COMPUTING IN SCHOOLS

CONFERENCE

`A Seminar on Computer Education´

ADELAIDE

JANUARY 28,29

1975

SEMINAR ON COMPUTER EDUCATION

ADELAIDE: January 28th - 29th, 1975

VENUE: Department of Further Education Training
and Development Centre

46 Greenhill Road,
WAYVILLE.

REPORT

This report is concerned with the use of computers
and computer education in Australian Secondary
Schools. It is the result of the discussions held
during the afore-mentioned seminar and attempts to
indicate what has occurred in the various States to
date, what use exists for computers and computer
education in the educational system and finally to
suggest lines of action for the future.

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NOTE: Section 3.0 has been adapted from the British
Computer Society report of 1974 and is included here
because the framework of that report mirrors many of
the thoughts expressed at the seminar and clearly
specifies many commonly misunderstood terms.

1.0 SEMINAR PARTICIPANTS

A.C.T.:   Mr. F. Grotowski (Education Officer - Special Programs Branch)

Mr. F. Jones (Subject Consultancy Co-ordinator)

N.S.W.:   Mr. J.D. Burge (Inspector of Schools)

QUEENSLAND: Mr. B. McBryde (Research Officer)

S.A.:   Dr. P.I. Tillett (A/Principal Planning Officer)

Mr. K.M. Hamann (Principal Education Officer)

Mr. I.F. Appleton (Manager, Angle Park Computer Centre)

Mr. P. Sandery (Science/Computing Consultant)

Mr. D. Shires (Senior Master, Angle Park Computer Centre)

Dr. R.S. Northcote (Head of Data Processing Department, Institute of Technology)

TASMANIA: Mr. S. Brownell (Senior Education Officer)

Mr. T. Read (Senior Education Officer)

VICTORIA: Mr. G. Willis (Inspector of Schools)

Prof. A. Wearing (University of Melbourne)

W.A.:   Dr. N. Hoffman (Superintendent of Mathematics)

2.0 PROGRAMME

TUESDAY:

9.15   Official Opening
(Mr. W. Forbes, D.S.O.,E.D.,B.A.,
    Dip.Ed.,Dip.T.(Sec.), M.A.C.E.,
    Director of Secondary Education)

9.30 - 11.00   INFORMATION SESSION

(Short statement from each state on

a. what is currently being done,
b. future thinking

on the use of the computer in education).

11.30 - 12.30   QUESTION TIME

(Based on questions submitted and arising from first session).

2.00 - 4.00   VISIT TO ANGLE PARK CENTRE

(+ discussion on following topics

1. Teaching computing at secondary level,
2. Choice of languages,
3. Interactive V's batch mode,
4. Teacher Education,
5. Computer applications - when and how,
6. Simulations and their role in the curriculum).

EVENING : DINNER

WEDNESDAY:

9.30 - 10.30   The Role of Computers in Secondary Schools
        or
Computing Science V's The Computer as a Resource

11.00 - 12.30   The Use of Computers as an Aid to Teachers e.g. item banking, CMI,...

2.00 - 3.00   The Practical Implications
    Teacher Education
    Curriculum Development and Materials
    Hardware and Software Needs
    Drawing on Overseas Resources
    Co-operative Ventures

3.30 - 4.30   Conclusions of the Conference
Needs for further action
Needs for further communication -
    A major conference?
    Communication channels?
    Continuing discussion - newsletters
    An Australian Advisory Committee on
      Computing.

3.0 THE USES OF COMPUTERS IN EDUCATION

Before discussing the educational use of computers, it is important that the terms used within this Report should be clarified. It is quite likely that not everyone will agree with the definitions which we give; this is unimportant provided that the meaning which we attach to each term is clear. This refers principally to the application of computers within the educational system and not to basic computer terminology.

There are three main areas in which computers or computing facilities can be used in the educational system.

1. EDUCATION ABOUT COMPUTERS

This will be discussed at two levels:

(a) COMPUTER APPRECIATION: By Computer Appreciation we mean that level of education about computers which, we maintain, should be available to ALL children, before they leave school and which is concerned largely with the social impact of computers, what they can and cannot do and how they can be used to benefit mankind. It is NOT concerned with DETAILS of computer hardware or software but largely with computer applications.

(b) COMPUTER STUDIES: That level of involvement with computing and the computer which needs understanding of hardware, software and applications, and requires some programming skill.

2. THE COMPUTER AS A RESOURCE IN TEACHING AND LEARNING

Within many disciplines it is often advantageous to be able to use a computer to carry out lengthy or tediously complex calculations, particularly where such calculations would draw attention away from the subject matter under discussion. An example of this would be a lengthy statistical analysis within, say, a social study. Equally, since one of the prime abilities of a computer is to store and organise vast quantities of data, it is possible to build up large banks of information on a very wide range of subjects.

In either of these uses of the computer, it is not necessary for the user to know anything of the technicalities of the hardware or software in use. Provided the basic rules of usage are adhered to, that is all that is required.

(a) <u>COMPUTER ASSISTED INSTRUCTION (CAI)</u>

We would define CAI as being an interactive
encounter between the computer and the student
where the instructional or teaching material
is held within the computer.

(b) <u>COMPUTER MANAGED LEARNING (CML)</u>

Whilst the keeping of student records is
obviously a part of the educational administration
function (which is considered next) C L has a
more specific meaning. To record on a computer
even, say, weekly test results would NOT be CML
since no element of learning is involved. CML
implies two things: (a) testing a student's
comprehension, skill in problem-solving or role
learning of facts and (b) AS A RESULT OF THAT TEST
directing each student AS AN INDIVIDUAL to the next
task required.

(c) <u>COMPUTER ASSISTED LEARNING (CAL)</u>

There are many areas in education, particularly at
senior level where it is either impractical or
dangerous for students to become involved in
practical experiments: certain chemical reactions
or the scattering of particules are examples. By
the creation of models within the computer it is
possible to demonstrate to a class the effect of
complex actions and reactions in many areas of
scientific and social study. Thus, by using
CAL techniques, it is possible to enrich the
learning experience by providing a situation in
which the student can not only demonstrate to
himself his ability to manipulate facts by using
them to solve problems, but he can also use the
interactive situation to experiment and find out
what would happen if .....'. Thus the learning
of concepts can be enhanced by learning by
experience, experiment and involvement.

3. <u>EDUCATIONAL ADMINISTRATION BY COMPUTER</u>

There are two areas to be considered here:

(a) <u>COMPUTER TIME-TABLING</u>

The ability of a computer to create an efficient
school time-table which allows a great flexibility
and takes into consideration the more and more
complex requirements of specialisation (particularly
in the area of senior school scheduling) will
obviously be of enormous benefit to the educational
system as a whole.

(b) STUDENT RECORDS

As well as putting the existing records about
students on to a large computer file, it will
obviously be possible to increase the size of
these files to include much other relevant
information about students. As a result of
Computer Managed Learning it will also be
possible to keep the results of students'
tests which may then, with caution, be used
as the basis of continuous assessment. The
social implications of extending the use of
the computer to cover all aspects of student
data, however, need to be considered very
carefully.

4. VARIOUS EDUCATIONAL COMPUTER SYSTEMS.

Teachers seeking the best type of computing facilities
for school use are confronted by a bewildering array
of conflicting advice. Each enthusiast proclaims
the merits of his own system, and the newcomer is
tempted to accept the views of the one who shouts
loudest or last. Even the most unpromising scheme
can be made to work through the enthusiasm and
ingenuity of the teacher in charge. Those inexperienced
in the use of computers, therefore, need a guide which
can be applied to their particular situation, and it is
hoped that teachers will be encouraged to ask pertinent
questions about the computing facilities which they
require.

3.1 EDUCATION ABOUT COMPUTERS

(a) INTRODUCTION - WHY TEACH ABOUT COMPUTERS?

The study of computers in the Secondary School can take place in various forms and at various levels. Some people attach different meanings to the words 'computing' and 'computers', affecting the emphasis which is put upon presenting the computer as a machine, as opposed to the tasks which the machine can accomplish. It is worthwhile considering why the subject should be taught at all; is there any real justification for adding to an already crowded school curriculum? This is a question to which there is no direct and simple answer, since it touches on the much broader philosophy of education for children in schools. The matter is, of course, further complicated by conflicting pressures from other sources for liberalisation of the curriculum, and the case for computer education must take its place among these. Computers, however much one may try to ignore their existence, are a fact of life and the effects which they have now and will have on our society in the future, are the concern of everyone. The case for teaching children about computers and their implications is a very powerful one, affecting the quality and direction of the society in which they are growing up.

(b) APPROACHES TO TEACHING ABOUT COMPUTERS

In general, three methods of approach present themselves as possible introductions to the subject of Computer Education. They should not be regarded as alternatives to each other; rather should they be a logical progression in the construction of ideas by which children may come to a fuller appreciation of the computer and the part it plays in their everyday lives.
These methods are:

(i) The study of the computer as an information processing machine, in which it is seen to affect the way in which we live through its applications and implications. In this type of course, the nature of information and aspects of its collection, preparation, storage and retrieval would be taught within the total context of an application or organisation studied, so that the computer is seen for what it is in that context i.e. a highly useful storer and processor of information.

(ii)   The study of the computer as a subject in
       its own right, with much more emphasis
       upon the nature and modus operandi of the
       machine.

(iii) The study of the computer and its use
       within the much larger framework of what
       may be called 'Technology' education. In
       this, other aspects of modern technology
       such as the development of travel, the
       implications of television, or the problems
       of the emerging world may also be taught,
       and the computer would, in this context,
       be seen to be one among many influences by
       which technology affects the way in which
       we live.

It would, of course, play a major part in the course
since it is often the use of the computer which has
made rapid technological progress possible, but the
total picture presented would be much broader than
simple 'computing'. One problem of this approach
is the lack of teachers with the necessary breadth
of knowledge to develop it, and in spite of the
research which is being carried out in a few places,
it seems likely that this shortage will persist
for some considerable time.

The Computer as an Information Processor

The statement: 'All children need to know something
in the nature and uses of computers as part of their
general education' is fully justifiable if one
considers the tremendous effect of computers on the
everyday social scene. It is impossible to make children
aware of the working of our society without making
reference to the uses of computers in Government and Local
Government, Industry and Commerce, Medicine and Finance,
to name but a few of the areas which rely heavily on
computers for their operation. It is no exaggeration to
say that, without computers, the fabric of our present
society would collapse in a very short time, and on these
grounds alone there is ample justification for
introducing a course which creates some awareness of the
place of the computer in our society. Such a course
may go under the title of "Computer Awareness" or
"Computer Appreciation" or any other similar title
but its main emphasis is, fairly obviously, based on the
Social Sciences rather than the physical ones.

In discussing this type of approach we should also
investigate the further possibility of establishing
a computer course based on information and information
processing as a course linking into other subjects
within the curriculum.

Computer Studies - the machine-oriented course

It is more difficult to justify courses which only consider the design and construction of computers. However, if such topics are part of a more broadly based course (such as the elements of information processing) then we may accept it as a valid component of a balanced curriculum.

For some children a Computer Studies course is a rewarding and entirely justifiable activity which could, and should, take its place among the other options in the school curriculum. There is, however, one rider which should be added. The teaching of programming is often a time-consuming task; in such a course one should beware of devoting too much attention to this function, to the detriment of other essential ingredients such as applications and implications. The teaching of programming in a vacuum, divorced from any practical application of the tool which is the focus of the exercise, too often leads to a sterility of outlook on the part of the learner, and a lost opportunity to put the machine in its proper place, as the subject, not the master of men.

ASPECTS OF THE SYLLABUS

It is not the purpose of this document to go into the enormous problem of what to include in, or what to omit from the syllabus. This must be decided by the teacher either after formulating the educational objectives of a proposed course or after choosing an examination syllabus. However, it is felt that teachers may need some guidelines, if only to distinguish what may make the study of computers and computing a unique subject in its own right.

(A)   COMPUTER APPRECIATION

At what age should children be made aware of computers? Before trying to answer this question it should first be realised that most children are fully aware of computers by the age of eight. They know, simply by watching television, that computers talk to people, and that they can dematerialise people and make them reappear many millions of miles away. They know too that every police box has one and if programmed correctly, can be used to propel one through space and time. At what age should we dispel these happly misconceptions of youth?

Certainly there is evidence that work about computers with Primary School children is successfully being carried out, and that the children are no less happy for knowing the real capabilities of a computer and how, in general, these functions are carried out. Given the right approach these children can simulate the components of a computer, and by so doing so

learn how the arithmetic works and that storage
is used. In view of this, it must be apparent
that 'Computer Appreciation' can be introduced
into the secondary school at any age, and, because
children may wish to follow up computer experience
at primary level, the earlier the better.

The problem of who should teach such a course
is more difficult. In the past, mainly for
historical reasons anything to do with computers
has been passed to the mathematics teacher for
action. Indeed mathematics teachers have done
much valuable pioneering work in Computer
Education. However, is it appropriate that he or
she should be involved in discussing such social
and moral issues as 'Computers and the Law'. 'The
Place of the Computer in Government?' There is, of
course, no reason at all why the mathematics teachers
should not be involved provided that he is not expected
to include it in the mathematics syllabus, but it seems
more appropriate that the Civics, General Studies,
Social Science or even Religious Education departments
should be prepared to accept their share of the work
involved in the moral and social issues raised in a
course of this kind. It is important to appreciate,
however, that non-mathematics teachers will require
considerable training in the ways in which computers
are used in our society. It may be necessary for them
to study computing techniques in commerce and industry.

What sort of things should be taught under the umbrella
of 'Computer Appreciation?' The emphasis should be on
the debunking of computer myths and on the real capability
of a computer, preferably with particular reference to
those things which affect the lives of the children and
those who are close to them. Some element of the
implications of the use of computers in our everyday
life should play an important part. This would indicate
an emphasis on computer applications and implications,
a constant reference to the information which it accepts
and processes rather than an over emphasis on the way
in which the machine performs its functions. It may be
that the intending teacher of 'Computer Appreciation'
can find much of merit in the list of topics supplied
under the next section on Computer Studies'. Many teachers
maintain that it is impossible for a child to comprehend
fully what a computer can and cannot do without being
given the opportunity to write a simple program, while others
suggest that it does not matter how a computer functions
as long as children appreciate its capabilities and the
effect that these capabilities have on the society in
which they will find themselves as adults. This must
depend upon the individual choice of the teacher.

(B) COMPUTER STUDIES

This content of the course obviously depends very much on the knowledge of the teacher, the facilities available to him in terms of information, hardware, and other resources, and the capabilities of the children being taught. We suggest that the following topics are fairly representative of those included in many of the current syllabuses in schools but do not present them as definitive statements of what should be taught.

     (i)   History of Computation
    (ii)   Computer Concepts
  (iii)   Computer Applications
   (iv)   Information Processing
    (v)   Programming
   (vi)   Logic & Problem Solving
 (vii)   Social Implications
(viii)   People and careers

We do not suggest that this is an exhaustive list of topics for inclusion in a syllabus, but we suggest that the classifications may be usefully considered as an indication of those around which a syllabus can be constructed.

3.2 THE COMPUTER AS A RESOURCE IN TEACHING AND LEARNING.

It is not always possible to draw a clear distinction
in the classroom between teaching and learning. However,
it is helpful when considering the computer as an
educational resource to identify applications in which it
is primarily operating in a didactic mode and those
applications in which it is enabling and encouraging pupils
to learn. It is also important to view the computers'
potential in terms of current trends in educational practice.

(a) Computer Assisted Instruction

Following the wave of enthusiasm for Programmed
Learning, a great deal of emphasis has been placed,
particularly in the United States, on computerised
programmed learning. This is often called Computer
Assisted Instruction (CAI) in this country though
the term is used to include other applications.
Instructional sequences may have quite a simple
structure and provide only 'drill and practice' in,
say, arithmetic and vocabulary. More sophisticated
structures may be adaptive and take account of a
pupil's progress by which he moves rapidly through
some well understood section but is provided with
remedial work should it appear that he is in
difficulty.

There are many questions associated with such
individualised teaching techniques. For example,
to what extent do children benefit from individual
rather than group learning? Is the natural
development of understanding implicit in such programmes
sufficiently well understood to enable difficulties
to be diagnosed?

A serious practical drawback to CAI is that of cost.
This occurs in two ways. First, a fairly large
computer installation is required and an adequate
number of terminals for pupils are expensive. The
second cost is that of preparing and validating
instructional materials. Although special computer
languages simplify this to some extent, the time
involved in constructing and developing teaching
material is very high.

(b) Computer Managed Learning

An alternative way to tackle the problem is by
the use of Computer Managed Learning (CML). The
main difference between CAI and CML is that in
CAI, the instructional material is stored in the
computer with which the student reacts directly,
whereas in CML more traditional learning materials
are used by the pupils and the computer is used to
test their attainment.

The main objective of CML is to allow a class
of pupils to work through tasks in small groups
or individually at an appropriate pace. At the
end of a task or section of work, the pupil's
progress is monitored by the computer as a result
of a direct test dialogue at a terminal or by
means of an external test, the results of which
are entered into the computer. The pupil's record
sorted in the computer enables the teacher to find
out at any time the pupil's progress and the record
may be used to assign to the pupil an appropriate
new task. Such a system is intended to relieve the
teacher of management problems and thus allows him
more time to assist individual pupils with learning
difficulties.

The advantage of this system is that it does not
require the storage of the teaching material within
a computer (always a costly business) and allows
great flexibility in the preparation of such
material. It means that group activity can also be
included where required and teachers feel that they
have a greater measure of control than they would
have when using a CAI system. From a purely
practical point of view a CML system has much to
recommend it in that it is possible for a teacher
to introduce it in stages within his own subject
and not be forced, as would be the case with a more
comprehensive CAI system, to wait for a very
considerable range of subject matter to have been
prepared.

(c) Computer Assisted Learning

In this final section we consider applications of the
computer in what may be purely heuristic learning
situations. In practice there will always be a
mixture of educational methods but it is possible
to exploit certain aspects of computer use in this
direction. The term Computer Assisted Learning
(CAL) is often used in this context since the objective
is that the computer will help in the LEARNING process
and is not confined to the didactic approach as in CAI.

Much recent curriculum development has emphasised
the importance of pupil participation and investigation.
The form of this development has naturally depended on
the subjects involved but, where appropriate, there
has been an increase in the proportion of laboratory
work, field study and gaming. Much of this pupil activity
is well catered for by non-computer materials and it is
pointless to use a computer when other, usually less
expensive, facilities are educationally adequate. It is
important that teachers should not be misled in this
respect by computer enthusiasts into 'finding something
for the computer to do'. Nevertheless, certain pupil
activities can be significantly enhanced by the use of
computer based materials; particularly those which

offer a greater freedom to pupils to ask the
question, "What will happen if......?" There are
a number of forms of computer application which
fulfil these requirements but perhaps the most
obvious and common one is that of simulation.
The range of possibilities is enormous. Certain
investigations are simply impossible for pupils
(or anyone else for that matter) to perform but at
the same time sufficient is know of the factors
involved to allow a model to be constructed,
a model that in no sense can be real but which can give
a feeling for "What would happen if....?" Models
of economy, urban planning and historical events fall
into this category as do those of population and
genetics. Given an adequate simulation of the
environment, the pupil is free to change parameters
and discover the effect of that change. In other
situations, the investigation may be impossible in
a school laboratory, take an excessive amount of time
or be too dangerous. These restrictions give rise to
simulations of planetary motion, ecological change
and certain chemical reactions, to mention just a few.
Using this approach, it is easy to see the computer
as adding a new dimension to learning, supplementing
and complementing existing laboratory and field work.

3.3 EDUCATIONAL ADMINISTRATION BY COMPUTER

(a) COMPUTER TIME-TABLING

It has been demonstrated that the computer can be used for school timetabling: it now requires to be shown that its use for this is worthwhile. For several years, head teachers and/or their time-tablers longed for a system whereby, once the initial allotments, or allocations, of teacher-to-class-to-subject-to-number-of-periods had been made by the head teacher, the whole of these allocations could rapidly be juggled into place to give a workable timetable. Rarely, if ever (especially in more recent years), has the timetabler been able to construct a timetable from the original allocations, or data, without some compromises, without some changes in the allocation of teachers to classes. It has been held by some that the computer should, indeed ought to, do better, whilst others have argued that even if possible, its use would remove the "personal factor".

In "hand" timetabling, despite compromises during construction, or even, to some extent, because of some of them, the last few "per cent" of the timetable could be infuriatingly difficult to fit: a complete (100%) solution was so elusive as to be virtually unattainable. This was partly caused by the inability of the human mind to contemplate or survey at once the whole of the timetable needs with the hand time-tabler working on a section of the timetable at any one time and largely unaware of the effects of what he was doing on the other parts yet to be fitted. Frequently, having achieved 90% or so, and realising the reasons why the rest would not fit the hand timetabler would have liked to begin again, only to be prevented from doing so by the urgency to produce a solution which would work.

Parallel with preparing the main timetable, but part of it is the difficult task which has to be faced each year in the problem of attempting to find the most efficient arrangement of the senior school teaching groups. The timetabler must devise a system of teaching blocks, having been given the pupils' subject choices (usually six) and the aims of minimum restriction of those choices and maximum economy in the use of the teaching force available. The arrangement he produces will usually satisfy the needs of a large proportion of the pupils but there is always a significant number of those who find themselves compelled either to amend their choice of subjects or take one subject less. Clearly it is important that the number of pupils so affected is kept to an absolute minimum. It is worrying for the timetabler, knowing that the permutations can be so numerous, to have to think that the arrangement of teaching blocks he has produced may very well not be the most efficient possible. It becomes unavoidable to conclude that the senior school often operate at less than maximum efficiency, that very many pupils are restricted in subject choice, and that an efficient, logical system of determining and time-tabling subject blocks could well minimise this unfortunate situation.

(b)   STUDENT RECORDS

In view of its ability to store, sort and make
available in many forms, vast files of information,
the computer is ideally suited to the keeping of
student records. These records may consist simply
of names and addresses, dates of birth and other
purely factual data but it must be remembered
that the amount of work entailed in creating these
files and keeping them up to date is very considerable
and that the amount of backing storage will need to
be large.

Where the records are seen to be "purely factual",
it seems likely that they could be computerised without
causing undue 'social' problems but where other more
'personal' records such as medical information or
any form of academic assessment are included in the files,
a great deal of thought needs to be given to student
reaction - as has already been seen in the United States.

As has been suggested, the computer may be used for
Computer Managed Learning when the result of students'
tests (either external or carried out at a terminal)
are used to direct the student to the next area of work.
The results of these tests could be entered into the
students' record files and could thus form at least the
basis of continuous assessment. If this were to happen,
however, it would obviously be vitally important to be
certain that the test results did, in fact, reflect the
students attainment and it may be that a great deal of
work will have to be done in the area of automatic testing
before this addition to students' records will be
acceptable. There are many educationalists who maintain
that multiple-choice testing and even the simplified
constructed-response required by automated marking
leave much to be desired.

3.4 VARIOUS EDUCATIONAL COMPUTER SYSTEMS

Types of Systems

Systems may be divided into six main types. It is unnecessary and even undesirable to be too specific about definitions and in some situations, more than one method can be combined.

(a) SLOW BATCH-PROCESSING

By post or courier van. The time-lag at least 24 hours, and may be up to one week.

(b) FAST BATCH-PROCESSING

By courier van or by pupils working in the computer centre. (i.e. sent and received within one working day or overnight).

(c) REMOTE JOB ENTRY

Although the computer is at a distance, a batch entry device, situated in the school, allows an almost instantaneous turn-round, but without interactive capabilities.

(d) OFF-LINE LINK TO A COMPUTER INSTALLATION

A terminal in the school is connected to a terminal in the computer centre. This allows paper tape entered at the out-station to generate an identical tape at the computer centre.

(e) ON-LINE LINK TO A COMPUTER INSTALLATION

A terminal in the school is connected directly to the computer.

(f) SMALL IN-HOUSE COMPUTER (MINI-COMPUTER)

The school has its own mini-computer normally comprising a minimum of a 4K word processor and a terminal (usually a teletype).

Different uses of Systems

The two approaches discussed in earlier sections are:-

(a) Teaching about computers

(b) The computer as a resource - including CAI, CML and CAL.

CAI has usually been implemented on a system
wholly dedicated to this purpose. CML requires
a system which will handle large quantities of
data; this means that fast batch-processing
is the most suitable system. In view of this CAI and CML
will not be further mentioned since their needs are so
specific. The software and hardware requirements
for CAL and for teaching students about computers
are, however, very similar.

Slow Batch-Processing

Pupils' programs which are prepared on coding forms,
punched or marked cards or paper tape, are processed at
a computer centre which may be any distance away from
the school. Depending on whether a courier van or the
postal service is used, the delay between submission of the
programs and the return of the results is at least
twenty-four hours and usually about four days. Except in
an urban area, the use of a courier service may be
more expensive than the Post, but which ever system is
adopted, a carefully prepared plan is necessary in
the school whereby programs are submitted for running in
the way that homework is handed in, marked and returned.
Regularity is the important factor.

Fast Batch-processing

It is natural to look for methods to speed up
batch-processing in order to reduce the time interval
to hours or even minutes. One way is to send students to
the computer centre to make use of 'cafeteria service',
by which programs are run as students file past in a
queue. This works well in higher education and it is
feasible in schools, provided that the administrative
problem of getting students to and from the centre is
not too great.

Remote job entry

Another method is to have a remote-job-entry terminal
at the school, which may be in the form of a mark-
sense card-reader and a fast printer. The main
disadvantage of this is the cost but the system gives
access to a powerful computer and may satisfy the
requirements of a cluster of schools. A way of
speeding the turn-round is to send the students'
cards to the centre by courier and to use a terminal
for de-bugging and running the programms.

All methods of batch-processing can deal with large
quantities of data so that the bottlenecks involved
in using a single terminal are avoided.

Off-line link to a computer installation

A different approach to speeding up batch processing
is to use an off-line terminal with a telephone
link to a large computer centre. The terminal is
normally a teleprinter with a facility for sending
and receiving by paper tape. Programs or data
are punched at the school, possibly by trained
punch staff, and transmitted in batches to the centre
where identical tapes are automatically created. After
processing, the computer output is transmitted back to
the teletype where paper tape at the computer centre
creates at the school error diagnostics or output
from successful programs.

On-line terminal to a computer

An on-line terminal is capable of sending and receiving
directly to and from the computer. The computer may be
commercially owned, belong to a Local Government Authority
or an educational institution or may be dedicated to provide
a service for schools. The distance of the terminal from
the computer may vary from a few miles up to a hundred
miles or more.

Costs may include hire or purchase of the teletype
and a modem, the use of a telephone line and of the
computer itself. They differ widely and range from the
high cost of a commercial terminal at a long distance
from the computer to the relatively low cost of a short
link to a dedicated educational machine. Considerable
savings can be made if it can be arranged that only local
charge telephone links are required.

Where only one terminal is available, there is likely
to be a bottle-neck. Ideally there would be more than
one terminal in each school, but the costs of such a
system are high. Although the computer itself and its
supporting service will certainly be expensive, the process
of sharing is likely to lower the cost to individual schools.

Small in-house computers (or mini-computers)

The reduced costs and improved performance of mini-
computers means that a dedicated computer is now
economically feasible for use in schools and Colleges of
Education. A mini-computer can be defined as a central
processor with at least 4K works of core store, capable
of using at least one high level language as well as an
assembler language.

An advantage of mini-computers is that, although they are
less flexible than larger machines, they are primarily
interactive, and this provides a great incentive,
particularly for pupils who are not naturally sympathetic
to computers. Secondly, they are very simple to operate,
which removes the awe for many beginners; also, they are
entirely under local control. They can be used as an
educational tool, particularly in Mathematics and Science.
Individual working is facilitated because direct communication
with the machine is possible and a classroom teacher can
use a mini-computer in a way similar to that for an on-line
terminal.

The final decision on the type of computer system
to be installed will depend on a number of factors,
one of which is likely to be the geographical
locations of the users. It is essential, therefore,
that a full study of the total computing requirements
of a school or region are made before a particular
solution is recommended.

4.0 REPORTS FROM AUSTRALIAN STATES ON COMPUTER EDUCATION

4.1 NEW SOUTH WALES

4.2 QUEENSLAND

4.3 SOUTH AUSTRALIA

4.4 TASMANIA

4.5 VICTORIA

4.6 WESTERN AUSTRALIA

4.7 AUSTRALIAN CAPITAL TERRITORY

These reports represent a synopsis of the statements made by the state delegates at the opening 'INFORMATION SESSION' on the first day of the Seminar.

4.1 NEW SOUTH WALES: COMPUTER EDUCATION IN SECONDARY SCHOOLS

It is considered desirable that secondary students
in N.S.W. undertake a school based course in computer
appreciation. The fundemental aim of such courses would
be to give all students a useful understanding of what
computers can and cannot do, how computers are controlled
and their impact on society with appropriate consideration
of advantages and dangers.

Since all pupils of all abilities should be involved,
courses need to be designed, in part, for junior secondary
as well as senior groups. Integration with the existing
syllabi of the majority of subjects is favoured over an
isolated approach.

To maintain interest it is essential to involve
pupils in practical work and this should be developed to
the stage of programming with decision making. The
most economical and widespread method of giving this
practical experience would seem to involve the use of a
programmable calculator. The use of such "micro-
computers", selected for language simplicity and ready
pupil access, has increased rapidly in N.S.W. It is
estimated that in excess of 70% of high schools now own
programmable calculators and many are organising courses
similar to that envisaged in the preceding paragraphs.
There are also some twenty micre-computers distributed
among the Area Offices of Education for circulation among
schools which are considering purchasing one or are unable
to finance such a purchase but wish to introduce a school
based computer appreciation course. The latter situation
is widespread among the central schools where the secondary
enrolments are generally between 50 and 200.

The Department of Education has recently purchased
four Wang 2200 "mini-computers" and arranged for the hire
of two C.S.A. terminals. These are to be placed in
schools where an initial course, using the micro-computer,
has been established. Schools adjacent to those selected
are to have access and each group of schools is to form
committees to investigate the teaching sequence, micro
to mini computer, and possible administrative and simulation
uses. Future policy will depend upon the recommendations
of these committees.

For some years schools have had access to the Basser
Computing Laboratory facilities at Sydney University. This
is a mark-sense card, batch processing and courier/postal
system with costs met by the Department of Education.
Individual schools have also developed links with
computing facilities through tertiary institutions and
commercial enterprises.

Future developments are difficult to anticipate. Should
the micro-mini computer teaching sequence prove successful
with the mini-computer being flexible in usefulness then
further development would be attempted. This would not
preclude the establishment of computer centres should such
still be educationally desirable and financially feasible.

4.2   THE USE OF COMPUTERS IN SECONDARY EDUCATION IN QUEENSLAND

A.   Courses

There are two prescribed courses which require students to make use of a computer, one of these is the semester unit "Computer Mathematics" which is one of the twelve semester units available in Mathematics in Grades 11 and 12. This unit was trialled in 1973-74. It is now available to all schools and may be used for matriculation purposes. The other is an option in advanced mathematics in Grades 9 and 10.

Some schools are experimenting with courses involving the use of computers as school subjects or as club activities (i.e. outside normal school hours). These courses do not count towards matriculation although school subjects are listed (with a rating) on student certificates. The objectives and content of school subjects are determined by the school.

B.   Hardware and Software

Some schools are processing student jobs on large commercial or University computers. Most jobs use "batch", but one school owns a terminal and at least one other school sends students to the Univeristy to use terminals. Since no specific language is required in the unit "Computer Mathematics" schools are experimenting with the language which are available. These include:

.   BASIC

.   MINITRAN

.   MIDITRAN

.   FORTRAN

.   MINIWAFT

.   A.P.L.

In addition, some schools are experimenting with the use of simulation packages. Some schools are using programmable calculators to teach the principles of programming. These are also being used for mechanical arithmetic computations in Mathematics and Physics.

C.   Administrative

A number of schools are using the computer for correcting multiple choice items. The program used gives teachers a number of output options. These include:

.   the frequency of choice of distractors

.   item difficulty

.   an item discrimination index

.   a ranking of students

.   rescaling scores to a given mean and standard deviation

A few schools are experimenting with the use of computers in keeping achievement records of students and producing student

reports. One school is attempting to produce information on student progress in a form which will be acceptable to the Board of Secondary School Studies as an alternative to its official form. One school experimented with a timetable produced by computer, but has not continued with the experiment.

D. Teacher Education.

One of the major problems in introducing courses in computing or computer awareness is the lack of availability of suitably trained teachers. Several of the institutions which are responsible for training teachers are responding to the need in this area. At one centre, vacation courses are conducted for interested teachers. At another, courses are being offered as electives to students. These courses offer an introduction to computers and computing and the social implications of the use of computers in society. One course for future Maths/Science teachers concentrates on the application of computers to these subjects through the FORTRAN language.

Some students with teacher scholarships at Universities are taking courses in computing as part of primary degree.

E. Future Developments

The administrators within the Department are aware that there is an urgent need to provide some overall sense of purpose and direction for developments in Computer applications in schools. In order to achieve this, a Computer Policy Advisory Committee on Education has been established. The committee has fourteen members. The terms of reference for the committee are:

(i) to identify the areas where application of computers in schools can assist education;

(ii) to collect and disseminate information on the ways in which computers are being used to assist in education elsewhere;

(iii) to make recommendations on the conduct and evaluation of trial projects in Queensland schools;

(iv) to recommend priorities for the possible applications of computers in education in the Department of Education;

(v) to advise on the curricula implication of computers.

The committee has now formed working groups in five areas. These are:

- Administration
- Classroom Instruction
- Computer Education
- Facility
- Teacher Education

The working parties will report their deliberations and make recommendations to the committee.

In the field of teacher education, one college has proposed that all first year students should take a course in computer literacy. This course will include the social and educational implications of the use of computers in society.

4.3 COMPUTER EDUCATION IN SOUTH AUSTRALIA

A. A BRIEF REVIEW OF THE HISTORY OF COMPUTING IN SOUTH AUSTRALIA.

1. The Period 1968-1971

In 1968 an I.B.M. 1620 computer was installed at the Angle Park Boys Technical High School (now called Angle Park Boys High School). This installation was brought about largely by the efforts of Mr. I. Appleton who was then a mathematics teacher at the school and who is now the manager of the current computing facilities at Angle Park. The 1620 was initially used mainly for processing of work brought by visiting classes. The programming languages used were, in the main, various subsets of FORTRAN. None of them proved entirely satisfactory.

A version of the Monash University porta-punch card input system (called Mikkitran here) was tried using a C.D.C. 3200 to try to over-come the problems of data preparation. This proved unsatisfactory.

2. The Period 1971-1972

In 1971 an 8K I.B.M. 1130 was installed at Angle Park to replace the 1620. (This was later updated by the addition of an additional 8K and more suitable peripheral devices.)

This enabled us to introduce new programming languages that have since proved more efficient and more suitable for student use. The main languages introduced at this time were A Programming Language (A P L.) and Beginners All Symbolic Instructional Code (BASIC). These are still the main languages used.

3. The Period 1972-1974

During this time, development of the features mentioned previously continued at a steady rate. Late in 1972, however, a new feature was introduced - the concept of package programs.

The number of classes visiting the centre increased markedly as did the number of student authored and package program jobs, as is indicated by the following data:

Schools using Angle Park facilities

	1971	1972	1973	1974
Govt. Metropolitan	37	44	47	48
" Country	19	35	52	50
Non Govt. Schools	5	14	19	15
Total	61	93	118	113

Class visits of schools

	1971	1972	1973
Govt. Metropolitan	57	83	101
" Country	4	7	14
Non Govt. Schools	8	13	21
Total	69	103	136

This period also saw the development of further student and teacher materials to service the course, a detailed set of computing options, a statement of aims, the production of "A Handbook of Computing Resources" (a Departmental publication to guide teachers in the use of the computing facilities available), an experiment with interactive computer terminals in schools etc. The growth in the use of package programs necessitated the rental of a second I.B.M. 1130 dedicated solely to the running of package programs.

B. METHODS USED TO INTRODUCE THE COMPUTER INTO THE MATHEMATICS CURRICULUM

1. Computer Clubs

Historically, it has usually fallen to the mathematics teachers to introduce computing into secondary schools. In South Australia this was initially done in most cases by forming computer clubs. These clubs met either during school hours in periods set aside for club activity, or during lunch breaks, after school etc.

Computer programming was the main activity of these clubs and most of the programming efforts were directed towards topics from the mathematics syllabus.

2. Elective Topics

Many teachers, after having had some introduction to computing themselves either as part of their own university education or through inservice conferences, sought to make more use of the computer in their classes. Unofficial programming courses were devised and used as elective (usually 'elected' by the teacher) or enrichment topics in mathematics in grades 9 to 12. In grades 11 and 12 these electives were usually presented to students studying for an internal certificate (i.e. non-Public Examinations Board classes).

During the last three years, some changes have
been made in this arrangement. Computing is now an
examinable elective topic in Grade 12 P.E.B. mathematics.
A section on computing is now part of the 'suggested'
Grade 9 mathematics core and computing electives have been
prepared for grades 9 to 12 (non-P.E.B.). These electives
take the form of modular programming courses in APL and
BASIC.

3. Package Programs

General Description

A package is a set of computer functions written in APL
(that are stored on disk) and a booklet of instructions
on how to use these functions. We have found APL to be
the most suitable language for us to use. The only
computer allied skill required of the user is that of
being able to prepare data for input to the computer. In
South Australia this involves being able to place a pencil
mark in the correct position on an OMR card.

The instructions include background information on the
topic of the package, what data is required, how to mark
cards with such data and a set of questions and exercises.

4. Areas of use of Package Programs.

(a) As a means of "painlessly" introducing people
(students and teachers) to computing.

(b) As a source of teaching aids. The output can be
used as wall charts, masters for overhead
projector transparencies etc.

(c) A set of packages can be used from the school
resource centre, much like other resource material.

(d) Packages may be used in the classroom either as a
whole class activity or as an activity for small
groups of students.

(e) The packages may supplement laboratory or field
studies activities.

C. CURRENT DEVELOPMENTS IN SOUTH AUSTRALIA

1. The Use of Electronic Calculators

Calculators of three types are finding increasing use
in South Australian secondary schools. These three types
are

(1) Relatively simple calculators that perform the
processes of +, -, x, ÷ with an eight figure display.
They are chiefly used as motivating agents with low
ability students and to improve number skills.

(2) "Scientific" calculators. These generally tend to have a number of functions such as $\sin$ $\cos$, tan, arc functions, log x, ln x, e^x, $\sqrt{x}$, 1/x with at least one memory directly under user control. They are used as "number crunchers" both in Maths and Science.

(3) Programmable calculators. These tend to have the same type of use as the two types already discussed (although it may be more complex), but in addition may be used to

    (a) teach a programming language

    (b) run simple simulation programs

    (c) illustrate a topic in mathematics, e.g. series summation, numerical integration etc.

A number of schools have purchased CANON 1614P programmable calculators and others are contemplating either purchase or lease. Future years should see a considerable variety of uses to which these machines will be put, supplementing the central computing facilities at Angle Park. Some packages have been developed for use on this type of calculator.

2. The Trial of a Travelling Mini-computer

A 4K Wang 2200 mini-computer has been purchased by the South Australian Education Department for use in four schools in a country region situated around the town of Clare in the lower-north of South Australia. The WANG has been transported between the schools by teachers' cars and has been used both for student programming and package programs of a type similar to those designed for use at Angle Park, but of a more inter-active nature. As the WANG provides hard-wired BASIC, this has been the language used.

The value of having a mini-computer available to a country region on the above basis has been evaluated and has indicated the desirability of extending this concept to other areas.

3. Developments of a Service Nature

We are currently looking at the possibility of computerised item banking and school time-tabling. So far, developments in this area are at the trial stage.

4. Upgrade of Hardware

To enable the Computing Centre to cope with the increasing workload of student jobs, it is proposed to upgrade the two I.B.M. 1130's in the near future. As our needs expand, it is planned that further improvements in provision of hardware will be made.

4.4 COMPUTING EDUCATION IN TASMANIA

A. COURSES

Hundreds of Tasmanian students in the age range of 12 to 18 are studying Computing or Data Processing. Computer Studies is a popular Higher School Certificate, Level 3 subject and is either studied over 2 years or taken in 1 year by the more competent students.

The Division I Course covers the history of computers; their application to science, commerce, medicine and education; the different vocations in the computing industry; the significant social implications and problems created by computers; how computers work and an introduction to computer programming.

In the 2nd year course, computer hardware and systems; machine coding and assembly language; software; numbers and the computer; data processing and operations research, are studied. 50% of the Computer Studies marks are gained by students doing their own project. Some previous projects have been on:-

Stock Exchange Data Analysis, Statistical Analysis on Deaths in the Hobart Area, Accounting System in a Dental Surgery and Computing Games.

A level 2 Higher School Certificate Course on Data Processing covers such topics as manual, mechanical, punched card and computer data processing; application of these methods for invoice preparation, sending of electricity bills etc.; elementary programming and the students also complete a project of their own.

At 4th year high school level a syllabus covering the fundamentals of a digital computer; other computer devices; history of computing devices and program language, is held in a number of schools.

Geilston Bay High School, an open-plan school, offers an introduction to computing to all 2nd year students, in which the principal aim is to stimulate interest in the computer and its uses. A basic course designed to lead up to Higher School Certificate level is run for interested 3rd year students.

B. HARDWARE

The principal centre for computer hardware is at Elizabeth Computer Centre, where the Central Processor - a 48K PDP-11/40 computer with 3 Disk Drives, is housed. There are also, 3 Console Teletypewriters, a Visual Display Unit, Fast Paper Tape Reader, an Optical Mark Sense Card Reader, a Line Printer and a 30 Character per Second Terminal.

Linked by dedicated lines to the Central Processor
are:-

<u>Rosny College</u> - 4K PDP-8/F; teletypewriter; Mark Sense
Card Reader; VDU; 30 CPU Terminal.
<u>Hobart Matriculation College</u> - 4K PDP-8/F; 30 CPU Terminal,
TTY; Mark Sense Card Reader.
<u>Cosgrove High School</u> - TTY: VDU: 30 CPU Terminal.
<u>Hobart Technical College</u> - 2 Teletypewriters.
<u>Taroona High School</u> - 1 Teletypewriter.
<u>Geilston Bay High School</u> - 1 Teletypewriter.
<u>Post Office Museum</u> - 1 Teletypewriter.
<u>Research Branch of Education Department</u> - 1 Teletypewriter.

Other hardware is at:-

<u>Launceston Matriculation College</u> - 20K PDP-11/20, 30 CPU
Terminal, TTY, Mark Sense
Card Reader.
Linked to Launceston Matriculation College is Alanvale
College with one Teletypewriter.
<u>Devonport Matriculation College</u> - 8K PDP-8/F, 2 Teletypewriters.
<u>Burnie Matriculation College</u> - 8K PDP-8/F, 2 Teletypewriters.

C. <u>MANAGEMENT</u>

The Elizabeth Computer Centre performs an advisory,
co-ordinatory and administratory role for Computer
Education. The Centre runs Batch Processing for
Devonport Matriculation College and for local high
schools, which do not have terminals. It also provides
an assortment of software and publishes bulletins, etc.

Decisions such as allocation of space on the magnetic
disks and installation of equipment are decided by either
a Computer Users' Committee or the Computer Policy
Committee. The Policy Committee includes representatives
of the schools and of the Education Department.

D. <u>ADMINISTRATIONAL USE OF THE COMPUTER</u>

The main use of the computer facilities for school
administration is by Elizabeth Matriculation College,
Rosny College, Hobart Matriculation College and
Geilston Bay High. These schools do their time-tabling
and record students' names, addresses, time-tables and
results on the computer. The Research Branch of the
Education Department also utilises the computer for
projects such as Teacher Supply Planning.

4.5 COMPUTERS AND COMPUTER STUDIES IN VICTORIAN SECONDARY
    SCHOOLS.

A. INTRODUCTION

The Education Department of Victoria has not yet
allocated funds for any form of computer education,
except for small financial support for pilot projects
involving single schools. This is due primarily
to the desire to maintain comparable facilities
throughout the State and partly due to the large
costs involved.

B. Computer facilities in Victoria at present are almost
entirely located in tertiary institutions: Monash
University and a number of C.A.E.'s provide batch
processing facilities, the costs of which are borne
by the students at schools choosing to use the
service. At present Monash has 200 secondary schools
registered as users of its minitran or miditran
service.

Monash Computer Centre staff have played a very big
part in developing computer software and in providing
facilities and I.S.E. for teachers and it has done so
with very little support from the Education Department.

Many schools have purchased pocket, desk and programmable
desk calculators using available school funds. Less than
25% of secondary schools would own a programmable
calculator and no curriculum materials or courses have
been specifically prepared for these machines.

Only 2 high schools and 2 technical schools and 4 private
schools own computer facilities. One High School is linked
by landline to a neighbouring school by A.P.O. line and is
planning to establish a small network. (This and other
projects have been funded by Schools Commission innovations
grants). Scotch College has received the largest amount
($20,000) for a project extending over four years and
including the development of curriculum materials.

C. Computer courses:

There are no set syllabuses below form 6 in Victorian
high schools and below form 5 in Technical schools. A
number of schools use neighbourhood C.A.E. facilities
or the Monash minitran service to teach programming
courses, generally to the better form 3 or 4 classes ...
this activity largely varies with the enthusiasm of the
individual teacher.

In 1976 a computer-based optional General Mathematics
course will be introduced in the form 6 HSC examinations.
It is not known how many schools will elect to teach this
course, but only those with local facilities could attempt

it successfully as the course involves the use of the computer throughout as a tool for studying mathematical ideas and other problems. (The General Mathematics course is taken by the students not intending to take maths/science courses, but rather social science or commerce courses at the tertiary level. A course was introduced here first because the more serious maths student will have opportunities for computer studies at the University). Discussion is currently underway on the introduction of either an Applied Maths option or a full computer course at HSC level. Such moves are certain to generate more interest in teaching computing at school and more pressure for computer facilities.

In the Technical schools, the suggested course at the form 4 level for Maths I and II each contain a computer studies unit which should be taught with the use of a computer, but which may in part be given using calculators. These units were introduced in 1969. A pilot course for form 5 Maths C (for less scientific oriented students) is being trialled in 1974/5 in 4 schools and will be introduced into the certificate examination courses in 1976. The unit is an elective in a core/elective course but may in fact become part of the core. Technical schools have been guided to form links with local Institutes of Technology so that computer studies can be taken.
BASIC is the language suggested (or prescribed in the case of Maths C) because of the ease with which it may be learnt and the support material available for teaching it.

D. **Future thinking**

Developments are directly linked to the availability of funds. So far funds have not been available for a state wide service and the outcome has been to leave tertiary institutions to provide services. The development of H.S.C. computer courses will create the need for more support for facilities and for teacher training.

Schemes for establishing different networks have been mooted by a variety of agencies, but no firm decision has been made e.g. State Colleges and schools, Public service network, Education Department network, etc.

The Technical Schools Division has set up an Information Processing Committee including DP and computer personnel from industry, staff members from I.O.T's, and members of the Education Department, to act as a working and reference group on computer matters. The availability of TAFE money has meant a development of facilities planned for middle-level college: plans are being drawn up for the establishment of a computer network to service each of the 30 Colleges within the next 3 triennia. Present and immediate plans call for the

initiation of 3 investigatory projects designed to provide information about the facilities and software required to service the multiple needs of these Colleges:

(1) Collingwood T.S. will have a computer where investigations relating to batch vs interactive processing will be carried out. (A second machine later will be used for RJE).

(2) A Technical region will be serviced by a mini-based system to test joint student administration use, with particular emphasis on the latter (8 or 9 schools will be involved).

(3) A Country region will be provided with a fixed (ECS type) computer with a second unit circulating among schools to provide interactive learning situations.

There are no immediate funds for secondary networks to service schools, but pilot projects based on mini-computers may be established using innovative funds if these are approved.

E. Teacher training

Nearly all new teachers in Victorian High Schools are four year trained with degree plus Dip.Ed. in the academic subjects. While a small number are graduates in information science, and many take a programming course in first year, teacher preparation is a problem and will probably remain so until better facilities for teaching computing become available.

4.6 A BRIEF SURVEY OF THE DEVELOPMENT OF COMPUTING IN SECONDARY SCHOOLS IN WESTERN AUSTRALIA, 1964-1974

A. **1964-1971**

Experimental classes using a hands-on approach with an I.B.M. 1620 were conducted at the Computing Centre of the University of Western Australia. Dialects of FORTRAN were taught to selected year eleven students on Saturday mornings. Vacation courses and Saturday morning courses were also conducted for teachers.

B. **1971**

(i) Preliminary investigations into the financial problems of bringing computing into each secondary school lead to the rejection of the following possibilities:

(a) A teletype in the school with telephone linkage to a remote computer.

(b) A mini-computer (costing approximately $10,000) in the school.

(c) A mini-computer (costing approximately $30,000) in the school and servicing the needs of that school and several nearby schools.

(ii) In November of 1971 a meeting of representatives of the Computing Centre of the University of Western Australia, the Independent Schools, and the Education Department of Western Australia decided on the introduction of a system of batch processing of student programs prepared on pre-punched cards:

(a) The prepunched cards would be identical to those used by Monash University in their Minitran system.

(b) The Computing Centre would sell the cards to schools.

(c) The Computing Centre would develop the software to process the fortran program. The fortran language would be FORTRAN IV and Minitran programs were to run in the system. The system was to be called Miniwaft (Minitran was thus to be a subset of Miniwaft). Miniwaft was to be essentially Fortran IV using pre-punched cards and good student diagnostics.

(d) The Education Department would prepare pseudo-machine software which would run, with suitable diagnostics, student pseudo-machine language programs prepared on the pre-punched cards.

(e)   The Education Department would prepare
a student text on Miniwaft.

(f)   The Education Department would run appropriate
inservice courses for teachers.

C.   1972

(i)   In February, the Miniwaft compiler was
released for school use.

(ii)   In March the processor for the pseudo-machine
language, now named Mal, was released for school
use.

(iii) In August the first edition of the Miniwaft text
book became available for schools.

(iv)   In September the Education Department agreed to
pay for the cost of processing programs prepared
by students and teachers in Government schools.

D.   1973

(i)   Inservice courses held for teachers.

(ii)   Enrichment courses for year ten students provided
opportunities for programming in the interactive
mode.

E.   1974

(i)   An increasing number of schools offered Miniwaft
to students.   More than 55,000 programs were
processed during the year.

(ii)   A version of Cobol, using pre-punched cards, was
developed.   Named Miniwac, it was used by two
classes of vocationally oriented year eleven girls.
These classes were experimental and were held
on Saturday mornings during second and third terms.

(iii) An appetite for computing in the interactive mode
started to develop one school, Applecross Senior
High School has its own PDP 8E, won for it by its
students in a national T.V. competition.   Several
other schools have made submissions to the Schools
Commission for funds for this activity.

(iv)   The Education Department has put forward a
submission to the Schools Commission for funds
to explore the relative effectiveness of several
of the various ways currently available for
extending computer facilities in secondary schools.
However Miniwaft is still seen as the financially
viable means of bringing introductory computer
experiences to the bulk of the secondary school
population.

4.7   COMPUTER EDUCATION IN A.C.T. SECONDARY SCHOOLS.

Developments to Date

During the last few years a small number of maths teachers have sought to promote some interest in the use of computers in secondary school mathematics courses. They have had little difficulty in obtaining assistance from people in the industry, and access to computer facilities in the A.C.T. Until recently however, their efforts have touched a very small proportion of secondary students and no teachers at all outside the study of mathematics.

In some schools, senior students studying 3rd level maths (N.S.W. Syllabus) have taken the computing option within that course of study.

A survey made in 1974 revealed that programmable calculators were used in 70% of the secondary schools in the A.C.T. By this time a growing number of people believed that the immense significance of the computer in our daily lives should be recognized in the schools, and that its potential as an aid to learning, teaching, and administration should be explored and exploited.

Two Seminars were held during the year to provide interested people with an opportunity to discuss the whole question of the place of computers in education - both primary and secondary.

Current Position

The views which were developed and generally supported during these seminars were recorded in a report of the proceedings which has influenced the pattern of events since then.

In summary form, the recommendations made were -

(1)   Computer awareness should be promoted among students through the use of the computer in subjects such as Maths, the Sciences, Economics, Geography, Commerce, History and others.

(2)   This awareness should be developed through modification of existing curricula and teaching methods rather than through the creation of a new subject although there is clearly a place for Computer Science.

(3)   These modifications might include

(a)   greater emphasis on a problem solving approach to learning

(b)   wide use of conceptual models so that solutions to problems can be tested and generalisations established

(c)   inclusion of simulation and games packages (see South Australia) among learning resources available to students

(d)   development of open ended computer
      programmes designed to permit the user
      considerable control over the type of data
      to be entered and the extent of its
      manipulation.

(e)   the use of computer based item banks for
      various forms of computer managed instruction.

(4) The computer should be exploited as an aid in the
     administrative work which must be done in the school.
     Student records should be rich enough to provide staff
     with information needed in designing programmes of
     study for students and should in turn be enhanced by
     continuous input from staff as they assess student
     progress.

Approximately one third of the secondary schools are
already making some use of simulation packages and/or instruct-
ion books in APL which have been devised for use in South
Australia. Two ACT schools are to participate in the trialling
of the C.T.S.S. item bank (biology) which is to be undertaken
by South Australia this year.

Future Thinking

Should funds be made available it is hoped to offer schools
the resources they will need to implement the recommendations
listed above should they wish to do so. In addition it is
hoped that consultant services will be available to teachers
who may wish to have existing software modified to suit their
needs, or who would like new courseware and supporting software
developed. It is thought to be vitally important that the
organization be responsive to the needs of teachers. Non Maths
teachers in particular will need encouragement and assistance
even though neither they nor their students will need to have
learned a programming language in order to make use of the
computer as a learning resource.

The introduction of secondary colleges (similar to those in
Tasmania) in 1976, will probably increase the demand for courses
in computer programming. The administration of the colleges will
also have greater need for computer support than the high schools
have had in the past.

Teacher Training

In the short term, training will concentrate upon teachers
already in the service. The In Service Training Section within
the Interim Schools Authority provides the resources and
organized seminars, workshops and some longer courses which
may run for a term. Opportunities of this kind are offered to
staff as the need arises.

Teachers are also given time off to attend lectures at the
C.C.A.E. or the A.N.U. where this work contributes to a
recognized upgrading of qualifications. Approximately twenty
places are offered each year for full time study on full pay.
Several teachers are currently studying some aspect of Computer
Science under this programme.

This year a consultant section was established and it is
planned to include at least one officer in this section who will
be able to assist teachers with any aspect of computer use with-
in the school.

5.0 AREAS OF GENERAL AGREEMENT

5.1 SOCIAL IMPLICATIONS

a. Any course in computer education should give the student an opportunity to critically analyse the effect on society (such as job redundancy, privacy invasion, credit card systems, home-computers,....)

b. Some immediate problems to solve involve,

who will teach the course?
who will train staff?
who will decide content?
will the course be integrated, and if so, with what?
will the course be a separate subject,....

c. Whilst technological change produces social change and in turn changes in schools, there has been little real impact on schools yet.

5.2 COMPUTER ASSISTED AND COMPUTER MANAGED INSTRUCTION

a. There seem to be no technological problems for organising a centralised computer-assisted instruction (CAI) network. While unit costs are rapidly decreasing, the preparation of courses is costly in terms of manpower (200 hours per 1 hour course or the total life of 1 teacher for a 200 hour course) and the rate of redundancy of material.

b. Much CAI is actually a "flash page turning" method or a disguise for page turning. These schemes fail quickly because they lack real substance.

c. CAI appears to have been good for administration, remedial work and minority groups. Its use has not been widely accepted in U.S.A. schools.

d. CAI experimentation should be left for tertiary institutions.

e. Computer Managed Instruction (CMI) appears to offer more advantages than CAI. It promotes self discipline, costs less per work unit, allows for individual progression and improves administration.

5.3 TEACHER EDUCATION

a. There is a need for courses in the teacher training institutions and for direct familiarisation with all aspects of computing.

b. A comprehensive range of inservice programmes should be introduced and/or maintained. This should include the use of programmable calculators and mini-computers.

5.4 CURRICULUM DEVELOPMENT

a. Computing should be used in the total curriculum as a tool.

b. There exists a real need for curriculum development guidelines in all subject areas.

c. A continuation of the development of packages and support material is needed. (For example, it was suggested that a good point of contact could be made with the State Directors of the Social Science project for further package use. In addition, the simulation procedure might well be expanded into the environmental science field).

5.5 CTSS AND ITEM BANKING

a. CTSS (Classroom Teacher Support System) has been used successfully in the U.S.A.

b. Such schemes could change the role of the teacher in the classroom.

c. Experimentation in this area should be supported e.g. the ACER Item Bank Project.

5.6 TERTIARY INSTITUTIONS AND COMPUTING

Many tertiary institutions have good computing facilities and co-operation between schools and these institutions should be encouraged.

5.7 COMPUTING FACILITIES FOR SCHOOLS

It was agreed that a system and centre such as Angle Park, which is solely devoted to computing in schools, is an excellent way of focussing attention and co-ordinating activities of schools, teachers and students.

6.0 <u>CONCLUSIONS AND RECOMMENDATIONS FOR ACTION</u>

6.1 There is a need for each state to develop its own policy on Computer Education.

6.2 There is a need for a Computer Education information service and the States should seek to co-operate with each other in this field.

To this end:-

(a) South Australia offered to act as the Secretary State for the gathering, collating, printing and distribution of information on all developments in Computer Education.

and

(b) Tasmania offered to seek the support of the Directors-General of Education for a follow up conference in Hobart in December, 1975, to further report on and discuss the progress made in topic areas outlined in this report.

6.3 The Director-General in each state should be approached and asked to give the matter of Computer Education in Schools a high priority at their next conference. To this end, members of this conference would be pleased to act as an advisory committee and prepare a report for tabling at their conference.

6.4 That in view of the unanimous agreement that Schools Commission monies for Innovations Programmes in the area of Computer Education were largely unco-ordinated and often not innovative, the Director-General in each state should be informed of our feelings, and asked to bring this matter to the attention of the Commission.