience education.

It was felt that there has been too much dependence on resources in the traditional formal educational system. Available educational resources outside the school system such as mass media, educational magazines and pamphlets have not been fully utilized.

For the successful implementation of both in- and out-of-school science-technology programmes, the co-operation and co-ordination of relevant governmental and non-governmental personnel and agencies, and local experts such as craftsmen and farmers, is vital and should be consciously sought.

It was agreed that the community in which a school is situated would be an important resource for science-technology education. For example, the village craftsmen would possess skills which the pupils would want to learn, or, the existing industries could provide opportunities to pupils for work and production experience. The mobilization of community resources, it should be remembered, needs systematic and sustained effort to motivate community participation. It has also to be a community education programme.

Evaluation

Where curricula, or certain elements of them, are developed in a decentralized setting, the entire framework of learner evaluation, and selection processes for further institutional learning and for employment, would need to be thought out anew. Ways to assess those aspects of science-technology education that cannot be examined by written examinations would need to be developed. These at present are virtually non-existent in most Asian countries. The focus on mass education raises a cluster of problems in the development of [illegible] type diagnostic evaluation material and [illegible] followed by remedial or compensatory education.

For decision-making in such areas as curriculum development, teacher preparation or resource allocation, the absence of systematic programme evaluation has been deeply felt, and is recognized as a serious barrier to programme planning for successful implementation.

SUMMARY OF CONCLUSIONS

The development of science and technology education should be seen in the context of national development policies aimed at securing greater social equity for the deprived and disadvantaged sections of the populations and of the demands of mass education.

Curriculum development in science-technology education has to be specifically oriented to real-life problems.

A considerable measure of decentralization would be called for in curriculum development to ensure relevance to local environments.

The training and retraining of teachers should focus on developing competencies which are critical to implementing locally designed and developed curricula.

To obtain maximum benefits from available resources, their allocation among programme priorities needs to be examined. Greater emphasis should be given to the production of low-cost equipment and utilizing the environment and local resources for learning.

4. THE INTER-RELATIONSHIP BETWEEN SCIENCE AND TECHNOLOGY EDUCATION

The discussions in the Meeting centred on identification of the areas where inter-relationship of science and technology can be brought about and the forms which such inter-relationship might take in learning/teaching situations. Science and technology education were seen to have several objectives in common in the domain of knowledge, skills and attitudes. It is also necessary to take into account possible inter-relationships with other subjects such as the humanities and social sciences as well.

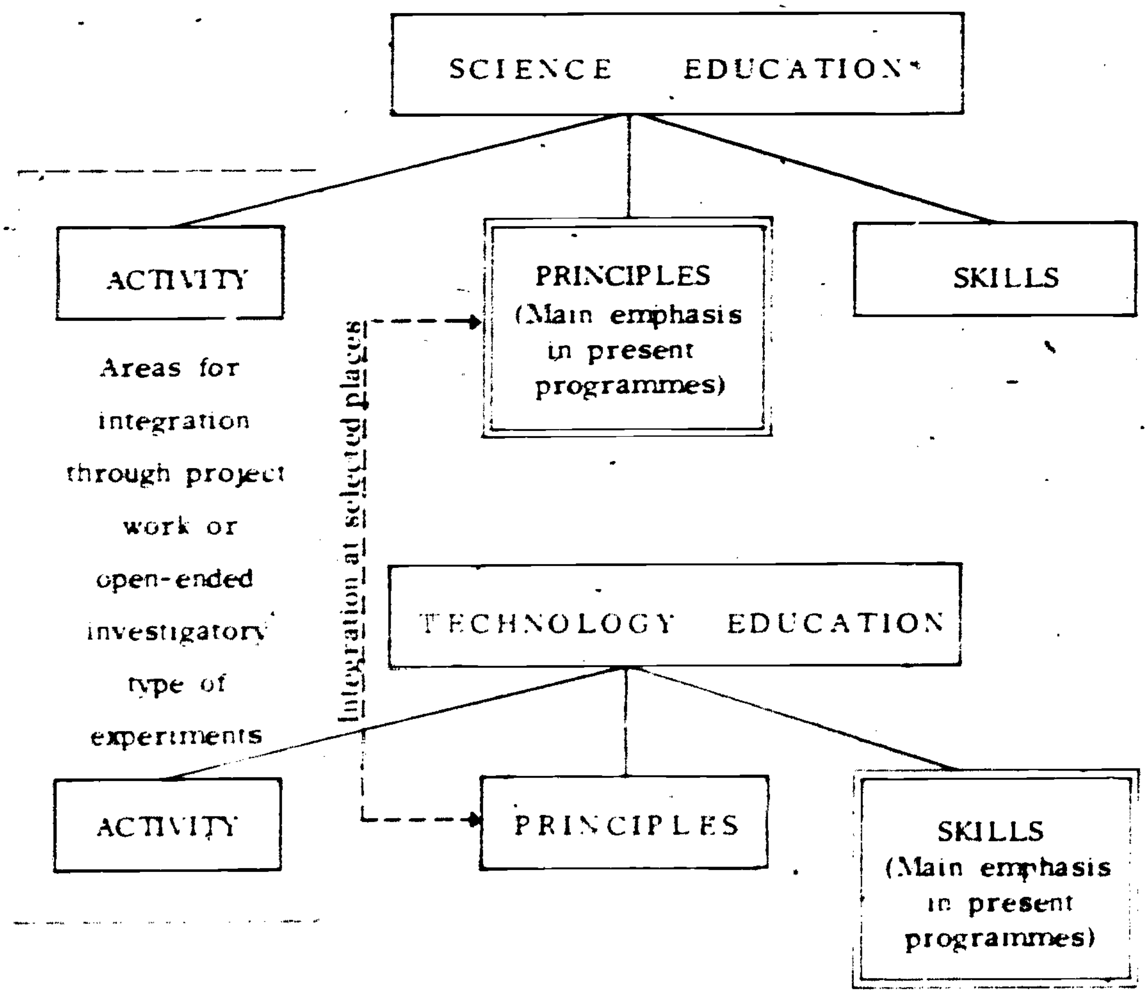
The inter-relationship of science and technology may be seen in two different aspects. The first is in relation to the learner, particularly in the school-going group. Learning, it was premised, is more effective if it takes place in a context of 'doing' or 'action', is activity-based and there is constant interaction between knowledge in its abstract form of generalizations and its particular application. In this aspect of the matter, science education can be as little divorced from technology as technology can be de-linked from an understanding and knowledge of the principles which are embodied in it. Looked at from the point of view of the learner, separation between science and technology would make the learning of science or of technology much less effective.

The second aspect of the science and technology inter-relationship relates to the development needs of the countries. These development needs are being defined, among other factors, by technology in its diverse forms. Therefore, if science-technology education is to meet the requirement of making education more relevant to the learner, particularly those in rural and deprived areas, and as a response to the development needs of the country, the curriculum content in these areas will have to be derived from certain problems and needs as they are found in the physical, cultural and socio-economic environment. Concepts, principles and skills will be educed and learnt in the process of examining a real-life situation or a problem. In brief, relevant real-life situations will be used as the vehicle through which science will be learnt.

These real-life situations include a variety of technologies which (taking the rural environment as an example) would comprise such a range of activities as to include making dried fish, irrigating paddy fields, producing cooking pots, repairing farm implements, or building houses; or (taking the urban environment) from technologies such as those in radios, electrical home appliances or transportation, to problems of pollution or large-scale construction. In these technologies are embodied many scientific principles, and thus by relating science teaching to life, a closer relationship between science and technology at both the first and second levels of school education can be identified.

Work-experience situations intended to associate work and learning, and focussed on the improvement of the quality of life; particularly in the disadvantaged rural areas, provide another area for inter-relating science and technology, especially in the establishment of adequate technologies for rural transformation.

The general patterns for inter-relating science and technology which can be established even within the existing formal educational structures are diagramatically represented below.



In project work, as in other suggested methods, active learning opportunities are very high and 'thinking' and 'doing' can be brought together effectively. Some of these inter-relationships may be particularly meaningful at the upper levels of secondary education.

On a general and abstract plane, one can identify two areas of human activity which, though different in attributes, are closely related. These are:

- the effort associated with man's natural desire to know, to understand, to explain, or to predict, and
- the result of man's equally natural desire to find ever new and better ways of satisfying his needs, performing his tasks and achieving his goals.

The former moves towards what is recognized as 'science' and the latter, 'technology'. The relationship between these two activities could provide a basis for inter-relating science and technology and should be emphasized in science-technology education.

SUMMARY OF CONCLUSIONS

1. A close articulation between science learning experiences and technology learning experiences is essential both for making the learning of science or technology effective for individual learners and for enhancing education's contribution to national development.

2. The inter-relationship can be realized if real-life situations are used for deriving learning experiences. Work-experience situations also provide another important area for articulating science and technology education.

3. Links between science and technology education can be established in project activities as well as in the learning of principles and basic concepts.

5. COMMUNITY-BASED SCIENCE-TECHNOLOGY EDUCATION

Proceeding from the premise that learning should be related to life, the discussions of the Meeting identified two aspects of this premise in relation to science-technology education. First is the need to orient science-technology education to community problems. These may be problems of urban or of rural communities. The vast majority of populations in the Asian region are to be found in the rural communities. In the countries of the region, the major orientation of science-technology education would necessarily be towards the rural problems, such as health, sanitation, nutrition, soil erosion, water conservation, crop production and the improvement of village technologies.

The second aspect of community-based science-technology education is to make use of community and local resources in its implementation.

A number of examples of community-based science-technology education in the Member States (within as well as outside the formal school system) were presented. Among them were the enhancement of agricultural productivity; technical schools which relate their activities to specific eco-systems; manual work; work experience and pre-vocational studies directly linked to community problems; vocational and out-of-school programmes flowing from national efforts in large rural development programmes such as animal breeding, fertilizer use, high yielding crops, health and nutrition programmes; and functional literacy programmes.

The method most commonly utilized for the orientation of science-technology education to community problems is project work. This usually occurs outside the normal time-table of the schools and may be generated either by the pupil or the teacher. Several Asian countries have gone further and have made work experience, and/or pre-vocational education, in which learning and work are interlinked, a mandatory part of formal schooling. This work experience is often focussed on community problems. In science education, real life situations have been directly utilized to develop the learning of science concepts; these concepts are then applied to community and life problems. This learning process, based on a dynamic flow from real-life situations to concepts, and from concepts to their application, provides the frame for integrating science education and technology education in situations of immediate relevance and interest to the learner.

A direct outcome of these efforts has been a certain degree of 'deformalization' of the school system (although the extent varies from one country to another) and has contributed towards a more dynamic relationship between the school and the community. The school as a main educational institution would also be brought more directly into the mainstream of national socio-economic development. The Meeting recognized that an additional reason for improving the level of science-technology education in schools arises from the fact that children are potentially powerful contributors to creating the climate of opinion through which parents and the community may imbibe a better understanding of science and technology.

In the practice of these innovations, it has been recognized that surveys of community needs are essential for the planning of such a learning sequence. Further, this curriculum development requires new categories of personnel, often outside the education system, such as officers from Agriculture, Health or Rural Development Departments, if life situations and problems are to be developed into valid and effective learning situations for science-technology education. Teachers will need to assume increasingly the role of 'facilitator', working in partnership with local technologists, tradesmen, farmers and others with experience and expertise in the relevant life situations. A few countries have developed special evaluation instruments to evaluate the learning in these new settings.

It is clear that a considerable effort needs to be made to train teachers in their new roles, to orient the new personnel outside the education profession to enable them to make their contributions to the learning of pupils, and to provide a wide variety of learning/teaching materials and resource materials specifically designed for these new situations. Judicious use of mass media could be important, although there is little evidence at present that newspapers and other mass media are being asked to support this effort.

It was noted that, in non-formal education, major efforts which are focussed on solving community and rural problems are being made by various ministries, departments and agencies. An obvious feature of such non-formal education is the intimate and immediate relationship between education (acquiring of knowledge, skills and attitudes) and work activities. There are many instances, however, when a designed educational input — beyond pure information — may be missing, so that the learners are not exposed to such educational aspects as understanding, decision-making and problem-solving. The non-formal programmes, however, provide good examples of wide-ranging uses of local human, space and material resources, including institutional resources.

Experiences in several countries that have launched substantial programmes of education for population out of school have brought to light important design considerations that have to be kept in mind. Many of these have implications for education in the school system as well, particularly as new curriculum development activities shift towards greater relevance to life and more direct contribution to socio-economic development; for example:

- The curriculum developer would need to consider groups of learners having a far greater range in chronological age or experiential background than a group of learners in a conventional classroom.

- The stock of human knowledge would need to be considered and drawn upon for the design of learning situations from a variety of angles and not only in terms of the conventional divisions into disciplines, bearing in mind that the structure of learning experiences is not differentiated by different disciplines.
- Learning and action should not be separated. Education needs to be linked to productive application, such as to work. Every act of learning would thus result in an increased capacity for self-learning.
- A variety of learning modes other than 'being taught' would be utilized, such as self-learning, group learning, dialogue, inter-learning.
- Various learning methods should also be utilized, such as modular learning or flexible time-tabling, to meet the variety of individual and group requirements.

SUMMARY OF CONCLUSIONS

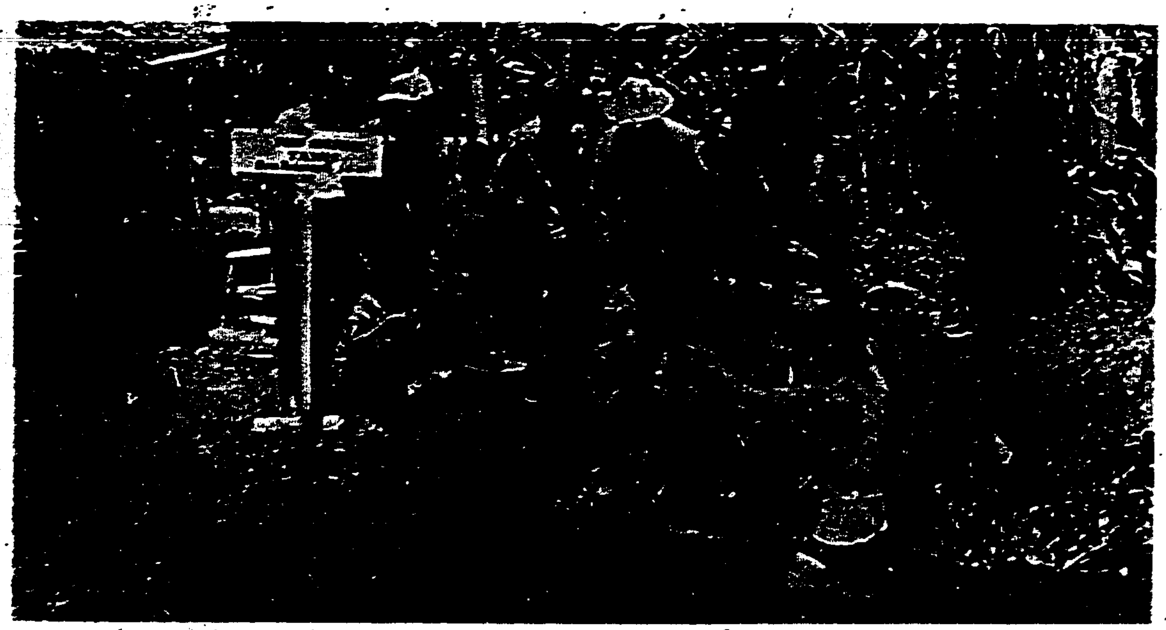
1. Community-based science-technology education is oriented to community problems, with real-life situations being utilized for the learning of science concepts and the application of these concepts to community problems.

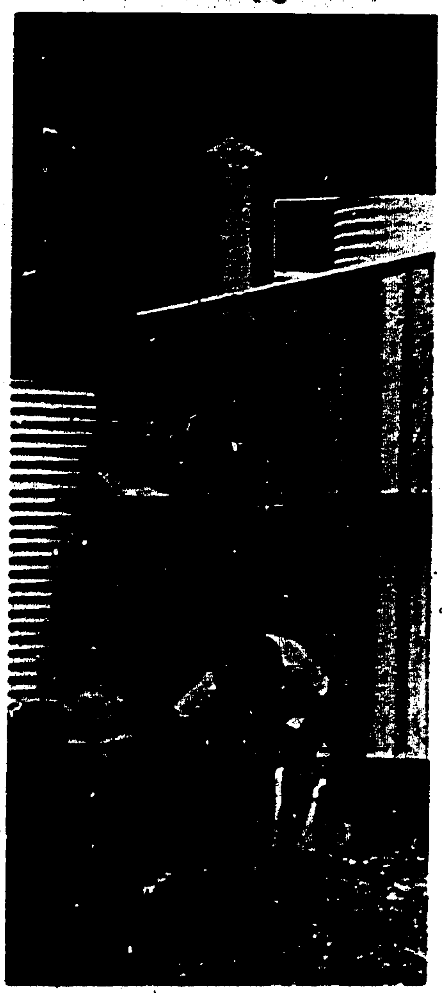
2. A dynamic relationship has to be established between the school and the community so that the school does not just receive community support in funds and resources but, in offering training and producing usable goods, it contributes towards the community's development.

3. The approach to developing curriculum through life situations and problems calls for the development of new techniques and instruments.

4. In community-based science-technology education the role of teachers is a vital one, and their training in the use of local resources and in self-learning skills would be vitally important.

5. Science-technology education has also an important contribution to make in non-formal education. The designing of education inputs in non-formal education would have important implications for education in the school system as well. These implications relate to interlinking learning with practical application, using environmental resources for learning, and with emphasis on a variety of learning modes and methods.





6. PROBLEMS FOR FURTHER STUDIES AND RESEARCH

The discussions highlighted a variety of significant problems in science and technology education in the Asian region, as indicated in Chapter 3. It was clear that, while a considerable effort has been made in facing up to these and other issues, most of the innovative efforts undertaken so far have suffered from the lack of a sound systematic research or data base, and there is a need for further studies to provide more information on science and technology education. The items listed below were suggested for priority attention; the Meeting recommended that Member States consider the importance and feasibilities of initiating further studies and research in these areas. The Meeting also recommended them as most suitable for bilateral assistance.

The activities indicated focus on the general studies: How can curriculum development in science and technology education based on real-life situations be planned and developed? How can these curricula be effectively implemented so that the vast numbers of learners, especially in disadvantaged areas, may be reached? How can these efforts be suitably evaluated?

These questions apply to both the school system and outside it, with the recognition that the problems in the out-of-school situation are more complex

and diverse. The following were among the specific studies and research activities recommended in the respective areas listed:

1. Planning aspects

- Studies on the objectives of science-technology education at various levels of education;
- Survey studies at macro and micro levels for the identification of community resources and techniques and technologies in use at micro level;
- Problems of community resource mobilization;
- Studies on different types of science content for current programmes in technical and vocational education and for community education;
- Studies on science and mathematics programmes for pre-vocational education;
- Studies on out-of-school populations including drop-outs, non-enrollers and educated unemployed, with particular reference to their learning needs;
- Studies on problems of and strategies for upgrading teacher education for science and technology.

2. Implementation aspects

- Studies on communication channels among various administrative units involved in science and technology education;
- Studies on the role of Science Teachers' Associations in promoting science and technology education;

- Studies on the teacher's emerging role and competency in handling new science and technology curricula;
- The development of self-learning materials for the in-service education of the large number of teachers at primary and secondary levels; the establishment of decentralized local resource centres of a simple type that can provide these resources for teacher self-development; the establishment of a knowledge-flow system that reaches these decentralized centres;
- The development of pre-service education programmes fostering new and urgently-required competencies of teachers, such as the skills of self-learning, the skills of being a facilitator of learning, management skills, decision-making skills, skills for the preparation of self-learning materials for learners;
- Appraisal of supportive activities such as those for the production of simple equipment, including the use of toys and games for learning.

3. Evaluation aspects

- The development of evaluation instruments for learners to meet the specific requirements — if decentralized curricula based on real-life situations in science and technology education are to be utilized — such as diagnostic testing, criterion-referenced testing, self and peer evaluation;
- The development of evaluation techniques to monitor and sustain national standards in the situations of decentralized and/or adapted curricula based on real-life situations;
- The development of process and product evaluation instruments to evaluate the various programmes (planning, implementation and evaluation) of science and technology education based on life situations.

7. CO-OPERATIVE ACTION PROGRAMMES FOR SCIENCE AND TECHNOLOGY EDUCATION IN ASIA

The discussions in the Meeting helped to identify a large variety of innovative programmes which the Member States have under way for strengthening and improving the education of young people in science and technology. Important as these activities are, even more significant are the new directions which are being explored by the Member States in order to extend to all young people the benefits of science and technology education in forms which would be appropriate and relevant to the developmental needs of the individual as a person and as a citizen, and to the larger needs of national development. The discussions also drew attention to a range of problems and constraints which, in varying degree, the countries have in common.

The Meeting was of the view that a significant area for inter-country collaboration lies in working jointly towards finding solutions to the important problems which the countries may have in common, through the sharing of their experiences and insights. Indeed, inter-country collaboration is particularly valuable at the present stage of development when the programmes in the Member States are moving towards new frontiers of social relevance and equity. Such inter-country co-operation and sharing will also contribute to enhancing each Member State's capacity to find solutions to its own particular problems in their specific context.

Bearing these considerations in mind, the Meeting made the following recommendations, inviting the Member States to participate in carrying them out, and Unesco and other international bodies to co-operate with and support the initiatives of the Member States in this regard.

Development and dissemination of information and materials

1. Unesco is requested to extend its support for the preparation of case studies and inventories of significant programmes relating to science and technology education and in particular to the inter-relationship of science and technology in educational programmes which are being undertaken in the Member States in the region.

2. Asian Member States are requested to provide relevant materials, information and pertinent research data on significant projects and studies relating to science and technology education in their countries. The Asian Centre of Educational Innovation for Development (ACEID) of Unesco should act as a continuing clearing house for these materials.

3. Unesco is requested to extend its support for:

   a) the preparation of an inventory, and case studies of in-service methods of training science and technology teachers, and for disseminating them to the Member States;

   b) the preparation of an inventory of design of equipment for basic science and technology education programmes. These designs should relate to the basic levels of education and be possible in very simple classroom situations. The inventory of designs should be widely disseminated to the Member States.

4. Unesco is requested to provide support to the Member States, as required, for the translation into English of samples of learning/teaching materials in the national languages successfully developed and used by the Member States, for sharing with other Member States.

<u>Technical co-operation among Member States</u>

5. Unesco and other interested international bodies are requested:

   a) to provide support, at the request of a Member State, to convene co-operative group meetings of experts (with participants from within and outside the country) to elaborate, at technical level and in a specific national context, the methodologies for the interlinking of science and technological learning experience with suggestions for try-out and implementation;

   b) to provide support, at the request of a Member State, for co-operative development in a country's context, and with the participation of experts from the region and outside, of integrated science-technology units or modules designed for in-school and out-of-school populations and for use in group/self-learning situations;

   c) to facilitate the preparation of a Handbook on conducting advanced-level workshops for science and technology teacher educators. The Handbook should be prepared co-operatively and would include significant case studies and their analysis in order to activate self-learning.

<u>Inter-country exchange of experiences</u>

6. Unesco, other interested international bodies and the Member States are requested to provide facilities for study visits by project workers to relevant activities in other countries in the region and for on-the-job training by attachment to on-going projects in host countries.

7. Unesco and the Member States are requested to facilitate the organization, in selected national centres, of training courses for teacher educators designed to enable them to instruct teachers in self-learning skills, and in teaching from real-life situations.

ANNEXES

ANNEX I

LIST OF PARTICIPANTS AND OTHERS ATTENDING

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ANNEX II

AGENDA

Inaugural Session

1. Election of Officers of the Meeting

2. Consideration of Provisional Schedule of Work

3. Current Trends in Science and Technology Education in Asia

4.1 Problems of Science and Technology Education in Asia

4.2 Inter-relationship between Science and Technology in Education

4.3 Community-based Science and Technology Education

4.4 Problems for Further Studies and Research

5. Consideration of the Recommendations for Co-operative Action Programmes for Science and Technology Education in Asia

6. Consideration of Draft Report and Its Adoption

7. Closures of the Meeting

ANNEX III

LIST OF DOCUMENTS

Information Documents

General Information	ROEA-76/STEAM/INF.1
List of Documents	ROEA-76/STEAM/INF.2
List of Participants	ROEA-76/STEAM/INF.3
Schedule of Work	ROEA-76/STEAM/INF.4

Working Documents

Agenda	ROEA-76/STEAM/1
Annotated Agenda	ROEA-76/STEAM/2
Rules of Procedure	ROEA-76/STEAM/3
Country Reports:	ROEA-76/STEAM/4/Country
	- Afghanistan - Australia - Bangladesh - Burma - Indonesia - India - Japan - Republic of Korea - Malaysia - Nepal - New Zealand - Pakistan - The Philippines - Singapore - Thailand - USSR
Current Trends and Problems in Science and Technology Education in Asia	ROEA-76/STEAM/5
Technology and General Education	ROEA-76/STEAM/6
Inter-relationship between Science and Technology in Education	ROEA-76/STEAM/7

APPENDIX I

Address of Welcome
by Mr. Raja Roy Singh, Director
Unesco Regional Office for Education in Asia

Your Excellency Senior Minister of State for Education
Ladies and Gentlemen,

It is an honour and privilege for me on behalf of Unesco to extend a warm welcome to the distinguished participants and guests to the Regional Meeting on the Trends and Problems of Science and Technology Education in Asia and to its Inaugural Session this morning.

It is most appropriate that the venue of this Meeting is Singapore, a country which symbolizes par excellence the dynamics of development when science and technology are bonded with the creative energies of the people. We owe the honour of holding the Meeting here to the generous host facilities provided by the Government of the Republic of Singapore, its Ministry of Education and the Singapore National Commission for Unesco. On behalf of Unesco, I offer our thanks and deep appreciation to them for the cordial welcome they have extended to the Meeting and the characteristically efficient way in which the organization of the Meeting has been handled. May I, take this opportunity also to pay my Organization's special tribute of appreciation to the Government of Singapore for the unvarying support and co-operation extended by it to Unesco's programmes for furthering regional co-operation in the service of educational development in Asia.

We are grateful to the authorities of the Regional English Language Centre for making available its premises for holding the Meeting and for all the courtesies and consideration that the Centre's staff have extended to us.

Preparations for this Meeting were initiated last year when Unesco invited the Member Countries in the Asian region to send in reports of the situation of science and technology education in the countries. There was an immediate and favourable response which also showed a profound concern for making science and technology education an integral and dynamic element in national development. It was here in Singapore that earlier the Third Regional Conference of the Ministers of Education and Those Responsible for Economic Development in Asian Member States had stressed with special emphasis the role of science and technology education in national development. The reports received from the Member Countries early this year were testimony to the dynamic efforts under way in the countries and to the rich variety of experiences which had emerged in retooling education since the Third Regional Ministerial Conference in 1971. Along with these experiences new problems have also emerged. The present Regional Meeting is therefore seen as a timely opportunity for the Member Countries to share each other's experiences and to contribute to sharpening of the insights into problems which they have in common. We hope that through such sharing of experiences and of problems, the Meeting will give us its suggestions for a co-operative action programme for the development of science and technology education in the Asian region.

It is a matter of deep gratification to Unesco that the Member States have responded to its invitation by making available for participation distinguished educators, specialists in science and technology education, and those who bear the responsibility for planning and implementing science and technology education in their countries. I should also like to express our thanks to the Representatives of U.N. bodies and other Organizations for participating in the Meeting and sharing their experiences with us.

Your Excellency, it is a great honour to have you with us to inaugurate this Meeting, and on behalf of Unesco I thank you for being with us this morning despite the many calls on your time by duties of State. May I request your Excellency to inaugurate the Meeting.

APPENDIX II

Inaugural Address
by H. E. Mr. Chai Chong Yii
Senior Minister of State for Education

First on behalf of the Government and the people of Singapore, I welcome all of you to this gathering of distinguished delegates from 17 countries in the Asian region. Though a small developing country, Singapore has had the good fortune to host many international conferences, seminars and workshops. This is in fact the third Unesco meeting to be held in Singapore during the last 12 months - the first was the Technical Working Group Meeting on Educational Technology in Asia under the Asian Programme of Educational Innovation for Development (APEID) and the second, held only last month, was on the subject of Bibliography on Malay Culture.

The theme chosen for this Meeting is relevant to Singapore and other developing countries in Asia. In today's world, modernization generally involves some degree of industrialization, the key to which is the application of science and technology. I am pleased to note that this Meeting will discuss the trends and problems in science and technology education at the primary and the secondary levels. If a strong foundation is laid at these levels, the future success of the entire effort to industrialize and modernize is almost assured.

Receptivity to industrial technology depends to a large extent upon education. This subject has attracted great interest and aroused heated discussions in countries all over the world whether developed or developing. Every country seems to be critical of its education system and people everywhere expect education to play a diversity of roles in addition to imparting basic knowledge and skills. The ability of the education system to respond to the needs of a modern society is being questioned. Thus the system of education is continuously undergoing reappraisal.

However, not all forms of formal education are geared towards economic development and industrial growth. Educational programmes at primary level are mainly concerned with the individual development of the child to acquire language and manipulative skills. These in turn form the basis for the later teaching of science and technology which will be needed for economic progress. At the same time, the education system must foster in the growing child various qualities or attitudes considered desirable for his role as a citizen. Thus education has to play the dual role of preparing young people to take their place in the economic and civic life of the community.

In Singapore, we have a situation where over-two million people are crowded on a tiny island with no natural resources apart from its harbour and strategic location. Our population is a young one - more than 23% are of school-going age. In the face of this, our national planners have recognized that in the development of our young people lies the key to the future. Investment in science and technology education is therefore a means to achieve economic growth.

At the secondary level, we have since 1969 embarked upon a programme of exposing the majority of our students to what is popularly known as workshop practice. It is in this programme that we see science and technology education integrated. In addition, training in a wide range of industrial skills is available at numerous vocational institutes. At the teachers' training institution, a special department exists to train technical teachers. In Singapore, therefore, science and technology education at the first two levels are of great importance and large sums of money are invested in these programmes. I would like on behalf of my Government to extend to each of you an invitation to visit some of our schools and institutions to see at first hand our efforts in the areas of education and skill training. We shall be delighted also to hear your comments.

Science and technology education are the building blocks in the acquisition of technological skills and development of the economy. But this development though urgent is difficult. One wonders why the same machines so successful in developed countries malfunction when imported into the developing countries. This Meeting will give countries in the Asian region a much-needed opportunity to examine their own problems and experiences which are different from those of the developed countries. I trust that this Meeting will yield useful suggestions and recommendations for follow-up action to be undertaken by education planners. On that note, I now have the pleasure to declare this "Regional Meeting on the Trends and Problems in Science and Technology Education in Asia" open.