DOCUMENT RESUME

ED 222 636 CE 032 937

TITLE Vocational and Technical Education: Development of Curricula, Instructional Materials, Physical Facilities and Teacher Training with Focus on Electrical and Electronic Subjects. Asian Programme of Educational Innovation for Development. Report of a Technical Working Group Meeting (Adelaide, Australia, October 6-18, 1980).

INSTITUTION United Nations Educational, Scientific, and Cultural Organization, Bangkok (Thailand). Regional Office for Education in Asia and the Pacific.

PUB DATE 81

NOTE 104p.; For related document, see ED 208 134.

AVAILABLE FROM UNIPUB, 1180 Avenue of the Americas, New York, NY 10036.

PUB TYPE Collected Works - Conference Proceedings (021) -- Information Analyses (070) -- Guides - Non-Classroom Use (055)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.

DESCRIPTORS *Curriculum Development; Educational Facilities; Educational Innovation; *Electricity; *Electronics; Guidelines; Instructional Materials; *Material Development; Nonformal Education; Postsecondary Education; Secondary Education; *Teacher Education; Technical Education; Vocational Education

IDENTIFIERS *Asia; Asian Programme of Educ Innovation for Development; *Pacific Region

ABSTRACT

This report contains summaries and syntheses of materials from the Technical Working Group Meeting for curriculum planning and instructional materials design for vocational and technical education. Chapter 1 gives an overview of the objectives and procedures of the meeting and lists the participants. In chapter 2 are presented summaries of the participants' analytical papers regarding existing methodologies and approaches in curriculum planning, development of instructional materials and facilities, and teacher training in the field of electrical and electronics subjects and in the relevant parts of the science curriculum for general education courses. These countries are represented: Australia, Bangladesh, India, Indonesia, Japan, Malaysia, Papua New Guinea, Philippines, Republic of Korea, Sri Lanka, and Thailand. Chapter 3 synthesizes the country experiences under these headings: general education, vocational and technical education, formal and nonformal education, curriculum planning, instructional materials, physical facilities, teacher training, problems and strategies for solving them, innovations, and future plans. Chapter 4 provides guidelines for development of curriculum, instructional materials and physical facilities, and teacher training. Conclusions and recommendations for future regional cooperative action are given in chapter 5. Appendixes include a summary of participant experience from visits, inaugural and closing addresses, and other materials from the meeting. (YLB)

APEID

ASIAN PROGRAMME OF EDUCATIONAL INNOVATION FOR DEVELOPMENT

Vocational and Technical Education: DEVELOPMENT OF CURRICULA, INSTRUCTIONAL MATERIALS, PHYSICAL FACILITIES AND TEACHER TRAINING WITH FOCUS ON ELECTRICAL AND ELECTRONIC SUBJECTS

Report of a Technical Working Group Meeting
Adelaide, Australia, 6–18 October 1980

UNESCO

UNESCO REGIONAL OFFICE FOR EDUCATION IN ASIA AND THE PACIFIC
Bangkok, Thailand, 1981

Published by
Unesco Regional Office for Education in Asia and the Pacific
G.P.O. Box 1425
Bangkok, Thailand

Printed in Thailand

Opinions expressed in this publication are those of the participants of the Technical Working Group Meeting and do not necessarily coincide with any official views of Unesco. The designations employed and the presentation of the material herein do not imply the expression of any opinion whatsoever on the part of Unesco concerning the legal status of any country, or of its authorities, or concerning the delimitations of the frontiers of any country or territory.

TABLE OF CONTENTS

Chapter One

INTRODUCTION

Background

While formulating the guidelines for APEID's second-cycle plan, the Fourth Regional Consultation Meeting on APEID, Bangkok, 1977, suggested the addition of a new area of innovation, namely Vocational and Technical Education. Vocational and technical education is related closely to other areas of innovation in APEID, notably curriculum development, science education and non-formal education.

Considering that vocational and technical education is a relatively new area of innovation under APEID, the main action at this stage is on collection and regular exchange of innovative experiences; collaborative designing of strategies, methodologies, and instructional materials in the various fields of vocational and technical education including training of teachers; and co-operative research and development on problems of common concern to the Member States. This action will be linked to two development themes, namely: development of productive skills and integrated rural development.

One of the projects in the Work Plans of APEID related to vocational and technical education has special emphasis on innovative curriculum planning and relevant educational materials design. In the execution of this project, a series of Technical Working Group Meetings for curriculum planning and instructional materials design are envisaged to take place.

Objectives of the Meeting and participation

The present Meeting, the second in the series, was convened with the following objectives:

1. To examine existing methodologies and approaches in curriculum planning, in developing instructional materials and physical facilities, and in teacher training in the field of electrical and electronics subjects and in the relevant parts of the science curriculum for general education courses.
2. On the basis of the synthesis of experiences of projects in the participant countries of to develop suggestions and guidelines for planning, curriculum, instructional materials, physical facilities, and pre-service and in-service teacher training.

Thirteen participants from 10 Unesco Member States attended the Meeting; one each from Bangladesh, Indonesia, India, Japan, Malaysia, Papua New Guinea, Philippines, Sri Lanka and Thailand, and four from Australia. The participants of the Meeting are listed in Annex 2 of this report.

The nominee of the Republic of Korea was unable to participate in the Meeting, but forwarded his analytical paper to the Meeting. This allowed the paper to be presented by the secretariat of the Meeting in his absence.

Procedures of the Meeting

The participants were welcomed by Mr. D. Thornton, Vice-Principal of the Regency Park Community College, the venue for the Meeting. The inaugural address was given by Mr. R. Gordon Tasker, Director of Educational Services, South Australian Department of Further Education. The text of Mr. Tasker's address forms Annex 3 of this report.

Mr. A. Dyankov, Specialist in Instructional Materials, ACEID, Unesco Regional Office for Education in Asia and Pacific, Bangkok, and Ms. M. Gallagher of the Australian National Commission for Unesco, Canberra, responded to the welcome and the inaugural address.

During the Official Luncheon, participants were welcomed to South Australia and the College by Mr. L. Davis, Member of the Legislative Council of the South Australian State Parliament, representing the Minister of Education, and Mr. L.A. Kloeden, Director General of Further Education in South Australia.

The Officers elected by the Meeting, together with the Secretariat, are listed in Annex 2 of this Report. The Annotated Agenda, which forms Annex 4 of this Report, was adopted by the Meeting together with the Schedule of Work (Annex 5.)

The Technical Working Group Meeting comprised:

1. Plenary Sessions, led by the Chairman.
2. Group Sessions, in three groups, each led by a Vice-Chairman (see Annex 6 for composition of the groups).
3. Visits to educational institutions in Melbourne and Perth before the Meeting and in Adelaide during the Meeting.
4. The preparation and adoption of this Report.

Chapter Two

SUMMARIES OF PARTICIPANTS' PAPERS

The following summaries were prepared by the participants of the Technical Working Group Meeting. A single summary was prepared for Australia although four representatives attended the meeting and presented summaries of their analytical papers.

AUSTRALIA

A. Typology of current courses

Australia, with a land area of 7,687,000 square kilometres and a population of approximately 14 million, has one of the lowest population densities of the world. The country consists of seven states and territories which are bound together in a federation. The responsibilities of the Australian and the various state governments are defined in the Federal Constitution. Education is a responsibility of the state governments although the Australian Government provides much of the financial resources used by the education system, thus ensuring some form of equality across the continent. Since education is basically a state responsibility, the state population centres are geographically isolated and there is little inter-state employment movement, there may be significant differences in vocational and technical education from State to State.

Post-secondary education can be divided into three sectors:

- Universities providing education programmes of at least four years' full-time duration for professional engineers.
- Colleges of Advanced Education including the Institutes of Technology, which provide courses for professional engineers and for the upper para-professional grades.
- Colleges of Technical and/or Further Education which provide vocational and technical courses.

The courses offered can be divided into three levels according to the three major employment categories of professional engineer, technical officer (or engineering associate) and tradesman:

- Professional or degree courses;
- Technician (or Certificate, or Diploma) courses;
- Trade (or craftsman, or vocational) courses.

General education in Australia takes 12 years, and degree courses in general are started after the completion of general education—although there is an increasing opportunity for alternative forms of university entry. Degree courses may typically include 2,200 hours of lectures, tutorial and practical work, seminars and projects.

The technical courses are generally begun after 11 years of general education and include about 1,400 hours of class work. The apprentice trade courses usually require at least ten years of general education, and involve a minimum of 800 hours of class work, supplemented by in-plant training. If a person is apprenticed he/she is nevertheless entitled to enrol in the appropriate apprentice course regardless of his/her secondary education achievement. A range of off-campus courses are offered by various educational institutions throughout Australia, including some in electrical and electronics engineering.

The Technical Working Group Meeting is primarily concerned with the Technical and Further Education (TAFE) sector of post secondary education. Each State has a Government authority responsible for TAFE activities in that State; the authority may be a separate department as in South Australia and New South Wales, or a division within the education department as in Victoria and Tasmania. Moves are being made to increase TAFE co-operation and co-ordination between the States.

B. Curriculum planning

In general each State TAFE authority has a curriculum planning branch but usually these branches are more concerned with the co-ordination of curriculum planning process rather than the planning itself.

Each TAFE authority attempts to develop courses to meet the perceived and stated needs of the industries, government departments and utilities of the State. Except for the electrical apprentice course very little formal interstate co-ordination occurs. As there is little interstate employment mobility, independent curriculum planning effort is likely to be more effective and result in higher resource utilization than if curriculum planning occurred on a national basis.

Recently, mainly because of the licensing of electrical workers, the States have agreed on a number of topics that should be included in electrical apprentice courses and nationally co-ordinated efforts have been made to write and publish textbooks and other instructional materials.

C. Instructional materials

There are few instances where the student population in the areas of electrical and electronic engineering education is sufficient to warrant the development of instructional material other than in the actual teaching situation.

In general, instructional software is developed by the teachers and modified and updated as part of their normal teaching preparation. TAFE authorities have received tied Government grants to improve the library resource centres located in TAFE colleges. While a few textbooks are written and published in Australia, most are developed and published by overseas companies but are readily available in Australia. Printed and projection materials are commonly used.

Most TAFE institutions have adequate instructional hardware such as projection equipment and video recorders. The number of items of laboratory test equipment may be sufficient, although much of this equipment is now reaching the end of its economic life.

D. Physical facilities

Physical facilities range from excellent to unsatisfactory. However, unsatisfactory facilities are gradually being replaced. Because of the declining birth rate (in fact some states are nearing zero population growth) Australia does not have the need to rapidly expand its vocational and technical education physical facilities.

E. Teacher training

All states have some form of pre-service or initial service training. Some states, for example South Australia and Victoria, conduct short courses of a few weeks' duration in survival skills. In most states, teacher training occurs in a university or college of advanced education and leads to a formal qualification such as a Diploma in Teaching or a Diploma in Education.

In-service training after the initial teacher training is more *ad hoc* and is largely dependent upon the available resources. Because of the reduction in the budget allocation to education in Australia the needs for technical updating and development of new teaching skills are not being adequately met. Other than for initial teacher training, the opportunities for study leave and industrial experience are limited.

F. Assessment methods

The student assessment methods vary from course to course depending to a large extent on the number of students undertaking the course and the number of centres in which the course is offered. In some instances student assessment is centrally determined, whereas in other cases it is the prerogative of the institution offering the course. In most courses the student assessment is based upon an amalgam of factors including tests, homework assignments, projects, seminars and examination.

G. Theory and practice, safety, drawing

The ratio of theory to practical work varies, but, more importantly, the nature of the practical work depends upon the course. For vocational courses the practical work is likely to be more skills oriented than in the technical courses, for which practical work may explore the limitations of theories and models and the limitations of equipment, and develop broad practical skills.

In most courses the issue of work safety is intrinsic to the course and it is not uncommon to find that students are required to be competent in basic first aid, mouth-to-mouth resuscitation and heart massage.

Likewise, students generally are expected to master the basic skills in technical drawing, more so in the electrical area than electronics. Australian Technical Drawing and other standards are used exclusively.

H. Links with general education

Many courses include work in mathematics and science. In some cases the mathematics subject matter is presented in its own right whereas in other cases it is integrated with the technical subject matter. In many cases where science is presented as a separate subject it is used not only to be a basis for technological studies, but also a vehicle through which the student can initially develop his powers of observation and analysis.

I. Innovations

Among the more significant innovations in Australia are:

1. Development of a national common core for electrical mechanic apprentice courses throughout Australia.
2. Development of a co-ordinated study programme for electrical engineering students in South Australia allowing an apprentice with suitable secondary school achievement to obtain a degree in minimal time.
3. Development of full time and an extensive range of part-time trade and technician level courses throughout Australia.
4. Many technician level courses incorporate a significant proportion of personnel and project management studies.
5. Direct negotiations between unions and educational institutions regarding retraining.
6. Assessment methods appropriate to the required skills of the students, for example, multiple choice tests are favoured for trade level students who are not expected to have great written fluency.
7. A TAFE National Clearing House for information related to innovations and initiatives has been established in Adelaide.
8. A TAFE National Centre for Research and Development is being established in Adelaide.
9. Large TAFE off-campus networks.

BANGLADESH

A. Typology of current courses

In Bangladesh there is a five-year primary education followed by a three year junior school, two-year secondary school and a two-year higher secondary school (H.S.C.). Secondary education is offered in high schools and higher secondary education in the intermediate colleges or Intermediate sections of Degree-Colleges. After secondary school certificate, students can pursue, in accordance with their abilities and aptitudes, higher education in Bachelor Degree courses. The general pattern of education is therefore 5 + (3+2+2) + (2/3 + 2/1) years. The duration of degree courses is four years in engineering and agriculture and five years in medicine after H.S.C.

The organization of Technical Education in Bangladesh is in three tiers: Certificate Courses, Diploma Courses and Degree Courses. The Certificate Courses in general train skill workers and have 1-2 years duration. Entry into these courses generally needs 8 years of schooling. Each vocational institute and technical centre offer two to three subject areas.

Polytechnic and Monotechnic Institutes offer Diploma courses—of three years' duration in Engineering and Industrial fields—after 10 years of schooling. The Board of Technical Education prescribes courses and syllabi and awards the Diploma.

The Diploma holders occupy intermediate positions between Degree Engineers and craftsmen. This course is so designed that a Diploma holder can interpret the ideas of the planning engineer to the craftsman.

Higher Education in Engineering and Agriculture is offered in the Colleges and Universities of Engineering and Technology and Agriculture. The duration of these courses is four years after 12 years of schooling.

B. Curriculum

The curriculum of three year Diploma Courses was first designed with the help of American experts and local experts in Technical Education in 1955. It was revised in 1960 in a series of meetings of the local experts in conference techniques. At the time of revising the curriculum, they carefully considered three elements—planning phase, development phase and evaluation phase.

C. Instructional materials

In Bangladesh the teaching is still 'teacher-centred'. So the conventional methods and materials are the 'chalk and talk', textbooks, classroom notes, question papers and solving problems. Due to the shortage of trained teachers and lack of physical facilities, the lesson plans, job sheets and information sheets are only occasionally used by the teachers. Teachers mostly prepare notes which contain either details of the topics in the form of explanation and sketches or worked-out problems, or both. Occasionally they make use of models and audio-visual aids for demonstration, and take their students out for some visits to industries.

D. Physical facilities

In terms of number of workshops, equipment, machines, instruments and tools available in the polytechnics, one may say that physical facilities are more-or-less sufficient, but most of the equipment and machines are obsolete and outdated. As such, when considered in terms of usage of the equipment and machines, the facilities are insufficient and cannot meet the requirements of the education programme.

E. Teacher training

In order to impart a true technical 'know-how' to the students it was felt necessary to acquaint the new polytechnic teachers with both current technology, and with the philosophy, art and methods of teaching, psychology of students and various other delicate phenomena which go along with the successful teachers. For proper dissemination of knowledge the instructors need to be trained and as a result a Technical Teachers Training College was established in Dacca. This T.T.T.C of Bangladesh was granted due affiliation as a Degree College of the University of Dacca in November 1967 and also offers B. Ed. (Technology) degree courses.

F. Assessment methods

Assessment of the students performance in classrooms and workshops during the first year and second year, i.e. for four semesters, are the responsibilities of the concerned polytechnic. However, for the sake of unified and standard evaluation, the Bangladesh Technical Education Board is responsible for evaluating the attainments of the students in the 5th and 6th semester by conducting the theoretical and practical examinations. All successful candidates are awarded Diploma-in-Engineering certificates in the relevant field of technology.

G. Theory/practice ratio

The Certificate courses are designed for 20 per cent theory and 80 per cent practical training, the Diploma courses are designed for 40 per cent theory and 60 per cent practice, and Degree courses are designed for 80 per cent theory and 20 per cent practical training.

H. Safety practices

The curriculum of the Technical courses is designed so as to provide proper instructions in safety precautions whenever the students have to perform any practical job in laboratories.

I. Links with general education

In Diploma courses science and mathematics occupy nearly 20 per cent of the curriculum but in vocational courses this percentage is only 5 per cent.

J. Technical drawing

In addition to the first year Technical Drawing courses I and II, the Electrical and Electronics students have to take a three credit drawing course in the first semester of the second year.

K. Innovative features

1. The main feature is that the curriculum is developed using a systematic approach, and it is objective-based.
2. In order to acquire technical knowledge and skills, both students and teachers are exposed to on-the-job training in various industrial enterprises during the months of the long vacations.
3. The polytechnics teaching staff undertakes visits to various industries and factories with the aim of understanding some modern trends and to acquaint the industries with the content of the curricula.
4. Modular courses, particularly in vocational education, have been introduced.

INDIA

A. Typology of current courses

The general education in India consists of five years of primary education followed by five years of secondary education. At the 'plus-two' higher-secondary stage of school education, two streams of courses are offered: the academic stream preparing students for higher education in universities, and the vocational stream to prepare them for a variety of occupations. India has a big network of technical and vocational institutions offering a wide variety of education and training programmes in various areas of electrical and electronics engineering.

Type of Institution	Course	Entry Qualifications	Duration of Study	Category and level of occupations
Vocational Schools	Plus-two stage (Higher secondary level)	Passing 10th grade	2 years	Vocationally qualified tradesman for productive work like servicing domestic appliances simple electronics equipment, radio, television and projection equipment, electrical wiring and motor winding
Industrial Training Institutes (ITIs)	ITI Certificate Course	Passing 10th Grade (Lesser Qualification for few courses)	2 years/ or 1 year	Skilled workers for industries such as wire-man, electrician, electro-plater, instrumentation mechanic, electronics mechanic, radio and T.V. mechanic and Wireless operator
Advanced Training Institutes (ATIs)	ATI Certificate Course	ATI Cert. Holders/ Industrial Workers	Modular Courses (Duration varies in terms of months)	Industrial workers with undated and upgraded skills like process Control and Instrumentation - Foreman, Highly Skilled Craftsman
Polytechnics	Diploma course	Passing 10th Standard	3/3½ years	Technicians in Electrical Engineering, Electronics and Communication, Industrial Electronics and acoustics and Television Engineering for middle-level positions in industries and technical services, like supervisor, foreman, head-draughtsman and operator
	Part-time Diploma course	Industrial Workers with I.T.I. certificate	4 years	Craftsmen turned into technicians, level of occupations as above
	Post-diploma course	Diploma in the relevant field	1 year	Technicians with upgraded knowledge and skills-Technicians in medical apparatus, Electronics, Television, etc.
Engineering Colleges, Technological Institutes and Universities	Degree course	Passing Higher Secondary level	4 years	Professional engineers in Electrical, Electronics, Communication and Instrumentation Engineering. Executives at different levels, Maintenance engineer, Design engineer, Sales Engineer, etc.
	Part-time degree course	Diploma and 2 years of experience	3½ years	Technicians qualified as engineers, level of the above listed occupations
	Post-Graduate course	Degree Holders	2 years	Technical personnel for specialised fields, e.g. computers, communications control systems, etc. Specialised engineers for Research and Development Units in Industries and Technical Teachers
Technical Teacher Training Institutes	Diploma/ Degree in Technical Teaching	Diploma/ Degree	1 year	Polytechnic teachers in Electrical and Electronic Engineering

B. Curriculum planning

The basic principles, strategies and methodologies adopted in curriculum planning for technical and vocational education are based on job analysis, task analysis, analysing knowledge and skills required for performing the activities identified, formulation of course objectives, identification of curriculum areas and course contents, evaluation scheme and working out resources required for implementation.

In vocational schools at least 50 per cent of the time is devoted to vocational practice, 20 per cent is devoted to language learning and 30 per cent to basic sciences or social sciences relevant to the vocation.

The scope of the curriculum in craftsmen training courses is restricted to the training in a particular trade. Acquisition of skills in specific trades is the central theme of curriculum. Theory, drawing, computation and curriculum science are related and integrated with practical skills to be acquired. About 55 per cent of the total time is devoted to practical work, 35 per cent to trade theory, 5 per cent to engineering drawing and 5 per cent to workshop calculations and science in electrical and electronics trade courses.

The curriculum for a technician programme has approximately the following components: Mathematics and Science 10 per cent, Technical Skills 20 per cent, Drawing 10 per cent, Humanities and Management 10 per cent, Practical Specialization 50 per cent. In the case of 'sandwich courses' the industrial training forms an additional component. In the revised Electrical Engineering Curriculum new subjects like Industrial drives and control, Electronics, Trouble Shooting and Repair of Electrical equipment have been introduced. In Electronics courses subjects like Computer Engineering, Test Instruments and Servicing, Pulse and Digital Circuits, Television and Radar, Project Work in Integrated Circuits have been introduced to suit the requirements of industries. A subject 'Entrepreneurship' has also been introduced in these courses to prepare the students for self-employment.

The present curriculum of a degree course in Electrical and Electronics Engineering emphasizes the following aspects: modern mathematical concepts for design and synthesis, computers, microprocessor control, energy studies, linear and digital integrated circuits, power electronics and modern methods of measurement and instrumentation.

Assessment procedures vary from subject to subject in different courses. But in general the assessment is based upon a combination of continuous assessment and a final examination. In the technician education both objective items and structured essay type questions have been introduced in class tests and final examinations. The item/question banks are used for the examination question papers.

C. Instructional materials

Quality improvement programmes and curriculum development courses are conducted for the development of curricula and instructional materials. The following types of printed instructional materials in the areas of Electrical and Electronics Engineering have been developed by the Curriculum Development Centres at Technical Teachers Training Institutes and some of the state units.

1. Student support materials relating to the specific objectives for different theory subjects.
2. Laboratory manuals in Basic Electrical Engineering, Electrical Machines, Basic Electronics and Industrial Electronics adopting structured exercises.
3. Data manual for Electronic Components relating to the curricula.
4. Drawing manuals for Electronics and Electrical Engineering incorporating appropriate technical standards as per I.S.I.
5. Programmed instruction materials on basic principles and devices in Electrical and Electronics Engineering for self-learning.
6. Monographs providing brief information to the teachers on new methods of teaching a topic, uses of equipment, etc.
7. Handbooks for classroom demonstrations in Electrical and Electronics Engineering.
8. Objective test items in Electrical and Electronics subjects.

The Technical Teachers' Training Institute, Madras, has produced a set of 16 demonstration boards in basic electronics circuits for classroom instruction and large group experimentation. Electronic kits for school projects and for job oriented laboratory programmes have been developed. A number of prototype dynamic demonstration models, demonstration boards and simulators have been developed in the areas of Basic Electricity, Magnetism, Circuits, Measurements and Measuring Instruments, Electrical Machines and Power Systems. It is intended to conduct validation exercises with these teaching aids in actual classroom situations, before going in for mass production. Production of multi-media learning packages on selected topics in the areas of electrical machines, transmission and distribution and electronics have been undertaken under a special project.

Long-term teacher training programmes leading to the award of a Diploma and a Degree in technical teaching are conducted in Electrical and Electronics Engineering. Some of the future plans in teacher training are to conduct a four-month Certificate Course in Curriculum Design and Instructional Materials Development for overseas teachers in Engineering and Technology, and 12-week Certificate Course in Instructional Aids for the teachers of polytechnics and research programmes in technical teaching.

D. Key innovative features

1. *Vocationalization of General education*

   The structural and functional changes which India has introduced in the pattern of general education recently is in itself a major innovation. The innovative aspect is the involvement of the community in the educational endeavour so that institutional and community resources are fully utilised for preparing the future manpower.

2. *Diversification of courses*

   With the fast technological developments in Electronics, more diversified courses are offered to meet the actual needs at different levels.

3. *Instructional resource centres*

The Instructional Resource Centres not only keep a wide range of learning materials such as films, filmstrips, slides and programmed materials and multi-media learning packages but provide special space for each individual to practice resource-based learning.

4. *Media production centres*

These centres are being established with all required basic facilities for large-scale production of different teaching aids such as films, filmstrips, slides, models, charts, magnetic cut-outs, slide tape sequences for supply to polytechnics on a no-profit, no-loss basis.

5. *Community polytechnics*

With increasing emphasis on rural development, India has established 35 polytechnics as community polytechnics which transfer the technology to rural areas and meet the needs of the rural community.

6. *Industry-institute co-operation*

Industries are involved in designing, developing, implementating and evaluating the curricula. Sandwich courses have brought a revolution in the structure and organization of the technical education. The concept of 'adoption of polytechnics' by the industries is gaining ground.

7. *Item/question Bank for continuous evaluation*

All the activities related to evaluation serve the qualitative improvement of technician/technical education through Examination Reforms. Establishment of validated item banks for classroom use contribute towards its improvement.

8. *Educational research*

In view of the inadequate research studies in technical education, a number of projects related to educational research in the areas of science and technology have been identified. Both basic and applied research facilities are envisaged to offer new ideas, concepts and processes in the Curriculum design and development of instructional materials.

9. *Extension Centres of Technical Teachers' Training Institutes*

These extension centres work in collaboration with the polytechnic faculty to improve the teaching and learning process and to develop instructional materials.

10. *Other innovative features*

Training of the teachers in educational technology, curriculum evaluation projects, introduction of correspondence cum contact courses for science teachers in polytechnics, continuing education programmes and establishment of special vocational training institutes are some of the other innovative programmes introduced in India.

INDONESIA

A. Typology of current courses

General education in Indonesia consists of six years' elementary education, three years' junior secondary education and three years' senior secondary education.

Tertiary education is provided at Polytechnics, Academies, Institutes of Technology and Universities. At the junior and senior secondary level there are a number of vocational and technical schools offering courses of three and four years' duration, but these junior secondary vocational and technical schools will be phased out in the near future.

Vocational and technical education is offered by various schools in the fields of:

- industrial technology,
- agriculture,
- business and commerce,
- home industries,
- arts and culture,
- social services, and others.

Under the Ministry of Education and Culture there is a Directorate General of Primary and Secondary Education, and within this Directorate General, a Directorate of Vocational and Technical Education is charged with the responsibility to produce guidelines for establishment, management and accreditation of vocational and technical schools. These schools are job-oriented so their graduates are expected to be able to enter the labour force as tradesmen or technicians to meet the industrial needs and also for self-employment. The ratio between the engineers, technicians and trade technicians is shown in the following technical manpower pyramid:

Ratio	Qualification	Institutional Training
1	Engineer	University, Institutes of Technology
2	Higher Technician	Polytechnics, Diploma course
3	Trade Technician	Senior Technical School 4 yrs.
25	Tradesman	Senior Technical School 3 yrs.
–	Semi-skilled worker	Junior Technical School 3 yrs.
–	Unskilled worker	

B. Curriculum planning

The objective of the Senior Technical School is to prepare youth for employment or self-employment. To achieve this objective the Government attempts some improvement and modification of the Curriculum. This Curriculum was prepared in 1975 by a Committee comprising Directorate officials, experts from abroad, e.g. Unesco experts, Headmasters and Senior Teachers, Lecturers of University and Institutes of Technology as well as specialists from industry and employers. The Curriculum document consists of the following parts:

Part I:
- institutional objectives,
- definition of industrial technician and tradesman,
- qualification of graduates, and
- structural programme for every course offered.

Part II:
- syllabus, starting with stating the curricula objectives, general instructional objectives, topics, subtopics, and teaching materials.

Part III: provides guidance in —
- teaching preparation,
- school administration,
- evaluation, and
- guidance and counselling.

In the senior Technical School, offering a three-year course in the field of Electrical and Electronics Engineering trade, there are two profiles: Electrical tradesman and Electronics tradesman. Senior Development Technical schools offer four-year courses for technicians specialized in: industrial electricity, power electricity, industrial electronics, communications electronics, and process instrumentation.

The ratio between theory and practice is about 1:1, and this instructional programme can be divided into:

1. The general programme, which consists of:

   Principles of moral education, religion, Indonesian language, and health and sports.

2. Vocational and technical programmes, which consist of:
   - English language;
   - Mathematics;
   - Physics;
   - Related theory in Vocational and Technical subjects, and
   - Practice.

The Curricula are designed and developed on the basis of certain principles through the following phases:

1. Planning phase. This phase includes determining of the objectives based on the following considerations: job requrements, entry qualification of the students and identification of the courses needed to meet the job requirements.

2. Implementation and Development phase;
   - Specification of the course contents,
   - Production of instructional materials,
   - Preparation of guidelines,
   - Training of the teachers.
3. Evaluation phase. The Curriculum evaluation includes:
   - Assessment of student performance, both in school and in industry or other employment.
   - Evaluating the effectiveness and efficiency of the curriculum implementation.

C. Development of instructional materials

The problem in Indonesia is shortage of electrical and electronics textbooks in the national language.. To solve this problem the Directorate has set up a Committee at the Technical Teacher Upgrading Centre in Bandung to develop job sheets and instruction sheets for all trades, for all semesters, to be distributed to the technical institutions. In addition, senior teachers, people from industry, lecturers and others are encouraged to write textbooks and given an allowance.

D. Problems encountered and efforts to solve them

1. Problem of finding qualified teachers.
2. Problem in the development of instructional materials.

   To solve these problems the Directorate is going to establish a Diploma III Vocational and Technnical Teacher Training Course in Bandung (for technical filed) and in Jakarta (for business and commerce and other vocational fields).

   Those who qualify for enrolment in these programmes are people who:
   - graduate from Vocational and Technical Institutions;
   - have some experience in industry or employment;
   - possess a certificate or diploma higher than vocational or technical school

These Institutions are expected to start functioning in January 1981.

E. Innovative features

1. Objective-based curriculum planning and development;
2. Systems approach in conducting teacher training;
3. Modular training system in technical and vocational programmes; and
4. Approaching the specific instructional objectives from three domains.

JAPAN

A. Typology of current courses

The Technical Education system in Japan consists of:

- technical high school (3 years) and technical college (5 years) after graduating from junior high school, and
- vocational training school – (1-3 years), junior college (2 years) and university (4-6 years) after graduating from high school.

The technical college system was established in 1962 aiming at providing five years full-time education to give the graduates from junior high schools sufficient knowledge and skills, enabling them to meet the requirements of recent technological innovations. At present there are about 60 colleges, most of which are national establishments.

B. Curriculum

The curriculum consists of fundamental compulsory subjects and optional or elective ones; the former are specified by the Ministry of Education while the latter depend on the free choice of the individual colleges. Basic theoretical subjects are emphasized so as to be applicable to rapidly developing technologies. For example, out of the total of 89 credits allocated for technical subjects, 17 credits are devoted to laboratory experiments and workshop practice, and 2 credits – to Technical Drawing.

Students' evaluation is conducted through regular examinations (four items a year as well as by status of attending lectures and reports on laboratory courses and graduation study.

At the beginning, the curriculum was strictly specified by the Ministry and all subjects were compulsory. After about ten years' experience, it was changed so as to give more flexibility to individual colleges by introducing elective subjects. The new curricula have been applied since 1977, and they are being up-dated by individual colleges to meet rapid developments in electronic and computer technologies.

C. Instructional materials

Textbooks in Japanese are widely used and various kinds of instructional materials are introduced. In particular, in line with the advancement of computer technology, the micro-computer becomes important and available at reasonable price. In some colleges, micro-computer kits are provided for every student. These are used for experiments, practice and graduation studies. On-the-job training is carried out by most colleges, which results in good effects to both student students and industries.

D. Innovative features

The introduction of fundamental compulsory subjects and elective ones makes it possible to follow rapidly progressing technologies. Most industries are going into computerization and require electrical engineers skilful in computer technologies. Therefore, the electrical course includes computer hard-ware and soft-ware technologies as compulsory subjects as well as electrical power engineering.

E. Qualification

Graduates from the electrical courses acquired the Certificate of Senior Electrical Technician of the second kind after 5 years practical experience in the relevant field. The certificate qualifies to supervise installations, maintenance and operation of electric equipment of less than 100 kilovolts. For this, safety measures are emphasized in the related subjects.

F. Problems

There are two main problems in meeting the rapid changes of technology: retraining the teachers, and updating the facilities and equipment. It is intended to reduce teachers' loads so as to give them opportunities for studying new technologies. Micro-computers are widely used in many fields of the new technology.

G. Future prospects

The new curricula are expecting prospective outcomes in the near future. New universities (Joetsu and Hyogo) are being established for retraining teachers. New universities of technology (Nagaoka and Toyohashi) were established in 1976, and have opened the way to higher advancement for the graduates from the technical college. The universities are also contributing to the improvement of college teachers by exchanging teaching staff.

MALAYSIA

A. Typology of current courses

The Ministry of Education has a division known as the Technical and Vocational Education Division, responsible for planning, implementing and supervising of technical and vocational education at craft and technician level. There are some 30 vocational schools at the moment, offering vocational education in engineering, agriculture, commerce and home science. The objective of this programme is to provide the commercial and industrial sectors with manpower equipped with basic skills and knowledge at the craftman's level.

The engineering trade is the largest component in the vocational schools. It consists of the following courses:

1. Fitting and machining
2. Motor mechanics
3. Sheetmetal work and welding
4. Air-conditioning and refrigeration
5. Woodworking and building construction
6. Radio, television and electronic servicing
7. Electrical installation and maintenance.

The duration of vocational courses is two years. The courses include general studies such as languages, social studies, mathematics and science besides vocational skills training.

B. Curriculum planning

The curricula of the courses are broad-based and consist of two components: vocational studies and general studies. The distribution of time for the curricula is generally as follows:

General Studies		29% (543 hours)
Vocational Studies consisting of:		71% (1,329 hours)
Trade theory	19% (253 hours)	
Trade practice	70% (932 hours)	
Drafting	11% (147 hours)	
	100% (1,332 hours)	100% (1,872 hours)

The curriculum development consists of the following phases:

1. Formulation of rationales, policies and aims of vocational education in Malaysia.
2. Identification of industrial needs, preparation of job description, and task analysis of the various occupational groups covered by the vocational school curricula.
3. Preparation of course and instructional objectives. Selection of curriculum content.
4. Development of instructional material at institutional level.
5. Evaluation of instructional objectives and contents in curricula.

C. **Instructional** materials

Instructional materials are developed at institutional level by the teachers implementing the curricula. Those are in the form of project sheets, laboratory sheets, and other printed materials.

D. Teacher training

There is a college to train teachers in various areas including Electrical and Electronic courses. Besides studying the vocational subjects, these teachers are given a background knowledge of teaching methods. The training lasts three years.

Training of teachers and instructors is planned and carried out by the Technical and Vocational Education Division and the Teacher Training Division of the Ministry.

E. Methods of assessment

There are two methods of assessment—practical and theoretical exams. These are carried out at both institutional and national levels. At national level, the students sit for the Malaysian Vocational School Certificate Examination in both theoretical and practical subjects. At the institutional level, the assessment is based on project work as well as theoretical subject examinations.

F. Work safety

General safety rules are taught to and observed by the students when they are working in the workshops.

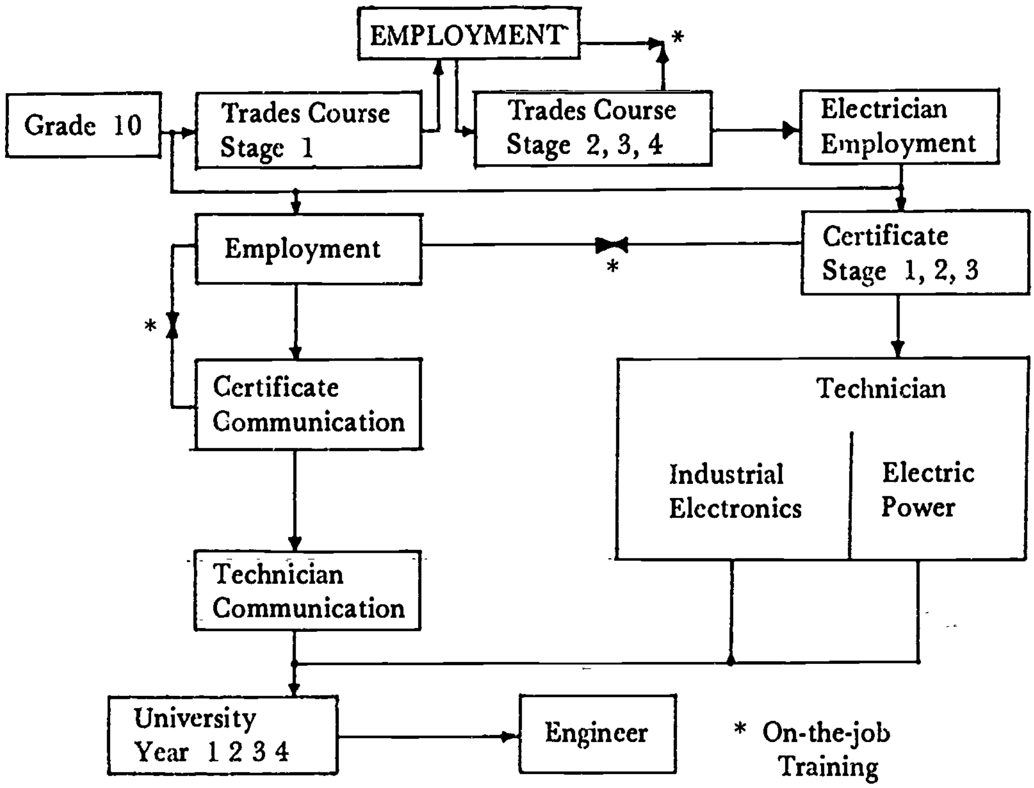
G. Future plans

It is hoped in the future to (1) build 42 vocational schools and 5 polytechnics, and (2) start new short-term courses in various areas including Electrical and Electronic courses within the existing secondary vocational schools system.

PAPUA NEW GUINEA

A. Typology of current courses

A block diagram of all possibilities open to a student when entering electrical and electronics courses is shown below:



All students are sponsored by their employers. After completing the first stage of the trades course there is a possibility of employment as a semi-skilled labourer. On completion of all four stages of the trades course the student becomes an electrician. Students who show ability for further training are sponsored for certificate courses. On completion of all three stages of certificate courses a student becomes a technician.

There is one college for trades course, and approximately 30 students enter each year. At the college for certificate courses the annual intake is about 15 students.

The university conducts a certificate course in communications engineering. On completion of this course the student becomes a communications technician. Students wishing to undertake degree courses in engineering can be exempted from first year if they successfully complete a certificate course.

B. Curriculum planning

Prior to 1975 the curriculum was somewhat a condensed version of the curriculum of other countries such as Australia or England. In 1975 a Government-sponsored investigation was carried out in the technical area. The conclusions of the investigation with regard to technician education stressed that technician education should be based on the needs of industry in Papua New Guinea.

A World Bank project initiated in 1977 had as one of its aims the investigation of possible ways to decrease the number of expatriate technicians in Papua New Guinea. To achieve this, the existing system of technician education had to be revised.

In 1978 an industrial survey was conducted to accurately assess the needs of industry. The new curriculum introduced in 1980 is based on the results of this survey.

The present certificate course is 3 years in duration with 20 weeks each year. There is a large number of elective subjects available for final year students. This was necessary for possible future requirements. At present there are only two possibilities for choice, namely in the fields of Industrial electronics or electrical power. The reasons are:

- The availability of teaching staff (4)
- Present demands from industry within these fields
- The small number of students entering (15 in 1980)

It may be possible to increase the choice of electives in the near furture if demand arises from industry.

C. Instructional materials

All textbooks must be purchased from overseas. The evaluation of the suitability of a textbook is determined by the teaching staff.

It was decided to minimize the use of textbooks as much as possible. Instead, references are given from various texts for each topic of the syllabus. The teacher involved then makes his choice as to which to use. It is also practiced to compile a set of notes, based on the available references, for reprinting and distribution as students' notes. A substantial saving can result from the above method. A complete set of student notes was expected to be developed by the beginning of the 1981 school year.

D. Physical facilities (laboratories)

The laboratory for electronic subjects can accommodate 16 students at a time, working in groups of two. All the required experimental work in electronics subjects can be carried out with the presently available equipment.

The laboratory for electrical machine subjects can only take from four to six students at a time for reasons of safety, teaching staff available, and shortage of equipment (there is a variety of equipment available but usually only one or two of each kind).

A laboratory for basic electrotechnology and measurements is at present not completed and a full range of equipment is not available yet. All laboratories were equipped only recently by means of World Bank funds.

E. Teacher training

Teaching is one of the less financially attractive occupations for Papua New Guineans. A person with suitable qualifications for technical teaching is likely to seek employment in industry, which is financially much more attractive. All teachers in certificate area courses are expatriates. In the trades area courses the ratio of expatriates to Papua New Guinean teachers is much more promising. Suitably qualified Papua New Guineans who wish to enter teaching must complete a one-year course at the teachers' college in technical teaching. Each year there is a compulsory one-week in-service training for all technical teachers. In 1979 a "Colombo Plan" course was conducted for developing objectives and methods of evaluation. In 1980 a similar course was conducted using materials sent from the Colombo Plan Staff College in Singapore.

F. **Assessment methods**

Continuous assessment is made on the basis of the formula given below:

Final Mark		Topic tests averaged		LAB averaged		Home assist. averaged		Project
M	=	$(K_1 X T)$	+	$(K_2 X L)$	+	$(K_3 X A)$	+	$(K_4 X P)$

All K's are constants and determined for each subject. Some examples are shown below:

K_1	K_2	K_3	K_4	
.7	0	.3	0	Mathematics
.6	.25	.15	0	Elect. Machines
.5	.25	.1	.15	Electronics
.55	0	.15	.3	Elect. Installations

G. Theory/practice ratio

Electronics subjects are entirely conducted in the laboratory in order to "properly integrate theoretical and practical components". Other subjects requiring practical work have laboratory components of 60 per cent and theoretical components of 40 per cent of the total time.

At times it is not possible to arrange the above ratio of Theory to Practical work due to shortage of staff or equipment or time. It is intended to observe in the future the prescribed ratios.

H. Work safety

Some theoretical aspects of work safety are included in the curriculum but it is generally expected by the employers that students have attained safe working habits.

I. Link with subjects in general education

Mathematics and Science courses are provided but only topics that are relevant and necessary to the course are included.

J. Drawing courses

Drawing courses are designed to enable students to interpret drawings rather than produce them. There are no separate drawing subjects for electronics.

K. Innovations

1. The new curriculum is based on the needs of industry and drafted in objective form.
2. There is no more need for various organizations to run their own training facilities.
3. There is a possibility that all Electrical Technician education in Papua New Guinea can be conducted under the Department of Education.

PHILIPPINES

A. Typology of current courses

1. *Structure.* The education system of the Philippines comprises pre-school education beginning at the age 4-5-6, followed by six years of elementary education (grades 1-6) to four years of secondary education (grades 7-10). Post-secondary education of non-degree type is given in a variety of one, two or three-year vocational courses, while the technical or commercial degree courses are four-to-five years' duration (11-15).

   Master's or Doctor's degree courses are offered in Selected universities. The private sector plays a major role in the educational system particularly at secondary and post-secondary level.

2. *Administration.* Education and its administration involve two separate agencies. Policy is determined by the National Board of Education, which includes members of the National Economic and Development Authority, the Department of Finance, and the Budget Commission together with representatives of Public and Private education institutions administratively responsible for public schools and non-chartered colleges. The supervision of private schools rests with the Ministry of Education and Culture (MEC). The MEC was re-organized in 1976 by the Presidential Commission to survey Philippine education. Under the re-organization, three bureaux by types of school (Public, Vocational and Private) were replaced by three integrated bureaux organized by level of education (elementary, secondary and higher education). The three previous parallel field organizations were also consolidated into one organization in each of the 13 regions which

have sub-units corresponding to the three levels of education. Additional units in the re-organized MEC at both levels include offices for planning, administration, finance and management and information.

3. *Structure of vocational and technical education.* The main purpose of vocational and technical education is to prepare the individuals for useful employment and to meet the national developmental needs and to produce craftsmen and skilled workers.

4. *Vocational/technical post-secondary education* is provided in 96 institutions, mostly called Schools of Arts and Trades (SAT) together with 171 other private institutions. The two year programme offers craft courses in such subjects as auto-mechanics, general mechanics, building construction, electricity, electronics, foundry work, woodwork, textile, food-processing and cosmetology. The three year courses are aimed at producing technicians in similar fields of study. The four-year courses mostly aim at Bachelor of Science in Industrial Technology (BSIT) or in Industrial Education (BSIE).

5. An applicant for post-secondary or Technical schools must qualify through admission test. For college level, an applicant has to pass the National College Entrance Examination (NCEE). For short-term courses, one must obtain a PC (Philippine constabulary); NBI (National Bureau of Investigation) or Police clearance.

B. Curriculum planning

This covers the following:

1. Two-year Trade Technical Programme,
2. Three-year Industrial Technician Programme,
3. Four-year Industrial Teacher Education Programme,
4. Masteral Programme in Industrial Education,
5. Five-year Engineering Programme,
6. Four-year secondary programme, and
7. Special programme for Baking and Garment Trades.

C. Instructional materials

The following instructional materials are employed in electrical and electronics subjects: Printed materials, modules, charts, safety posters, models of dynamic demonstration display boards, printed modular materials, instructional manuals, textbooks, information sheets, safety posters, mock-ups, slides, transparencies, VTR, overhead projectors, 16 mm and 8 mm sound projectors, cassettes, open-reel recorders, projectors and video equipment.

D. Physical facilities and teacher training

Both these areas need some improvement:

1. More space in workshops is required.

2. Further improvement of facilities in electrical and electronics laboratory is needed.

3. There is a lack of adequate centralized tool rooms with textbooks, manuals, experiment books, training programme manuals and other software materials.
4. More information mock-ups are needed.
5. More space in demonstrators areas is required.
6. There is a need to exchange scholars in the field of electrical and electronics subjects with other countries.
7. More seminars and workshops are needed.
8. Some industries require re-training and upgrading of their electrical/ electronics manpower by technical teachers to update them with new methods.
9. There is a need to establish new Technical Training Centres for further improvement in teaching methods.
10. It is desirable also to establish a National Integrated Research and Training Centre for Vocational Technical Teachers.
11. More Training in Educational Technology for Faculty members should be provided.

E. **Assessment and evaluation methods**

Students' assessment is conducted through examinations. Evaluation of the effectiveness is carried through: (1) observation of formes student activities, (2) observation of teaching/learning activities; and (3) discussion with the students.

F. **Link with subjects in general Education**

Theory subjects, Principles of Science, Mathematics, Communication Arts and Technical Drawing are taught in formal classes, providing the following units of credits

- Mathematics = 24 units
- Science = 24 units
- Drawing = 4 units

G. **Theory/practice ratio**

The ratio between theory and practice is as follows:

1. Secondary education 70% practical, 30% theory,
2. Technical Education: 40% theory and 60% practical,
3. Technician education: 60% theory and 40% practical general work-safety rules are incorporated in laboratory work and workshop practice.

H. **Problems and constraints**

1. Inability of the co-operating industries to absorb much on-the-job training,
2. Lack of proper co-ordination between industries and schools,
3. Shortage of trained faculty staff, and
4. Lack of adequate equipment/materials/tools.

I. Key innovative features

Main features are the following:

1. Creation of an Advisory Board which consists of:
   a) selected instructors of electrical, electronics departments,
   b) representatives from electrical/electronics industries, and
   c) selected instructors from the social science, maths and science departments;
2. Letter of agreement being introduced between the school and the industry with regard to the on-the-job training programme;
3. Establishment of a centralized Tool room which is equipped with Technical books, manuals and other software materials;
4. Improvement of training process by providing high-quality facilities.
5. Introduction of centralized production of instructional modules and other materials;
6. Mass production of instructional materials; and
7. Use of video cassette recorder and Video Tape Recorder for training.

REPUBLIC OF KOREA

The Technical and Vocational Education in the Republic of Korea is undergoing a considerable change at present. This is largely due to a realization that Korea's economic future lies in the development of a high-technology-based industrial and commercial system.

The present technical high schools were expanded so as to meet the urgent demand for skilled craftsmen for a rapidly growing industrial sector. For this reason the amount of time devoted to skills development at the workshop bench and work with machines and instruments was increased to exceed half of the total teaching time. The pressure to develop manual skills was increased by the insistence on the achievement of a Craftsman's Certificate based on rigorous tests. Many students devoted long hours outside school activities to reach the required level of skill and also to compete for school, provincial and national skills awards. Changes now going on tend to reduce the skills development component of the courses, aiming to reduce the pressure to involve the students in very lengthy evening sessions and to increase the time for the general education components, especially in mathematics.

There are two types of Technical High School, both of which recruit students from Junior High Schools; that is, after nine years of general education. There are 70 general technical high schools with about 52,000 students and 29 specialized technical high schools with 62,877 students. There schools specialize in preparing students for particular industries, such as electronics; they are large (training over 2,000 students each), very well equipped and provide boarding facilities. These special schools now train over half of all technical-high school students, and entry is highly competitive.

The actual training provided by these schools is presently in a state of change. Technical High School principals are responsible for the development of the school curricula under the general guidance of the Ministry of Education. Books and teaching manuals are produced in schools at present but recently a centralized national programme to develop instructional materials has been entrusted to the Korean Educational Development Institute (KEDI). This will take many years for writing, field testing and rewriting/improvement phases which have been envisaged.

Technician-level courses are provided at the post-secondary stage in two-year Junior Technical Colleges. These recruit students from both General and Technical High Schools. A programme has also started to prepare instructional materials at this level.

A serious constraint has been, and continues to be, the difficulty in provision of good technical and vocational teachers. The system requires that these teachers should be University or College graduates, but few students enrol for such courses. Most Universities and Colleges recruit their students almost entirely from General High Schools. A recent attempt to recruit potential teachers from Technical High Schools seems to have failed.

The Republic of Korea is fortunate in being able to provide almost all teaching equipment needed from local manufacturers. In practical workshop training some attention is given to safety matters. Technical drawing is a required subject in most technical high schools but less teaching time is allocated for technical drawing in electrical and electronics courses than in some other fields of technical and vocational education.

SRI LANKA

There is no centralized curriculum development and planning for technical and higher education in Sri Lanka. Responsibility for this function lies with the individual institutions conducting the courses. Full-time technician-level courses in electrical and electronics subjects are conducted mainly by the University of Moratuwa. The present state of affairs is not satisfactory since the Departments of Electrical Engineering and Electronics and Telecommunication Engineering are hard pressed to conduct the Degree and Postgraduate Degree courses which are their primary concern. A separate Directorate of Technical Studies within the Universityframework has been thought of, and if implemented may solve the problem. Structural changes to the scope and content of the courses based on analysis of changing technology and evaluation of the needs of industry are not possible due to the above constraints. Changes are however made by some Departments; e.g. introduction of digital methods and techniques in electronics subjects:

1. Pulse modulation techniques (PAM, PWM, PPM, PCM etc.) during the past year in the existing National Diploma in Technology (NDT) Telecommunication Syllabus.
2. Digital trainer experiment included in the laboratory work to demonstrate logic gates AND, OR, NOT, and the like and combined functions.

Another example is the establishment of a T.V. laboratory for training, which is being presently equipped. These are typical examples of curriculum development which are a consequence of changing Government policies and programmes related to the introduction of new techniques and technologies in the country.

Technician training is now centralized under the responsibility of the National Apprenticeship Board (NAB). Created through an act of Parliament by the Government, all engineering organizations which have training facilities are required to contribute to the training schemes of the NAB. Most of the programmes are carried out by the Government Services and Corporations such as the Telecommunications Department, Electricity Board, Overseas Telecommunications Service, Railways, Broadcasting Corporation and Petroleum Corporations. The NAB appoints committees which include the technical personnel from these Institutions as well as representatives from the Trade Unions, in addition to their own training officers, and these committees draft the apprenticeship standards, trade tests and requirements for issuing certificates.

The formulation of the training programme itself is more or less the responsibility of the organization providing the facilities for training. As an example, a training programme in the communication branch of the Ceylon Electricity Board would take the following lines:

- Introduction to the aims, objectives, scope and practices of Power System Communications; familiarity with the particular system of the Board by means of network diagrams, technical manuals, and circuits; visits to installations within the company of experienced technical staff; developing proficiency in handling tools and ability in minor repair work in the workshop.
- Familiarization with the conditions under which field work is achieved by actually accompanying technical staff in maintenance and trouble-shooting assignments. This is accompanied by the submission of a report by the trainee for evaluation and subsequent interview before a board consisting of NAB, University and the Engineer responsible for the training in the Communication Branch of the Electricity Board. There is provision for the NAB to pay the trainees an allowance during the periods of training. The NAB training scheme covers the Degree in-plant training requirements as well; therefore the NAB may be considered a centralized body responsible for technical training in general. The duration of training is from six to nine months for a four-year Degree course, and 12 months for a three-year Diploma course.

The Sri Lanka Institute of Distance Education (SLIDE) is a very recent innovation, where courses have already started in Electrical and Electronics subjects. Presently, only the Postal Services are being used to send instructional materials, to receive completed assignments from students and to return the moderators' evaluation. SLIDE is to be incorporated into the Open University which has just been set up and Radio, T.V., Cassettes and other aids will then be available. In order to provide the practical skills and training, SLIDE intends using the laboratory facilities in schools and Universities during the vacations. The Higher National Diploma Parts I and II which SLIDE intends awarding is expected to be equivalent to a Non-Professionally Qualified Engineer's level and will provide an avenue by which the already employed technician may improve his prospects while continuing his work within an industry.

It is too early to assess the impact and success of SLIDE as yet. The Sri Lanka Institute of Engineers has also started part-time courses catering to the employed technician, though these are at a higher level and the curriculum and syllabuses are modelled according to those of the Council of Engineering Institutions (London). These courses, including the practical requirements, together constitute the acceptable qualifications of a professional engineer.

The demand for admissions to technician-level courses far exceeds the available facilities. This is true not only at the technician level but also at the degree level for university admissions. The government has therefore introduced a district quota system which in effect overrides the merit system of selection. The entire selection for the diploma courses is according to quotas allocated to each district whereas the university admissions are on the basis of 30 per cent merit, 55 per cent on district quotas and 15 per cent to backward areas; i.e., in effect, 70 per cent of the available places to be allocated according to quotas. This means that the best talent in the country cannot be channelled into these courses and utilized in the electrical and electronics industries and services of the country. This is a typical example of the vicious circle of deprivation both to the individual as well as to the country where the resources and facilities are insufficient to meet the demands of an exploding population.

THAILAND

Vocational Education in Thailand started in 1935 with carpentry and building construction and was extended to six trades in 1958 by the SEATO Skilled Labour Project. The major improvement was accomplished by LIVE project in 1967 in industrial and agricultural areas.

Due to the new technology, economy and society are changing quickly and the need for semi-skilled and skilled workers is increasing. The education system must adapt and re-adjust itself, to keep up with the changes. Thai education authorities introduced a change to the system of education in the ratio of 6:3:3 which is sequentially the ratio of the number of years for compulsory, junior secondary and secondary or vocational education to be implemented by or before 1981.

Since the new education legislation was issued about four years ago, the Ministry of Education is well prepared for changes in secondary and vocational education and in production of instructional materials. The most important elements in this process of changes are the design, evaluation and implementation of the curriculum aiming at high efficiency, adaptability to work requirements, and technological changes.

The Vocational Department, which is responsible for the implementation of these changes, includes a committee which is composed of experienced trade school teachers, supervisors and administrators. The committee organized a number of seminars, evaluated feedback from invited industries, and co-operated with the Labour Department and other government departments. As a result, a new vocational education curriculum has been developed. Instructional materials are prepared as soon as the curriculum is finalized and approved. A special committee is set up for development of instructional materials. Many contemporary instructional materials are published in Thai language.

Problems still confront us; one of the most important concerns teacher competence and capacity. Some teachers are strong in theoretical knowledge but weak in practical skills while others are the opposite. To rectify this problem, a Training Centre for the Vocational Department has been established. The duty of the Vocational Training Centre is not only to train and upgrade teachers but also to arrange the planning, development, and production of training sets and testing job sheets, as well as to improve other instructional materials.

The electrical and electronics curricula are very difficult to implement, due to new technologies being introduced. Therefore, all committees must be kept aware of the new changes, to ensure the development of appropriate instructional materials. The other difference in nature of these two trades when compared to others is the greater involvement of mathematics and science. For example, before the subjects of transmission line or antenna and transmission line can be taught, students must at least know hyperbolic functions and some physics of electromagnetic fields.

The last topic is job availability. There are more jobs in the field of electrical power than in electronics. This is due to numerous construction projects such as office and industrial building. National statistics indicate that technicians are in great demand so our responsibility is to ensure a supply of well-trained students.

Chapter Three

SYNTHESIS OF COUNTRY EXPERIENCES

Introduction

Summaries of the participants' papers form Chapter Two of this report and an appendix summarizes the experiences of participants gained through visits to various educational institutions in Australia.

This chapter attempts to combine these inputs under the following headings:

A. General education
B. Vocational and technical education
C. Formal and non-formal education
D. Curriculum planning
E. Instructional materials
F. Physical facilities
G. Teacher training
H. Problems and strategies for solving these problems
I. Innovations
J. Future plans

A. General education

The general education provided in participating countries is summarized in the following table.

Summary of General Education

TOPIC / COUNTRY	Compulsory general education	Typical age of children starting school	Number of years in elementary (primary) school	Number of years in secondary school*
AUSTRALIA	Yes	5	6 or 7**	6 or 5**
BANGLADESH	No	5	5	3 + 2
INDIA	No	5	5	5 + 2
INDONESIA	No	6	6	3 + 3
JAPAN	Yes	6	6	3 + 3
MALAYSIA	No	6	6	3 + 2
PAPUA NEW GUINEA	No	6	6	6
PHILIPPINES	Yes	6	4	4
REPUBLIC OF KOREA	Yes	6	6	3 + 3
SRI LANKA	Yes	5	5	5 + 2
THAILAND	Yes	6	6	3 + 3

* If 2 figures are given, the first is for the junior secondary school and the second for senior secondary school.

** Varies from state to state. The total duration of schooling in each state is 12 years.

The data of the table reveals that general education is not compulsory in all countries. Those children who attend school usually start at about five or six years of age and can continue attending school from ten and twelve years.

B. Vocational and technical education

While the range of vocational and technical education courses varies from country to country and without common nomenclature, their academic level can broadly be divided into three categories: vocational (or craft, trade); technical (or certificate, diploma); and professional (or degree).

The Technical Working Group Meeting is primarily concerned with vocational and technical education. This education may be provided in either the secondary schools as distinct from the general secondary education or in institutions other than secondary schools. The table below summarizes the usual types of institutions in which vocational and technical education is provided in electrical and electronic engineering.

Types of institutions providing training in electrical and electronic engineering

COUNTRY	Secondary Schools		Other Institutions	
	Vocational	Technical	Vocational	Technical
AUSTRALIA			✓	✓
BANGLADESH	✓		✓	✓
INDIA	✓		✓	✓
INDONESIA	✓	✓	✓	✓
JAPAN	✓	✓	✓	✓
MALAYSIA	✓		✓	✓
PAPUA NEW GUINEA	✓		✓	✓
PHILIPPINES	✓	✓	✓	✓
REPUBLIC OF KOREA	✓	✓	✓	✓
SRI LANKA	✓		✓	✓
THAILAND	✓			✓

Except for Australia, secondary schools generally provide vocational and in some cases technical education. This may results in the greater utilisation of the available facilities and teacher competence, but may make the development of responsible attitudes in the students undertaking technical and vocational courses more difficult because of the intermingling with less mature students taking general secondary education.

C. Formal and non-formal education

According to the adopted Terminology of Technical and Vocational Education Guide, formal education generally takes place in schools and other educational institutions within the educational system whereas non-formal education occurs outside the education system on either a regular or intermittent basis. Formal education may occur in institutions which are not under the control of the Ministry of Education. In most participant countries non-formal education can be divided into two types:

- structured learning, using facilities within industry; and
- learning processes using a variety of media outside the conventional school and institution system, outside of industry.

Extensive educational facilities within the industry are available in Japan and relatively significant facilities are operated by industries in Papua New Guinea, and in other countries – to a lesser extent. Such non-formal education, unless properly controlled, may lead to inefficient use of resources and become an undue financial burden on the community. In South Australia non-government based training facilities are licensed by the government thus ensuring some overall co-ordination and control of educational facilities and standards.

At present it appears that in most of the participant countries studying in electrical and electronic engineering is structured and institution-based, either in the educational system or in the industry. However, Sri Lanka, through the Sri Lanka Institute of Distance Education, has attempted to provide postal correspondence courses and intends to extend these services through audio and video cassettes. Course practical work is completed by students at various schools and unversities during the normal vacation periods for these institutions.

D. Curriculum Planning

Participant countries expressed the objectives of curriculum planning either in terms of national goals or in terms of worker characteristics.

The Republic of Korea clearly expressed curriculum planning objectives in terms of national goals by stating that the objective of curriculum planning was to facilitate the transition of the country from a labour-intensive industrial base to a technology-intensive base and from this viewpoint derived further objectives in terms of worker characteristics. Similarly the Philippines states that its primary objective was to prepare the individual for useful employment. Most other countries expressed their curriculum planning objectives in terms of worker characteristics, such as training of craftsmen.

In general, the curriculum planning methodology was expressed in the form of a model consisting of the identifiable stages of analysis, curriculum design, course conduct, evaluation, and validation. The frequency of curriculum review varied from country to country. Where the number of course students was relatively small with only one or two institutions involved, the review and modification process was continuous and relatively informal, whereas where a large number of institutions, teachers and students were involved, the course reviews were much less frequent and more formalised.

In most countries the curriculum process was nationally co-ordinated but in Australia the process is state-(and not nationally) based. In general the curriculum process was carried out in some centre or division and involved the collection of information from teachers, past students, employers – through advisory committees, personal liaison, surveys, meetings and seminars.

E. Development and utilization of instructional materials

The extent to which instructional materials are used and the various types of media utilized depends upon (a) the affluence of the country and the availability of resources; (b) the extent of teacher training; and (c) the instructional language.

Countries such as Australia and Japan are very affluent and have well-trained teachers whereas there are countries such as Bangladesh and Indonesia which have only very limited resources and very few adequately trainedand experienced teachers. The availability of instructional materials in those countries which have both resources and trained teachers appears to be very good, whereas some other countries have very limited facilities and materials, and even those that are available are not effectively used.

Instructional materials may be divided into two categories, software and hardware. In countries such as Australia, Japan and Korea, a wide range of instructional hardware is available; for example, basic test equipment, sophisticated test equipment, simulators and models, experimental and laboratory aids, projection equipment, video recorders and computing oriented equipment. On the other hand the equipment available in countries like Bangladesh and Sri Lanka is both elementary and of limited availability.

Likewise the quality and availability of instructional software varies from country to country. The range of instructional software available includes text and reference books, slides and video tapes, films, printed sheets for various purposes and teaching and laboratory manuals. Some countries, like Australia, have well-developed learning resource centres. The factors affecting the type and availability of instructional software appear to be the availability of hardware, financial resources, trained and experienced teachers, and instructional language.

Countries such as Japan, Indonesia and Thailand, where the instructional language is not English are unable to utilise the ready supply of commercially prepared materials in that language. Consequently, there is a need for some countries to develop their own materials or to translate materials into the instructional language. While this may not be a significant problem for technologically advanced countries or countries for which English is a second language, it is a significant problem for a number of them.

In some countries like India the instructional software is centrally produced, and as a result the most experienced teachers can develop the materials. This approach offers advantages where the availability of experienced teachers is limited as it is of economic importance to avoid the duplication of effort. In other countries instructional software is prepared by the practicing teacher. In the majority of countries, however, some instructional software is prepared in a centralised facility and other items are prepared locally. In many cases, for example, in India and Bangladesh, conscious efforts have been made to prepare instructional materials from inexpensive, readily available local materials.

With changes in technology and without any doubt electronic technology being one of the fastest changing technologies, there will be a constant need to update instructional materials — both hardware and software. In addition, electronic test equipment has limited economic life and it is necessary to make adequate allowance for replacement while basic test equipment which might be in nearly constant use may have to be replaced every five to eight years. More sophisticated instruments such as spectrum analysers, high performance oscilloscopes and logic analysers, while having a lower degree of utilisation, may become technically obsolete a few years after purchase. These problems add to those of providing additional materials, equipment and facilities needed to meet the increased demand brought about by the invasion of electronic technology into areas previously using non-electronic technology.

F. Physical facilities

In general it was found that the availability of physical teaching facilities was reasonable in most countries even though there were some deficiencies, as in Bangladesh and Sri Lanka. Additional facilities will be required in most of the countries to meet the needs created by the widespread adoption of electronic technology and any increase in population.

Student facilities such as common rooms and recreational facilities appear to be lacking in many of the countries.

G. Teacher training

In many participating countries both pre-service or initial training facilities are available although the adequacy of these facilities varies. In most countries the pre-service or initial training occurs in specially designated institutions whereas in parts of Australia, use is made of the broad spectrum of institutions in the advanced education sector of the tertiary education system.

In-service training and technical updating opportunities are available in some countries, such as professional upgrading, but in many cases a greater allocation of resources to this activity appears advisable.

In general, there appears to be an inadequate supply of suitably qualified teachers. While in Australia the supply can just meet the demand, the supply is inadequate in many countries such as Bangladesh, Indonesia, Sri Lanka and Thailand. In many countries such as Thailand, Sri Lanka and Indonesia, the salaries paid to teachers is much less than those paid to their industrial counterparts thus making it nearly impossible to attract adequately qualified personnel to the teaching profession.

H. Problems and ways to overcome them

While many of the participating countries have solved some of their problems in accordance with their own socio-economic and developmental needs, many more have yet to be solved. Education and, in particular, vocational and technical education, is not an isolated human endeavour but rather occurs in an environment surrounded by political, economic and industrial constraints. The field of electrical and electronic engineering is under a process of rapid and continuous change; it is to a large extent this rapid and continuous change itself that generates some of its own problems.

In spite of the large differences in the wealth and affluence of the participating countries, they face similar problem areas. The problems are relative to the economic development of the country and the degree of technological development in the industry. As a result the problem of adequate equipment in Australia, for example, is no less a problem for them than for, say, Bangladesh; the educational system of these two countries must respond to the needs of their industries. In one country, for instance, a logic analyser may be considered to be a basic test instrument whereas in another it may be someting that is heard about but never seen.

Nearly all countries reported a lack of appropriately trained teaching staff; even if the required number of teachers is available, they lack technical and teaching competence and flexibility. In most countries the salaries of teachers of high technological competence are inadequate to attract capable personnel from the industry and then hold them in the teaching service for a useful period of time. In a few countries both education and industry face a significant shortage of technically competent manpower. Because of the rapid development of electronic technology, all countries are experiencing difficulties in retraining, technically updating or providing adequate technical in-service work experience.

The second main problem faced by participating countries is the lack of technologically appropriate equipment even though in some of them other physical facilities are in fair-to-adequate quantity. Electronic equipment has a relatively short life of between five and ten years. After such a time it is either technically obsolete, its performance has deteriorated by component aging, or replacement components are no longer available. Working on the basis of an eight-year life, some 12½% of the total capital value of the equipment needs to be invested in new equipment each year.

Solutions to either of these two problems would involve a greater proportion of the educational budget being dedicated to these aspects of education in electrical and electronic education. This involves not just the issue of allocating more money for vocational and technical education but, in addition, positive discrimination in favour of electrical and electronic engineering education. A subsequent issue results from the fact that electronics have infiltrated areas of industry that previously employed non electronic technology thus making demand on education in electrical and electronic engineering from non-traditional industries. This fact could be used as the basis for arguing for a reallocation of budgetary priority in favour of electrical and electronic engineering education.

Other main problem areas identified by participating countries are:

- Inadequate manpower forcasting (Australia, India, Thailand and Papua New Guinea),
- Problems in servicing remote areas of the country (Australia, Sri Lanka);
- Effect of a large number of part-time evening students (Australia),
- Lack of adequate supply of suitable textbooks and other materials (Bangladesh, Indonesia, Sri Lanka),
- Lack of industry involvement in technical and vocational training (Bangladesh, Malaysia).

J. **Innovations**

That which is innovative in one country may have happened years before in another, or be not even applicable in another. Just a few of the identified innovative features of the participating countries were:

Australia

- Establishment of a three-level structure of complementing institutions, namely universities, colleges of advanced education and colleges of technical education;
- Development of a nationalcurriculum, including supporting materials, based on areas of knowledge for electrical trades course;
- Distant teaching of isolated trade students in television servicing by conference line telephone;
- Accountability for all educational operations including teching, curriculum development, industrial liaison etc., being school based (South Australia);
- Establishment of a system of advisory committees for curriculum development and evaluation;
- Availability of a range of digital, microprocessor teaching facilities available;
- Utilization of evaluation methods chosen to be appropriate to the level and skills expected from students.

Bangladesh

- Adopting a systematic approach to curriculum planning;
- Use of guest/visiting lecturers;
- Introduction of modular courses.

India

- Development of new types of institutions, for example community polytechnics;
- Development of learning resource centres and media production facilities;
- Establishment of item/question banks for electrical and electronic subjects;
- Implementation of educational research into vocational and technical education.

Indonesia

- Objective-based curriculum planning and development;
- System approach in conducting teacher training courses;
- Modular training system in technical and vocational programmes.

Japan

- Establishment of new Universities of Technology;
- Development of extensive work in digital electronics/computers;
- Adopting project team approach in some final academic year work;
- Attitudes and presentation ability in seminar work included in assessment of student's performance;
- Implementation of on-the-job training in industry.

Papua New Guinea

- Development of curriculum, based on the needs of local industry;
- Student assessment based on a combination of marks received for tests, laboratory work, home assignments and project work.

Philippines

- Mass production of training aids such as modules for teachers and students and video tapes;
- Introduction of team teaching;
- Use of video recorders to demonstrate complex procedures in electrical and electronic engineering;
- Development of curriculum, based on the functions which graduate students can be expected to perform in industry.

Republic of Korea

- Establishment of a specialized Textbook Administration to prepare and publish technical textbooks;
- Utilization of locally produced equipment for schools;
- Practical on-the-job training successfully implemented.

Sri Lanka

- Establishment of Sri Lanka Institute for Distance Education to provide education to remote areas;
- Introducing the requirement for students to submit reports and to undertake an interview on their in-plant training;
- Establishment of a single body responsible for in-plant training programmes at all levels.

Thailand

- Establishment of a modular training programme;
- Introduction of a project to produce own electrical and electronic training kits;
- Implementation of a programme and priorities for obtaining necessary equipment.

K. Future plans

In general, the future plans of most countries revolve around devising and implementing solutions to current problems, expanding the number of student places available, and improving the quality and effectiveness of the learning process. Some of the specific plans of participating countries are:

Australia

- To devise methods to attract more women into electrical and electronic engineering;
- To develop new techniques for industry through education;
- To place more emphasis on self-help programmes;
- To consider the introduction of new specialist areas such as Medical Electronics.

Bangladesh

- To devise methods for overcoming the shortage of technical teachers and instructors;
- To implement technical teacher training for experienced craftsmen and technicians;
- To devise methods for overcoming the lack of adequate equipment.

India

- To implement the concept of career development of teachers;
- To validate teaching aids and item banks;
- To implement training courses in curriculum development and preparation of instructional materials.

Indonesia

- To establish Vocational Education Development Centre;
- To develop strategies for overcoming shortage of materials written in the national language.

Japan

- To establish more specialized Universities of Technology;
- To emphasize retraining and upgrading of teachers.

Malaysia

- To build 42 vocational schools and 5 polytechnics;
- To introduce short-term vocational courses into secondary schools.

Papua New Guinea

- To implement new curriculum including development of facilities and materials.

Philippines

- To increase the output of technician students;
- To implement procedures for upgrading technical teaching personnel;
- To revise and update curriculum for electrical and electronics subjects.

Republic of Korea

– To change emphasis between general and vocational education.

Sri Lanka

– To devise methods for co-ordinating curriculum planning for electrical and electronic subjects;
– To further develop and extend the programme of Sri Lanka Institute of Distance Education (SLIDE programme).

Thailand

– To devise methods for improving industrial liaison;
– To evaluate recently introduced curriculum for vocational and technical education.

Chapter Four

GUIDELINES FOR DEVELOPMENT OF CURRICULUM, INSTRUCTIONAL MATERIALS AND PHYSICAL FACILITIES, AND TEACHER TRAINING

Introduction

Each country must organize its educational system in accordance with its own needs, aspirations and traditions. In order to become more productive and efficient, vocational and technical education should be co-ordinated with the state of industrial and commercial development and the economic resources of the country as a whole. Nevertheless, it is felt that the following guidelines may be useful to the countries when designing or evaluating their systems of vocation and technical education.

Guidelines for Curriculum Development

In view of the varying levels of development prevailing in the electrical and electronic industries and educational institutions in different countries and because the need arises for the development of curricula in electrical and electronic subjects for different types of courses, the approach to curriculum development should be sufficiently universal to be applicable to as wide a spectrum of requirements as possible. Certain principles of curriculum formulation and development need to be identified and a systematic application of these principles needs to be carried out to establish the curriculum for any particular course. Such an approach results in a model which is not only systematic and comprehensive but is also flexible and amenable to subjective decision-making. The entire process may be divided into four interrelated areas of activity, namely:

- Analysis Phase,
- Design Phase,
- Implementation Phase, and
- Validation Phase.

This process is illustrated by the model depicted in Figure 1, where interrelationships between various elements of the model are indicated by arrows.

The Analysis Phase consists essentially of the acquisition of data in relation to the required course and the setting up of the managerial and resource machinery. The Design Phase involves the actual structuring and formulation of the course while the Implementation Phase deals with the harnessing of resources and the conducting of the course. The Validation Phase is concerned with the feedback and possible modifications to the curriculum.

The extent to which the guidelines offered by this model are to be applied to any particular course curriculum development activity will depend upon the length of the course, whether it is a new development or a revision, and whether the course will be discrete or have varying levels of relationship to other courses or study areas. The application of the model to a course revision is illustrated in Figure 2.

Figure 1. Curriculum Development Process

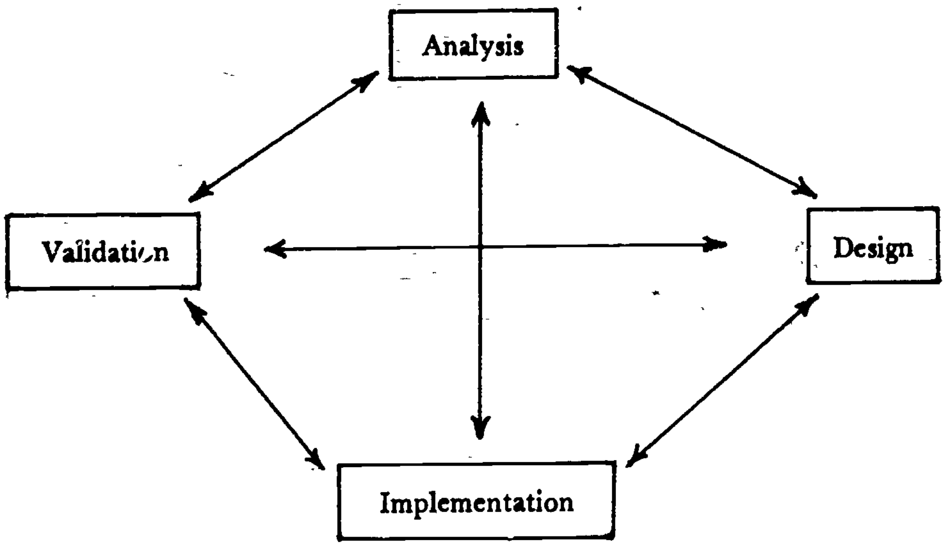
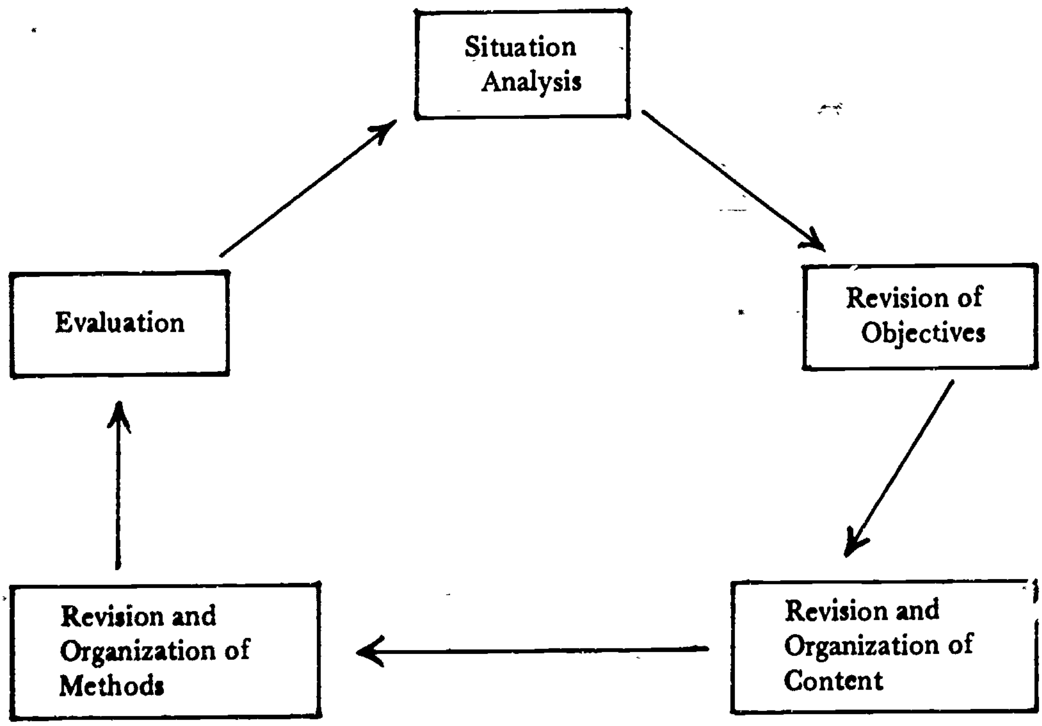


Figure 2. Curriculum Revision Process



Curriculum Model

This curriculum model offers an overall impression of all the phases necessary for a total curriculum development process. To identify more clearly the elements within each phase of the model, this paper discusses the phases under separate headings, and suggests appropriate actions which may be taken.

A. Guidelines for the Analysis Phase

The analysis phase incorporates the steps to be taken to ensure that the curriculum development process is effectively managed, that the basis for the proposal is examined in detail, and that sufficient data is gathered to permit efective design.

1. **Establishment of management structure:**

   a) Form a committee which is responsible to a curriculum development officer who will be in charge of the process. This committee should include the teachers who will be teaching the course and others in the institution who can contribute to the development of the specified curriculum.

   b) Specify the terms of reference of the committee such as limits of authority, a time scale for completing the work, powers to co-opt others into the committee if and when required.

2. **Examination of origin and context of proposal:**

   a) Determine the exact origin of the proposal to start the course. The The proposal may originate from employer groups, government organizations, community groups or from within the institution by initiatives from departments or teacheers.

   b) Investigate the motives and reasons for the proposal. The motives may include need for qualifications, in-service requirements, training for new staff, training for new technology, social or political pressures.

   c) Determine the characteristics of the target group. The curriculum committee should find out what type of people will be interested in following the course, the numbers involved, their educational background and other similar characteristics.

   d) Find out the relationship between this course and other courses in the institution or which are operating elsewhere in the community.

   The curriculum committee will then be in a position to draw on the expertise and experience of people who can help in the development of the curriculum and make the course a success.

   e) Decide on the legitimacy of the course. The curriculum committee must make sure that the particular course will fit into the educational objectives of the institution.

   f) Determine the priority of this course within the institution.

3 **Submission of curriculum committee's recommendations**

These regard the advisability and feasibility of conducting the course.

4 **Decision to continue the curriculum development activitty**

Based on the report, the decision to continue the curriculum development activity will be influenced by the needs and interests of the students, the community, the institution and the source of the proposal.

5 **Data acquisition**

a) Rationalise the scope of the course.

If there are areas of study or subjects already being taught which overlap with the course, these must be identified.

b) Analyze student characteristics.

Decide what background students should have in order to enrol. With such a background the question of students' interest and motivation needs to be gauged.

c) Evaluate resources.

The staff and facilities available for teaching the course should be identified and any shortcomings should be noted.

d) Determine the relevant job requirements and tasks to be performed.

These factors will be determined in consultation with industry, emplyers, unions, government departments and other agencies. Information may be derived from relevant job/task specifications. Where no such specifications exist, education authorities can assist in their formulation.

The process of assessing the various kills and knowledge required to perform a particular job is known as *task analysis.*

Task analysis provides informaion relating to:

- the required levels of ability and aptitude;
- the required area and degree of knowledge and skill;
- the required extent of decision-making and responsibility.

A typical procedure for task analysis is to list in order each step in a particular operation, noting at each step key features which affect the ease, quality or safety of the operation. The outcome of task analysis reflects the characteristics required of the operator and facilitates the determination of the objectives and content of courses designed to educate and train the operator.

In addition, the task analysis may indicate an hierarchical order of importance of objectives leading to an ordering of content under the categories of: *must know, should know,* and *could know.* For example, an electrical technician *must know* the physical principles underlying the manner in which electrical energy is generated, *should know* how electrical energy is transmitted, and *could know* something of the history of the electrical engineering industry.

B. Guidelines for the Design Phase

During the design phase the aims and objectives of the course are developed, the structure of the course is determined, the data gathered in the analysis phase is used to formulate a syllabus, necessary resources are specified, and approval to implement the course is sought.

1 Definition of the aims and objectives of the course

a) Decide on the *aims* of the course. These are usually stated in general terms:

- to produce a person with the ability to reason conceptually, to analyze and solve problems and to act in a manner appropriate to the norms of society and requirements of technical standards.
- to equip students with the technical knowledge necessary to exercise the wide range of skills and procedures required by an electrical/electronic tradesperson or technician.
- to develop and supplement the practical skills experienced in an industrial environment and to perform these skills in a workmanlike manner and according to the principles of safe practice.
- to enable the student to attain the relevant theoretical knowledge and practical skills necessary to satisfy the requirements of authorities external to the educational process such as licensing authorities or professional associations.
- to produce a person with the ability to adapt to changes in technology.

b) State the *objectives* of the course. The objectives are specific and should state what the learner is expected to do as a result of undertaking the course. Objectives should be classified according to: (i) basic skills and knowledge; (ii) specific skills and knowledge; (iii) supportive material; for example:

i) Basic skills for the *electrical and electronic trades,* such as sketching, drawing, reading and proper interpretation of technical illustrations representing electrical components, apparatus and machines, including electrical diagrams and schemes;
- proper handling of tools and equipment in some general metal workshop, electrical workshop operations like fitting, filing, turning, shaping, electric installation work, soldering and such.

ii) Specific skills for *electrical and electronics trades,* such as proper use and maintenance of electric tools and electrical/ electronics measuring instruments, electrical machines, electronics apparatus, trouble-shooting, repair work, dismantling and assembly work on electrical and electronic gadgets.

iii) Supportive materials needed for *electrical and electronics trades,* such as may be found in libraries, resource centres and data banks; leading to correct use of terminology, observing standards, instructions and maintenance manuals, proper language usage, and application of mathematics, science and any other area relevant to the aims objectives of the course.

2 Structure of Course

a) The identification of appropriate skills and knowledge leads to the specification of the learning experiences necessary to achieve the course aims and objectives.

b) The course should be formulated around important themes and major concepts, for example:

i) A course in *Communication Engineering* will evolve from three major themes:

- Processing of information at the source;
- Transmission of this information through a medium; and
- Reception and detection of information at the destination.

ii) A course in *Microprocessor Techniques* will evolve from:

- Concepts of analogue to digital conversion;
- Storage, processing and retrieval of digital information; and
- Programming techniques.

iii) A course in *Electrical Machines* will evolve from:

- Bassic Principles;
- Design; and
- Operation.

3 Syllabus

Specification of learning experiences leads in turn to identification of topics to be covered in the course. Listing the topics leads to the formation of the course syllabus. In the majority of cases, listing the topics suggests a grouping into subject areas, for example, all topics relating to electrical principles may be grouped into one or more subjects ('Electrical Principles I', 'Electrical Principles II'); all topics relating to electronic circuit analysis may be grouped into a subject under that title; all topics relating to mathematics and science may be grouped into mathematics and science subjects. The course syllabus will contain both a theoretical and a practical component.

4 **Ratio between theory and practice**

Generally it is advisable for trade courses to have more emphasis on practice and less on theory, while technician courses would emphasize theory over practice.

Typical examples:

		Theory %	Practice %
Vocational :	Full-time	30	70
	Part-time	50	50
Technical :	Full-time	70	30
	Part-time	80	20

5. **Determination of student assessment procedures**

   A combination of continuous assessment, which provides students with constant motivation and instant knowledge of progress, and final examination, which tests overall retention of knowledge and relatively long-term recall, is always desirable.

   A guideline for the weighting: for continuous assessment 40 per cent and for terminal examination 60 per cent of the total mark.

6. **Dtermination of organization of the course**

   It is recommended that consideration be given to the following approaches to organizing a course:

   a) modular/sandwich/integrated or lock-step;
   b) compulsory/elective combinations;
   c) separate from, or integrated with, other institutions;
   d) central or local administration; and
   e) self-paced, individualized or teacher-centred.

7. **Specification of instructional materials**

   Relevant guidelines are provided separately in this report.

8. **Specification of physical facilities**

   Relevant guidelines are provided separately in this report.

9. **Specification of qualifications and experience of teaching staff**

   In general, teaching staff should be acaemically and technically qualified to a level above that at which they will be teaching. However, this should not automatically preclude the highly experienced but less academically qualifed teacher from being involved in specific teaching programmes. Relevant guidelines are also provided in this report.

10. **Preparation of curriculum document**

    Formal approval of the curriculum is needed before it can be implemented in the teaching institutions (schools, colleges, training centres). It is necessary, therefore, to prepare a curriculum document which details the steps which have led to the developed curriculum.

    The Curriculum Document should be organized under four main headings: (a) Background; (b) Syllabus; (c) Context; and (d) Resources.

a) Background (needs, demands, analysis, procedures):

- Status (new course/revision),
- Title,
- Aims,
- Classification of Award,
- Justification of Classification,
- Nature and extent of need and how identified,
- Nature of demand and how established,
- Employment opportunities,
- Composition of advisory committee (if used), determining its capacity, qualifications, experience,
- Development procedures,
- Recommendations and endorsements of colleges and curriculum Committees.
- Implementation Plan: (a) Where ? (which colleges)
  (b) When ? (commencement date)
- Proposed date of submission for accreditation (if necessary).

b) Syllabus

- Title,
- level of Award,
- Aims and objectives,
- Entry requirements,
- Total length,
- Attendance patterns: Part-time, Full-time,
- Course structure
  (1) schedule and structure of subjects and units
  (2) total instruction hours for each subject showing lecture/laboratory/workshop/excursion or other, where appropriate.
- For each subject provide:

  subject objectives
  topics and content
  methods of assessment and weighting
  prescribed texts and other educational material
  prescribed special equipment
  accommodation.

c) Context (relationship with other programmes and institutions).

. for a revision, how students may transfer to the new programme,
. status and credit for relevant educational programmes and work experience,
. relationship between this course and other similar courses within the institution and outside the institution,

- effect on enrolment in other courses within the institution and outside the institution,
- implementation of this course (all or in part) by other educational institutions, industry and other community organizations.

d) Resources

It should be noted that since resource requirements may increase for succeeding years of a course, their provision must be planned in sta

- staff development requirements,
- educational curriculum resources required,
- procedures for the maintenance of standards and co-ordination,
- full-time and part-time teaching staff needs: existing and extra; requirements prior to the next review (Ex: Year 1 to Year 5),
- qualifications and experience requirements of teaching staff,
- Support staff (non-teaching); existing and additional, requirement for Year 1 to Year 5.
- Additional physical facilities required in the first 5 years,
- Additional equipment required in the first 5 years.

11. **Presentation of curriculum document for approval**

This stage provides the opportunity for a final approval to implement the developed curriculum.

12. **Preparation of activity profile**

The activity profile is a document which should accompany most courses, depending upon the length and importance of the course. This activity profile will contain suggestions for the implementation of the course rather than prescriptions. However, the Curriculum Committee could profitably spend some time preparing this profile.

The activity profile may contain the following items:

- topic objective,
- suggested lessons,
- suggested teaching methods,
- suggested references,
- suggested visual aids,
- suggested activities associated with the community,
- a minimum level of acceptable performance, and
- suggested testing procedures,

C. **Guidelines for the implementation phase**

During the implementation phase, the developed curriculum is put into practice. The teaching staff must be made fully aware of the intent and content of the curriculum, the resources must be harnessed, the course conducted and student performance evaluated.

1. **Communication of curriculum details to all relevant staff**
2. **Organization of resources, staff training, publicity, facilities by appropriate authorities**
3. **Interpretation of activity profile and preparation of lesson plans by teaching staff**
4. **Presentation of activity or course content to students**

   This is seen as a teaching function and guidelines for this activity are provided separately in this report.
5. Evaluation of students

   a) Consideration must be given to the kinds of evaluation data required and it is recommended that a wide range of evaluation instruments be examined, for example:

   (i) Data to be considered:

   – Objectives and evidence pertaining to them
   Thinking abilities
   Attitudes
   Skills
   Ingenuity
   Concepts
   Levels of perception

   – Factors affecting learning
   Initial level of subject matter mastery
   Motivational patterns
   Special abilities
   Feelings

   – Teaching-learning operations
   Nature of assignments
   Procedures for maintaining control
   Patterns of teacher response to student behaviour

   (ii) Instruments to be considered
   Objectively scored tests
   Essay tests and other written exercises
   Sentence completion tests
   Tape recorder techniques
   Attitude scales
   Behaviour check lists
   Sociograms and participation flow charts
   Questionnaires
   Interviews
   Performance tests
   Rating scales for performance and products
   Oral and written reports

b) Formal tests should call for the behaviour specified in the objectives. Such tests should be developed prior to the instruction, so that the objectives, rather than the lesson contents, are tested. A good test will be:

valid — it will determine whether the student has learned what he should have learned.

reliable — it will give consistent and objective results.

suitable — it is administratively feasible and appropriate for the student for whom it is intended.

c) Each lecturer should be responsible for evaluating his or her students' learning outcomes. It is desirable that the lecturer's assessment instruments be reviewed by colleagures and administrators.

D. Guidelines for the Validation Phase

Validation examines the whole curriculum process, but is particularly concerned with evaluating the analysis phase.

Validation establishes whether the most appropriate aims and objectives were developed during the analysis phase. In most cases modifications will result from validation, allowing the curriculum to be appropriately changed. Effective validation results in courses which are dynamic, relevant, flexible and systematic.

In practice, validation is the most difficult step in the curriculum development process. The student's career subsequent to his studies must be followed up; employers' views on the effectiveness of students in the workplace, need to be sought. The data acquired in the analysis phase may need to be re-assessed, a new job/task analysis may need to be undertaken.

In terms of the curriculum development model, validation feeds back into the analysis phase and influences the design and implementation phases. (see fig. 1) It may be of use to the organization at large, and to other curriculum groups, however, to prepare a report on the total development, presentation and review of the course subsequent to the validation phase.

E. Guidelines for the development of instructional materials and physical facilities

Regardless of the care and attention to detail given to the preparation of a curriculum, in the final analysis the success of any education endeavour must ultimately rest on the shoulders of the person who has the responsibility of implementing the programme. The fact cannot be overstressed that, in the classroom situation, the full success of a teaching enterprise is completely dependent on the teacher. It is possible for administrators to tell a teacher to teach but it is beyond the scope and ability of administrators to completely monitor how he/she teaches.

On the other side of the picture, those who administer the programme have an equally important and significant responsibility. It was made apparent by several participants of the APEID Technical Working Group Meeting that, no matter how competent a teacher was or how dedicated he was to his profession, unless he had access to apporpriate aids and facilities his chances of success were severely limited. Teachers' needs extend both to adequate documentation as well as the necessary equipment and facilities to give industrial and vocational relevance to the material being taught. Such assistance can, to some extent, compensate for some lack of training and expertise and to a lesser degree affect any lacking of dedication. In fact, it could be argued that merely the availability of such assistance would, and should, lead to the development of expertise and contribute to the reinforcement of the teacher's dedication and performance as he senses the support of his superiors.

The level of the practical assistance being given to a teacher may be considered as an indication of the level of administrative support.

It was considered by the working group concerned with the guidelines for the development of instructional materials and physical facilities that the areas in which the teacher should reasonably expect the support which is necessary for the proper execution of his role as an educator could be divided into six different categories, which may be briefly described as follows:

1. Adequate documentation on which to base both his/her lesson preparation and presentation.
2. Appropriate assistance in the development of his/her own teaching materials.
3. Provision of sufficient and suitable materials for distribution to, or acquisition by, each student to complement the teacher's presentation.
4. Assistance in the development of appropriate instruments for the assessment and measurement of students' achievement as well as evaluating outcomes of the teaching programme with regard to the stated golas of the programme.
5. The necessity for appropriate and adequate training of technical and vocational teachers and provision for on-going training for the duration of the teacher's career.
6. The provision of suitable and sufficient equipment both for use by students and for demonstration purposes so that the material presented by the teacher be relevant to the present and future industrial environment of the trainees.

With regard to Category 1, the working group held the view that the curricula designed to meet vocational and technical needs in any given electrical subject area in all countries possess a certain degree of commonality. This would ensure at least an ad hoc recognition as a step towards reciprocity of accreditation. It was felt that a further consideration of transferability most appropriate for future international co-operation was mainly in the area of curriculum design, which was within the competency of another working group of the meeting.

Similarly, it was felt that there is a need for an equivalent degree of commonality in teacher training matters, which justifies future exchange of information and experiences in this area. Again this was considered to be outside the terms of reference of this working group.

Finally, apart from the restraints in building design where specialized equipment, for example computers and sophisticated test equipment, are concerned, where humidity and suspended matter inimical to the proper functioning of the equipment is a factor, the identification of building design criteria should not be considered the exclusive concern of electrical and electronic executed courses. Consequently such matters were only discussed when they were considered as being an integral part of a topic being discussed in another context.

Before undertaking an itemized examination of the remaining categories described above, a review of these categories in the context of the guidelines of Agenda Item of the Technical Working Group Meeting (provided as Annex 4) was first carried out.

The relevance of these six categories and their relationship with the agenda guidelines have been tabulated, along with identification of their signifcance in the terms of reference of the working group concerned with the guidelines for development of instructional materials, educational equipment and physical facilities, in the following manner:

	Category	Guideline (Agenda Item 4)									Considered by the Group
No.	Description	1	2	3	4	5	6	7	8	9	
1	Documentation (Curriculum)	X		X	X						No
2	Teaching materials		X								Yes
3	Learning materials					X					Yes
4	Assessment instruments						X	X			Yes
5	Teacher training	X								X	No
6	Demonstration and practical equipment				X		X		X		Yes

Dealing with each of the remaining categories in turn, the salient features of the topics considered in each category have been briefly outlined as follows:

Category 2: Preparation of teaching materials

This section is concerned with the manner in which the lesson is prepared. Essential for all preparation is the syllabus statement of the curriculum. Although the actual syllabus content and the manner of its development was beyond the concern of this group, the actual manner of its implementation through supplementary instructional materials was a major concern. It is well known that the syllabus may provide definitive statements of aims and objectives but unless the teacher has guidance in his preparation he/she may be uncertain of the most suitable means of achieving the stated goals.

1. **Lesson plans and summaries**

It is felt, therefore, that the teacher should have access to detailed lesson summaries pointing out the main features of the lesson and *suggestions* for presentation. The summary is not meant to replace the teacher's own research or preparation, but to provide a framework which can be filled out by the teacher on the basis of his own experience and of his recognition of the special needs and industrial experience of his students. The teacher should then produce a lesson plan which reflects the above considerations and which is based on the issued summaries.

It is suggested that where some commonality of syllabus content had been established the preparation of lesson summaries could be a co-operative enterprise drawing on the expertise of people from different countries.

The successful presentation of a lesson plan is largely dependent on the provision and availability of appropriate text. It was felt by the members of the group that in countries where English is a second language the use of expensive foreign textbooks was not universally possible due to the cost factor and the level of vocabulary employed.

It was the opinion of the group that the guidelines for the preparation of text books should be:

a) available for use by all students at a cost consistent with student's income or allowance;

b) written in a manner that could be fully comprehended by all students and, where necessary, supplemented by national language and local dialect materials. To this end the level of English should be such that emphasis is placed on the understandability of the material;

c) written in such a manner that emphasis is placed on basic theory and application and with a minimum of complex concepts;

d) illustrated to the maximum possible extent with explanatory notes and simple definitions set in bold letters for each reference and based on the principle of gradually building a vocabulary and with condensed self-contained dictionary at the end of each book, arranged in the alphabetical order of the relevant electrical special terms used throughout the text, and

e) accompanied by students worksheets or supplementary textbooks prepared in a semi-programmed manner requiring student's interaction in order to motivate active learning with understanding and to provoke logical thinking, decision making and creativity related to the practical implementation of the theoretical concepts by solving problems.

Note 1: It was suggested that the preparation of such textbooks could be done on a co-operative basis and could lead to reciprocity of recognition of equivalent courses.

Note 2: A point was also made that the lesson summaries should contain adequate references to the relevant textbook to enable, the teacher to guide students in their own learning.

Note 3: While the foregoing refers specifically to textbooks for the classroom, it recognizes the necessity for more advanced reference books for use by teachers and by senior students. References to such more advanced textbooks should also be made in the lesson summaries.

Note 4: A need was also identified for the development of self-paced learning materials written either in an appropriately graduated level of English or in the national language to assist persons who could not maintain the normal class progress.

Note 5: The group also envisaged that the printing of such textbooks could be achieved more economically in some of the less-developed countries.

Note 6: In all commercially available and self-produced instructional materials there must be constant emphasis on *SAFETY* at every appropriate point in the presentation.

Note 7: The term 'textbook' can be regarded to include laboratory manuals and guides, workshop project and inspection sheets, all of which would be used by the teacher in preparing an instructional package.

Note 8: In addition to the proposition made in Note 7 there should be adequate provision of follow-up materials for the students' use and for consolidation of knowledge. This could be related to assessment and evaluation of student's performance through individual assignments contained in the specially designed students' workbooks.

Another area in which assistance could be given to teachers is in the provision of teaching charts and similar non-projected visual aids for display. The guidelines that should apply to such visuals could be summarized as follows:

- they should be available at a price within the reach of all institutions;
- they should be suitable for using by teachers and students to the best educational advantage;
- they should be durable and preferably unaffected by climatic conditions.

Note: It was suggested that a committee concerned with the production of simple textbooks could also address itself to the design of suitable teaching charts and, further to this, audio visual materials generally.

Displays and models

Another area where assistance could be given to teachers is in the provision of suitable displays and models. The working group made the following recommendations with regard to appropriate guidelines:

1. The sectioned models:
   a) should be easily transportable;
   b) should be light, simple, readily available and, wherever, possible, dynamic rather than static;
   c) preference should be given to the actual device or component rather than a simulation wherever this is possible, practical and safe;
   d) efforts should be made to have various models and simulators carefully designed and produced. Teachers should be encouraged to show initiative and to make innovative efforts to produce their own models, aided, where necessary, by technicians and/or students.

Note 1: When it is not possible or convenient to use models, other audiovisual devices should be employed. However, such audio visual devices should never be used exclusively as substitutes for real items, if the actual components are readily available.

Note 2: It is advisable that, where possible, details or models of commonly used devices should be made available to all institutions throughout the countries to ensure the use of similar models in similar situations.

Audio-visual equipment

As mentioned earlier, the working group identified the need to use appropriate audio-visual equipment. Such equipment includes: (1) slide projectors — 35 mm, (2) overhead projectors, (3) motion picture projectors — 8-mm, 16-mm, 35-mm, and (4) video recording and playback equipment, both cassette and open-reel. The emphasis in the use and provision of audio-visual equipment should be on cost-effectiveness and, in particular, relative cost-effectivness based on the different options available.

The provision of expensive audio-visual equipment, like any other equipment, is open to question when comparable results can be achieved more economically by less sophisticated means. The use of more economical equipment will open the way for its use in many more institutions. Novelty should not be used as a rationale for the provision of expensive equipment. The choice of equipment should be determined by considerations of discretion and its effect as contributive to understanding rather than confusing.

The group also took account of the increasing use of microprocessors in teaching both as a teaching tool and as an aid to administration, but here again the group emphasised the need for discretion.

Class sizes

In the discussion of physical facilities in the classroom situation, it was considered appropriate to give consideration to the optimal class size for technical and vocational education. While it was established that, in some instances, classes of 40 students in theory lessons and 20 students in practical activities may be feasible in the light of shortages of equipment, teaching staff and financial restraints, it is recommended that these should represent absolute top limit. The working group recommends that the desirable maxima be 30 and 15, respectively, and technical education administrators and planners should work with these figures in view. It was also suggested that in some instances even these figures may be above the acceptable limit, especially in groups where high-level technology is involved or in practical training with a high level of skill content and especially when carried out in a hazardous environment.

Building design restraints

The group also considered it proper to make some recommendations with regard to building design restraints for buildings intended to house electrical and electronic classes. The guidelines to be observed may be summarized as follows:

1. Safety features

   a) Emergency exists

   In addition to the normal entrances for teaching staff, students and service staff, there should be provision for emergency exits, particularly in laboratories and workshops where hazardous conditions exist.

   b) Equipment ratings

   All equipment should be designed to suit the supply of voltage and frequency of the area in which the instituion is located. In addition, each electrical outlet and socket should provide facilities for adequate earthing (grounding) to ensure proper safety levels.

   c) Emergency stop buttons

   All electrical laboratories and workshops, in addition to having locked main switches, should provide for emergencies by having emergency stop buttons at strategic positions throughout the building. It must be emphasized that such emergency stop buttons should operate only on the power circuit, and lighting cirucuits are to remain operative for safety reasons.

   d) Core balance protection

   In addition to having a secure earth (grounding) system it is suggested that in electrical laboratories and workshops where students are involved in practical exercises there be a core balance protection system on all electrical supplies.

   e) Fire extinguishers

   All laboratories and workshops should be equipped with adequate fire extinguishers of a type suitable for electrical fires.

   f) First aid equipment

   Each workshop and laboratory should have an adequate first aid kit and, whereever possible, trained personnel available in an emergency.

2. Building considerations

   a) Special design

   Although it is important, particularly in developing countries, for facilities to be provided in the most economical manner, the security and proper housing of electrical and electronic equipment should receive appropriate attention.

(i) Thermal insulation

Particular emphasis should be given to the matter of thermal insulation. This is particularly important where mean ambient temperatures are such that the interior environment in uninsulated buildings may be harmful to sophisticated and delicate electronic test equipment.

(ii) Floor covering

Although concrete may be acceptable for workshop areas, other coverings or floors may be necessary for laboratories and similar areas required in electrical and electronics field. If wood or linoleum is used over concrete, between the covering and the concrete some material impervious to misture should be laid which could contribute to excessive humidity conditions.

(iii) Cooling systems

In addition to solar energy for water heating, solar energy could be considered as a means of achieving evaporative cooling for areas where high temperatures are undesirable.

b) Storage areas

In addition to specially-designated areas in which tools and equipment for use in electrical and electronics workshops and laboratories are housed, provision should be made for some equipment to be located at students' work stations. Such tools should be housed on 'shadow boards' or similar mountings to ensure easy checking. The major storage areas should be secure and lockable.

c) Co-operative use

Particularly in areas where severe financial restraints exist, there is a need for co-operative use of all equipment by all levels of training. This should result in considerable saving in the initial establishment of teaching institutions.

B. Category 3: Learning materials

1. Textbooks

It was suggested that, while textbooks should be available at a cost that is within the means of all students, there is a complementary need to produce the textbooks in a form and quality that would induce the respect of the students. It was also suggested that in addition to being written in a clear, concise and comprehensible manner, the textbooks should be well illustrated by appropriate drawings, photographs and diagrams. Once again a suggestion was made for the establishment of a co-ordinating committee to sponsor the development and writing of such textbooks and other printed materials.

A further suggestion was made for the preparation of textbooks to meet the actual needs at different levels of instruction in both electrical and electronic fields. In conformance with the definitions included in the Unesco Guide to Terminology of Technical and Vocational Education, the levels of specific textbook needs were defined to be as follows:

a) textbooks for the vocational level of technical education, and
b) textbooks for the technician level of technical education.

For each level of textbook production there should be provision of information for:

- faculty (teaching staff); this should include textbooks and appropriate reference books to supplement the teacher's knowledge and experience,
- students; sufficient to cover all the information required by the students to supplement material given in lessons and to provide resource material for laboratory and workshop exercises.

2. **Revision aids**

It is important that the information prepared for the students also include material that provides for the revision of the course content. Such material could include tests of objective type questions. It was also suggested that such questions could form the nucleus of an examination question bank from which material could be drawn for the production of examination papers. The use of such banks would be a step towards the construction of examinations of common level of difficulty in any given subject area.

It was also suggested that all material in a given subject area should form a cohesive entity and the different components should complement each other.

3. Ancillary equipment

In addition to the supply of suitable and adequate material to provide all the information necessary to the students, it is also essential that the necessary equipment be made available to ensure the successful implementation of the suggested programme. This need requires laboratory and test equipment, workshop facilities, and supporting facilities such as libraries and resource centres. It is impossible to fully document all the equipment essential to a proper electrical and electronics training programme as this will in part depend on the state of development of the country but there is a possibility for a recommendation setting out those minimum standards that should be met to enable students to acquire a satisfactory level of knowledge.

4. Support staff

The need was also identified for appropriate non-teaching support staff to assist in the setting up and preparation of experience and tests. At the vocational level the need for support staff was not so great since there was the benefit from involving students in the setting up of tests as part of their training experience.

It is suggested that Unesco should address itself to the task of sponsoring or producing standard training recommendations. These should be phrased in such a way that they are independent of language or culture. This, as well as the recommendation of a minimum equipment list could, for example, complement the building specification of the Unesco document "Info TVE 9". An integral part of all recommendations should be the establishment of minimum safety standards as the subject of safety cannot be overlooked. The group wished to draw the attention to the diagram of the Unesco document "Info. TVE 10" – Annex 11, Code 01971 P. 3, which gave the impression of lacking in safety considerations, particularly where the device is intended for use by the learner.

The use of micro-computers as a teaching tool at the vocational and technical level at this point in time was seen to have little relevance apart from those courses specifically concerned with their operation, maintenance and repair. However, the group wished to draw attention to the fact that the increasing availability not only of micro-computers, but to a greater extent micro-processors and dedicated chips, made their possible use in other areas of training increasingly imminent. The group suggested that Unesco should draft recommendations on the general use and limitations of micro-processors and micro-computers on a cost effective basis.

5. Repair facilities

In addition to providing the necessary equipment for tests and exercises it is also necessary to provide full and comprehensive repair facilities. A further benefit of such facilities could be their application in equipment manufacturing processes to ensure the full utilization of all equipment and the minimizing of repair time.

All countries and all institutions should adopt the principle of "self-help". It was suggested that implementing practical construction projects should be a compromise between students' efforts and institutional needs. It is often far more economical and the results are more in line with institution specifications whenever the institution manufactures its own equipment. Equipment in this category would include power supplies, small transformers, wave form generators, load banks, laboratory test panels and other small items of equipment. Here again, an emphasis must be placed on a strict adherence to rigid safety standards.

6. General recommendations

It was also recommended that guidance be given with respect to the creation of an environment appropriate to the equipment. Sophisticated equipment should be protected from extremes of temperature and humidity and should be located in areas which avoid the presence of dust and other organisms likely to damage the equipment. This is to be emphasized as a cost saving exericse to greatly prolong the useful life of the equipment and enhance its effectiveness. Laboratories to be used for electrical experimentation should be wired in a way which conforms with the strictest safety standards and could, for example, include appropriate earthing and core balance protection.

It is also recommended that continuous displays of safety posters be prominently featured in all laboratories and workshops. Such posters should emphasize the use of "Right" and "Wrong" practices for the guidance of students. The use of illustrations and diagrams, rather than written textual materials, should be emphasized. For example, various posters should always be displayed in all electrical workshops and laboratories, promoting, for example:

- Correct colour coding of cables and conductors for safety,*
- Use of safety glasses in hazardous locations,
- Use of rubber gloves,
- Correct techniques in pole climbing and use of ladders,
- Use of safety shoes and hats in the appropriate situations,
- Correct lifting technique,
- Proper use of tools – grinding wheels, portable electric tools and so on, and
- Resuscitation and heart massage techniques.

Category 4: Assessment and evaluation

As stated earlier in this group report it is proposed that to assist in the establishment of some relative standards in different countries, an examination question bank should be established. Teachers would then be able to draw on this question bank for material from which to construct examinations. It would also be expected that respective teachers and administrators of the member countries of APEID would contribute to the establishment of the bank.

a) Establishment of examination question bank

In the long term it was envisaged that a data bank of such questions be established in a form that would be compatible with a large number of systems, possibly in cassette form for economy and ease of transport and storage. This is a long-term projection and its successful implementation would depend on a considerable increase in availability and reduction in cost of the appropriate equipment.

With regard to evaluation of courses this should be done giving due regard to a suggested common basic course and the concrete needs of the industry served by each particular institution.

The actual course presented at any level of training should reflect a common aspect to all similar courses wherever they are offered and also reflect the needs of the local community with regard to special community needs. Each course should also contain elements of material outside the normal industrial experience of the student at the time of training to assist in his more rapid and ready transference to a new industrial environment. Again the need was seen for commonality of course content as a means of establishing portability of credits from different educational institutions. This was seen more as a curriculum matter having also a strong link with

---

*) There are problems inherent in colour coding which may be due to such vision defects as colour blindness and similar disabilities. The teacher should not have the responsibility for such matters which are related to proper staff selection and are more the concern of the employer. Nevertheless, the teacher must be alert to identify such disabilities and report them.

the assessment and evaluation aspects of the work of a teacher and areas in which he requires assistance and guidance.

The earlier proposed question bank could also be used as teachers' resource material for assignments in class and for home studies and should be made available in printed form to students for revision purposes.

The subject of assessment carries with it the concept that such assessment will identify those not reaching the required criteria it was emphasized that such assessment should be criteria-referenced rather than norm-referenced as a further step towards reciprocity of qualification. The teacher should also have access to material with which to render assistance to those not reaching the criteria. The criteria should be established in accordance with universal guidelines.

Assistance should be given to the teacher by appropriate in-service training in several different areas, viz: the assessment of theoretial knowledge and the assessment of practical skills.

b) Marking Guides

In this model the practical mark has a weightage of 60 per cent and the theory with two distinct components has a weightage of 40 percent. This gives a possible maximum mark of 100 per cent. These weightings will vary for different levels of instruction and different subjects and the model is not to be interpreted as a rigid guide.

Assessment would also serve to identify the more advanced students and a properly constructed syllabus should contain means whereby such students could obtain the maximum benefit.

It was also suggested that special guidelines should be developed to assist teachers in assessing the practical work of the students. As an indication of what the group considered, it is suggested that a correct and proper assessment of a practical exercise should give due regard to:

(i) time taken to complete the exercise in relation to allotted time;
(ii) achievement of purpose of exercise (accuracy, neatness, — if dynamic — does it work in accord with specifications ?);
(iii) quality of finish;
(iv) correct use of tools and equipment (adherence to safety standards); and
(v) evidence of initiative and self reliance.

For example — a mnemonic code used for assessing drawing work:

P Printing
L Layout
A Accuracy
N Neatness
T Time

Alternatively, laboratory exercises could include marking scales for the guidance of teachers *and* students).

It was also suggested that in cases where student work-books include material to be completed and pages torn out, or otherwise removed for assessment purposes, that provision should be made for a carbon or other duplicate copies to be retained by the student.

Category 6: Demonstration equipment

The group suggested that appropriate aids should form an integral part of any lesson presentation particularly at the vocational level of instruction. While there is room and need for both commercially produced and self-manufactured models, the emphasis should be on the self-produced ones with encouragement given to teachers to develop innovative concepts. Suggested criteria for all models are as follows:

a) Emphasis should be on dynamic rather than on static models;
b) They should be of adequate size and simple in concept and operation;
c) Great emphasis should be placed on utilizing indigenous, low-cost (or "no cost") materials.

(Note 1) *It is advisable that all models have adequate instruction to guide the user as to the manner in which they may be best utilized and operated.*

(Note 2) *In some cases the model may be of coloured plastic in a two-dimensional format to enable its use on an overhead projector.*

d) They should be accessible to all staff and centrally stored;
e) Where applicable, a modular construction technique should be used as basis of presenting the material in the simplest manner;
f) Models, either sectioned or complete, should never be used to replace an actual item unless there are inherent dangers implied in the use of the actual device;
g) Due regard should be given to safety considerations as a corollary of item(f);
h) A multi-media approach is recommendable; for example, kits including slides (visual) and cassette (audio), in addition to written explanatory material.

Where the use of appropriate models is not practicable, lesson presentation should be capable of supplementation by appropriate audio-visual equipment. The possibility of a central bank of suggestions for AV materials and techniques should be explored, perhaps in consultation with the group concerned with common written and printed material.

In the long term, larger institutions should consider closed-circuit TV networks where monitors in various locations can provide access to material from a central location. This concept may not be cost-effective in smaller institutions but such a scheme could service many disciplines, and, with the improvement in data transmission facilities, could service many institutions.

As mentioned earlier, there should be enough equipment available for all students to achieve the maximum benefit from any skills-oriented programme.

The possibility of the use of micro-computers was also seen as a viable proposition for simulation purposes, particularly in the long term but their use at present should not be at the expense of cheaper and more essential basic equipment.

Guidelines for technical teacher training

In setting out guidelines for the training and upgrading of technical teachers a and instructors for electrical and electronics subjects and courses, reference should be made to the following terms, explanations of which are included in Annex 1.

Further training	Secondary general education
Initial teacher training programme	Study leave
Initial teaching programme	Technical education
Instructor	Technical teachers
Main tea[illegible] programme	Vocational education

1. Recommended entry qualifications and experience for Electrical and Electronic Teachers to the teaching service, appropriate to Secondary General, Vocational and Technical Education.

   a) For *Secondary General Education*, where programmes introduce the concepts of electrical and electronics technology to students, *teachers* with a Mathematics/Science academic qualification may be employed in the conduct of such programmes.* It is desirable that the teacher have some industrial or other practical experience since the completion of his academic qualification.

   b) *Teachers of Vocational and Technical Education* have a wide range of educational backgrounds. Therefore, differing requirements of industrial or other practical experience, gained since the appropriate qualification, are proposed as setting a minimum standard.

Qualification on entry to teaching service	Required minimum industrial or other practical experience	
	Vocational**	Technical***
Vocational qualification	4 years	6 years
Technical qualification:		
Technician certificate	3 years	5 years
Diploma	2 years	3 years
Degree	1 year	2 years

   c) *Instructors* employed in these sectors should have two years of industrial or other practical experience.

2. Aspects of Training for Teachers of Vocational and Technical Education.

The group considered the following apects of a complete and continuing teacher training programme:

   a) Initial Teacher Training Programme

   This is a complete programme designed to equip a person with sufficient skills to operate efficiently as a teacher.

* Recognition is made of secondary education systems in which a separate secondary technical education system exists and in which vocational teachers as well as Mathematics/Science teachers conduct these subjects.

** Some systems require all vocational teachers to be vocationally qualified.

*** Consideration should be given to problems which could arise when a teacher is placed to teach at a level higher than that for which he or she is qualified; however, the teacher is a resource, and should be used most effectively.

It is recommended that the course be conducted by a teacher training institution working in close co-operation with a school at which the trainee could obtain teaching practice. The aims of the course should be to produce a competent teacher who, in the short term:

- Effectively carries out duties in a professional manner as evidenced by oral and written communications and use of appropriate methods and procedures;
- Displays consistent and careful planning;
- Exhibits creativity, flexibility, sensitivity and originality;
- Assumes responsibility for materials and equipment;
- Seeks appropriate help when needed;
- Accepts supervision in a positive manner;
- Works constructively with students, parents and school personnel;
- Assists with extra-curricular activities;
- Adheres to school policies and procedures;
- Meets responsibilities promptly;
- Observes professional ethics;
- Demonstrates enthusiasm for his assignments;
- Effectively interprets the school programme to the community;
- Is emotionally suited to school work, as evidenced by stability, self-confidence, friendly attitude and sense of humour;
- Reflects strong moral character and self discipline; and who, in the long term:
    - Shows professional knowledge and growth as evidenced by ground in subject field, advanced study, participation in appropriate work shops, conferences and committees.
    - Develops an awareness of himself and his role in the school in its local community.

To this end, applicants for entry to the teaching service should be assessed as to the likelihood of the possession or the possibility of inculcation of these characteristics as part of the overall teacher training programme.

The aims of Initial Teacher Training Programme, which should contain the following topics, (not necessarily conducted in the order given below, should be to provide the trainee with skills sufficient to demonstrate his or her ability as a successful teacher. The topics are divided into two groups, the latter specific to electrical and electronics subjects:

(i) Common topics

Pedagogical studies:

- Principles of learning, including concept formation and individual differences;
- Design of teaching;
- Instructional materials based on locally available resources;
- Instructional techniques;

- Classroom control;
- Evaluation techniques;
- Historical perspectives of education.

(ii) Electrical/electronic topics

- Safety;
- Acquisition of skills in use of basic electrical and electronic instruments;
- Awareness of rapid technological change;
- Cleanliness and neatness;
- Precision;
- Industrial awareness;
- Industrial experience;
- Subject matter updating;
- Standards and symbology, electrical and electronics;
- Interrelationship of hardware and software in systems;
- Skills in high reliability soldering;
- Industrial awareness of electronics invading other fields.

(iii) Electives appropriate to the local situation

- Learning difficulties;
- Innovative use of local resources;
- Particular local industrial characteristics.

b) Implementation of Initial Teacher Training Programme

An orientation programme will help the trainee to locate himself in the classroom and in the school. It should not need to last longer than three weeks, during which time its objectives should have been met — the prime one of these is to give the trainee self-confidence in the new situation. A suggested list of topics follows:

- Introduction to school geography:
  - . First aid,
  - . Office,
  - . Toilets,
  - . Cafeteria,
  - . Classrooms, laboratories, workshops,
  - . Library/resource centre,
  - . Recreation facilities, etc.
- Introduction to regulations of education authority,
- Introduction to school administrative requirements;
  - . Safety, emergency evacuations,
  - . Class times,
  - . Absences from classroom or school (teachers and students),
  - . Assemblies,

. Announcements,
. Protocol.

(i) Initial Teaching Programme

This is applicable to both trainee teachers and instructors, the programmes should meet all the initial teaching requirements of instructors:

- Instructional techniques;
- Classroom control; and
- Observation and consultation with other teachers.

(ii) Main Teaching Programme

A suggested list of topics follows:

- Safety;
- Basic pedagogical studies;
- Subject matter updating;
- Applied pedagogical studies;
- Teaching practice programme;
- Optional industrial or other practical experiences (i.e., if requirements not met prior to recruitment);
- Special educational practices (e.g., project method of teaching, laboratory-centred instruction, team teaching, computer-aided instruction, individualized instruction);
- Management instruction.

The teaching practice programme should include a recording of the trainee teaching a lesson using closed circuit television or a tape recorder, as appropriate. Tapes should be played back to to the trainee as an integral part of the consultation process with the training supervisor.

The supervisor's reports, which should indicate an improvement in the trainee's teaching performance as the training period progresses should include comments on:

. Lesson preparation,
. Classroom communication,
. Questioning technique,
. Adaptability to change, following feedback from students as a result of questioning,
. Use of various teaching/learning aids,
. Relationship with students,
. Demonstrations,
. Variation of activity,
. Use of voice,
. Teacher as a motivator,
. Use of humour, and whatever other attributes the supervisor considers desirable, concomitant with sound educational practice.

Criticisms should be couched in positive terms, to encourage rather than deter the trainee; and not all faults should be identified early in the trainee's teaching practice programme, in order that his behaviour may be modified at a suitable rate. Maintenance of the trainee's self-confidence, and the inculcation of a desire for improvement in the trainee's performance should be foremost in the supervisor's mind when discussing or reporting on a trainee's lesson.

c) **Further Training**

Further training should be seen as part of the development of the career of the teacher and should be formalized. It should include programmes which lead to:

Extension of technical competence caused by technological change:

. Technical awareness – e.g., the impact and possibilities of the utilization of computers;
. Educational awareness – macro-education;
. Educational extension and refreshing.

A further feature which is most desirable is the development of an approach to technical and educational innovations which incorporates both consideration and caution

In addition to an awareness of the entry of electronics into other disciplines as mentioned above, teachers of electronics subjects should be aware of the need to develop a working relationship with teachers from these other disciplines in order to assist them to cope with the innovations; and they should keep themselves sufficiently well-prepared to be able to advise teachers from other disciplines on suitable strategies for curriculum development and implementation, and training of teachers in the new approach to their discipline which the introduction of electronics has necessitated.

To this end, the difficulties of the layman (and in this case, any teacher other than those conducting electronics courses) in understanding both the language of electronics and the silent, motionless operation of most electronic equipment vis-a-vis the logical visual operation of mechanical equipment, should not be allowed to inhibit communication. It is the electronics teacher's responsibility to maintain a communication ability.

(i) A selection of themes or topics for further education of electrical and electronics teachers is offered below:

– Curriculum development and evaluation;
– Innovations in Education Technology (e.g., multimedia learning packages, computer-aided instruction, computer aids to education (e.g., evaluation) availability and content of films, film strips, slides, audio and video tapes);

- Education managements;
- Educational innovation and development;
- Sociological implications of development in the electrical and electronics fields, including the introduction of electrical and electronics equipment in developing countries:
- Educational research;
- Technological research;
- Education in technological innovations;
- Evaluation processes and reforms;
- Awareness of disciplines into which electronics is spreading;
- Guidance methods for students in career planning, study problems and course progress.

A further topic which should be considered for inclusion is the methodology appropriate to many of the above topics (e.g., curriculum development methodologies, research methodologies, etc.)

An awareness of the necessary dichotomy existing at the vocational level between electrical and electronics courses should not be allowed to extend into technical education. At the vocational level, the student is engaged in learning skills appropriate to either area and there is little overlap; however, the overlap disappears at the lowest level of technical education. Consequently, an awareness of electrical and electronics principles, processes and practices, would serve as a useful topic for further education for teachers of vocational education whose pre-teaching experience has been limited to only one of the fields.

The establishment of an Instructional Resource Centre to which all teachers have access, and which they are encouraged to attend, is one method of providing further education.

Other methods of further education, such as courses of appropriate duration, conducted by visiting lecturers on campus, or at a venue away from the teacher's school, should be supplemented by back-up activities and motivation. Further education activities which contribute to formal qualifications will also provide high motivation, and the possibility of this type of activity should be investigated.

(ii) Further education topics suitable for the upgrading of instructors could be drawn from the following list:

- Innovations in educational technology;
- Educational innovation and development;
- Education in technological innovations;
- Access and proper utilization of the Instructional Resource Centre mentioned above;

- Laboratory and workshop management and maintenance;
- Safety education.

d) Industrial Experience

Industrial experience in terms of release from teaching duties should be viewed as mandatory in order for the teacher to maintain and develop expertise in a chosen field, as well as to maintain contact with the students' future employers. Only by obtaining industrial experience will the teacher gain first-hand knowledge of, and skills in, developments and practices occurring in the electrical and electronics industries.

Due to the extremely rapid developments occurring in the electronics industry and the removal of the artificial barrier which used to exist between electricity and electronics beyond the vocational education level, teachers should have the opportunity to obtain some industrial experience after a period of employment in the teaching service. One term (three months) after no more than nine terms of teaching is suggested, and consideration should be given to effecting an exchange with industry during these periods. A variation of experience within the teacher's area of major study or pre-teaching expertise should be sought in order to broaden the teacher's approach to teaching.

Release for industrial experience for instructors does not appear to be necessary.

Problems, which may arise if the above scheme for teachers is to be adopted, should be identified, and solutions should be sought by consultation between appropriate parties. Such problems may include:

(i) Objection by unions, where non-union labour is used or where demarcation issues may arise;
(ii) Compensation arrangements arising from injury;
(iii) Industrial unwillingness to loosen its security arrangements due to competition, etc.

Contractual arrangements between educational authorities, teachers, industries and unions may provide solutions to some of the problems, and this avenue should be explored.

e) Study Leave

Although not appropriate to instructors, study leave programmes, where provided, are eagerly sought after by teachers. Study leave should be considered as being beneficial to education generally, because the teacher, in widening his horizons, should be able to become a more efficient component of the educational structure. Study leave can be implemented by full-time or part-time release for all or part of a course of instruction, and consideration should always be given to the teacher's desire to undertake a course not immediately related to his area of expertise in order to be better equipped in a broader sphere.

f) Validation of the Overall Training Programme

Just as the curriculum should be validated, a review of all aspects of teacher and instructor training, and consideration of entry qualifications to the teaching service, should be reviewed as part of a continuing programme designed to produce a teacher best suited to the education authority's needs.

Chapter Five

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE REGIONAL CO-OPERATIVE ACTION

1. Summary of Co-operation

In reviewing the needs for co-operation in the field of electrical and electronic technical subjects, the participants of the Meeting considered that further efforts are necessary to develop and improve vocational and technical education through regional co-operation.

In support of the discussion, a questionnaire was given to the participants to obtain their views. (The tabulated responses are given in Annex VI of the report).

The participants identified the areas in which the participating countries have offered to share their experiences with other countries with regard to vocational and technical education in the field of electrical and electronic engineering.

The main areas of co-operation were summarized as follows:

a) Areas of co-operation via exchange of information on:

- Curriculum planning;
- Instructional materials development; and
- Educational facilities planning.

b) Areas of co-operation through participating in regional/sub-regional activities:

- Participation in seminars;
- Hosting regional activities;
- Jointly conducting research;
- Participation in international projects implemented at the national level; level;
- Contribution to regional exchange of materials and flow of information; and
- Other areas.

2. Conclusions

The results of the survey conducted by means of the questionnaire completed by all participants in the APEID Technical Working Group Meeting may be briefly summarized as follows:

a) Areas of co-operation via exchange of information

(i) Curriculum planning

The need for co-operative effort in this area is very strong although there was a considerable imbalance between those willing to offer and those who would like to receive assistance. As may be seen in the table the strongest expression of required assistance is in the assessment of needs and curriculum research.

(ii) Instructional materials development

The most evident need for assistance in this area is for textbooks, laboratory manuals and worksheets. Here again imbalance is evident. This trend can be seen in every aspect of the section tending to indicate a necessity for some definite action to meet the needs of those countries who have identified their requirements in this regard. Some participants suggested that a necessary precursor to any concrete coordination activity should be the establishment of some coordinating body to focus attention on needs on a priority basis.

(iii) Educational facilities planning

While there is evidence of an equal need in this area, the imbalance between those who would like to receive and those willing to offer assistance is not as marked.

b) **Areas of co-operation through participating in regional/sub-regional activities**

The questionnaire listed a number of specific activities in which participants were invited to indicate their willingness to become involved. The table shows that the topics cover a wide range of diverse but complementary activities. The response in this section ranged from 50 per cent to 90 per cent in favour of participation. It is felt, however, that concrete proposals to carry out such co-operative activities would in all probability draw active participants from a wider range of countries than those represented at the present Technical Working Group Meeting.

c) Other areas of co-operation

From the evidence of the responses to this questionnaire item by the participants, it can be stated that there is an identified need for some formal co-operative action in the field of electrical and electronics vocational and technical training.

The area where the need for co-coperative action appeared to be most apparent was in curriculum development and associated matters. Response by participants to this section was practically unanimous in the expressed need for co-operative endeavour. Curriculum development in the area of general education courses did not receive as much emphasis as curriculum development in vocational and technical education.

The results of the survey appear to indicate that there is an equally strong-felt need for international co-operation in such matters as the development of instructional materials and learning devices and in the planning of appropriate facilities and equipment.

The expressed need for follow-up is not as evident in the areas of administration and management or staff training facilities but a need was again indicated.

The order of importance of the different areas of follow-up activities may be summarized as:

(i) Curriculum and associated teaching material aspects,
(ii) Administration and management, and
(iii) Staff training facilities.

3. **Recommendations for Future Co-operative Activities**

It was suggested by the participants that the activities in the area of curriculum development and designing of instructional materials and physical facilities and training of teachers for electrical and electronic subject areas are not limited to the centres and institutions represented at this meeting. Other agencies in each participating country are also involved in the curriculum development and planning of instructional materials and physical facilities and training of teachers. There is thus a need for collaboration on a broad basis among the participating countries.

A. **General recommendations**

a) The participants should take appropriate action to bring the work of other countries that they have studied during the Technical Working Group Meeting, to the notice of the relevant agencies within their own countries.

b) The participating countries should hold follow-up programmes based on the guidelines which have been adopted during the meeting in respect to curriculum development, planning of instructional materials and physical facilities, and teacher-training.

c) The APEID Associated Centres and other agencies represented at the meeting should keep each other informed of their future achievements and maintain a continuous flow of information about their work and future plans. They should also seek advice of other institutions and agencies in the other countries whenever necessary.

d) ACEID should act as a continuing clearing house for information relating to curricula, instructional and other materials relevant to electrical and electronic subjects in the areas of vocational and technical education, produced in the Member States.

e) The Associated Centres in Member States should organize in-country training activities aimed at enabling teaching staff to develop skills in curriculum and instructional materials development. Participation in such activities by specialists in the electrical and electronics areas from other member countries would also be desirable.

f) ACEID should promote international training activities aimed at enabling the staff to acquire skills in the development, use and evaluation of curricula and instructional materials. Such activities should, whenever possible, include visiting fellows from those Member States where relevant skills are well developed.

g) Where appropriate, Member States should encourage the development of curricula and instructional materials for some subjects (e.g., mathematics, science and technical drawing) which are supportive of vocational and technical education in general and of electrical and electronics subjects in particular.

h) ACEID should promote interlinking all areas of science and other supportive subjects with vocational and technical education through collaborative action in the process of curriculum development and the planning of instructional materials and physical facilities.

i) ACEID should promote comparative analytical studies of successful experiences in the development of curricula and instructional materials in the Member States, and disseminate the resulting information.

j) ACEID should select problems and issues which are stated by the Member States to be of common critical concern, and should organize study groups to undertake in-depth study of the problems and issues in curriculum innovation.

B. Specific Recommendations

The underlying principles and the design concepts incorporated into the relevant technology are fundamental features of any educational programme in the field of electrical and electronics studies. Whilst the levels of sophistication and the degree of advancement in technology vary from country to country it is possible to identify common elements within the electrical/electronics context. Although there may be wide disparity between the levels of sophistication of electronic *systems* in different countries, typical *circuits* and *devices* have universal application.

A major determinant of these common elements is the level of awareness of current technology. Identification of common elements can form the basis for curricula which will have international application.

Consideration by the Meeting of the significance of the foregoing led to two specific recommendations:

a) That Unesco/ACEID, in association with some countries, work toward raising the level of awareness in Member States through the dissemination of information relating to new technology.

b) That Associated Centres in Member States be invited by ACEID to contribute to the formation of a topic inventory which may be used to devise vocational and technical curricula for international use.

Whilst safe working practices should be inculcated in every occupation, safety becomes of paramount importance in the fields of electrical and electronic technology because of the potentially lethal nature of electricity. Two further specific recommendations related to safety were therefore added:

c) That, in the development of curricula for electrical and electronics subjects, high priority should be given to the inclusion of material relating to safe working practices, to help students develop an awareness of safety in relation to their work, for their own protection and for the protection of others.

d) That Associated Centres in Member States should exchange information, and, where possible, sample materials (e.g., posters, pamphlets) relating to safe working practices.

APPENDIX

IMPRESSIONS GAINED FROM VISITS IN AUSTRALIA

Introduction

As a portion of the Technical Working Group Meeting, participants visited the following educational institutions in Australia:

a)	Western Australian Institute of Technology	
b)	Mount Lawley College of Technology	Western Australia
c)	Collingwood Technical College	
d)	Box Hill Technical College	
e)	Royal Melbourne Institute of Technology, Technical College Section	Victoria
f)	South Australian Institute of Technology	
g)	Open College of Further Education	South Australia

1. Visit to Educational Institutions in Western Australia

The following participants visited Educational Institutions in Western Australia: Prof. Haruo Akimaru (Japan); Mr. Chitchai Sudhaswin (Thailand); Mr. S. Ekambaran (India); Mr. Anandaraj Ponnambalam (Sri Lanka).

On arrival in Perth the visits that were arranged to the Western Australian Institute of Technology (W.A.I.T.) and the Mt. Lawley College of Technology provided the visitors with a brief but perceptive insight into the technical education system prevailing in Australia. The visits served to crystallize some of their own ideas as well as to compare and contrast the more obvious aspects of the Australian system with that obtained in the participants' own countries. In addition to this, there seemed to be a possibility of comparison of the systems within the participants' own countries and an understanding thereof, on the basis of the Australian framework. In the discussions held with the Australian hosts, the participants not only acquainted themselves with the technical education scene in Australia, but in addition, and as a consequence, they perceived some aspects of the technical educational systems operative in Japan, Thailand, India, and Sri Lanka. This experience was felt valuable and was exploited in the deliberations of the working meetings that were to follow.

The participants were very impressed by the overall standard of facilities afforded to the students, and felt that the students had every opportunity of leading a full student life. While the laboratory, library and other learning facilities were not very much different from those available in Japan and India and perhaps Thailand, all participants visiting Perth were impressed by the aesthetic environment and facilities for recreational and extra-curricula activities that were available for the students. The arrangements made by the authorities for the maintenance and administration of these facilities seemed excellent. In the course of the discussions, the visitors could also discern a climate of cordiality and rapport between the staff of the various faculties and the pooling of resources within the faculties was evident.

Since the two Institutions visited were representative of the Australian technical education system, the general impressions were that it boded well for the future technical education in the country taken as a whole.

It may be pertinent at this stage to mention a few points about which the authorities may be concerned. One is the general impression of under-utilization of equipment. This was felt may be due to the commitment by institutions of this nature to keep on updating the hardware and thereby building up surpluses, without extending or increasing the range or versatility of the experimental and measurement techniques. This raises the rather serious questions of finances as well as the justification of initiating students' thinking and responses by providing the most sophisticated equipment. One must pause to consider whether this approach promotes originality or actually inhibits it. The answers to these questions may lead the authorities to a more rational, flexible and financially viable approach while ensuring the efficient use of materials and equipment and contributing positively to the learning process of the students.

The strongest impression gained by the group in their visit to the Western Australian Institute of Technology was that the Institute was extremely advanced and progressive in the technological area, as evidenced by projects involving a satellite receiving system, computers and solar cells. Student projects in telecommunications reflected a practically applied rather than theoretical approach.

At Mt. Lawley College of Technology there was a greater emphasis on electrical power rather than on digital electronics. A highlight is the production of educational T.V. programmes in a television studio. Student involvement in T.V. production is quite high.

2. Educational Institutions in Victoria

The following participants visited Technical Education Institutions located in Melbourne city and the Suburbs in Victoria: Mr. Harry Suderadjat (Indonesia); Mr. Ali Endut (Malaysia); Mr. Fernando Alfonso (Philippines).

On Monday 6th October, 1980, visits were made to Collingwood Technical and Box Hill Technical Colleges, and on the following day a visit was made to the Melbourne Institute of Technology (Technical College Section). The following are several points that the members consider worthy of raising after the visits:

a) It was found that in Australia the responsibiliity for implementation of the educational system rests with each State. Funding originates from the Commonwealth and is disbursed to the States.

b) The physical facilities of the Colleges, such as workshops, are well-planned and equipped. Most of the electrical and electronics workshops are located at the higher floors of the buildings.

   In the Royal Melbourne Institute of Technology (RMIT), workshops for basic and advanced courses for electrical and electronics subjects are conducted in one large area separated by glass partitions. This is used as a means of motivating junior students by permitting them to see advanced students working on higher-level projects.

Equipment is sophisticated and is well-maintained, especially in digital electronics.

c) All curriculum is developed in close co-operation with industry. Curriculum for short courses (which do not lead to formal qualifications) is develo at the institutional level and each institute has its own technique and strategies in implementation.

   Curriculum for trade, technician and certificate courses is centrally developed.

d) Teacher to student ratio is about 1 to 20, although this may be reduced for practical classes. All teaching staff have industrial experience prior to teaching and plans are being made to obtain further industrial experience.

e) Supporting staff: In R.M.I.T. the ratio between supporting staff and teaching staff is 1 to 3. In the Education Department colleges, the ratio is about 1 to 5.

f) Most of the colleges in Melbourne offer at least two levels of training in each vocational area (tradesman and technician). The third level of training leads to a Certificate of Technology (i.e., at Engineering Associate level).

g) Colleges aim to establish and maintain good working relationships with industry and the community.

h) Off-campus studies are offered for many subjects in post-vocational (technician) and certificate courses.

3. Visit to South Australian Institute of Technology, the Levels, Pooraka

The participants of the Technical Working Group Meeting visited the South Australian Institute of Technology, the Levels, Pooraka.

The South Australian Institute of Technology is an independent organization, managed by a council composed of recognized leaders in the fields of education, government and industry. The objective of the Institute is to produce highly qualified men and women to meet the need for technologists in the applied science, business, engineering and paramedical areas. The Institute consists of 19 schools and departments offering a wide range of courses. The Institute campuses are located in three places, viz., The Levels, North Terrace-Adelaide, and Nicolson Avenue at Shyalla. The Institute is almost totally financed by the Federal Government.

The group visited The Levels Campus where most of the science and engineering courses are offered. The complex of modern buildings with well-equipped laboratories and workshops provides the opportunity for approximately 770 full-time and 900 part-time students to pursue their advanced education studies in congenial conditions. In addition there are excellent facilities for students' recreational and cultural activities in the union buildings, sports centre, drama workshop and sports fields.

The Institute of Technology awards degrees and diplomas for successful completion of courses accredited by The Tertiary Authority of South Australia. Two year Masters Degree courses, one year Graduate Diploma courses, a number of full-time/part-time degree courses extending at least three years and a number of sub-professional courses are offered. Courses are offered in different branches of engineering which include Electrical Engineering, Electronics Engineering and Computer Studies. The teacher-student ratio in the schools of Electrical and Electronics Engineering is in the order of 1:10. The curricula in the Electrical and Electronics courses are based upon the theory-to-practice ratio of 1:1 (approximately). The curriculum of Electrical Engineering course includes studies in applied electronics, computers, automatic control and instrumentation. Subjects such as energy conversion and machines, computer technology, materials science and control systems are included in the Electronics course.

People from industries are involved in the curriculum design and development. Besides a number of optional subjects being offered to the final year students, the curriculum emphasizes that the students apply principles and practices in design projects in their chosen area.

Students' performances are assessed based on both continuous assessment scheme (50 per cent) and end examinations (50 per cent)

The Institute has a number of well-equipped laboratories for the students of electrical and electronics engineering. Some of the laboratories visited by the group were: electrical workshop, electronic workshop, electrical machine laboratory, project laboratories, digital laboratory, communication laboratory, micro-electronics laboratory and the anechoic antenna-measuring chamber.

A number of microprocessor-based experiments and projects were in evidence. Besides these, a computer network with eight interactive terminals, an industrial data acquisition and control system and several other mini-and micro-computers handling data logging experiments are the other facilities available in this Institute. A sufficient number of supporting staff work in these laboratories. Compared to some other Asian and Oceania countries, the utilization of facilities is low.

Instructional materials in the Institute are being supplied or prepared by the teachers. A number of laboratory instruction sheets were in evidence and being used by the students.

In order to build up the required experimental kits for a laboratory, student projects are utilized. Many projects undertaken by the students are based on the requirements of several industries which financially support the projects. These projects are mostly related to the latest technological developments in the field. Many opportunities are available for the teachers to work in industries under specified projects. Creative contribution to teaching is considered in staff selection and promotion.

4. Visit to Open College of Further Education, Adelaide

The participants of the Technical Working Group Meeting visited the Open College of Further Education, Adelaide. The Department of Further Education in South Australia provides further education activities for occupational and general education in 28 major teaching institutions incorporating 327 branch locations in the Adelaide metropolitan area and some 130 country towns. Over 1,600 courses are offered through these centres which attract an annual enrolment of over 100,000 students.

In terms of numbers of students, the Department of Further Education is the major provider of occupational education at the post-secondary level. The Open College of Further Education is one of the metropolitan colleges of the Department of Further Education, and is spread over three campuses, which have the responsibility of preparing the various media and utilizing the methodologies recommended by the teachers preparing the software.

Distance education differs from correspondence education in that it can extend student co-operation in class-type activities. Telephone linking can provide interaction between teacher and students reinforced by occasional attendance at remote centres. Many practical training activities are included in course material. Assistance can be given to institutions outside the Department of Further Education in preparation of AV material.

Finance is obtained from the South Australian (State) Government. No tuition fees are charged for occupational courses though there are charges for some materials and enrichment courses do involve fees. Flexibility is the key to success in distance education for human and physical resources.

The participants of the working group meeting visited the Educational Publications Unit of the Centre for Resource Development on Wakefield Street, Adelaide, and the Educational Multi-Media Unit of the Centre for Resource Development, at Kilkenny. The Educational Publications Unit devotes about 90% of its capacity to printing the course study materials needed for distance education. The remaining 10 per cent is devoted to some major projects for other Department of Further Education Colleges.

The instructional materials are carefully designed to aid the students to reach their educational goals, with emphasis on skills and the management of human resources. The teacher prepared materials pass through different stages on their way to being turned into book form. The group visited several sections of the Publications Unit, including the typesetting section, graphics department, offset and screen printing sections, photographic section, printing section, collating and book-binding section. Offset duplicating machines and an electric guillotine were in use in this unit where it is estimated that printed materials for 300 vocational subjects are produced. Automated addressing is used in preparing materials for despatch to students.

Teachers may either prepare software at their own schools or they may be accommodated at the Open College of Further Education, where production facilities are available for their use. Teachers produce the software themselves because of their subject expertise. Electronic typewriters with memory banks of about 200 words, and electronic compositors, plus cards for additional memory, are used in preparation of printed materials.

The Educational Multi-Media Unit of the Centre for Resource Development at

Kilkenny is the non-print counterpart of Educational Publications and provides design expertise and production capacity for slides, audio tapes, and video tapes. It tends to provide a higher percentage of its capacity to other colleges, than the Educational Publications unit, as much as 50 per cent of its output being primarily designed for Open College use. Content of the non-print material produced here is based on the same curriculum as used in the colleges. Facilities for multi-media development are increasing in all colleges under the Department of Further Education in order to increase open access, and to provide better teaching. One series of video cassettes which has been produced here, and which was of interest to the group, comprises a course on high-reliability soldering.

Production assistance from outside the Department of Further Education must be paid for, e.g., where a teacher is on loan to the Open College of Further Education for production assistance to a course being developed on his behalf, funds for a part-time replacement teacher in his school are made available by the Open College of Further Education. Production staff at the Open College of Further Education are trained teachers, because they must be educationally aware, must work as part of a team with teachers on loan, and the material they produce must be based on sound educational principles. Technical production is up to broadcasting standards; the production staff are specialists, and they are backed up by expert technical staff.

ANNEX I

TERMINOLOGY

The following terminology adopted by the Meeting is based on the Unesco Guide *Terminology of technical and vocational education.*

This annex contains definitions of the following terms:

Course	Post Secondary Education
Curriculum	Secondary General Education
Education System	Skilled Worker
Engineer	Specialist Worker
Formal Education	Study Leave
Further Training	Supervisor
Initial Teacher Training Programme	Syllabus
Initial Teaching Programme	Technical Education
Instructor	Technical Teacher
Main Teaching Programme	Technician
Non-formal Education	Worker

COURSE	An educational unit within the curriculum dealing systematically with a particular subject or 'discipline' in prescribed ways: lectures, laboratory work, workshops, etc. A series of such courses (e.g., mathematics, physics and electricity) are thus co-ordinated to form the 'curriculum'.
CURRICULUM	An organized programme of both theoretical and practical studies, the successful completion of which is considered necessary to achieve specified educational goals corresponding to different levels of knowledge and qualifications.
EDUCATION SYSTEM	The over-all structural organization, through which education of all types and all levels is provided to the population.
ENGINEER	A person who requires knowledge and skills based on a high degree of specialization in one or several scientific, technological or technical fields. The education and training giving rise to his qualifications will have been at university level or its equivalent. According to the nature and level of his education, training and experience, an engineer may assume responsibilities at various levels: execution, production, high level management, etc.

FORMAL EDUCATION — Systematic education which normally takes place in schools and other educational institutions within the education system. Formal education in structured as a series of progressively more difficult and specialized levels. Successful completion of each level is, in principle, sanctioned by an award which permits entrance to the next educational level. A term often used as a synonym is: formal schooling.

FURTHER TRAINING — Any educational activity taken after the Initial Teacher Training Programme which aims to develop the abilities or broaden the horizons of the teacher. It includes such terms as in-service, updating and upgrading education.

INITIAL TEACHER TRAINING PROGRAMME — A total training programme which the teacher undertakes upon entering the teaching service; it consists of an Initial Teaching Programme and the Main Teaching Programme.

INITIAL TEACHING PROGRAMME — A short course undertaken by an entrant to the teaching service, which is designed to equip him or her with sufficient skills to efficiently approach teaching.

INSTRUCTOR — The term is usually applied to a person responsible only for the practical instruction with a given programme of technical education. Instructors are usually good professionals who do not possess the academic credentials required of teachers.

MAIN TEACHING PROGRAMME — A portion of the Initial Teacher Training Programme remaining after the Initial Teaching Programme.

NON-FORMAL EDUCATION — A term referring to education which takes place outside the formal education system on either a regular or an intermittent basis. Such education may provide an alternative to formal education as a means of acquiring educational achievement or professional qualification. A term sometimes used as an equivalent is: 'out-of-school education'.

POST-SECONDARY EDUCATION — A term often used to refer to those programmes which terminate with a specific award at the end of the first cycle of tertiary education.

SECONDARY GENERAL EDUCATION — The period of formal education following primary education, completion of which is required for continuation in higher education. Secondary education may last from five to eight years depending on the number of years allocated to primary education. Generally, primary and secondary education total ten to twelve years of schooling. The main differences among formal education systems first appear in the organization of secondary education in terms of the age level at which students move from a common programme to separate ones – 'stream' – for example, classical, general, technical, scientific, etc. Separate cycles of upper and lower secondary education are not distinguished in this definition.

SKILLED WORKER	A person who has acquired the full qualifications required for performance of a recognized trade or other occupation. In some countries and in some occupations the terms 'journeyman' (usually in the artisan trades sector), 'craftsman' and 'tradesman' are used synonymously.
SPECIALIST WORKER	A person who has been trained to perform a limited number of skilled functions or operations but who does not possess the all-round technical skills and knowledge required for a recognized trade or other occupation.
STUDY LEAVE	Release from teaching duties for a teacher to undertake a course leading to higher qualification.
SUPERVISOR	A person whose main tasks are the control and supervision of workers. His functions often include planning and giving instructions for the work.
SYLLABUS	Outline of the elements of a course, presented in a logical order of growing difficulty.
TECHNICAL EDUCATION	Designed to prepare middle level personnel (technicians, middle management, etc.) at upper secondary and lower tertiary levels, and to prepare engineers and technologists at university level for higher managgement positions. Technical education includes general education, theoretical, scientific and technical studies, and related skill training. The components of technical education may vary considerably depending on the type of personnel to be prepared and the education level.
TECHNICAL TEACHER	A person employed in an official capacity for the purpose of guiding and directing the learning experience of pupils and students in an educational

institution, whether public or private. Usually the person has completed a professional training course in a teacher education institution leading to the award of appropriate credentials.

TECHNICIAN

A person who requires knowledge and skill of more practical character than those required of the qualified scientist, engineer or technologist, on the one hand, and of a more theoretical character than those required of the skilled worker or craftsman, on the other. His education and training are likely to have taken him at least up to a level equivalent to the end of secondary education in a general or technical stream; he may have had post-secondary level training and corresponding degree or diploma. 'Junior' and 'higher' technican levels may be distinguished though a sharp line can rarely be drawn between them.

WORKER

Any person engaged in manual or non-manual work, irrespective of the sector of economic activity or the level of qualifications. The term therefore includes salaried employees and persons who are self-employed, and covers various levels of qualifications.

ANNEX II

LIST OF PARTICIPANTS, OFFICERS, AND SECRETARIAT OF THE MEETING

AUSTRALIA	Mr. R.L. Windsor, Head, School of Electrical Engineering, Regency Park Community College, *Adelaide*, 5000
	Mr. R. Seidel, Acting Head, School of Electronic Engineering, Regency Park Community College, *Adelaide*, 5000
	Mr. J. Lilley, Executive Officer, Joint Electrical and Electronics Standing Committee, Technical Schools Division, 80 Collins Street, *Melbourne*, 3000
	Mr. A. Mychael, Head, Division of Electrical and Instrument Trades, School of Applied Electricity, Sydney Technical College, *Broadway*, 2007
BANGLADESH	Md. Idris Ali Sardar, Chief Instructor (Electrical), Dacca Polytechnic Institute, Tejgaon, *Dacca-8*
INDIA	Mr. S. Ekambaran, Assistant Professor, Technical Teachers' Training Institute (Southern Region), Adyar, *Madras 600 020*
INDONESIA	Mr. Harry Suderadjat, Directorate of Technical and Vocational Education, J1. Hanglekir 11/16, Kebayoran Baru, *Jakarta*,
JAPAN	Dr. Haruo Akimaru, Professor, Toyohashi University of Technology, School of Information and Computer Sciences, Tempaku-cho, *Toyohashi* 440.
MALAYSIA	Mr. Ali Endut, Senior Organizer, Technical and Vocational Education Division,

	Ministry of Education, 2nd Floor, Strait Trading Building, *Kuala Lumpur*
PAPUA NEW GUINEA	Mr. Zoltan Frasch, Lecturer in Electrical Engineering, Lae Technical College, P.O. Box 305, *Lae - Morobe Province.*
PHILIPPINES	Mr. Fernando S. Alfonso, Head, Electrical-Electronics, Technological University of the Philippines, P.O. Box 3171, Ayala Boulevard, *Manila-2801.*
SRI LANKA	Mr. A.L. Ponnambalam, Department of Electronic & Telecommunication Engineering, University of Moratuwa, *Moratuwa.*
THAILAND	Mr. Chitchai Sudhaswin, Supervisor, Supervisory Unit, Department of Vocational Education, Ministry of Education, *Bangkok.*
AUSTRALIAN NATIONAL COMMISSION FOR UNESCO AND HOST INSTITUTION	Ms. Marie Gallagher, Secretary, Education Committee, Australian National Commission for Unesco, Department of Education, P.O. Box 826, Woden A.C.T. 2606 Australia
	Mr. R. Gordon Tasker, Director, Educational Services, Department of Further Education, South Australia.
	Mr. John McCarthy, Principal Education Officer, Curriculum Development, Department of Further Education, South Australia,
	Mr. Richard J. Willing, Education Officer, Training and Development Centre, Department of Further Education, South Australia.
UNESCO REGIONAL OFFICE FOR EDUCATION IN ASIA AND THE PACIFIC	Mr. Alexander Dyankov, Specialist in Instructional Materials, ACEID. Mr. Cecil T. Crellin, Educational Advisor

OFFICERS OF THE MEETING

CHAIRMAN:	Mr. R.L. Windsor	Australia
VICE-CHAIRMEN:	Mr. S. Ekambaran	India
	Mr. H. Suderadjat	Indonesia
	Dr. H. Akimaru	Japan
RAPPORTEUR-GENERAL:	Mr. R. Seidel	Australia
CO-CORDINATOR-ASSISTANT TO RAPPORTEUR-GENERAL:	Mr. A. Endut	Malaysia
GROUP RAPPORTEURS	Mr. A.L. Ponnambalam	Sri Lanka
	Mr. J. Lilley	Australia
	Mr. A. Mychael	Australia

SECRETARIAT OF THE MEETING

Mr. A. Dyankov	Specialist in Instructional Materials, ACEID, Unesco ROEAP, Bangkok.
Mr. J. McCarthy	Principal Education Officer, Department of Further Education, South Australia.

ANNEX III

ADDRESSES

INAUGURAL ADDRESS

- by

Mr. R. Gordon Tasker, Director, Educational Services, Department of Further Education, South Australia.

Mr. Chairman, esteemed officers from UNESCO, distinguished participants for this meeting, colleagues and friends. It is with the greatest of pleasure that I have accepted the honour of inaugurating this Technical Working Group Meeting on Curriculum Planning for the Electrical and Electronic Engineering areas of vocational and technical education.

This meeting as you know was initiated by APEID, the Asian Programme of Educational Innovation for Development, through the UNESCO Regional Office for Education in Asia and the Pacific, Bangkok. The meeting is being jointly hosted by the Australian National Commission for Unesco, and by the South Australian Department of Further Education.

In 1979 the Department of Further Education became an Associated Centre in the area of vocational and technical education. Vocational and technical education has emerged as one of the seven areas of innovation in education requir' o urgent attention during the second cycle of APEID from 1978 to 1981 inclusive.

I would now on behalf of the Department of Further Education, as an Associated Centre, like to relate the topic of this meeting to the aims of APEID. I do this with some degree of humility as we here in South Australia are but an infant in terms of being an Associated Centre. Many, if not all of the participants' countries represented here at this meeting, have a longer history of APEID association than Australia. My humility is deepened also by the knowledge that Australia in the area of vocational and technical education has a short history of national development.

Technical and Further Education, or TAFE as we know it in Australia, has always been, and continues to be a State, rather than a national responsibility. It was only in 1973 that TAFE was formally recognized as being of national importance in Australia by the establishment of the Australian Committee on Technical and Further Education (ACOTAFE). Member countries of APEID will, I am sure, be experienced in the issues which arise between local and national developments in education.

My humility in relating the topic of this meeting to the aims of APEID is further intensified by the knowledge that this meeting will itself develop the relationship to which I will briefly refer. My references are in no way intended to influence or to pre-empt the outcomes of this Technical Working Group Meeting.

This meeting is concerned with Curriculum and Training in the areas of Electrical Engineering and Electronic Engineering. The first aim of APEID is "To stimulate efforts of the member states to improve the quality of life of the people. . ." The applications of the disciplines of Electrical and Electronic Engineering have the potential to influence not only the quality but also the continuance of life as we know it. I ask you to reflect upon the applications in your countries of Electrical and of Electronic Engineering in such areas as food and non-food production, health and medical care, communications, basic education, transport and the harnessing of energy for power, for heating and for cooling. India sets an outstanding example of such applications to education via the use of satellite.

The second aim of APEID is "To encourage member states to make all groups . . . aware of the need for relevant changes in education . . . as an essential pre-requisite for the improvement of the quality of life of the people." Just who these groups are, the degree of awareness of, and the involvement in changing of education/training in Electrical and Electronic Engineering, will, in no small part, reflect the education systems and the cultural context of each member state.

Within Australia there are variations as to the nature of such groups and the degree of involvement in changes in the electrical and in the electronic curriculum. Variations are also dependent upon the level of training, e.g., basic trade, technician or professional engineering. It would be fair to say that teachers make a significant contribution to curriculum change. At the basic trade level this contribution reflects the teachers' previous experience in industry as well as on-going connections with industry. But most changes reflect a tri-partite influence, namely; education, employers and employee organisations.

The third aim of APEID is "To promote understanding and appreciation of the differences in educational practices and approaches of the member states, and thereby contribute to international understanding and the creation of a new international economic order." Let me take just two examples of this aim as they might apply to this meeting. Computer Aided Design (C.A.D.) and Computer Aided Manufacture (C.A.M.) can be ignored by no country in the world in "the new international economic order". To decide not to train personnel and not to apply C.A.D./C.A.M. in a country is to decide to withdraw partially from the international economy. This is not to say that such a decision might not be the best one for a particular country at a particular point in time. But such a decision must be made in the light of the potential outcomes of C.A.D./C.A.M. applications. I am reminded also of the importance of Computer Aided Management.Indonesia is an excellent example of these developments.

The second example which I cite arises from previous practices in education whereby so-called 'developed' countries used to adopt the teacher/student relationship towards the so-called 'under-developed' countries. I am pleased to say that to the extent of my knowledge most teacher countries have also become student countries. To quote my own experience as an Australian expatriate who had the privilege of working in Papua New Guinea prior to that country's independence: I state with no embarrassment whatsoever that as an Australian I had much to learn from Papua New Guinea in education. My country and I had, at that time, much to learn from Papua New Guinea in such areas as community involvement in education, the transmission of culture and the regionalisation of education. We can all, I am sure, find examples where we are both students and teachers – the APEID principle of reciprocity between countries is warmly endorsed.

As the Papua New Guineans also had much to teach us Anglo-Saxons about the art of listening I shall conclude my comments about the very real connections between the meeting topic and the aims of APEID. I return to my very real humility in the face of the expertise and experience represented here at this meeting. Nevertheless, I will state my overwhelming confidence in the success of this meeting in that it will help to promote understanding and appreciation of the differences in educational practices and approaches of the eleven member countries represented at this meeting.

I acknowledge the contributions of Unesco through APEID and ACEID and the Australian National Commission for Unesco which caused this meeting to take place. I have the greatest pleasure therefore of inaugurating this Technical Working Group Meeting on Curriculum Planning and Instructional Materials development for Electrical and Electronic Engineering Courses in Vocational and Technical Education.

CLOSING ADDRESS

by *R. Gordon Tasker,* Director, Educational Services, Department of Further Education, South Australia.

Mr. Chairman, members of the Technical Working Group meeting, friends and colleagues. I have the responsibility to officially close this Technical Working Group meeting. I do this with a slight sense of sadness and a sense of great happiness. The sadness arises from the knowledge that you will leave shortly to go back to your own States, to your own countries and to your own homes. It is unlikely that all of us will be together again under the same roof, in the same room as we have been over the last two weeks at the Regency Park Community College. Although we all knew that this would occur, this parting remains a somewhat sad event. The happiness and pleasure of this occasion are far greater than the sadness. These good feelings arise from the knowledge that this meeting was a beginning to what is to follow in curriculum developments in the areas of electrical engineering and electronics engineering.

During these last two weeks you have worked hard examining problems, sharing and assessing innovations, all of which are crucial to the curriculum of your particular systems. Every single time I listened to your discussions and every single time I read your learned papers I was able to relate the subject matter to students. I related it to students of electrical and of electronics engineering in the process of gaining additional knowledge, of gaining new skills and of gaining new attitudes. I could relate your discussions to your country's people not only as students but also as workers in industry and in such industries that would influence the quality of life of your countries.

This then is the essence of APEID – the Asian Programme of Educational Innovation for Development. During your meeting here at Regency Park Community College and, when you visited other Australian education institutions in Adelaide, in Perth and in Melbourne, and in visits to industry, you have contributed to the attainment of the APEID aims. You have taken initial steps to stimulate efforts of some APEID member states to improve the quality of life of the people through creating and strengthening national capabilities for the development and implementation of innovations in education, both formal and informal. This is APEID aim number one. You have begun the process to encourage some APEID member states to make all groups aware of the need for relevant changes in education as an essential pre-requisite for the improvement of the quality of life of the people. This is APEID aim number two. You have promoted understanding and appreciation of the differences in educational practices and approaches of some member states, and thereby contributed to international understanding and the creation of a new international economic order. This is APEID aim number three.

When I inaugurated this Technical Working Group meeting I spoke to you with humility. Today, in closing this Technical Working Group meeting I speak with great pride in relation to what *you* have accomplished during the meeting. I speak with confidence regarding the future outcomes of your meeting achievements. These outcomes will flow out of the communications developed at this meeting. The meeting report will be a major vehicle for stimulating these outcomes.

There is one outcome which, whilst not a stated aim of the meeting is, for me, of great significance. This is in relation to vocational and technical education as an activity in its own right. I know it to be true that vocational and technical education is at least the equal of any educational provision, including that of primary education, secondary education, and higher education. There are some aspects of vocational and technical education which place it above other areas of education. It has its own integrity in terms of philosophy, of practice, of intellectual rigour and of academic merit. I believe that this meeting has endorsed and added to this integrity.

This meeting has used and, I believe, endorsed the mechanisms of APEID in relation to the curriculum of electrical and electronics engineering. These mechanisms have as their basis a close study of the curriculum innovations of the various countries and the study has actively used the APEID principles of reciprocity, mutual learning and self-reliance. I congratulate you upon the practical applications you have made of these principles.

I say thank you and good-bye to my colleagues and friends from the Unesco Regional Office at Bangkok, from Australia, Bangladesh, India, Indonesia, Japan, Malaysia, Papua New Guinea, Philippines, Sri Lanka and Thailand.

I formally close this Technical Working Group Meeting on planning of curriculum and instructional materials for electrical and electronics engineering courses in vocational and technical education.

ANNEX IV

AGENDA

1. Opening of the Meeting
2. Election of Officers of the Meeting and consideration of Agenda and Provisional Schedule of Work.
3. Review and synthesis of experiences of the participating countrices and visits to the projects and institutions in the host country with special reference to:
   a) Strategies and methodologies of curriculum planning and instructional materials design illustrated with the experiences of one or two specific innovative national projects and of the host country's projects visited by the participants;
   b) Problems and issues encountered
      i) in curriculum design, development and implementation and
      ii) in development and use of instructional materials; and strategies used to solve problems and to resolve issues, at different times during the development of curriculum and materials and their assessment for effectiveness; and
   c) Training and upgrading of technical teachers and other personnel for electrical and electronics subjects.
4. Development of guidelines for curriculum planning, design and development of instructional materials, inter-alia bringing out implications for preparation of teaching staff, physical facilities, and interrelation with science and mathematics and practical arts courses in general education.

Consideration and adoption of the draft report of the meeting.

ANNEX V

WORKING GROUPS FOR DEVELOPING GUIDELINES

Three working groups were formed under the chairmanship of each of the three elected vice chairmen for discussion of the topics listed in the annotated agenda under Agenda Item 4. The topic areas and groups are:

Planning, designing and implementation of curricula for electrical and electronics subjects.

Chairman – Mr. H. Suderadjat
Group rapporteur – Mr. A.L. Ponnambalam
Group members – Mr. Z. Frasch
Mr. R.L. Windsor
Mr. J. McCarthy

Development and utilization of various instructional materials and physical facilities.

Chairman – Dr. H. Akimaru
Group rapporteur – Mr. A. Mychael
Group members – Mr. C. Sudhaswin
Mr. Ali Endut
Mr. F.S. Alfonso

Training and upgrading of technical teachers and instructors for electrical and electronics subjects at various levels.

Chairman – Mr. S. Ekambaran
Group rapporteur – Mr. J. Lilley
Group members – Mr. Md. I.A. Sardar
Mr. R.D. Seidel
Mr. A. Dyankov

ANNEX VI

TABULATED QUESTIONNAIRE RESPONSES FOR DETERMINING AREAS OF INTER-COUNTRY CO-OPERATION

Areas of Inter-country Co-operation in Electrical/Electronic Engineering Education

Areas in which the participating countries have offered to share their experiences with other countries with regard to Vocational and Technical Education of the field of electrical and electronics subjects.

	Number of responses of countries willing to OFFER Information	RECEIVE Information
A. Areas of co-operation via exchange of information on:		
1. Curriculum planning:		
a) Needs assessments (individual, social, economic)	2	9
b) Curriculum research	4	9
c) Statements of aims, goals, objectives	5	8
d) Curriculum organization and structure	4	7
e) Task analyses	4	8
f) Evaluation schemes	4	8
g) List of curriculum planning/research agencies	3	7
2. Instructional materials development:		
a) Text books	4	9
b) Laboratory manuals	3	10
c) Work sheets	3	10
d) Modular materials	3	7
e) Self-paced learning materials	3	8
f) Sectioned models	3	8
g) Actual devices	4	8
h) Charts, posters, graphs, drawings, diagrams	3	6
i) Syllabi/lesson plans	6	7
j) Test and evaluation materials	4	9
k) Educational television programmes	1	7
l) Films	1	8
m) OHP transparency materials	3	7
n) Video tapes	1	10

	Number of responses of countries willing to OFFER Information	RECEIVE Information
o) Tape/slide series	1	8
p) Tape/filmstrip series	1	9
q) Models, simulators, training kits	3	9
r) Microprocessors	4	10
s) Computer programmes	1	9
3. Educational facilities		
a) Building specifications	4	4
b) Classroom layouts and equipment lists	4	5
c) Laboratory layouts and equipment lists	4	7
d) Workshop layouts and equipment lists	4	9
e) Work safety standards and devices	5	9
f) Educational building specifications for complete schools (colleges)	2	2

B. Areas of co-operation through participating in regional/sub-regional activities	Number of countries willing to co-operate:
1. Participation in seminars, training workshops, T.W.G. Meetings, etc.	10
2. Hosting of regional activities (seminars, workshops, meetings, etc.)	7
3. Jointly conducting research with others with a view to the preparation of teaching materials for use in electrical and electronics subjects.	10
4. Participation in international projects implemented at national level.	9
5. Participation in international studies, related to:	
a) the utilization of microprocessors and computers in education	10
b) study of the effectiveness of the use of microprocessors, computers and their practicalities	10
6. Contribution to regional exchange of materials and flow of information:	
a) by sending publications and documents related to new trends in the training of electrical and electronics technical manpower to the documentalist of Unesco ROEAP	8

	Number of countries willing to co-operate:
b) by preparing reviews on recent publications on innovations in the field of electrical and electronics education for ACEID/Unesco ROEAP	8
c) by sending sample instructional materials:	
i) printed materials	9
ii) software (other media)	7
7. Other areas of co-operation	
a) Administration/Management	
(i) Institutional planning and programming	6
(ii) Institutional administration	5
(iii) Resource generation and utilization	5
(iv) Institutional evaluation	6
(v) Performance appraisal and staff development	7
b) Staff Training Facilities	
(i) Facilities offered	5
(ii) Materials offered	5
(iii) Specialists offered	4
(iv) Needs for assistance from other countries (please specify): Establishing technical teacher upgrading and diploma courses for trade teachers	1
c) Areas of national follow-up activities	
(i) Revision of school curriculum and syllabi:	
a) In general education courses with a view to electrical and electronics element in science subjects	8
b) In vocational education courses	10
c) Technical education (technician level)	10
d) Technical teacher training	10
(ii) Organizing workshops, seminars and conferences at National Level	
a) For developing of instructional materials and learning devices	10
b) For planning of appropriate facilities and equipment.	10
(iii) Teacher education and upgrading and staff development on National Level	
a) Revision of electrical and electronics teachers pre-service education in view of new technologies	8

	Number of countries willing to co-operate:
b) Professional up-grading and up-dating of electrical and electronics teachers and instructors	8
c) Special familiarization courses for science teachers from general education in the field of new electronic technological development.	6

APEID* PUBLICATIONS

RELATING TO VOCATIONAL AND TECHNICAL EDUCATION

1. *Curriculum development for work-oriented education; report of a Regional Field Operational Seminar, Japan. 1975**

2. *Diyasena, W. Pre-vocational education in Sri Lanka. 1976**

3. *Singh, P. Harbans. Centralized workshops in Singapore. 1975*

4. *Inventory of educational innovations in Asia and Oceania, EIA Nos. 96-109. 1979*

5. *Development of productive skills; report of a Sub-regional Workshop, Philippines. 1979*

6. *Vocational and technical education: Development of curricula and instructional materials for mechanical and civil/building subjects; report of a Technical Working Group Meeting, Republic of Korea. 1980*

7. *Co-operation in vocational and technical education in Asia; exploratory field studies on vocational and technical educational systems and projects. Report of Inter-country and Inter-project Study Visits. 1980*

* Out of stock

The *Asian Programme of Educational Innovation for Development (APEID)*, initiated on the recommendation of the Third Regional Conference of Ministers of Education and Those Responsible for Economic Planning in Asia (May–June 1971, Singapore) and the authorization of the General Conference of Unesco at its seventeenth session (Paris, 1972), aims at stimulating and encouraging educational innovations linked to the problems of national development in the Asian region.

All projects and activities within the framework of APEID are designed, developed and implemented co-operatively by the participating Member States through their national centres which have been associated by them for this purpose with APEID.

The 21 countries in Asia and the Pacific participating in APEID are: Afghanistan, Australia, Bangladesh, China, India, Indonesia, Iran, Japan, Lao People's Democratic Republic, Malaysia, Maldives, Nepal, New Zealand, Pakistan, Papua New Guinea, Philippines, Republic of Korea, Singapore, Socialist Republic of Viet Nam, Sri Lanka and Thailand. Each country has set up a National Development Group (NDG) to identify and support educational innovations for development within the country and facilitate exchanges between countries.

The Asian Centre of Educational Innovation for Development (ACEID), an integral part of the Unesco Regional Office for Education in Asia and the Pacific in Bangkok, co-ordinates the activities under APEID and assists the Associated Centres (AC) in carrying them out.

The aims of APEID are:

- to stimulate efforts of the Member States to improve the quality of life of the people through creating and strengthening national capabilities for the development and implementation of innovations in education, both formal and non-formal;

- to encourage the Member States to make all groups (students, teachers, parents, village and community leaders, administrative personnel and policy makers) aware of the need for relevant changes in education (both formal and non-formal) as an essential pre-requisite for the improvement of the quality of life of the people;

- to promote understanding and appreciation of the differences in educational practices and approaches of the Member States, and thereby contribute to international understanding and the creation of a new international economic order.