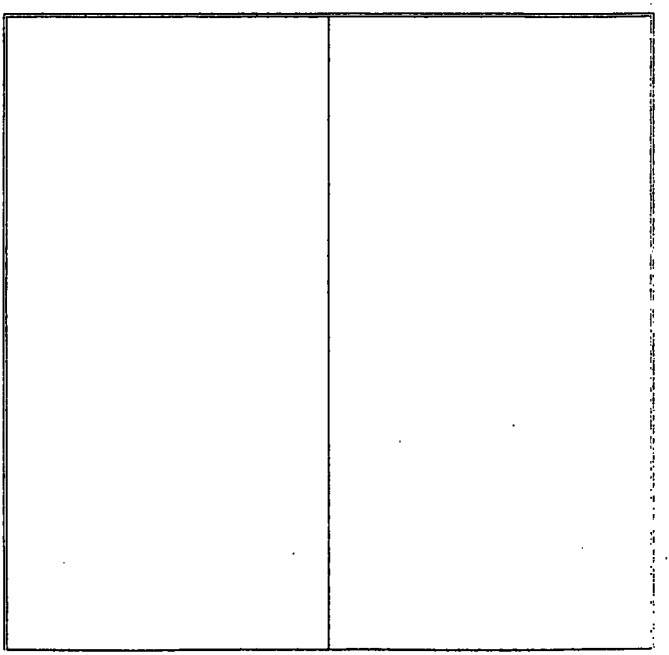


TO: THE HONOURABLE DR G. v.N. VILJOEN, MINISTER OF NATIONAL EDUCATION AND CHAIRMAN OF THE CABINET COMMITTEE RESPONSIBLE FOR THE EVALUATION OF THE RECOMMENDATIONS OF THE EDUCATION WORKING PARTY ON THE BASIS OF THE RECOMMENDATIONS OF THE HSRC REPORT ON EDUCATION (PROVISION OF EDUCATION IN THE RSA), THE INTERIM MEMORANDUM OF THE GOVERNMENT AND THE COMMENTS SUBSEQUENTLY RECEIVED.

Dear Dr Viljoen

Included herewith is the report which at your request was prepared for the Main Committee of the HSRC Educational Research Programme and the Education Working Party by the Work Committee: The computer in education and training. The HSRC and the Main Committee of the HSRC Educational Research Programme subscribe to the recommendations contained in this report.

J.G. GARBERS
PRESIDENT
HUMAN SCIENCES RESEARCH COUNCIL

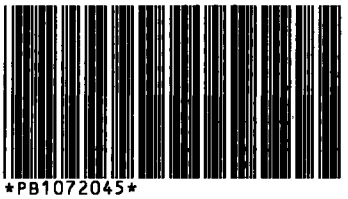
J.P. DE LANGE
DIRECTOR
HSRC EDUCATIONAL RESEARCH PROGRAMME

The computer in education and training

HSRC Education Research Programme

The computer in education and training

Report of the Main Committee of the HSRC Education Research Programme Part 1



Pretoria
Human Sciences Research Council
1983

The HSRC Educational Research Programme is organizationally and administratively linked to the Institute for Educational Research of the Human Sciences Research Council. Research and administrative assistance is therefore rendered on a continuous basis by the Director, Mr J.B. Haasbroek, and the personnel of the Institute.

Cover photo by courtesy of ComputerWeek

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PREFACE

The age in which we are living is characterized by changes that are taking place at a more rapid pace than ever before. Some of these changes are for the better, some for the worse, but the fact remains that man is progressing towards the twenty-first century knowing that the world which is awaiting him will be entirely different from the present one.

In this regard the developments in the field of science and technology, particularly in microtechnology, foretell radical innovations. The development of the computer has been phenomenal: within a few decades big, cumbersome mechanisms which used a lot of energy have been replaced by smaller, more efficient microcomputers which can perform the same functions faster and more cheaply.

In the midst of this process of change are the schools and other educational institutions which throughout the centuries, have always kept an easy pace with the gradual changes in science and technology. Now the so-called "explosion" of knowledge and expertise has resulted in the teaching profession suddenly finding itself in the invidious position of having to take special steps in many fields to keep pace with the changes. The changes that must take place in education will mostly be in respect of attitude, curricula and the place of education technology.

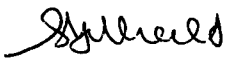
The statement has been made that the next crisis in education will evolve from the problem using the computer for education purposes. On the one hand there is the phenomenon that the computer penetrates all the facets of society, and on the other, there is the computer's particular potential as an educational medium through which instruction possibilities can be created that were formerly very costly or even dangerous. In addition there are possibilities that the computer could solve some of the most serious education problems in the RSA, for instance the large numbers of teachers that will have to be trained or retrained, the high pupil-teacher ratio and in some cases the large number of failures.

From the foregoing and also from actions taken in developed and developing countries, it is clear that a co-ordinated effort is necessary in respect of the computer in education. It has been said that in formulating no policy in this regard, a policy is actually being postulated. The aim of this report is to establish guidelines for the meaningful introduction of the computer in education in the RSA.

The members of the Work Committee are sincerely thanked for their valuable contributions to this investigation. The chairman of project committees and members of the Executive Committee had a heavy burden and they are especially thanked. During the week 18 to 22 April 1983 the following persons made valuable contributions to the writing of the report. Their penetrating criticism and comments are greatly appreciated:

Dr N.F. Alberts
Dr J.K. Craig
Mr D.S. Gear
Dr J.D. Roode
Prof. P.J. van Zyl

The large number of organizations/institutions/departments that contributed to the activities of the Work Committee, for example, by making infrastructure available and by submitting memoranda/comments, are also thanked. The financial support of the Department of National Education is also greatly appreciated.



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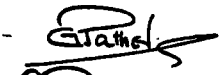

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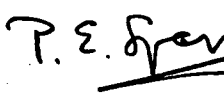

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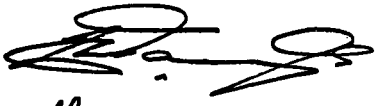

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* Mr H.J.S. Weideman died in a motor accident during May 1983.

I N D E X

CHAPTER 1

INTRODUCTION AND ORIENTATION

1.1 INTRODUCTION

In June 1980 the Cabinet requested the Human Sciences Research Council to conduct an in-depth investigation into education in the RSA in all its facets. This request to the HSRC read as follows:

"Your Council, in collaboration with all interested parties, must conduct a scientific and co-ordinated investigation and within 12 months make recommendations to the Cabinet on:

a. guiding principles for a feasible education policy in the RSA in order to

(i) allow for the realization of the inhabitants' potential,
(ii) promote economic growth in the RSA, and
(iii) improve the quality of life of all the inhabitants of the country

b. the organization, controlling structure and financing of education,
c. machinery for consultation and decision making in education,
d. an education infrastructure to provide for the manpower requirements of the RSA and the self-realization of its inhabitants, and
e. a programme for making available education of the same quality for all population groups

The investigation must be conducted in the light of, among other things, the present educational situation, the population composition in South African society and the means that can be made available for education in the national economy. The investigation must cover all levels of education, i.e., pre-primary, primary, secondary and tertiary".

This investigation was conducted under the guidance of a Main Committee with Prof. J.P. de Lange, rector of the Rand Afrikaans University as chairman. Prominent educationists and persons from all population groups who are concerned with education, served on the Main Committee in their personal capacities. The investigation was completed in 1981, in July of that year. The report of the Main Committee together with the supporting reports was presented to the Minister of National Education and in October the relevant reports were released. Two important developments followed the release of the report.

1. Together with the report of the Main Committee (Report No. 1: Provision of Education in the RSA) the Government released an Interim Memorandum containing certain provisional points of view with regard to particular recommendations. This memorandum also stipulated the appointment of an Education Working Party (under the chairmanship of Prof. J.P. de Lange), to submit to the Government guidelines for the implementation of the recommendations of the report. At the same time all parties concerned with education were invited to submit their comments on the report before 31 March 1982. It was also to be the task of the Education Working Party to pay careful attention to the comments received.

2. The HSRC decided to continue the investigation into education that had culminated in the report of the Main Committee (and which would henceforth be known as Phase 1 of the investigation). This decision was based on two matters, namely that a considerable number of aspects of education had not been researched to an adequate extent in Phase 1, and that it had become evident that some of the recommendations necessitated further research. Phase 2 of the HSRC's Programme, is headed by a reconstituted Main Committee (see Appendix A for further details) under the chairmanship of Prof. J.P. de Lange. One of the first tasks of the newly appointed Main Committee was to identify research priorities for the continuation of the investigation. The following arose from this:

   (a) The identification of priority research fields requiring in-depth research by work committees. The following fields were identified and a work committee appointed for each:

   - Non-formal education
   - Education for the highly gifted child
   - Teacher training
   - Education in the national states and rural areas
   - The computer in education and training
   - Learning needs and media utilization

   (b) In addition to the above priority research fields a large number of priority research projects were identified and introduced to the research community in the RSA through a brochure that also provided data on the financing available for such research projects. Further particulars on this are available from the HSRC.

This report has a twofold origin. On the one hand it emerged from the continuation of the HSRC's investigation into education, as apparant from the above priority research fields, and for which a work committee was appointed. On the other hand, the Education Working Party, at the request of the Minister of National Education, appointed a committee to advise the Minister on the use of the computer, radio and television in education. Since the members nominated independently by the HSRC and the Education Working Party for the two committees, respectively, corresponded to a great extent and because the fields for advice and research were also virtually identical, it was decided to amalgamate the two committees and to request the work committee of the HSRC to perform both functions.

The terms of reference for the committee of the Education Working Party were:

1. to make a survey of and evaluate current activities,
2. to make recommendations on the establishment of a clearing house after consultation with specialists,
3. to submit recommendations on the initiatives to be taken by the Government as well as on the channels and guidelines according to which they should be taken,
4. to conduct a study of developments in the field of computer-assisted training and television as an educational aid in the rest of the world,
5. to make recommendations on means of supporting education and training other than with computers and television as educational aids,
6. to advise on means of promoting computer awareness, computer literacy, computer assisted learning and instruction, computer managed instruction, computer study, computer assisted administration, informatics for highly gifted pupils and teacher training, and
7. to make a cost analysis of computer assisted instruction.

All the population groups in urban as well as rural areas should be involved.

The initiatives of both the HSRC and the Education Working Party on research into the computer in education and training stemmed from the recommendations on educational technology contained in the HSRC Report on Education. The relevant recommendations read as follows:

"5) That, as an important contribution to educational technology could lie in the integration of television, computers and telecommunications, it is vital that top-level co-operation be established between the educational authorities, the GPO, the SABC and the private sector.

The necessary liaison should be effected as a matter of urgency through the national service.

6) That immediate attention be given to the introduction of the computer in education. For this purpose a high-level research committee should be set up in collaboration with the HSRC to initiate the establishment of action research centres on the use of the computer in education". (Provision of Education in the RSA, p. 171).

Recommendation No. 6 in particular gave rise to the research contained in this report. Although the research did include a study of the use of the radio, television and BELTEL for educational purposes, the field is so wide that an additional work committee was appointed to conduct further investigation more specifically into Recommendation No. 5 above. This work committee is known as the Work Committee: Learning needs and media utilization.

1.2 OPERATIONALIZATION OF THE RESEARCH FIELD

On the basis of the recommendations contained in the HSRC Report on Education and the request of the Education Working Party, the Work Committee: The Computer in Education and Training (WCET) identified nine research projects. Project committees were appointed to take responsibility for each project. In some cases a contract researcher was appointed to conduct the research. The research projects, project committees and contract researchers where applicable, are as follows:

Project 1: A survey of the use of the computer in formal education in the RSA

Project committee: Dr D.L. Hattingh (Chairman)
Mr J. Brand
Dr J.K. Craig
Mr L.M. Taunyane
Prof. G. Wiechers

Project 2: Specifications for microcomputer systems in schools and other educational institutions: guidelines for users

Project committee: Dr J.K. Craig (Chairman)
Mr D.S. Gear
Mr A. Hansraj
Dr J.D. Roode
Mr C.J. Talbot
Prof. S.H. von Solms
Dr S.W. Walters

Project 3: Strategies for introducing computer awareness and computer literacy

Project committee: Dr S.W. Walters (Chairman)
Mr M.J. Chiles
Prof. W.T. Claassen
Mr D.S. Gear
Dr J.D. Roode
Prof. A.J.L. Sinclair
Prof. P.E. Spargo
Prof. S.H. von Solms

Project 4: The identification of the most appropriate fields for introducing the computer in formal education

Project committee: Dr H.J. Harmse (Chairman)
Mrs A.L. Kitto
Prof. G. Wiechers
Contract researcher: Prof. J.J. de Wet

Project 5: Investigation into the establishment and functions of a clearing house or clearing houses

Project committee: Mr N.D. Slabbert (Chairman)
Dr J.K. Craig
Prof. L. Glasser
Mr C.J. Talbot
Mr H.J.S. Weideman
Contract researcher: Dr J. Mulder of the Department of National Education.

Project 6: Specifications and criteria for the evaluation and design of educational courseware

Project committee: Prof. L. Glasser (Chairman)
Mr D.S. Gear
Mr T.P. Metrowich
Prof. S.H. von Solms

Project 7: The use of the computer in non-formal education

Project committee: Dr J.D. Roode (Chairman)
Dr N.F. Alberts
Mr G. Julius
Prof. P.J. van Zyl

Project 8: The cost of the use of the computer in education and training

Project committee: Dr N.F. Alberts (Chairman)
Dr J.K. Craig
Mr G. Julius
Prof. A.J.L. Sinclair
Prof. P.J. van Zyl

Project 9: Investigation into the use of the computer, television, the radio, and other information systems such as BELTEL to promote teaching and learning

Project committee: Prof. P.J. van Zyl (Chairman)
Dr N.F. Alberts
Prof. W.T. Claassen
Dr H.J. Harmse
Mr S.P. Viljoen

In some cases the compositions of the project committees changed, or the titles of the projects were slightly amended. The above data on each project show the situation as it was at the end of the investigation. To get matters under way economically and rapidly, an Executive Committee consisting of Dr S.W.H. Engelbrecht (Chairman), Dr J.K. Craig, Prof. L. Glasser, Dr J.D. Roode and Prof. P.J. van Zyl was appointed by the Work Committee.

The Executive Committee held meetings on 26 August 1982, 28 September 1982, 26 January 1983, 25 February 1983 and 28 April 1983, and the Work Committee on 30 March 1982, 23 June 1982, 20 October 1982, 29 March 1983 and 10 May 1983.

1.3 RESEARCH METHODOLOGY

The findings and recommendations of this investigation are based on a comprehensive literature study, empirical research where applicable and consultation with specialists in the fields of education, computer science and other relevant sciences. More particulars may be found in the reports of the project committees. The Work Committee was fortunate enough to have members who are specialists in Education, Computer Science and Educational Technology, while various practising teachers and lecturers from pre-tertiary as well as tertiary levels of education were also involved.

1.4 RATIONALE FOR THE USE OF THE COMPUTER IN EDUCATION

1.4.1 Comment

Any rationale for the use of the computer in education should be based on the realisation that there are needs in modern society and education which necessitate the implementation of the computer in education. Research has shown that the implementation of an educational medium simply on the basis of its availability or the wish to make room for it, can only hope for limited success. It is therefore essential that needs/problems in education which can best be satisfied/prevented through the use of the computer, should be identified with a view to justifying the use of the computer in education. A brief survey of this matter will now be given.

1.4.2 The role of the computer in society

With regard to the developed countries of the world it can be maintained that one has to do with societies which to an increasing extent revolve around the collection, preservation, processing and dissemination of information. This actually is related to the exponential growth in scientific and technological knowledge on the one hand, and to modern society's dependence on the availability of appropriate and recent information on the other. The speed and efficiency with which data can be transformed

into the required form have become vitally important to the individual and to the private and public sectors of society. This is reflected in both the USA and Britian where more than 50 % of the occupations pursued are concerned with the processing and dissemination of information. There is talk of the development and establishment of the so-called "information society". It is obvious that in this respect the RSA is following the example of the developed countries.

The computer obviously plays a vital role in this process since it is a multi-purpose device. It is pre-eminently the medium through which data are collected, processed and distributed. Virtually every sector of society is dependent upon the computer for its efficient functioning, for example the military, medical and transport systems, as well as telecommunications and education.

This development is irreversible and it can safely be predicted that within the next two decades the computer will become indispensable in just about every facet of society, including the ordinary household where it will revolutionize matters such as the management of the household budget, the purchase of necessities, the organization of entertainment, communication and education.

It is clear that modern youth should be prepared for a world in which the computer will play a prominent role. That this has already been accepted as inevitable by the developed countries is evident from the following:

- during the late sixties and early seventies official investigations were undertaken in the use of the computer in education
- various government aided projects concerning the utilization of the computer in education
- the stated aim of the State-financed Microelectronice Education Programme in Britain reads as follows: \to assist schools in preparing children for a society in which devices and systems based on microelectronics are commonplace.

The simple truth is that the prospective typist who does not become acqainted with the word processor at school is not being adequately prepared for her future occupation. The above points to two important uses of the computer in education. These are indicated as (the promotion of) computer

literacy and awareness on the one hand, and computer studies (secondary school level) and computer science (tertiary level) on the other. Both are also related to the job opportunities made available within society through the computer.

The above underscores the fact that this investigation into the use of the computer in education and training has come at an opportune time. It should be accepted that learning opportunities in the fields of computer awareness and literacy should not be reserved only for the privileged few but should be one of the fundamental aims of a system of education provision.

1.4.3 The computer as educational medium within more developed educational environments

A distinction should be drawn between the use of the computer as educational medium in more developed educational environments where its primary potential would be to enhance the quality of education, as opposed to its use in less developed educational environments where the major function for which it could be used would probably be to counteract more pressing educational problems, for instance in respect of inadequately and poorly qualified teachers.

The use of the computer in more developed educational environments is mainly concerned with the promotion of the following three interrelated matters:

- individualization by which is meant that the pupil is able to continue with subject matter at his own tempo and level, and through which enrichment and remediation become viable
- more opportunities and time for the teachers who will be rid of routine and administrative work and who can then concern themselves with the pupils individually
- access to subject matter that could otherwise not be made available to the learner with the same efficiency, or only at great expense (or even risk). In this regard compare simulation programmes developed within computer assisted learning.

The use of the computer to obtain the above is normally based on computer assisted or computer managed learning or instruction. The first two issues

mentioned above may also be promoted through the use of the computer for administrative purposes. It is important to note that the use of the computer in educational context is not essential in respect of all three of the above aspects. The first two issues mentioned (individualization and less involvement for the teacher in routine and administrative tasks) can be attained through other means (though less satisfactory). In the latter case (certain simulations) the computer is indispensable, and though education can do without the possibilities created by the computer, the quality of education will be lower. In all three cases, as already mentioned, it concerns the enhancement of existing high-quality education.

1.4.4 The computer as educational medium within a less developed educational environment

A point that is frequently raised is the possibility of using the computer to relieve some of the more pressing educational problems experienced in the RSA and particularly in Black and Coloured education. Here it does not concern the enhancement of the quality of education although this could also be possible in particular circumstances, but rather a fundamental involvement in education with a view to fulfilling a specific need in a novel and innovative way. Such problems that are commonly referred to include the shortage of qualified Black teachers, the large numbers of teachers that will have to be trained during the next two decades, the high failure rate particularly during the first four school years, and related to this the problem of environmental deprivation, the bridging of the gap between secondary education and further education and training and also the extent to which similar problems are experienced in the field of training. Computer assisted learning and instruction are mainly referred to as means of supporting teachers or even enhancing their capabilities, while the question of teacher training is frequently also mentioned in this regard.

It is clear that in a report aiming to make recommendations on the use of the computer in education and training, careful attention will have to be paid to the above rationale and definite guidelines offered for the implementation of the computer in the South African context.

1.5 FORM OF THE REPORT

The report of the Work Committee: The computer in education and training consists of the following five sections:

Part 1: The computer in education and training: main findings and recommendations

Part 2: The computer in education and training: supporting reports

Part 3: Specifications for microcomputer systems in schools and other educational institutions: guidelines for users

Part 4: Specifications for the design and evaluation of educational courseware: guidelines for users

Part 5: Strategies for the introduction of computer awareness and literacy

The main purpose of Part 3, Part 4 and Part 5 of the report of the Work Committee is to make separate documents concerning the topics mentioned available to those interested in implementing the computer in education and training. As the recommendations will show, it is the expectation of the Work Committee that the contents of Part 4 and Part 5 will have to be regularly revised.

1.6 SITUATION AS IN NOVEMBER 1982 WITH REGARD TO THE USE OF THE COMPUTER IN EDUCATION

As a further contribution to orientation, a brief description will be given of the situation as in November 1982 concerning the use of the computer in education in the RSA. For further particulars the relevant research report may be consulted in Part 2 of the report of the work committee.

As indicated by an investigation conducted in November 1982, only 101 schools (all, except one, attached to the provincial educational authorities or the Department of National Education) have access to a computer. This figure represents 4,07 % of all the schools of the above-mentioned educational authorities. From this it is evident that the computer has not yet made its appearance in the schools of the Departments of Internal Affairs and Education and Training.

When only the secondary schools of the departments concerned are considered, this percentage becomes 11,3 % and must be compared with the 50 % and more

secondary schools in the USA, 30 % in the UK and 25 % in France that have access to computers.

Ninety-one of the above 101 schools use computers that were acquired mainly for administrative purposes but frequently also to promote computer literacy or to present computer assisted learning. When the current uses of the computer in the schools are considered, the same order is established.

The most important problems experienced in the use of the computer in schools concern the non-availability or low quality of courseware. A large number of schools also indicated that there was a need for the training of personnel. Most of the courseware is developed in the RSA. In this regard it is also noticeble that many teachers are themselves involved in the development of courseware.

The most important source of finance for the purchasing of a computer is the school itself (48,3 %), while the parents (35,4 %) and the State (9,5 %) also contribute substantially. It is noticeable that approximately one half of the schools (49) acquired the use of a computer only in 1982. More recent information indicates that the number of schools and other educational institutions implementing the computer for educational purposes, is rapidly increasing.

With regard to tertiary education, the questionnaire survey indicated that mainly universities made use of microcomputers, especially for Computer Science, Engineering and Education. It also appears that the availability and quality of courseware do not pose such a problem at the tertiary level.

Various universities make use of mainframe systems, but few indicated that problems are being experienced with the mainframe systems. The use of the computer at tertiary level is mainly concerned with computer assisted instruction (19,6 %); administration (17,8 %), computer literacy (17,8 %) and computer science instruction (13,5 %).

Unlike the schools, the source of finance for the tertiary level is mainly the State (68,2 %), while in some cases the computers were bought at the institutions' own expense (20 %).

CHAPTER 2

THE COMPUTER IN FORMAL EDUCATION

2.1 INTRODUCTION

The introduction of the computer in education and the determination of policy in this regard are matters to which virtually every developed and developing country in the world has lately been paying attention. In a recent issue of the European Journal of Education (Vol. 17, No. 4, 1982) various articles were devoted to the problem concerning the determination of policy on computers in education in countries such as the USA, the UK, the Netherlands, the Federal Republic of Germany and Denmark. A problem that frequently arises can be identified as one concerning the appropriate points of entry at which to introduce the use of the computer in education. In his summary (in the above journal) of the most important problems and the key policy options, Ladislav Ceryck says the following:

"Assuming that financial and other resources do not allow computer education to be introduced immediately at all levels and in all sectors of the educational system, where should a national policy start, what should be its 'point of entry'; in primary schools, in lower or upper secondary education, or in general or vocational education?" (p. 422).

A complete survey of this problem would imply that the appropriate points of entry should be defined in terms of the following:

a. Educational level: Pre-primary, primary, secondary and tertiary. In the latter instance the emphasis may fall on teacher training which again leads to the question of pre-service and in-service training.

b. Curriculum: Important questions here are firstly, whether the emphasis should fall on the promotion of computer studies as a subject for a selected group only, or whether computer awareness and literacy for all pupils should enjoy preference at a particular level.

c. Potential uses of the computer: Which potential use of the computer in education should enjoy the highest priority: computer studies, computer awareness and literacy, computer assisted and computer managed learning and instruction, the use of the computer for administrative purposes or for the development of educational courseware?

d. With regard to computer assisted learning and instruction, the question arises as to the subject field that should first be concentratec on, for example Mathematics or languages.

e. Then there is also the question as to whether it would be more appropriate to make a start in education for Whites, in which case the emphasis would probably be different than if a start were made in Black education.

It is enlightening to note that each of the above approaches, insofar as applicable, have enjoyed attention in the developed countries previously referred to and that decisions were taken as to school level, teacher training, curriculum development, school subject, etc.

2.2 BASIC ASSUMPTIONS ON WHICH THE RECOMMENDATIONS ARE BASED

2.2.1 The points and time of entry of the computer into education should be related to basic educational needs or problems which can best be counteracted by the implementation of the computer.

2.2.2 Investments should not be made in sophisticated hardware for which the required applications software has not been, or cannot be, developed. This mistake has already been made in other countries with the expected negative results.

2.2.3 New educational technology will be favourably received in practice only by those persons who are prepared for its arrival and convinced of its usefulness.

2.2.4 The most important lessons learned so far in the United Kingdom in respect of the use of the computer in education are as follows: too much diversity may be an advantage as well as a disadvantage; adequate and justly distributed funding is essential; a degree of central co-ordination is advisable and teacher training is vitally important (Rhys Gwyn, European Journal of Education, Vol. 17, No. 4, p. 363).

2.2.5 Policies on the implementation of the computer in education will have great financial implications in respect of hardware, software and teacher training.

2.2.6 The recommendations contained in this chapter are basically applicable to all forms of special education.

2.3 RECOMMENDATIONS ON THE USE OF THE COMPUTER IN FORMAL EDUCATION

2.3.1 Concerning the point of entry of the computer into education, it is recommended that immediate attention be paid to the following four fields simultaneously and that they therefore be regarded as of the highest priority:

- the promotion of computer awareness and literacy (see the recommendations in Chapter 4) at particular educational levels and the further developments of the school subject, Computer Studies
- teacher training (pre-service as well as in-service training) with the emphasis on computer literacy for teachers
- the development or acquisition of appropriate educational courseware for computer assisted learning and instruction and the establishment of a central, co-ordinating body to implement this (also see the recommendations on the establishment of such a body in Chapter 5)
- curriculum development, by which is meant the identification of points of interaction with the information technology in existing or new syllabuses, with a view to introducing more pupils on a meaningful way to the information technology.

The following recommendations will elucidate these first recommendations further:

IN-SERVICE TRAINING OF EDUCATIONAL PERSONNEL

2.3.2 In introducing the computer into education, in-service training should be accorded the highest priority. This does not mean that the other priorities mentioned above should not receive immediate attention.

2.3.3 It is essential that the entire teaching corps be more widely informed so that they may become aware of the possibilities inherent in the computer and in particular the potential it has for enriching and re-inforcing the learning experiences of their pupils. It should be seen as the servant of the teacher not as a competitor. Various methods may be used, including the distribution of films and TV programmes on the computer, articles in educational journals and in the general press and short courses in appropriate places (also see the recommendations in Chapter 4).

2.3.4 As an interim arrangement, the authorities should instal computers temporarily at certain primary as well as secondary schools or centres to enable teachers to gain practical experience.

2.3.5 Both pre-service and in-service training of teachers should make provision for general computer awareness, computer literacy and the basic principles of computer assisted instruction.

2.3.6 Lecturers from teachers' training colleges and universities, and other educational personnel concerned with computer training, should be trained to conduct the training of instructors for both pre-service and in-service training.

PRE-SERVICE TRAINING

2.3.7 Training in the educational uses of the computer should form an essential component of the pre-service training of teachers. The Criteria for The Evaluation of South African Qualifications for Employment in Education should therefore be adjusted to make provision for this, and the criteria implemented by the other education authorities should accordingly be adjusted.

2.3.8 The final study year should include team or individual projects in which the students develop educational courseware for, inter alia, computer assisted learning and instruction in their major subject(s).

DEVELOPMENT OF COURSEWARE

2.3.9 Teachers and educationists should be encouraged to develop educational courseware for a fee after they have undergone the appropriate training.

2.3.10 To avoid unnecessary duplication and waste of manpower, the writing of educational courseware should proceed as co-ordinatedly as possible without inhibiting the initiative of teachers or other individuals. Co-ordination should be ensured through the establishment of a central coordinating body where writers of educational courseware can register. (also see the recommendations in Chapter 5).

2.3.11 The development of appropriate courseware, for which there is a great need in the RSA, should preferably be entrusted to teams of specialized teachers and programmers (cf. the development of the item banks since 1975 by the HSRC in collaboration with the education departments).

2.3.12 The private sector should be encouraged through tax concessions, cash grants, etc. to invest in the development of educational courseware.

2.3.13 It is absolutely essential that courseware intended for use in schools should be subjected to screening in terms of criteria established in Part 4 of the report.

2.3.14 Lesson generators should be developed which can be used by teachers as a framework or structure within which they can develop lessons for computer assisted learning and instruction.

2.3.15 The central coordinating body (SACCET) should play an initiating and a coordinating role with regard to all recommendations in this section (see also Chapter 5 for more particulars about SACCET).

OTHER RECOMMENDATIONS

2.3.16 The initiative of enthusiastic teachers to use the computer in education should be stimulated as much as possible, for example by allowing them access to departmental training facilities and developed courseware and by making software or hardware and time available to them where possible.

2.3.17 A National Advisory Council for Computers in Education and Training in South Africa (NACCET), with specialist representation by the education departments, the National Training Board, the CSIR, the HSRC and other institutions concerned, should be established to advise the Minister on a continuous basis on the implementation of the guidelines contained in this report.

2.3.18 The fields with the greatest need in respect of the development of educational courseware and to which immediate attention should be paid, are as follows:

- the so-called 'scarce' subjects, (for example Physical Science, English Second Language and certain commercial and technical subjects
- subject fields which particularly lend themselves to the use of the computer, including certain experiments and simulations in, for instance, Biology, Physics, Chemistry, Geography and Economics.

CHAPTER 3

THE COMPUTER IN NON-FORMAL EDUCATION

3.1 Introduction

3.1.1 The field of non-formal education

For the purpose of this report a limited definition of non-formal education is used, i.e., those planned and systematized facets of teaching and training which occur outside the formal education system and are linked mainly to the work situation.

3.1.2 The aim of non-formal education

Non-formal education should be a contributing component to the development of personnel. This development is effected by a combination of training programmes and practical experience and through which the individual is enabled to perform more efficiently and to promote his career.

3.1.3 The need for non-formal education

There are specific needs of low, middle and high-level manpower which can be satisfied only through non-formal education. Low-level manpower, for example, has a great need for basic literacy training, i.e., training in basic reading, writing and arithmetic; middle-level manpower has a need for specific vocation-oriented education, and high-level manpower for individual retraining and continuing training.

3.1.4 The role of the computer

Rapid technological development has resulted in an ever-increasing shortage of qualified manpower.

Four strategies can be followed to bridge this problem, namely:

- the use of well-planned training structures and the introduction of the computer in education
- an increase in technically trained personnel

- the improved training of existing technical personnel and
- an increase in productivity.

These four strategies should be regarded as components of a total strategy, with the computer playing a supplementary role in each.

3.2 THE INVESTIGATION OF THE WORK COMMITTEE INTO NON-FORMAL EDUCATION

In the investigation the following research methods were implemented:

3.2.1 A literature study was carried out to explore the implementation of the computer in non-formal education in overseas countries.

Little was gained by this exploration. The report, included in full in Part 2, does however contain references which could form useful starting points for further investigations.

3.2.2 A survey was conducted on activities in non-formal education in the RSA in which the computer was already involved.

Visits were paid to certain local organizations that were using the computer for non-formal education. It was also attempted, over a wide front, to obtain data on successful or experimental projects. Little emerged from this investigation and it must be concluded that no project in the RSA has been in operation long enough to serve as a yardstick for the success of the computer in non-formal education.

The most advanced project appears to be that at ESCOM, where an extensive training programme is being deployed. It is anticipated that by July 1984, 200 000 man hours of training will already be provided annually - a volume that would be impossible to cope with through a conventional approach without computer assistance. This project is also expected to be cost efficient.

3.2.3 From existing sources a survey was prepared on relevant aspects of the manpower situation in the RSA.

The learning needs of the country's manpower have to be determined first before meaningful conclusions and recommendations can be made on the implementation of the computer as an aid in non-formal education.

3.3 FINDINGS

3.3.1 The country's manpower learning needs

3.3.1.1 Low-level manpower (LLM)

There is a surplus of LLM, and a twofold learning need can be identified:

- basic literacy (reading, writing and arithmetic), and
- vocation-oriented education.

A significant percentage (26 % in urban and 49 % in rural areas) of the LLM is illiterate, and as a result has no access to further training. At the same time the Black population has a positive desire to master the skills of reading, writing and arithmetic. The upward mobility of the existing LLM should be accomplished through training so as to make better provision for the as yet unemployed section of the population.

The entry of the unemployed into the labour market can be facilitated through specific vocation-oriented education, which can be accelerated and improved by the implementation of the computer (see Par. 3.2.2).

3.3.1.2 Middle-level manpower (MLM)

MLM fulfils an essential supporting function for the country's high-level manpower. Shortages are assuming relatively large proportions in some cases, such as a shortage of 9,3 % (27 000) craftsmen and 2,3 % (18 700) clerical and administrative personnel in 1981. Low-level manpower is the source of this manpower, so specific vocation-oriented, non-formal education is essential at both low and middle levels. In many cases this training does not require highly structured and lengthy programmes and thus constitutes a field in which the computer can be used with great success.

3.3.1.3 High level manpower (HLM)

Although Whites constitute only about 30 % of the country's labour force, they contribute approximately 70 % to HLM as opposed to the Black population that constitutes 45 % of the labour force but only about 20 % of HLM.

The country's HLM is derived from an upper stratum of 10 % of the labour force with a standard 10 or higher qualification, and among the non-whites this "centre of gravity" is lower, at approximately standard 8 level.

A problem not always evident in statistics is the lack of quality in HLM as a result of high-level posts often being filled by persons who are not formally qualified for them. Consequently, specific vocation-oriented education is also required for certain areas of HLM.

A further problem is the increasing demand being made on HLM (including those who are formally or well qualified) from continuous technological development. This has given rise to an increasing need for retraining.

Retraining occurs mainly on an individual basis and is therefore particularly costly and time consuming. Implementation of the computer would therefore not only provide for such training on a more regular basis but also reduce the costs involved.

3.3.2 Relevant aspects of the current situation concerning in-service training

The following has emerged from an investigation into in-service training in South Africa which was conducted for the National Manpower Commission:

3.3.2.1 Employees in large organizations reveal a greater awareness of training opportunities, and more than 95 % of the training is undertaken by large organizations.

3.3.2.2 Forty-seven per cent of the above organizations are willing to spend more on training media.

3.3.2.3 Training staff are currently drawn from the different strata of manpower as follows:

17 % from HLM
17 % from MLM
66 % from LLM

From this it appears that the qualifications of the training staff are not as desired, and that the need for training at the low level is greater.

3.3.2.4 Even at a lower economic growth rate, say of 2 %, more training staff are needed.

3.3.2.5 The greatest need is for instructors and curriculum planners-cum-instructors.

3.3.3 Benefits of the use of the computer in non-formal education

3.3.3.1 It allows individualization. Learners are able to progress at their own tempo, and thus tend to be less inhibited, and revision can be adapted to individual needs.

3.3.3.2 Training can be carried out to suit both the learner and the employer.

3.3.3.3 Training time can be reduced, for example conveying knowledge and skill through simulation.

3.3.3.4 The instructor is able to devote more time and attention to individual learners and preparation for the course.

3.3.3.5 Training can start at any time. There is no need to wait until a scheduled date for a particular course to commence or for sufficient learners to enroll.

3.3.3.6 Training schedules may be selected according to need.

3.3.3.7 Duplication of costly training facilities can be reduced to some extent through the decentralization of training opportunities with the aid of the computer.

3.3.3.8 Immediate feedback on the learner's achievement will ensure better motivation.

3.3.3.9 More efficient monitoring, management and control of the quality of training are ensured.

3.3.3.10 The computer can be used for testing and evaluation, and the results are usually promptly available.

3.3.3.11 Use of the computer will simultaneously promote the computer literacy of learners, which may be useful for further career development.

3.3.4 Problems on the use of the computer in non-formal education

3.3.4.1 "Computer phobia" can be expected to pose a considerable problem to many potential learners, and not only among LLM, since those at middle and top management levels are also unnerved by computers, terminals and the like.

3.3.4.2 It should not be expected that all training staff will necessarily welcome the computer as a training aid. Many will regard it as an intrusion, so the benefits of using the computer will have to be put across tactfully.

3.3.4.3 Resistance on the part of top management may inhibit the efficient implementation of the computer, particularly where the persons concerned lack the necessary training.

3.3.4.4 Shortcomings in the country's data communication infrastructure may impose considerable restrictions in some cases. Countrywide implementation of a training programme through (or with the aid of) a central computer, requires data communication lines to every point regardless of distance. This could rise to considerable frustration during training sessions due to a lack of data lines on the one hand, and a lack of reliable communication on the other.

3.3.4.5 Without the necessary courseware, computer assisted training cannot become viable. The provision of appropriate courseware will involve either the development of courseware, for which the funds and/or skill may be lacking or which may prove to be very expensive if insufficient learners are involved, or the adaptation of existing courseware (which may often not be ideally suited for the purpose), in which case the funds and skill may also be lacking.

3.4 CONCLUSIONS

3.4.1 Lower level manpower

3.4.1.1 Basic literacy training should enjoy a high priority and can be considerably facilitated through the use of the computer.

3.4.1.2 The relatively low productivity in the RSA can be ascribed mainly to the particularly low literacy level of a large percentage of the labour force.

3.4.2 Middle-level manpower

3.4.2.1 A strong MLM force is required to support and supplement HLM.

3.4.2.2 Upward mobility requires specific non-formal educational programmes which can only benefit from computer assistance.

3.4.3 High-level manpower

3.4.3.1 The economic progress of the country is seriously hampered by a lack of sufficient qualitative and trained HLM.

3.4.3.2 White HLM is almost fully optimized and other population groups must be exploited further.

3.4.3.3 Development programmes, with non-formal education as a component, are essential to maintain a high standard.

3.4.3.4 In the field of the HLM the computer can adjust well to the predominently individual needs of further training.

3.4.4 Availability of training staff

3.4.4.1 A lack of qualified training staff would cause any training effort to fail and should therefore enjoy immediate attention. Computer aids could make a significant contribution in this respect in that they should not only be regarded as a means of training and instructing actual learners but also as an important aid in training staff and catching up on backlogs.

3.4.4.2 To ensure greater efficiency in future, training staff should be more familiar with a variety of training media that may be used, more specifically with the computer.

3.4.5 Inadequacies in training management

Efficient training requires proper planning and management, and the computer can be used to good effect in the performance of important administrative tasks. Efficiency in the planning and management of training efforts will produce the expected positive results.

3.4.6 Multi-media

The computer should not be regarded as an instant solution to all problems. It will often be more profitable to use the computer in a multi-media context and not as an isolated aid (see Chapter 9, Recommendation 9.8.1).

3.5 RECOMMENDATIONS

3.5.1 The national policy on non-formal education should make provision for the use of the computer and more particulars on this should be included in the formulation of policy.

3.5.2 Immediate attention should be paid to the training of staff and instructors to take responsibility for training and the development and implementation of programmes of a non-formal nature.

3.5.3 Serious attention should be paid to training management and developing training management systems with the aid of the computer.

3.5.4 The utilization of existing courseware is strongly recommended even if it does not meet all requirements. At the same time intensive attention, on a co-ordinated basis, should be paid to the adjustment and development of self-initiated courseware.

3.5.5 Organizations should make optimal use of computer facilities for the purposes of non-formal education.

3.5.6 Exchanging appropriate courseware and making computer facilities available between non-formal and formal education is strongly recommended.

3.6 STRATEGY FOR PROMOTING THE USE OF THE COMPUTER IN NON-FORMAL EDUCATION

3.6.1 Determine a national policy.

3.6.2 Provide training staff.

Note: Financial support should be given if necessary, by revising the existing provision in terms of the Manpower Training Act. (Act No. 56 of 1981).

The private sector should at least be involved in this through its employers' organizations.

3.6.3 Develop training management systems and further management training.

Note: The initiative should be taken by the private sector, through employers' organizations.

3.6.4 Develop courseware and evaluate available courseware co-ordinatedly through

- a central co-ordinating body
- tertiary educational institutions and
- the private sector (group training centres).

3.6.5 Make computer facilities available over a wide front.

Note: The facilities of schools, technical colleges, technikons and universities should be made more generally available to the private sector, and vice versa, for specific training efforts. Mobile units financed by the public/private sectors may be used (cf. Israel and Soweto).

CHAPTER 4

STRATEGIES FOR THE INTRODUCTION OF COMPUTER AWARENESS AND COMPUTER LITERACY

4.1 THE NEED FOR COMPUTER AWARENESS AND COMPUTER LITERACY

The computer has already become part and parcel of man's everyday existence. Without doubt the present and future generations will increasingly become dependent upon, and be involved with, the use and application of computers in an ever-increasing number of fields.

The development of the art of writing and of printing has led to an education system in which the ability to read and write, i.e., literacy, is universally accepted as a matter of course to be an essential prerequisite basic skill. This has come about because information is stored in books and documents, or on film, in the form of the printed word, and is retrieved by reading. Literacy is therefore essential for the proper utilisation of any book-based information storage and retrieval system.

With the advent and development of the computer, and the availability of relatively inexpensive personal computers, more and more information is being stored in computer-linked memory systems. Programming languages for specialised tasks have led to an extension of the uses and capabilities of the computer in a variety of fields so rapidly that there is in effect no area, including education, in which computer based information storage, retrieval and processing systems are not employed.

These developments have generated the need for a new kind of literacy - namely computer literacy. Instruction in reading and writing skills, book education and library education, has its parallel in instruction in computer awareness and computer literacy. In addition to the teaching of the literacy aspects, the effects of technophobia (especially among adults), and the mysteries and misconceptions which have developed around the computer have to be removed and counteracted so as to result in the utilization without fear of computerized facilities by the general public.

In trying to determine priorities in the educational application of computers, the following aspects are immediately apparent:

- Computer Studies, Computer Science, and their related specialised subject areas, are reserved for the fairly limited number of individuals specially concerned with furthering their interest and careers in the computer field.

  It is not foreseen that these subjects will develop into more than electives.

- Computer Based Education is a rapidly developing field, depending, inter alia, on the development of suitable software and economical and easy-to-use-network systems suitable for a mode in which each learner can proceed individually at his or her own pace. At present this mode is available on main-frame systems and on microcomputer systems in the more expensive price range only. The main limiting factor, however, is the lack of suitable educational software of high quality specially designed for South African conditions and curricula.

- Information retrieval and dissemination applications in education are being developed. Their widespread use will depend on the effectiveness of a national communications network and the availability of user terminals.

- Experience has shown that high quality educational courseware is developed only where there is close co-operation with practising teachers. Both the quantity and the quality of educational courseware are dependent upon the number of teachers with adequate knowledge of computers, computer based instructional methods and programming. The development of "plain language" programming techniques and simple authoring languages may eventually supersede the need for programming expertise, but a fairly high level of computer literacy will always be a prerequisite.

- Administrative use of the computer is one of the main reasons advanced by schools for the purchase of computers. Software is at present supplied by commercial organizations which usually also provide the training required to run their particular systems and programs. No special national effort in training actual and potential users is deemed necessary at this stage.

. Computer awareness and computer literacy are obviously part of the preparation of the users of all the different modes mentioned above, with the exception of Computer Studies/Computer Science, where specialist training is essential. This fact, together with the need for computer literacy outlined above, makes it quite clear that computer awareness and computer literacy together form the most immediate area of concern. Not only does it lay the foundation required for eventual specialization in the various fields of study with regard to the computer, but it also provides for an essential education need which will become increasingly important in the years to come.

4.2 DEFINITION OF TERMS

Both the terms "computer awareness" and "computer literacy" are widely used in the literature. Neither of these terms is, however, being used with a uniquely defined meaning. Computer literacy, for instance, is used as a term to describe such diverse programmes as a structured course similar in aims, content and approach to the subject Computer Studies, and for the popular television series designed and presented by the BBC. It was therefore necessary to look into the various meanings of these terms and to develop definitions to serve as a point of departure for all further investigation and discussion.

In the context of this investigation -

COMPUTER AWARENESS will be taken to mean the minimum knowledge required by a person to function with confidence in a computer-using society;

COMPUTER LITERACY will be taken to mean the knowledge and skills required with respect to the uses, applications, limitations, and implications of computers for society.

4.3 BASIC CONCLUSION

Although there are many arguments for and against the very early (pre-primary) introduction of computer awareness activities, as well as reports in the literature of the operation of such programmes in practice, these had to be considered in the context of the South African situation and the most immediate and essential educational needs of vast groups of our population. Thus it is considered that: -

(a) Initially it would be inappropriate to introduce Computer Awareness to school pupils in the pre-primary and junior primary phases.

(b) Initially it would be inappropriate to introduce Computer Awareness on a formal basis to pupils in Standards 2-4 (Grades 4-6).

(c) Computer Awareness and Computer Literacy programmes in the school situation should not extend beyond the end of the junior secondary phase (Standard 7 or Grade 9).

(d) Computer Studies and computer clubs could cater for further advancement of interested pupils in Standards 8, 9 and 10.

(e) Although the need for "hands-on" experience cannot be sufficiently stressed, the provision of hardware and therefore also of "hands-on" experience for all, is perhaps a Utopian dream, but it is regarded as worth striving for.

Having arrived at these conclusions regarding the stage of introduction of Computer Awareness and the problems relating to the supply of hardware, it is not intended to prescribe a rigidly defined introductory age or a single approach to the teaching of Computer Awareness and Computer Literacy. The very fact that computer hardware and education in computers are both such rapidly developing areas, precludes the design of a final plan in this field.

For example, one approach to computer literacy, for which many claims are made, is the so-called "turtle-logic". The best developed of these approaches is LOGO, which has proved successful with pupils at pre-primary level.

4.4 RECOMMENDATIONS

The following formal recommendations are proposed for the introduction of computer awareness and computer literacy.

4.4.1 Informal computer awareness for pupils in Standards 2, 3 and 4 (Grades 4, 5 and 6)

Note: The principal purpose of computer awareness here would be to assist pupils in handling the problems of interfacing with a machine. Thus it would be important to make pupils familiar with the use of keyboards which are becoming increasingly common in everyday life, e.g., automatic teller machines, ticket-dispensing machines, typewriter keyboards and handheld calculators. A proposed course is set out in Appendix B.

4.4.2 More formal computer awareness/literacy for pupils in Standard 5 (Grade 7)

Note: Because of the difference in training between teachers in Standard 5 on the one hand and those in Standards 6 and 7 on the other, it is considered that Standard 5 should be seen as a "bridging" year between the end of Computer Awareness in Standard 4 and the beginning of "hands-on" Computer Literacy in Standard 6.

Thus in Standard 5 the great majority of schools would teach Computer Literacy principally via written materials and visual aids such as films. However, for those primary schools which can show that they are in a position (e.g., with competent teachers on their staff) to introduce "hands-on" Computer Literacy, material support should be provided by the authorities. This support should take three forms for this and the other levels:

(a) Further training of those teachers anxious to introduce "hands-on" Computer Literacy,

(b) Financial support for the purchase of microcomputers,

(c) Financial and other support for the national production of appropriate software.

4.4.3 Formal Computer Literacy for pupils in Standards 6 and 7 (Grades 8 and 9)

It is recommended that in Standards 6 and 7 Computer Literacy should be taught in a formal manner using hardware supplied wholly by the education authorities.

Note: To delay the introduction of a Computer Literacy programme for these standards until computer hardware (and the electricity supply required to operate it), is available in all schools throughout the country, would be most unwise.

It is further recommended that initially there should be two levels of Computer Literacy in Standards 6 and 7:

LEVEL 1: For schools with no or inadequately trained staff, a "non-hands-on" Computer Literacy course using television and/or written material, supported if possible by other media, should be introduced.

LEVEL 2: Where a school has the staff necessary to introduce "hands-on" Computer Literacy, it should be supplied with adequate computing equipment and the course should be introduced as soon as possible.

The provision for teacher training and in-service training should be co-ordinated in such a way that there will be a steady movement of schools from Level 1 to Level 2.

4.4.4 Computer activity for pupils in Standards 8-10 (Grades 10-12)

In Standards 8-10 the pressure of a full curriculum of examination subjects means that a separate compulsory subject like Computer Literacy as such would be inappropriate. In these standards, therefore, "computer activity" could take the form of either Computer Studies as an elective subject and/or Computer Clubs.

However, every effort should be made to bring to the notice of pupils in the senior secondary phase the value of the computer in a wide variety of disciplines. This could best be achieved by adding to most school subjects a topic reflecting the particular applications of the

computer in that subject and/or by teachers using the micro-computer as a didactical aid.

4.4.5 Provision of Teachers

4.4.5.1 Itinerant Teachers

The logistic problems of training the large numbers of teachers involved in such a programme (see paragraph 4.4.1-4.4.4) suggest that serious consideration should be given to making use of a small number of itinerant teachers specially trained for the purpose. Each such teacher would handle a group of schools in a particular geographical area as has apparently been done with considerable success in some states in Australia. These itinerant teachers would fulfil the dual function of handling computer literacy courses for pupils and at the same time training the staff of the schools concerned. If the schools concerned do not possess their own microcomputer, these could be brought to the school by the itinerant teachers. Suitable, easily portable models are available. Appropriate films could make a major contribution in the implementation of such a programme.

4.4.5.2 Initial Teacher Training

To teach Computer Awareness in Standards 2-4, and even "non-hands-on" Computer Literacy in Standard 5, primary school teachers must all receive training in both Computer Awareness and Computer Literacy during their diploma or degree studies, including "hands-on" contact with computers during their training period.

Because of the grave shortage of college of education staff able to teach such courses, it is recommended that such staff should receive training at the universities or colleges of education for further training on a full-time release basis for a period of 100-150 contact hours.

Because of the increasingly important role of computers in education, it is recommended that all secondary school teachers should undergo a course in "hands-on" Computer Literacy during their post-graduate HDE year, or its equivalent.

It is further recommended that these courses be included in the statutory requirement criteria for all approved teachers' diplomas, integrated degrees and certificates.

4.4.5.3 In-service training

Because of the very large numbers of teachers involved in any teacher in-service training programme, it is recommended that a "two-layer" approach be adopted:

(a) A course in Introductory Computer Literacy, planned jointly by the SABC and the educational authorities, which would consist of a series of television programmes broadcast on all channels of the public television system and also available on video cassette tapes. These programmes would be supplemented by manuals, including one for teachers.

(b) This would be followed by a "hands-on" course for teachers, such courses being held at Universities, Colleges of Education and, possibly, Technikons.

4.4.5.4 Interim training

There will inevitably be a period of delay until the recommended scheme is in operation. During this interim period, all in-service training courses, in all examination subjects, should include a component of computer awareness. All Teachers' Centres, or other institutions for the further training of teachers should run a regularly repeated series of lectures or courses on Computer Awareness and Computer Literacy as frequently as possible.

4.4.5.5 Regional Computer Centres (see Chapter 5, recommendation 5.3.4)

Serious consideration should be given to the establishment of regional computer centres to which pupils from schools with no computing equipment can be transported. Such centres would also serve as valuable institutions for teachers training in Computer Literacy.

Immediate attention should be given to the preparation and widespread publication of a series of booklets directed at subject teachers, e.g. "The Role of Computers in Geography (Accountancy, Mathematics, Physical Science, Biology, etc.) Teaching".

4.5 NON-FORMAL SECTOR

Computer literacy programmes for the non-formal sector (e.g., commerce and industry) will vary considerably in emphasis. Such a programme should therefore consist of the public television programmes (and video cassettes) and the basic manual mentioned above, supplemented by a series of manuals written with the need of specific industries or commercial operations in mind.

A core programme in computer literacy for the non-formal sector should be designed. This core should also serve as the criterion for registration as a training scheme with the Department of Manpower in terms of Article 11 sept of the Income Tax Law, 1962.

4.6 INFORMAL SECTOR

The following recommendations are made:

4.6.1 The subsidised publication, for widespread distribution or sale throughout South Africa, of an attractively produced, inexpensive and readable computer awareness booklet "What are Computers?" of not more than 50 pages in length should be produced. This booklet should be available in both official languages and in the major Black languages.

4.6.2 The basic manual referred to in paragraph 4.4.5.3 (a) above should, if possible, be written on a "stand alone" basis for those members of the public who do not possess television receivers.

4.6.3 The SABC-TV computer literacy programmes referred to in paragraph 4.4.5.3 (a) should be widely available in the form of subsidised video cassettes.

4.6.4 The assistance of the Computer Society of South Africa should be sought in designing a national programme(s) for Computer Awareness or Computer Literacy.

4.6.5 Serious consideration should be given to subsidising community computer clubs, an important avenue for the introduction of computer literacy either from government funds or via the computer industry. (National support for other organised activities such as sport is already accepted and practised.)

4.6.6 Consideration should be given to producing South African software as soon as possible, because software for Computer Literacy from other sources is often inappropriate for South African conditions.

Software should be produced on a decentralized basis, e.g., at universities via a centralized funding body, rather than at a large national centre. (See the functions of SACCET, Chapter 5, paragraph 5.3.1.)

4.7 OUTLINE PROGRAMMES

Details of the outline programmes for computer awareness and computer literacy are published in Appendix B.

CHAPTER 5

CO-ORDINATION OF ACTIVITIES ON THE USE OF THE COMPUTER IN EDUCATION AND TRAINING

5.1 INTRODUCTION

Developments in the field of the computer and its use in education and training occurred at an ever increasing pace during the last decade. This is particularly reflected in the phenomenal increase in the number of magazines and articles devoted to the computer in general and its use in education in particular. The practical implication of this development is, however, taking place in schools and other educational institutions where the number of computers is rapidly increasing (as indicated in the first chapter). The diverse developments that are currently taking place and the problem of incompatibility (see Chapter 6) are such that a lack of co-ordination and planning could seriously handicap the large scale implementation of the computer in education. The first level of authority has not yet formulated guidelines, with the result that schools are still to a large extent left to themselves. Better co-ordination is required and the dangers of unco-ordinated and unplanned actions are pointed out.

On the other hand , the disadvantages of a too narrow co-ordination are also known. In this respect the basic assumption stated in paragraph 2.2.4 is again stressed.

When the problem is considered it seems that there are various perspectives, but that all of them concern the bringing about of co-ordination. Firstly there is the problem of the large variety of computers, especially micro-computers, that are available. Schools, and other educational institutions and educational authorities need guidance on which type of computer to choose. This matter is dealt with in Chapter 6 and again referred to in the recommendations in this chapter. Closely linked to this is the current haphazard and unco-ordinated development of educational courseware and the duplication that often goes with it. Various people have already made recommendations on possible ways in which co-ordination and an effective method can be created (compare Part 2, Report 5, p. 13). The one possibility that continually emerges is the establishment of a centre or centres to fulfil these needs.

5.2 CENTRES FOR THE CO-ORDINATION AND EFFECTIVE IMPLEMENTATION OF THE COMPUTER IN EDUCATION

The problem referred to above are naturally not unique to the RSA but to a lesser or greater extent also experienced in all countries where the computer is (increasingly) being integrated into education. Guidelines in respect of microcomputer systems and the buying, evaluation and development of educational courseware are also creating problems. Centralised bodies that co-ordinate development in the use of the computer in education and training were established in various countries. The following are a few examples:

- Osterreichische Schulrechenzentrum - Austria
- The Elizabeth Computer Centre - Tasmania
- The Schools Computing Centre - Western Australia
- Centre for the Advancement of Microcomputer Applications - Israel
- Microelectronics Education Programme - United Kingdom
- Scottish Microelectronics Development Programme - Scotland
- Conduit - USA
- MECC (Minnesota Educational Computing Consortium) - USA

All these bodies/movements include functions which are broader than those of a clearinghouse and which have as their aim the co-ordination of activities on the use of the computer in education with particular activities such as the evaluation, development and distribution of educational courseware, the financing of development work, the training of teachers for the production of educational courseware, the compilation of criteria for computer hardware and educationanal courseware, and the co-ordination of research on the use of the computer in education and training.

When it is considered that one of the biggest problems with the introduction of the computer in education is the total lack of sufficient high quality educational courseware (and this problem is experienced in all countries concerned), then decisions on, and mechanisms for, the development of such courseware are of the utmost importance. It is important that the increasing use of microcomputers in schools be co-ordinated and that clear and useful guidelines be determined in this regard. It is equally important that the co-ordinated development of courseware should receive attention. A centre for co-ordination on central or national level and with the necessary decentralised branches, will play an important part in this regard.

5.3 RECOMMENDATIONS IN RESPECT OF THE ESTABLISHMENT AND FUNCTIONS OF CENTRES FOR THE CO-ORDINATION OF COMPUTERS IN EDUCATION AND TRAINING

5.3.1 It is recommended that a South African Centre for Computers in Education and training (SACCET) be established immediately with funds supplied by the Government and the private sector. SACCET should only have limited personnel and especially have the following important funcions:

- co-ordination of the activities of regional centres (see Paragraph 5.3.4)
- financing of the development work at regional centres and elsewhere by means of, for example, tenders and contracts after priorities had been determined in consultation with the National Advisory Council for Computers in Education and training (see Paragraph 2.3.17)
- liaison with clearing houses and other similar institutions in overseas countries, and the exchange of expertise and publications
- collection, processing and distribution of information on educational courseware that is developed internally or obtained elsewhere
- publication of a document which can be distributed among all parties concerned reflecting the activities of the regional centres
- the rendering of an SDI service (Selective Dissemination of Information) that supplies members with relevant literature references, if the SASDI service of the CSIR is not able to render this service fully. For this purpose SACCET can obtain sources of previously selected material on magnetic tape or in printed form, supplemended by own magazine subscription for geographical areas not covered by the selected sources, and
- advice should be given in respect of copyright

5.3.2 The way in which SACCET is to be accommodated within the present infrastructure and the relation that it has with the recommendations of the HSRC Report on Education on a Co-operative Educational Service Centre, at the first level, are closely linked to the recommendations of the Educational Working Party on this matter. The Work Committee, however, recommends that SACCET should be an autonomous body.

5.3.3 It is further recommended that the National Advisory Council for Computers in Education and Training in the RSA serves as controlling body of SACCET (see Recommendations 2.3.17, Chapter 2).

5.3.4 Regional centres should be established by making use of the existing infrastructure at education departments, universities, colleges for education, technikons and teacher centres, as well as such institutions that have already been established. These intitutions should be encouraged to establish such centres with financial support from SACCET. Regional centres can be established to serve as particular educational sector but must be affiliated to SACCET in order to bring about national co-ordination and to eliminate duplication.

5.3.5 The primary functions of regional centres should be the following:

a. To evaluate educational courseware and to supply consumers with an objective, scientifically verified report on a programme.
b. To obtain software, and if useful to make it available at reasonable cost. For example software, developed by a teacher or lecturer can be made available to his colleagues through the centre.
c. To render an advisory service to teachers and lecturers who develop software. Advice can be given to teachers individually, for example when they send a programme to the centre for evaluation. This implies that the teacher does the work but can obtain guidance from the centre. Experts should be appointed for this purpose. The advisory service can also include the presentation of courses and seminars for training teachers in the design of educational courseware.
d. To contribute towards the specifications for microcomputer systems in education and training.
e. To keep computerised registers, for example:

    1. of persons in different subject fields who are interested in the use of the computer in education and training, and
    2. of those in possession of particular programmes, so that prospective buyers can obtain an opinion on a programme from someone who is already using it.

f. To give advice in respect of copyright.

g. To undertake projects at the request of and with the financial aid of SACCET.

5.3.6 SACCET and the regional centres should be linked by a datacommunication system.

CHAPTER 6

SUGGESTED SPECIFICATIONS FOR MICROCOMPUTER SYSTEMS IN EDUCATION AND TRAINING

6.1 INTRODUCTION

With more than 80 microcomputer systems supplied by in excess of 300 firms in the RSA it is hardly to be wondered at that one of the first topics to be identified for urgent research was minimum requirements for microcomputers in education. With more than 15 different microcomputer systems already in use in more than 100 schools (in the RSA) it was inevitable that the question of standardisation should be raised. Principals and parent bodies want guidance as to what they should buy, education authorities want an organized set-up, and suppliers want to know what is expected of them. The "Specifications for microcomputer systems in schools and other educational and training institutions in the RSA", published separately as Part 3 of this Report, is an attempt to meet these needs.

6.2 PROBLEM AREAS

It was immediately apparent after only a cursory examination of the microcomputer scene in the RSA that much software (a collection of computer programmes) written for one make of machine (hardware) could not be used, without alteration or rewriting, in another make or even in an upgraded model of the same make. Such incompatibility between microcomputers, often propagated by manufacturers in an effort to secure a captive market, gives rise inter alia in the field of education to a number of problems, e.g., one school which has developed a worthwhile set of computer programmes in a particular subject cannot run them on a neighbouring school's microcomputer because the latter is not compatible or two different makes of machine in the same school cannot be linked in a network because of their incompatibility. Another problem identified by the Committee was the fact that so little attention is paid to an analyses of the educational needs before a microcomputer system is bought. The Committee addressed itself inter alia to these problems and decided that, while for uses of the computer such as initial programmes of computer awareness and computer literacy as well as for extra-mural activities like a computer club they are not so important, for others they are crucial. In this latter category uses such as for teaching Computer Studies, for computer based education (CAL, CAI, CML and CMI) and for school administration may be mentioned.

The Committee accordingly formulated detailed suggested specifications for these three last-named uses bearing the needs of the schools and problems like incompatibility in mind.

6.3 THE SPECIFICATIONS

Items or aspects of hardware to come under scrutiny were the video display unit or screen, the keyboard, the cabinets or casings, the internal and external memory, the microprocessor, the printer, the interface and expansion capability, power supply stabilisers, upgradability, portability and ease-of-use. Other points which received attention were the attributes of the programming language used, the operating system, the users' manual, user-training, maintenance of hardware and software, the guarantee, an advisory service by the supplier, and the reliability, viability and stability of the supplier. The reader should refer to Part 3 for details about all these points.

6.4 RECOMMENDATIONS

It is recommended that:

6.4.1 All users and potential users of microcomputer systems in education and training should make a thorough study of the "Specifications for microcomputer systems in schools and other educational and training institutions in the RSA", published as Part 3 of this report.

6.4.2 Potential users of microcomputer systems in education should determine whether:

6.4.2.1 the microcomputer system under consideration can accommodate different operating systems so that software written for other makes of machine can be used,

6.4.2.2 hardware can be upgraded, extended and linked into a network without having to rewrite software,

6.4.2.3 the system and the manual are user-friendly, that is, easy to understand and easy to operate or use,

6.4.2.4 the system makes provision for a low cost uninterruptible power supply with battery back-up where necessary,

6.4.2.5 the supplier is reliable, viable and stable, and provides adequate back-up support.

6.4.3 Potential purchasers or renters of microcomputer systems in education should follow the procedure set out hereunder.

6.4.3.1 Make a detailed list of needs and select which can be viably met by a microcomputer system, bearing expansion in mind.

6.4.3.2 Look for the software which will meet these needs.

6.4.3.3 Look for the hardware which will run this software.

6.4.3.4 Consult as many users of this software and hardware as possible, asking the following types of questions:

- What problems do you have with the software? And the hardware?
- Did the supplier keep all the promises which were written into the sales/rental agreement?
- Is service prompt? And for how long is your system "down" each month?
- Were there any hidden costs after the initial payments?

6.4.3.5 Request practical demonstrations from more than one supplier.

6.4.4 The RSA as a whole (and individual, education departments or institutions) should not standardize on one or two models of makes of microcomputer because of the rapidly changing technology, the benefits to education of healthy competition, and the need to adhere to the provision of the law with regard to monopolies.

6.4.5 Compatibility of software be achieved by requiring that microcomputers submitted for tender purposes can accommodate different operating systems and/or software written for different makes of machine.

6.4.6 The central coordinating body (SACCET, see Chapter 5), organize the regular updating of the specifications as set out in Part 3 as well as their extension if necessary (e.g., to include more detailed specifications on networks).

CHAPTER 7

SPECIFICATIONS AND CRITERIA FOR THE DESIGN AND EVALUATION OF EDUCATIONAL COURSEWARE FOR USE WITH COMPUTERS

7.1 INTRODUCTION

Unlike other education media, the production of computer courseware is beset with many hidden difficulties, which makes the selection and development of effective courseware a hazardous task. Technical and educational aspects are often difficult (if not impossible) to judge in a brief sales demonstration.

Just as textbooks have achieved a technical consistency in format and design (e.g., Contents, Foreword, Chapters, Index, etc.) computer based materials should have certain technical consistencies, which at present is often not the case. In addition, computer courseware has such innovative features as interactivity and selfpacing allowing for a more sophisticated lesson design than other media. Consequently a set of evaluation criteria must be based on a learning theory model for the design of courseware and lesson designers should be made aware of such a model and criteria.

This chapter outlines such a model and describes the basis for the development of evaluation criteria. The detailed specifications and criteria are published separately in Part 4 of this report.

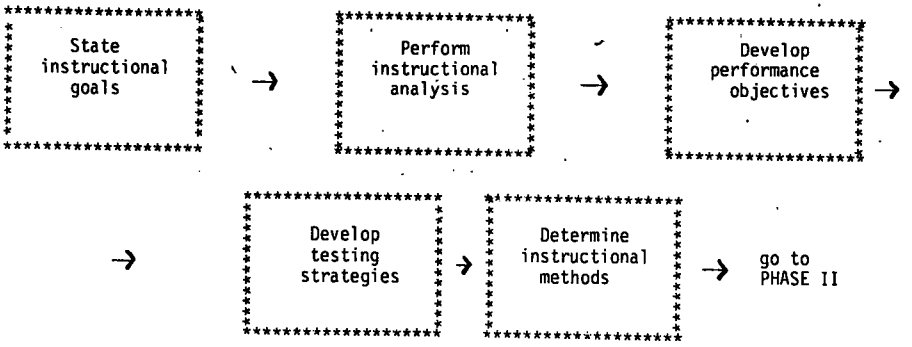
7.2 A SUGGESTED MODEL FOR THE DESIGN OF COURSEWARE

The need for a model on which to base the design of courseware has been stated by many writers in this field, a number of whom have proposed models ranging from the simple to the complex.

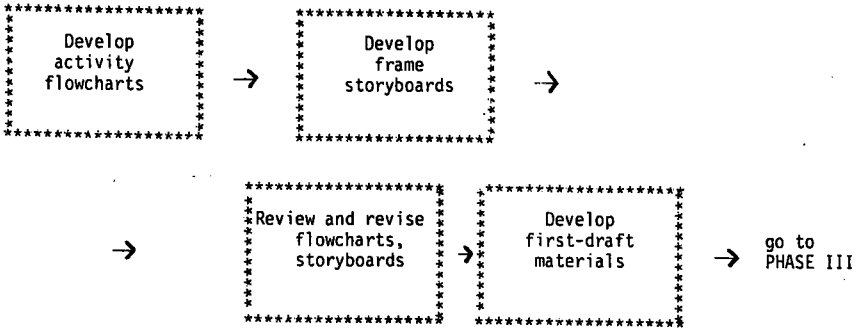
The model proposed by Roblyer (1981) has been selected for the purpose of this report. The main reason for the selection of this model is that it incorporates the ideas common to all of the other models studied as well as emphasizing the need for the model to be linked to learning theory.

FIGURE 1: ROBLYER'S MODEL

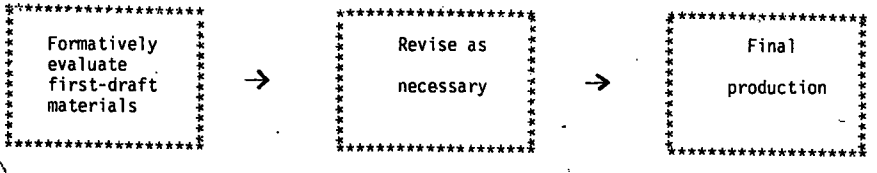
PHASE 1: DESIGN



PHASE II: DEVELOPMENT



PHASE III: EVALUATION AND REVISION



Roblyer's model lists three phases in the process of designing courseware:

Phase 1 - Design
Phase 2 - Development
Phase 3 - Evaluation and Revision

This model is shown in Figure 1.

The products of the model include:

Statements of goals and objectives - these are always in terms of what the learner is to do in the lesson, not in terms of what the computer or the courseware will do.

Learning map - this is especially necessary when the courseware package is a skills series. The map shows three things: all of the skills to be covered and those required as entry skills for each package, hierarchical or prerequisite relationships among the skills; and, finally, a suggested sequence for presenting the various instructional steps.

7.3 BASIS FOR THE EVALUATION OF EDUCATIONAL COURSEWARE

The development of the criteria that are discussed below has come about as a result of the observations and opinions of the many writers of courseware for either commercial or private use. Some of the criteria have been tested by observation and interview with the end-users (usually learners). Other criteria are the result of experience in the production (usually commercial) of courseware programs.

The purpose of documenting these criteria is to attempt to provide the instructional designer and intending purchaser with a guide as to what makes a good courseware program as opposed to a poor one.

The criteria for the evaluation of courseware may, for convenience, be divided into two categories, namely:

technical or design features, and educational features.

Broadly speaking, the technical features are those that concern the program design and layout, while the educational category deals with such factors as the subject content and level of presentation of the material in the program.

7.3.1 Technical Features

a. Screen Layout

The effectiveness of the presentation is influenced by such factors as the amount of information appearing at one time, the readability of the text, the consistency of positioning of information, questions and instructions. Some features of computer presentation (e.g., scrolling, excessive use of animation, colour and sound) are often counter-productive.

b. Menus, Instructions and Support Materials

Bearing in mind that a computer lesson is often expected to be used in an individual mode, adequate menus of lesson content and full instructions are regarded as essential. Suitable materials should be provided to facilitate the full integration of educational courseware with other lesson materials where appropriate (see paragraph 9.8.1)

c. User interaction

A computer allows dynamic interaction including such features as choice of lesson level, immediate feedback, remediation and recording of student progress. These features should be used in a consistent and useful way. Help should be available to a student experiencing operational difficulties.

d. Documentation

Adequate information to facilitate the use, modification and updating of the educational courseware should be available.

e. Operational Features

No computer skills should be necessary for the use of the program by teachers or pupils.

7.3.2 Educational Features

Theory based educational courseware will take into account factors such as the following:

a. Content and Objectives

Lesson content should be accurate and up to date in accordance with local syllabus requirements. Of particular importance is the clear statement of objectives to both the teacher and the pupils. This includes the relevance of materials to the pupils' cultural milieu. Choice of lesson type (e.g., simulation, tutorial, drill and practice) should be appropriate to the objectives.

b. Presentation

The computer allows the presentation of lessons to be logical, 'user-friendly', challenging and educationally sound. These features of educational courseware should be fully exploited. Level of presentation should take into account appropriate language and numeric skills, the learning environment and the pupils' previous experience.

c. Lesson Feedback

The ability of the computer to provide information on the pupils' progress to both the teacher and the pupil should be fully exploited. This should also include help to the student when experiencing difficulties with the lesson content. Feedback should not be excessive, e.g., intrusive musical reinforcement of correct answers.

d. Achievement

Testing of lessons is essential to ensure that the stated objectives are achieved.

7.4 AUTHORING SOFTWARE

Software designed for the generation of lessons by teachers must be compatible with the teachers' levels of skills and their educational requirements. Such software ranges from full authoring languages to structured lesson shells. Purchase of such software should be preceded by an analysis of available human resources and educational needs.

7.5 LOCAL NETWORKS

The design of local networks should take into account the educational courseware objectives. For example, software requirements are very simple if only drill and practice is required, whereas fully interactive lesson control from a master station requires careful planning if effective use of the system is to take place.

7.6 RECOMMENDATIONS

It is recommended that:

7.6.1 all users and potential users of computer systems in education and training and authors of educational courseware make a thorough study of Part 4 of this Report: Specifications and criteria for the development and evaluation of educational courseware.

7.6.2 the central coordinating body (SACCET - see Chapter 5) organize the regular updating and extension if necessary of the specifications and criteria as set out in Part 4, in consultation with all interested parties.

Note: With regard to the coordination of the evaluation of educational courseware see Chapter 5, paragraph 5.3

CHAPTER 8

A COST ANALYSIS FOR THE INTEGRATION OF THE COMPUTER IN EDUCATION

8.1 INTRODUCTION

The implementation of the computer in education implies specific expenses. A wide variety of factors are involved and without the support of empirical data no cost analysis can be completely reliable. In order to take certain decisions on the nature and extent of the application of the computer in education, it is essential to make an estimate of the possible cost implications. Such an estimate will rest on certain suppositions but may serve as a basis for related decisions on finance and planning.

8.2 AIM OF THE COST ANALYSIS

The analysis is made in order to obtain an indication of the expected cost per pupil, as well as the maximum expenses incurred, for the implementation of the computer for various purposes in formal education.

8.3 CONTRIBUTING FACTORS

Literature on the subject makes it clear that a variety of factors contribute to costs - directly or indirectly. For the purpose of this analysis the following factors were considered:

The cost of hardware, installation, maintenance, development of software, training of staff and current expenditure on paper, tape, floppy discs, etc.

This is not a detailed list of costs, but it indicates the main expenses that will be referred to.

8.4 SUPPOSITIONS

8.4.1 Although the average school in the RSA has about 300 pupils (5,57 million pupils attending 19 040 schools, (1982)), the estimates are

based on the number of pupils that can be accommodated by a system of 20 microcomputers or terminals. Nineteen units will be available for the pupils and one for the teacher.

8.4.2 It transpired from the literature on the subject that 50 to 100 hours are needed for the development of one hour's effective software. Since South Africa is at the beginning of such an organized development process, the proportional scale is 100:1 for the aims of the report.

8.4.3 The amount of time that a pupil should be exposed to the computer to make it worthwhile, poses a big problem. Educationalists and computer distributers have not reached agreement on this matter. However, the eventual aim of the computer will be of cardinal importance. Literature on the subject reveals that 15 minutes a day comprises adequate exposure for the pupil to the computer. For the aims of this report it can be accepted that 15 minutes a day for every pupil may be adequate to teach computer awareness but not to teach computer literacy or computer aided or computer managed learning and instruction.In these latter instances it seems more desirable to expose pupils to the computer for 30 minutes a day which is approximately the equivalent of one lesson period at school. That will imply about 2,5 hours a week for each pupil. If possible, the duration of the exposure can be increased to 5 hours a week if pupils work in pairs.

8.4.4 It is accepted that microcomputers or terminals will be available from 8h00 to 14h00 every school day. However, experience has taught that the maximum occupational time will amount to approximately 70 % of the available time. This means that every microcomputer or terminal will be utilized for 4,2 hours a day. If the equipment could be made available also during the afternoons and evenings, the average number of hours could be increased.

8.4.5 Considering the number of microcomputers available per system and the exposure time required per pupil, it seems as though 320 pupils a day will be able to utilize such a system (consisting of 19 units) in order to develop computer awareness, while it will be possible to teach computer literacy or CAL and/or CAI to 160 pupils a day.

The number of pupils attended to can be doubled if pupils work in pairs.

8.4.6 The purchase of large numbers of microcomputers or terminals can, in practice, lead to a negotiated price up to 40 % lower than the unit market price. It is consequently realistic to accept this as the basis for the large-scale implementation of the computer in education.

8.4.7 For accounting purposes the writing off of hardware is spread over a period of 5 years.

8.5 RESULTS

8.5.1 The computer for administrative purposes

One microcomputer per school with the necessary peripheral hardware is considered to be sufficient. Although the estimated cost for such a system is approximately R10 000, a negotiated amount of approximately R7 000 can be used as the basis for calculations.

For the 19 040 schools in the RSA in 1982, the total estimated amount for the immediate implementation of microcomputers for administrative purposes will be approximately R190 million and the negotiated amount approximately R137 million. The total amount of annual working costs is estimated at approximately R2,5 million.

8.5.2 The computer for computer awareness

If hardeware has to be purchased exclusively for this purpose, cheaper equipment will be required and the cost of developing software will be relatively low.

The number of microcomputers required per school will vary according to the number of pupils attending the school. As indicated in Paragraph 8.4.5, a system of 20 units (19 for pupils and one for the teacher) will expose 320 pupils to the computer for 15 minutes a day. The estimated cost of one system consisting of 20 computer units will in this case be approximately R22 000 and the negotiated cost (-40 %) approximately R13 000. If the computer is to be generally implemented

in formal education in order to promote computer awareness among all pupils at school, a total negotiated cost of R226 million will have to be incurred (17 407 systems of 20 units each at R13 000 a system).

If it is considered that equipment will be used repeatedly and that it will be written off over a period of five years, the annual cost will be approximately R45 million. In such a case, the cost will be close to R8 a year for every pupil.

Judging by findings and recommendations on the implementation of the computer in education to promote computer awareness in Stds 2 to 5, only about 2 066 000 pupils (in Stds 2 to 5) will be involved country-wide, which implies 6 457 systems of 20 units and at a negotiated cost of approximately R88 million. The annual working expenses for computer awareness in Stds 2 to 5 is estimated at about R1,2 million (R200 x 6 457).

8.5.3 The computer for computer literacy

More sophisticated computer systems are recommended for the presentation of courses in computer literacy so that, when circumstances allow, they can also be used for computer assisted learning and instruction. Considering the sophisticated nature of the apparatus required, estimated costs for the use of mainframe systems will also have to be discussed.

Calculations are based on a minimum of 20 terminals or microcomputers for every 160 pupils in order to achieve 2,5 hours' interactive contact a week. The cost of a system of 20 units is estimated at approximately R56 000, while the negotiated cost (-40 %) will be about R35 000. Considering the recommendation that computer literacy programmes should be aimed at Std 6 and 7 pupils, the total number of pupils involved (from all ethnic groups country-wide) is approximately 637 000. This implies 3 981 systems of 20 units each at a total cost of about R140 million for immediate introduction. As equipment is expected to last about five years, implementation costs are calculated at around R28 million annually. The resulting cost per pupil (Stds 6 and 7)will be approximately R44 a year. To this should be added the annual running cost which will, after the initial implementation, amount to about R9,4 million for every year (R2 360 x 3 981 systems). However, an important feature of this amount is the R1,50 a year included for each pupil to cover the cost of the development of courseware in order to promote

computer literacy.

It is assumed that mainframe systems will be rented and not bought. The same suppositions that were valid for microcomputers (regarding the exposure periods, etc.) are also applicable to mainframe systems. Amounts mentioned here are based on a mainframe system consisting of 1 000 terminals.

The annual rental (which includes communication expenses, buildings, services, software, installation, maintenance and working expenses) for 1 000 terminals will be approximately R900 000 and the negotiated cost (-40 %) in the region of R590 000. If presumed that (as with microcomputers) the systems will be available from 8h00 to 14h00 and occupied for 70 % of that period, one terminal will manage to serve eight pupils for 0,5 hour per each school day. Thus one mainframe system will provide half an hour's interactive exposure to 8 000 pupils per school day and the total number of mainframe systems necessary to reach the 637 000 pupils in Stds 6 and 7 will be 80. The total capital expense for the implementation of such a system will be approximately R47 million, which implies an amount of R74 a year for each pupil, while the annual running cost of the 80 systems will amount to approximately R3 million.

Mainframe systems can naturally also be used for administrative purposes and the initial installation of one terminal in each of the nearly 19 000 schools in the RSA will be about R11 million (negotiated rental per year). Besides the differences in actual costs, other pros and cons of microcomputer and mainframe systems also have to be considered when decisions on their possible implementation are taken.

8.5.4 The computer for computer assisted learning and instruction (CAL and CAI)

No estimated costs are suggested for the use of the computer for these purposes as there are too many factors which may have an affect, for example:

- Is the computer used for remedial or enrichment purposes (to reach only a percentage of the pupils)?
- Is it the aim of the CAL or CAI to present simulation of particular subject contents which cannot be achieved otherwise? (again only a limited number of pupils are involved).

- Will the computer be used to promote, for instance, the in-service training of Black Mathematics teachers? (the target group differs completely).

An additional factor is that very little, if any, useful educational courseware is available, and this will first have to be developed or adapted to South African conditions.

The correct procedure would therefore be to first identify the particular learning or educational needs as well as the target groups involved and then to analyse the costs for the use of CAL and CAI (after having decided that this is the most meaningful way in which to satisfy the particular need). Such a modus operandi will contribute to the meaningful implementation of the computer for CAL and CAI and is a task which SACCET can undertake.

8.6 RECOMMENDATIONS

8.6.1 Judging by the lack of reliable information on certain matters regarding both micro and mainframe computer and systems, it is suggested that in co-operation with a number of the suppliers of these systems a complete analysis is made of a particular region, with a view to investigating all the possible alternatives and cost factors.

8.6.2 In order to obtain an overall picture of the financial implications of the use of the computer in education, marginal factors such as publications, the use of the TV programmes for computer awareness and the inclusion of other apparatus in the teaching process should also be subjected to a cost analysis.

8.6.3 A cost analysis of the use of the computer in non-formal education should be conducted in collaboration with employers.

8.6.4 Since schools for special education were not included in present estimates, a cost analysis should also be made for these institutions.

8.6.5 Cost analysis on the use of the computer in CAL and CAI should be made in collaboration with those persons who will use the computer in education, and yet only after it has been determined what the special learning or educational needs are and who the target groups are.

CHAPTER 9

THE USE OF THE RADIO, TELEVISION AND OTHER INFORMATION SYSTEMS FOR THE PROMOTION OF INSTRUCTION AND LEARNING

9.1 INTRODUCTION

The original instruction to the Work Committee on the use of the Computer in Education and Training (WCET), extended beyond the use of the computer for promoting education and training in the RSA. The recommendation in the HSRC Report on Education which formed part of the foundation of the activities of WCET, states that it is essential to establish co-operation on the highest level between educational authorities, the Department of Posts and Telecommunications, the SABC and the private sector, since this will make an important contribution to education and educational technology. The purpose was particularly to investigate the possibilities of using radio, television and other mass media in education and training in South Africa.

Although WCET identified specific research projects in this field and related research has already been completed, it has become clear that this area is wide and demands extensive research and continual and close co-operation among the above-mentioned institutions. On the basis of this conclusion the Main Committee of the HSRC Educational Research Programme has established a new work committee with instructions to link specific learning needs identified in the RSA, to the utilization of particular educational media, and with a view to suggestions which could lead to the fulfilment of these needs. The work of WCET in the field of radio, television and information systems will therefore serve as a startingpoint for the new work committee on learning needs and media utilization.

9.2 RESEARCH UNDERTAKEN BY WCET

Regarding the use of radio, television, BELTEL and other information systems and their possible contributions towards education, the following research projects have been initiated:

1. Strategies for the integration of television and radio broadcasts in education and training.
2. The use of television and radio for formal education.
3. The use of television and radio for non-formal education.
4. The use of interactive video in education.
5. The possibility of using BELTEL and other similar systems in education.

As these research reports will serve as work documents for the Work Committee: Learning Needs and Media Utilization, this chapter refers only to the most important aspects of research, while a few recommendations that are important to the implementation of the computer in education and training are formulated.

9.3 TELEVISION AND RADIO AND FORMAL EDUCATION

Research undertaken overseas on the use of broadcasting media to promote formal education has been studied and conclusions drawn. Attention was given particularly to the control of projects and how other media could be integrated with broadcasting media. Similarities between the RSA and overseas countries received attention. The unique possibilities and limitations of television and radio are mentioned, and finally possible ways of implementing them in education, as well as the role of research in such implementation are investigated.

9.4 TELEVISION AND RADIO AND NON-FORMAL EDUCATION

The nature, advantages and disadvantages of the broadcasting media are discussed, while special attention is paid to differences between radio and television. The possible implementation of radio and television in non-formal education is constantly associated with particular identified needs.

9.5 STRATEGIES FOR THE INTEGRATION OF RADIO AND TELEVISION IN EDUCATION AND TRAINING

A situation analysis of the persons involved in the learning situation (pupil, teacher) and its implications for the integration of radio and television in education, is followed by an analysis of the aims of implementing these media. In addition, an analysis of learning opportunities, learning experience, contents and evaluation as components of the curriculum cycle is presented.

9.6 INTERACTIVE VIDEO IN EDUCATION

The implementation of interactive video in the didactic situation receives attention and the question is put if such implementation will be educationally justified. The development and evaluation of educational courseware, and the possible use of courseware that has been developed overseas, also receive attention.

9.7 THE UTILIZATION POSSIBILITIES OF BELTEL AND OTHER SIMILAR SYSTEMS FOR EDUCATION

The implementation of BELTEL in the RSA and similar information systems in overseas countries are recent developments which have not yet been researched with a view to their utilization possibilities in education. Consequently, few useful research results have been identified which could be analysed for the purpose of this study. These information systems, however, have obvious potential for education and this is illustrated with constructed examples.

9.8 RECOMMENDATIONS

Some recommendations which resulted from this research and which are relevant to the use of the computer in education, are as follows:

9.8.1 With the integration of the computer in education, more than one medium should, if possible, be used.

9.8.2 Computers and systems like BELTEL should be utilized as relay systems (for two-way communication) with television and radio for educational purposes.

9.8.3 The level of sophistication of interactive video necessitates -

- a thorough cost analysis of hardware and software development before decisions on implementation can be made, and
- empirical investigation on microscale in respect of remedial instruction for handicapped pupils.

9.8.4 New telecommunication services like videotex and teletext have opened many new possibilities for education and it is recommended that research in this field be undertaken and that consideration be given to the integration of videotex, teletext and the microcomputer, because -

- the integration of television, the microcomputer, videotex and teletext could become the most important development in education.
- practical problems such as high costs, lack of necessary infrastructure (telephone and television) and insufficient research, can hamper large-scale implementation in education.

CHAPTER 10

PRIORITIES IN RESPECT OF THE IMPLEMENTATION OF THE COMPUTER IN EDUCATION AND TRAINING

10.1 INTRODUCTION

Two matters should be clear from the preceding chapters. In the first place there are the rapidly charging circumstances in society which necessitate elementary knowledge for everyone in respect of the computer, the applications of the computer and its effect on society. Formal education must play its part in this regard, as evident from the fact that in several developed and developing countries action have been initiated to reach children and adults with computer literacy programmes. Although examples of successful computer assisted and managed learning and instruction programmes do exist, this type of instruction is not completely ready to take the important place in education as predicted since the sixties. These circumstances have no connection with the potential revolutionary effects that computer assisted and managed learning and instruction could have on education, but with practical problems, the two most important of which are the lack of suitable and comprehensive educational courseware and the cost of courseware and hardware.

The aim of this chapter is to summarise the most important recommendations of the preceding chapters and, in accordance with these, to design a development plan or policy in respect of the further implementation and use of the computer in education and training. In this regard, the recommendations which follow can be described as guidelines for the determination of a policy on the implementation of the computer in education and training.

10.2 RECOMMENDATIONS FOR THE INTRODUCTION AND USE OF THE COMPUTER IN EDUCATION AND TRAINING

10.2.1 A real learning need of our time

A fair measure of acquaintarce with the computer is a real learning need of our time and therefore it is recommended that the formal school system should become active in this field.

10.2.2 Central and other co-ordinating bodies

(1) It is recommended that a National Advisory Council for Computers in Education and Training in South Africa (NACCET) be established by the respective Ministers, with expert representatives from education, the National Training Board, the CSIR, the HSRC and other bodies concerned. The most important functions of NACCET will be to

- advise the Ministers concerned, on the policy for the introduction and use of the computer in education and training, and
- serve as controlling body for SACCET (see 2)

(2) A South African Centre for Computers in Education and Training (SACCET) must be established immediately, with limited personnel, financed by the Government and the private sector, and the following functions:

- co-ordination of the activities of regional centres (see 3)
- financing of the development work at regional centres through tenders and contracts
- collecting, processing and distributing information in respect of educational courseware and other relevant matters
- liaison with similar bodies in overseas countries
- publishing of documents to introduce and promote computers in education and trianing
- supporting the budgets of regional centres and
- giving advice on copyright

(3) Regional centres for computers in education and training should be established through the use of existing and developing resources at universities, education departments, technikons, colleges for education, teacher centres, and such institutions that already exist. Financial contributions from SACCET can serve as encouragement for establishing such centres.

The primary functions of the regional centres in collaboration with SACCET should be as follows:

- evaluation of educational courseware
- obtaining quality educational courseware and making it available
- distribution, storing and making information available on software
- giving advice to teachers, lecturers and other training personnel
- reviewing and evaluating specifications for microcomputer systems with feedback to SACCET
- reviewing and evaluating criteria for the evaluation of educational courseware with feedback to SACCET.

- keeping computerized registers on individuals involved with computers in education and training and on those developing programmes, and
- aiding the training of teachers (presenting courses, developing programmes)

10.2.3 Promoting computer awareness and computer literacy

(1) Computer awareness and literacy in the formal education sector must be promoted as soon as possible on the following levels:

Stds 2, 3, 4 : making pupils aware of the computer in an informal manner
Std 5 : a bridge year between informal awareness and computer literacy courses
Stds 6, 7 : formal computer literacy courses with or without the use of computer hardware
Stds 8, 9, 10 : computer activities on a voluntary basis and Computer Studies as an optional subject, while the inclusion of relevant information on computers in other subjects should be investigated

(2) The problem of the shortage of trained teachers to present these courses can be dealt with in the following ways:

- efficient, itinerant teachers should be used to present computer-literacy courses to pupils and also to train other teachers
- a special effort should be made to promote computer awareness amongst all members of the teaching profession by means of, inter alia, films and television programmes, articles in educational magazines and the general press, and also through short courses at suitable places
- lecturers at colleges for education and universities, and other teaching presonnel, should be trained to give instruction in this to future trainers
- the updating of computer literacy should be a standard part of every teachers' training, and for this purpose the Criteria for the Evaluation of South African Qualifications for Employment in Education should be amended
- an introduction to the computer should be initiated as a joint action of the SABC and the education authorities and should consist of television programmes which are also available on video cassettes and which can be supplemented by textbooks for teachers
- an immediate start should be made with a series of publications which

are meant for teachers of various subjects, dealing with themes such as:

"The role of the computer in teaching of Geography (Accountancy, Mathematics, Physics, Chemistry, Biology, etc.)"

10.2.4 The development of suitable educational courseware

(1) The development of suitable educational courseware, for which there is a great need in the RSA, should preferably be handled by teams of expert teachers and programmers (compare the development of item banks), and the Government and the private sector should support SACCET financially.

(2) The National Advisory Council for Computers in Education and Training must, in consultation with SACCET, determine priorities for the various fields for which educational courseware should be developed.

(3) Teachers and educationists should be encouraged (with compensation) to develop educational courseware, for example by means of tenders or contracts with SACCET.

(4) The co-ordination of the development of educational courseware and the elimination of duplication must be done by SACCET and the regional centres.

(5) The private sector should be encouraged by means of tax consessions or cash allotments or otherwise, to invest in the implementation of the computer in education and training in general, and in the development of courseware in particular.

10.2.5 Specifications for microcomputers and criteria for educational courseware

(1) It is recommended that all potential users of microcomputer systems should make a thorough study of the document on specifications for microcomputer systems compiled by WCET, and that any purchase of hardware should be preceded by a careful determination of needs.

(2) The RSA should not standardize in respect of one or more models of microcomputer systems, but compatibility regarding courseware must be obtained by ensuring that microprocessors of microcomputers which are submitted for tenders can accommodate more than one processing system, or that the same result can be achieved in another way.

(3) SACCET should have the specifications on microcomputer systems, and also the criteria for the development of courseware regularly revised.

10.2.6 The computer in non-formal education

(1) Organisations in the non-formal education sector should utilize existing computer facilities more effectively through the training of future trainers and by the development of training-management systems.

(2) The exchange of appropriate courseware and the mutual availability of computer facilities between non-formal and formal education, are strongly recommended.

(3) It is recommended that non-formal education be represented in NACCET and SACCET, as these two institutions will cover all fields (formal, non-formal and informal) of education and training.

10.2.7 Financing

In view of the preceding it is recommended further that the Government make an amount available to initiate implementation of the recommendations in this field. This would include subsidising schools and other educational institutions and also providing funds for the undertaking of development work and research. It is estimated that this would require an amount of about R10 million.

10.3 CONCLUSION

This report is the result of research undertaken during a period of one year and in which educationalists, computer scientists, educational technologists and other experts had the opportunity of making a contribution. The timely implementation of the recommendations in this report will not solve all the educational problems of the country, but will enrich education and training in the RSA, be advantageous to everyone in the country and will better prepare the student of the following decade for the world in which he must live and work.

APPENDIX A:

MAIN COMMITTEE FOR THE HSRC EDUCATION RESEARCH PROGRAMME

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MAIN COMMITTEE FOR THE HSRC EDUCATION RESEARCH PROGRAMME

The new Main Committee for the continuing HSRC Educational Research Programme is as follows:

Prof. J.P. de Lange (Chairman)	Principal, Rand Afrikaans University
Prof. M.J. Bondesio	Professor of Comparative Education and Education Management, University of Pretoria
Prof. A.N. Boyce	Rector, Johannesburg College of Education
Prof. A.J.J. Cupido	Professor of Education, University of the Western Cape
Dr S.W.H. Engelbrecht	Assistant-Director, Institute for Educational Research, HSRC
Dr J.G. Garbers	President, Human Sciences Research Council
Mr J.B. Haasbroek	Director, Institute for Educational Research, HSRC
Dr K.B. Hartshorne	Centre for Continuing Education, University of the Witwatersrand
Prof. H. Kroes	Professor of Applied Linguistics, Rand Afrikaans University
Dr R.H. Lee	Director, Planning and Development, Urban Foundation
Prof. S.R. Maharaj	Dean, Faculty of Education, University of Durban-Westville
Mr M.M. Morapeli	Head, Soweto Teacher Training College
Mr S.C.M. Naudé	Vice-Chairman, National Training Board
Prof. J. McG. Niven	Department of Education, University of Natal
Mr R.D. Nobin	Inspector of Education, Department of Internal Affairs (Indian Affairs)
Mr M.C. O'Dowd	Anglo American Corp. of SA Ltd.
Mr A. Pittendrigh	Director, Natal Technikon
Miss C.C. Regnart	Westerford High School
Mr J.F. Steyn	Chief Secretary, Transvaalse Onderwysvereniging and Secretary, Federal Council of Teachers' Associations

Prof. N.J. Swart	Vice-Principal, Potchefstroom University for Christian Higher Education
Mr L.M. Taunyane	President, Transvaal United African Teachers' Association
Mr J.D.V. Terblanche	Deputy-Director, Transvaal Education Department
Prof. R.E. van der Ross	Principal, University of the Western Cape
Prof. F. van der Stoep	Dean, Faculty of Education, University of Pretoria
Prof. P.J. van Zyl	Head, Bureau for Continuing Education, Rand Afrikaans University
Dr R.H. Venter	Head, Macro education policy, Department of National Education
Mr M.J. Wijnbeek	Director, Mabopane East Technikon

Appendix B

OUTLINE PROGRAMMES FOR COMPUTER AWARENESS AND COMPUTER LITERACY

APPENDIX B:

OUTLINE PROGRAMMES FOR COMPUTER AWARENESS AND COMPUTER LITERACY

1. Aims of a Computer Awareness/Literacy Programme

Generally speaking, the programme is aimed at dispelling the mystery associated with computers and to achieve the knowledge, skills and understanding set out in the definitions in paragraph 4.2, chapter 4.

The course has been designed using the following criteria as a basis:

- Stress is laid on understanding computer concepts rather than specific details
- Although "hands-on" experience is regarded as the ideal, the design makes provision for the fact that this will probably not be possible for all schools during the initial years
- The needs of the school-leaver have specially been borne in mind
- The needs of the employer have been taken note of, but only in as much as the Computer Literacy Programme will form part of vocational guidance

2. Design philosophy

Difficulties in obtaining hardware and suitable software will inevitably lead to problems in the presentation of the programme at school level. Thus the concept of a core with options has been proposed.

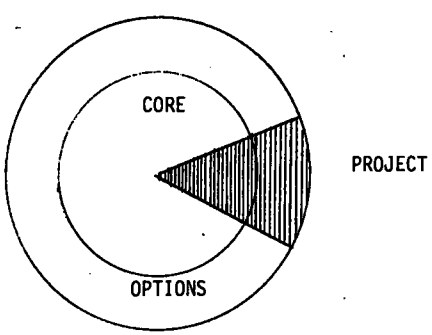

FIGURE 1

The core will contain the minimum that a pupil at a particular level should know. Optional material will be included more as an extension of the core

than as something new. It was agreed that one way in which the options could be included in the overall design would be to set each pupil or group of pupils a project which takes core material as a starting point and then expands upon it. Thus "hands-on" computer time could be included as an option for those schools having computers or terminals.

In the design of the course general computing principles have been stressed rather than specific areas. This allows for a greater flexibility in method and hardware used.

3. The scope of the programme

In the programme design the Committee has not drawn a definite line between Computer Literacy and Computer Awareness. Thus the topic introduced will start off at a relatively superficial level and increase in depth as the programme develops; there will thus be a natural flow from Computer Awareness into Computer Literacy, and from there into Computer Studies and Computer Club activities. The programme, and Computer Studies, could all run in parallel with a Computer Club which all schools must be encouraged to establish.

The seven topics selected cover the following areas (see Figure 2):

- Technophobia: Designed to reduce the fear that some people have of modern technology
- Systems : Hardware: An introduction to computers and micro-processors
  Software: Learning to use computers
- Applications: The following areas should be considered: Home, business, scientific, industrial, educational, etc.
- Implications: The implications for business, education and society
- Careers : Advice and information on the various careers in computing
- History : This could be tied to the first topic as fear is usually reduced if one knows where the object of one's fear originated
- The future : A discussion of the latest and possible future developments and applications

SCOPE OF THE COURSE

COMPUTER AWARENESS / COMPUTER LITERACY

Technophobia	Systems		Applications	Implications	Careers	History	The Future
Use Computers	Hardware	Software	Home:	Society in general	Management	Development of computers	Robotics
	Black-box level	User Software	Business: Computicket Autobank Building Society	Business and Industry	Hardware design	Historical aspects	Artificial Intelligence
		LOGO		Education	Sales	Important people and events	
		Systems design	Scientific: Monitoring Control		Software design		
					Education		
			Industrial: Robotics CAD		Etc.		
			Educational: Training devices CAI				

FIGURE 2

4. Teaching strategies

Because qualified teachers will, for the immediate future, be in short supply, it is suggested that in the primary school area, at least, the programme could be presented using the thematic approach. Thus the teacher would provide computer topics for theme-work and the pupils would do a large proportion of the work themselves. Such an approach would help to spread the load and a new subject would not have to be introduced. One teacher trained in the presenting of Computer Awareness/Literacy programmes, would co-ordinate the work and possibly handle the "hands-on" aspects.

The resumé of the programme presented in paragraph 8 will adopt this policy. The historical aspects may be handled by the History teacher; the Language teachers might introduce the writing of instructions, etc.

Rôle-play is suggested as a means of putting across the ideas involved in the operation of the computer. This could be a classroom activity.

The section on computer applications would best be handled by allowing pupils access to industrial concerns, businesses, schools making use of micro-computers, banks using money-changing machines, etc.

In secondary schools the presentation of the programme would best be left to specially trained teachers, preferably with some computing background.

5. Teaching materials and resources

The Committee was of the opinion that the programme would not succeed unless suitable resources were made available to the teachers. The various Education Departments should strongly consider the release of teachers in various subject areas to do research on computer topics falling in their sphere of interest. Each subject group would publish reports for distribution to schools for use in the Computer Awareness/Literacy programme.

It is recommended that the co-ordination of the various report writing groups should be carried out by the proposed SACCET. The SACCET should also investigate the acquisition of the following:

- Slide/tape sequences (A series of slide/tape sequences is available from the University of Wyoming, USA. The three sequences are:

  COMPUTERS Where are they found?
  COMPUTERS What do they look like? How do they work?
  COMPUTERS Anatomy of a microcomputer)

- Video presentations (BBC series; Mighty Micro, SATV, etc.)
- 16 mm Films (Obtainable from the larger computer vendors.)
- Computer software (Along the lines of the SRA Computer Literacy Course.)
- Publication of a newsletter containing updating and new information which would help the teacher.

6. Micro-processor controlled objects

It is recommended that, wherever possible, use could be made of any or all of the following objects:

. Graphics	:	"BIG-TRAK"
		"LOGO" Turtle
		"BBC BUGGY"
. Calculators	:	"Little Professor"
		"Speak 'n Spell"
		"Speak 'n Maths"
. Vending machines	:	tickets
. Automatic tellers		
. Computers in cars		
. Home appliances	:	Microwave ovens
		Washing-machines
. Point-of-sale terminals	:	Cash registers
		Bar-code readers
		Electronic balance/calculators

7. Visits

Visiting businesses and industries making use of computers and computer-controlled equipment should receive a high priority. The following is a list of possible places of interest:

- Car assembly plants utilising robot construction
- Computer cataloguing in libraries
- Manufacturing industries utilising computers, e.g., oil refineries
- South African Travel Services (Railways Computer System; SAA Booking System)
- "Computicket"
- INFO
- BELTEL and other Post Office facilities (e.g., mail-sorting, electronic telephone exchanges)
- Computer exhibitions

8. Outline programmes

The Committee has, as far as possible, endeavoured to break down the topics listed in paragraph 3 into subject areas and to give an indication of the content to be covered. It is reiterated that the intention is for most of the work to be done on a thematic or project basis. The themes/projects should then be discussed in the class/group. We emphasise the need to keep these themes within the child's frame of reference ("world-view").

8.1 Standard 4 (Grade 6)

History:

- Historical characters involved in the development of computers and data-processing, e.g., Pascal, Napier, Babbage, Jacquard, Hollerith, Van Neumann, Bolle, Turing, Lovelace. This could possibly be incorporated in the History section on "Heroes of the 20th Century".

Mathematics:

- Executing procedures for a familiar task. The procedure should involve decisions, e.g., long division algorithm
- Finding and correcting errors in a given procedure
- Modifying procedures to make them accomplish new tasks
- "Grid-location"
- "Journeys" - setting up a series of directions to accomplish a specific task, e.g., locating pirates' treasure on a treasure map

Science:

- Calculators (programmable, e.g, "Little Professor")
- Dispensing machines (money, tickets)
- Electronic washing-machines, etc.
- Life-cycles of animals

Languages:

- Writing out lists of instructions to achieve a particular task, e.g., using a telephone, frying an egg, etc.

Geography:

- As a tool in neighbourhood geography - "Computers in our neighbourhood" (e.g., visits to businesses in the neighbourhood using computers)

Book Education:

- Procedures involved in checking-in and checking-out library books
- Computerised book catalogues

Option:

- LOGO: - Familiarisation with
  - .. Loading LOGO
  - .. Keyboard
  - .. Turtle commands
  - Drawing elementary geometrical shapes
- High-level languages

  Those pupils wishing to learn BASIC, PASCAL or any other language should be actively encouraged.

8.2 Standard 5 (Grade 7)

History:

- Code-breaking during the war - leading to the need for computers
- Development of simple codes
- Gunnery during the war

Mathematics:

- Develop and de-bug procedures for familiar tasks, e.g., long multiplication
- "Journeys" - more complex than before
- Simulation - in money matters, e.g. "Lemonade"

Science:

- Classification of animals and plants, e.g., dichotomous keys
- Categorising items
- Food-chain simulations

General:

- The computer used in Mathematics, Science and other subjects for drill, practice, simulation, etc.

Option:

- LOGO - continuation of previous work extending to graphical work
- High-level language

8.3 Standards 6-7 (Grades 8-9)

Note

For this phase the topics have not been compartmentalised into different subject areas, as the intention is for a teacher trained in Computer Awareness/Literacy to handle the instruction.

Top-down design:

. The principle of breaking down a task into sub-tasks is to be stressed (this can be covered in many of the scientific/mathematical areas if necessary)

Procedures:

. General procedures for sorting and searching

Simulation:

. Areas of application are History, Science, Biology, Geography, Mathematics

Data-bases:

. Classification of books in a library and of plants and animals in Biology

Social implications:

. Possible disappearance of cash
. Privacy of information
. "Computer fraud"

Animation:

. Computer-generated cartoons
. Full-length movies (e.g., TRON)

Project approach:

. Design and execution of a project (e.g., the "Kennel project" in Fred learns about computers, MacDonald and Evans) with the following objectives:

- Pupils should become familiar with aspects of computing relating to small businesses
- They should be made aware of the possibilities and limitations of computers

- They should be made aware of alternative possibilities
- They should understand the concept of multi-tasking

Elementary computer architecture:

. Limited to the "black-box" level. (This could be done using rôle-play)

High-level languages:

. Extension to non-graphical areas emphasising the procedural design

9. Extension to the outline programmes

9.1 Standard 4 (Grade 6)

Pupils at this level should be exposed to computers, as users. They should be permitted to play educational games and use simulation where necessary.

9.2 Standards 8-10 (Grades 10-12)

The intention here is not to extend the Computer Awareness/Literacy programme to this phase as pupils will be concentrating on their major school subjects. However, the Committee expressed concern at the fact that syllabuses already teaching something about computers (Accountancy and Mathematics) were outdated and that these required immediate and constant revision, and that the teachers urgently needed support.

Where computers can be used to improve the teaching situation, teachers should not hesitate to use them. Examples can be drawn from many subjects, e.g.:

. simulation in Physics, Chemistry, Biology, Geography
. word processing
. company books in Accountancy

Computer Clubs should be established to cater for pupils who are interested in the "hands-on" aspects of computing. These clubs could also deal with aspects of electronics and the interfacing of computers with various scientific experiments.

The school guidance services must include computer-orientated careers in their guidance programmes.

10. Future development

The Committee recommends urgently that the contents of Computer Awareness/ Literacy programmes be continually updated and renewed when necessary. This means that the revision of the contents must be an ongoing task. Latest innovations must be introduced as soon as possible and not be left for some future revision as appears to be the case with many other school syllabuses. The task of disseminating new contents would best be handled by SACCET.

HSRC PUBLICATION LIST

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