

APPENDIX I

HIGHLIGHTS OF THE INTERRELATED MEETINGS OF EXPERTS OF SCIENCE, MATHEMATICS, TECHNICAL AND VOCATIONAL SUBJECTS HELD IN NICOSIA, CYPRUS, MARCH 1982

Twenty-seven specialists from 20 member countries throughout the Commonwealth, (see Appendix II) and observers from UNESCO and CASTME, participated. They met in three groups, which concentrated on: science, mathematics, and technical and vocational education. However, opportunity was provided for a certain amount of interaction between the groups.

The Science Group had as its main working paper "Junior School Science Curriculum: A Commonwealth Approach". In addition it had a background document "Science Education in the Commonwealth", position papers on science and mathematics education from participants' countries, and syllabuses in the relevant subjects from a number of Examination Boards in the Commonwealth. The group agreed that one way of meeting the 8CEC recommendation*, bearing in mind the varied circumstances in which the subject is taught in member countries, was to prepare, as an initial step, a core curriculum linking areas of study in science and mathematics. It then went on to draft a combined programme for the primary and junior secondary levels, i.e. up to the point where the majority of children in most Commonwealth countries leave the school system.

The group identified eleven areas of study to which, in their view, all school pupils should be exposed, both for their personal development and to enable them to contribute to development in their country. These eleven study areas were: senses and measurement; our universe; the human body; food; health and nutrition; ecology; resources (man-made and natural); population; energy uses; technology; and quality of life.

The group recommended that when defining each of these study areas, curriculum designers should prepare a statement justifying its place in the core curriculum. Additional statements should be prepared on (a) the concepts to be acquired, (b) the topics in mathematics and technical and vocational subjects which can be taught in relation to that particular theme, (c) ways of teaching the content so as to bring out interrelationships between the relevant subjects, and (d) the minimum competencies pupils should be expected to achieve.

*see p.1.

The Mathematics Group had as its main working paper "School Mathematics Curriculum: A Commonwealth Approach". Like the Science Group it also had position papers in science and mathematics from countries from where participants had come, together with syllabuses in the relevant subjects from a number of Examination Boards.

The Group deliberated on the role of the school, noting that as an instrument of society to restructure the society, which itself changes from time to time, the school must vary its role along with the changes. It should take into consideration the viewpoints of: (a) parents and children in preparing children for the world of work; (b) the government in producing the right kind of person-power i.e. in preparing children for employment (or unemployment) ; and (c) educators.

It agreed that in designing mathematics curricula one should look for the minimal intersection set (or core) which will prepare the majority of early school leavers to meet the world of employment/unemployment, with additional curriculum blocks (units, modules) for higher-ability students to continue to different stages of schooling. Such a core should emphasise conceptual understanding of topics included in the curriculum. It suggested that curriculum design teams should be composed of interest groups of parents, business and industry users and academics. But, more importantly, teachers ought to be involved in these interest groups in a very significant way so that they may carry the curriculum with them. The group proposed a core curriculum to which all primary school children should be exposed during their five to six years of schooling. In particular, it agreed that the skills of arithmetical operations should not be sacrificed through the use of calculators.

The Technical and Vocational Group had as its working and background documents "Craft, Design and Technology", "The Inter-relations of Technology, Science and Mathematics Subjects", "General Technical Education Pilot Project" and examples of technical education syllabuses in the following subjects - woodwork, metal work, technical drawing, electrical, automotive, home economics and agriculture.

The group noted that while traditional methods of teaching craft subjects are used in some countries, in others a practical problem-solving approach had been or was being developed. It agreed that to the extent that the total curriculum is a preparation for work, a concern for vocational preparation is the responsibility of all subjects. It further agreed that the acquisition of craft skills was no longer the sole objective of technical training and that solving practical problems was an important and integral part of workshop practice courses. Noting that it would take a long time for technical education courses based on the problem-solving approach, this group suggested that every effort be made to evolve the latter method because of the considerable benefits to be gained educationally when children are

involved in designing, developing and evaluating practical project work.

Teaching skills required for the successful implementation of curricula based on the problem-solving approach are markedly different from those required by traditional technical subject teachers. The new approach requires the teacher to act as a facilitator and an adviser in order to assist students to learn how to learn, to develop value judgements and skills for searching for resources. The implications for pre-service and in-service teacher training and the need for traditionally trained teachers to have a change of attitude cannot be over-emphasised.

The group also considered the issue of assessment in courses based on a problem-solving approach, noting the possibility of such assessment being accommodated within a formal examination system. Such an approach would include the assessment of intellectual processes as well as craft skills.

Finally, the group attempted to identify the knowledge, skills and attitudes and their most important components relative to a problem-solving type curriculum which are necessary for the generality of school leavers. Skills included investigation, innovation, modelling, realisation, communication, and evaluation. Knowledge included energy, control, materials, and context. Attitudes included resourcefulness, efficiency, reliability, precision, safety, and aesthetic aspects in craftsmanship.

The first interdisciplinary group considered the issue of measurement. It noted that in technical education primary school children are expected to use various instruments correctly and to have a fair understanding of the components; they are not necessarily expected to understand the principles involved. In science education on the other hand children are expected to acquire a wider concept of measurement through a variety of activities and to be encouraged to make inferences.

The group noted some questions that have to be reviewed in formulating guidelines. These include:

- (a) What experiences and activities are to be introduced, at what age and how possible is interrelation between mathematics, science and technical education?
- (b) What strategies are to be adopted?
- (c) What are the implications for the teacher and teacher education?

The second inter-disciplinary group had time to consider the use of materials only in the primary school. It examined materials and resources needed for study and materials and resources as the object of study. In science emphasis is on local materials although a few materials may need to be imported from other countries. In mathematics what is needed is mainly rulers, scales, and weights; many of these can be manufactured locally. Technical subjects require ordinary hand tools for skill development and for the application of science and mathematics.

The third inter-disciplinary group reviewed the areas common to science, mathematics and technology in the teaching about energy. The experts felt that in teaching science, especially at the primary level, the main focus should be on the uses, rather than the concept, of energy. It was suggested that the role of mathematics should be minimal; simple arithmetical applications and graphs could be employed to enhance children's understanding of sources of energy and the need to save energy. In teaching 'energy' in technology at the primary level, the focus should be on control while paying attention also to safety, and to the social, environmental, personal and economic aspects. It was noted, however that while topics may be common to the relevant subjects, in general there is a fundamental difference between scientific and technological methodologies.

The fourth inter-disciplinary group considered 'communication' as being a unifying inter-disciplinary element of the school curriculum in general and in those disciplines of science, mathematics, technical and vocational education. The experts discussed oral and literal, graphics, spatial and numerical skills which they considered fundamental to the teaching and learning of science, mathematics, technical and vocational subjects.

Finally, in a joint meeting of the two groups of experts, it was agreed that:

1. The education of teachers is crucial to the implementation of the proposed guidelines which demand an understanding of the relationships between science, mathematics and technology.
2. A problem-solving approach should be used so that the interrelationships are clearly seen and used as an integrating factor.
3. Any curricula designed should make use of locally available materials so as to keep educational costs at a minimum.

APPENDIX II

DIRECTORY OF PARTICIPANTS AT THE INTERRELATED MEETINGS

(Held in Nicosia, Cyprus, March 1982)

Science and Mathematics Group

Mr S O Agun
Assistant Director of Education
Federal Ministry of Education
Victoria Island
Lagos
NIGERIA

Dr M S Arora
DESM, NCERT
Sri Aurobindo Marg
New Delhi 110016
INDIA

Dr K A Awuku
Senior Lecturer
Faculty of Education
University of Cape Coast
Cape Coast
GHANA

Professor A C Bajpai
(CASTME)
Loughborough University of
Technology
Loughborough
UNITED KINGDOM

Dr (Mrs) S Bhattacharya
Reader
NCERT
Sri Aurobindo Marg
New Delhi 110016
INDIA

Dr Desmond Broomes
Senior Research Fellow
School of Education
University of the West Indies
Cave Hill Campus
Bridgetown
BARBADOS

Mr D G Chisman
Education Consultant
114 The Avenue
Sudbury-on-Thames
Middlesex TW16 5EA
UNITED KINGDOM

Professor G S Eshiwani
Director
Bureau of Educational Research
P.O. Box 43844
Nairobi
KENYA

Professor Peter Fensham
Monash University
Wellington Road
Clayton
Victoria
AUSTRALIA

Mr S Hadebe
Deputy Regional Director
Ministry of Education and Culture
Mashonaland Region
P.O. Box 8121
Causeway, Harare
ZIMBABWE

Mrs Sheila Haggis
Chief
Science Education Section
Division of Science, Technical
and Vocational Education
UNESCO
place de Fontenoy
75007 Paris
FRANCE

Dr J B Holbrook
School of Education
University of Hong Kong
Pokfulam Road
HONG KONG

Mr S Katende
Principal Curriculum Developer
Institute of Education
P.O Box 350094
Dar es Salaam
TANZANIA

Mr S Muralidhar
School of Education
USP
P.O Box 1168
Suva
FIJI

Mr A M Ranaweera
Deputy Director-General
Ministry of Education
Malay Street
Colombo 2
SRI LANKA

Dr Lee Chuan Seng
Associate Professor
School of Educational Studies
University of Sains Malaysia
Minden
Penang
MALAYSIA

Mr Evan Uzwysyn
Science Consultant
Ministry of Education
Winnipeg
State of Manitoba
R3G 0T3
CANADA

Mr B J Wilson
Head
Consultancies Group
EMSD
The British Council
10 Spring Gardens
London SW1A 2BN
UNITED KINGDOM

Technical and Vocational Group

Mr Peter Bleakley
Curriculum Development Centre
Department of Education
Wellington
NEW ZEALAND

Professor Charles Farrugia
Faculty of Education
University of Malta
MALTA

Mr V George
Headmaster
Mmengo Senior School
Kampala
UGANDA

Dr John Grant
Secretary
Technical and Further
Education Council
Commonwealth Tertiary
Education Commission
Benjamin Offices
Benjamin Way
Belconnen
ACT 2616
AUSTRALIA

Mr George A Hicks
H.M. Inspector of Schools
Department of Education and
Science
Elizabeth House
York Road
London SE1
UNITED KINGDOM

Dr P.O Igharo
Principal
Auchi Polytechnic
P.M.B. 13
Auchi
Bendel State
NIGERIA

Mr L.K. Rantofi
Director
Lerotholi Technical Institute
P.O. Box 16
Maseru
LESOTHO

Workshop Secretariat

Director

Mr Rex E O Akpofure
Director
Education Division
Commonwealth Secretariat
Marlborough House
Pall Mall
LONDON

Chairman

Mr M Maratheftis
Director
Pedagogical Academy
Nicosia
CYPRUS

Secretaries

Mr E Apea
Chief Project Officer
Education Division
Commonwealth Secretariat
Marlborough House
Pall Mall
LONDON

Mr A Johnson
Chief Project Officer
Education Division
Commonwealth Secretariat
Marlborough House
Pall Mall
LONDON

Senior Local Support Staff

Mr George Economides
Inspector, Technical Education
(1st Grade) and Commonwealth
Desk Officer

Mr Loizoa Loizides
Inspector of Primary Education

Mr Xenophon Christofides
Inspector of Secondary Education
(Science)

Mr Christos Pantelides
Inspector of Primary Education

Mr Alex Ioannou
Inspector of Technical Education

Mr Antis Savva
Administrative Officer
Ministry of Education

Mr M Michaelides
Inspector of Secondary Education
(Maths)

Mr F Demetriades
Assistant Headmaster
Pedagogical Institute
Nicosia
CYPRUS

Mr Andreas Skotinos
Teacher, "A" Gymnasium of
Acropolis, Nicosia
CYPRUS

Mr Antonis Michaelides
Assistant Headmaster
"A" Technical School
Nicosia
CYPRUS

APPENDIX III

PROVISIONAL SPECIALIST CONFERENCE AGENDA

1. Interrelation of Science, Mathematics, Technical and Vocational Curricula

- (a) Examining Commonwealth experience in the development of school curricula based on innovative approaches to the interrelation of science, mathematics, technical and vocational subjects and their interaction with the world of work.
- (b) Formulating guidelines for the design of inter-related science, mathematics, technical and vocational subjects.
- (c) Recommending practical ways to produce and implement interrelated curricula and arrangements to improve interaction between school and the world of work.

2. Teacher Education Systems and Interrelated Curricula

- (a) Examining teaching competencies necessary to implement interrelated science, mathematics, technical and vocational curricula.
- (b) Formulating teacher education strategies to achieve and maintain competence for teaching interrelated science, mathematics, technical and vocational curricula.

3. Communication in Science, Mathematics, Technical and Vocational Subjects

- (a) Examining Commonwealth experience in linguistic and graphical/pictorial difficulties which are encountered in teaching and learning of science, mathematics, technical and vocational subjects.
- (b) Recommending practical ways to overcome linguistic and graphical/pictorial teaching and learning difficulties in interrelated curricula.

4. Provision of Resources for Science, Mathematics,
Technical and Vocational Education

- (a) Formulating proposals to increase local self-reliance in the provision of resources including laboratory, workshop and physical facilities used in the teaching of science, mathematics, technical and vocational subjects.
- (b) Identifying special requirements for the assessment of performance in interrelated science, mathematics, technical and vocational curricula.
- (c) Formulating guidelines on suitable methods of assessment related to non-traditional experimental work, activities linked with the world of work and desired student attitudes in studying interrelated curricula.

5. Bilateral and Multilateral Co-operation

- (a) Identifying ways of utilising existing patterns of bilateral and multilateral co-operation to establish and sustain the interrelation of science, mathematics, technical and vocational curricula.
- (b) Formulating proposals for innovative programmes of bilateral and multilateral co-operation to improve and increase assistance to governments in their efforts to develop interrelated school curricula in science, mathematics, technical and vocational subjects.