The Australian Educational Computer That Never Was

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Abstract

In Australia, as in most developed countries, computers are now commonly used in schools. In almost all cases, schools will use either a Windows PC or an Apple Macintosh. This was not the case in the early 1980s however when microcomputers first began to appear in schools. At that stage, before the appearance of either the PC or the Macintosh, there was a multitude of incompatible microcomputers seeking to enter the education market. This presented a significant problem to education authorities: how were all these types and makes of computer to be supported with professional development for teachers and with suitable educational software? There were just not the funds to support such a large range of computer systems, and the choices available to schools needed to be reduced. The first step to addressing this problem was for each State Education Department to recommend only those computers that it would support. Later, for both educational and industrial reasons, Australia investigated designing and building its own educational computer: all schools would then be encouraged to use just this machine, making support very much easier and more efficient. I had a direct involvement in much of this project. This article tells the story of why and how this happened, and how Australia's educational computer was designed but never actually built.

Keywords

Microcomputers, educational computers, schools, Australia, 1980s

Introduction

Today in the developed world there would be few, if any, schools that do not have a considerable number of classroom computers. Both Primary (Elementary) and Secondary Schools use these computers for a multitude of educational activities including Internet access, e-mail, word processing and for running many specific educational software programs. Thirty years ago, in the late 1970s and early 1980s, however, things were very different. The microcomputer had just recently come onto the scene at a price that schools could afford, and there was huge excitement in the education community at the prospect of how these machines might be used to dramatically improve education. At this time I was a secondary school science teacher at a school that had just obtained a 16k Apple II computer. In these early stages only small number of schools had a microcomputer and this was typically used to teach programming as there was little other software available. Another use was to introduce students to computers through 'Computer Awareness' courses.

Over the next few years the proliferation of available low cost microcomputers presented Australian education authorities with both a marvellous opportunity to improve school education, and the considerable problem of how to provide adequate support to schools. Something had to be done to focus the attention of schools on a smaller, more manageable range of hardware so that educational

authorities could support teachers with relevant professional development activities, and schools with technical expertise and appropriate software. This task was made more difficult by the considerable number of different microcomputer companies vying for a place in the school market.

The first step to solving this problem was for each state to draw up a list of recommended computers for use in its schools: only these computers would then be supported. In 1985 I took up the position of Educational Computer Systems Analyst at the State Computer Education Centre of Victoria (SCEC) and my job was to draw up specifications, call for expressions of interest to become a preferred supplier, evaluate tended computers and draw up this list. The next step, in the mid-1980s was for the Commonwealth Government, following the example of Canada, New Zealand, Sweden and the United Kingdom, to developing plans for its own Educational Computer for use in Australian schools. In my position as Educational Computer Systems Analyst at the State Computer Education Centre of Victoria I became a member of the Technical Requirements committee that drew up specifications for this computer. This article tells the story of why and how this educational computer was developed but was never actually built. It investigates the way that education authorities in Australia in the 1980s (at both the National and State levels) attempted to solve the problem of how best to support the development of computer education in schools.

Early Uses of Computers in Australian Schools

The Commonwealth of Australia is a federation of six states and two territories each having a considerable degree of independence. Constitutionally, education is the role of each individual state; the Commonwealth Government being limited to co-ordination, leadership and the funding of specific projects [1]. State Education Departments are directly responsible for Government (State) Schools but also have oversight of the Non-Government Schools (Catholic and Independent), then making up about 25% of the total. While concentrating on Australia-wide issues, this article also gives specific examples from the State of Victoria.

In the early 1970s a small number of minicomputers began to appear in Australian schools, typically resulting from the exposure of particular teachers to computing during their university courses. These early computers were used almost exclusively by mathematics departments for the teaching of algorithm design and programming [1] as at the time programming was seen as a worthwhile skill for school students to have and was one of the few things that schools could do with these minicomputers. Computer usage at this stage thus had very little overall impact on education.

A bigger early impact however, was the introduction in 1974 of the Monash Educational Computer System (MONECS) when a group at Monash University produced a mark-sense card system to teach secondary school children programming in FORTRAN or BASIC. MONECS ran on a DEC PDP-11 minicomputer and several universities in Melbourne operated this system for use by local schools, making it possible to provide students with some access to a computer. [1]. Another development at this time was experimentation with Control Data's PLATO System [2] of computer-assisted instruction for the training of apprentices. The system was, however, very expensive and did not prove useful in fulfilling its intended educational purposes [3]. It was not until the arrival of the Apple II in 1977 that significant growth was seen in the use of computers in Australian schools [1]. This was despite the fact that the Apple II then saved its software and data only on cassette tape – the floppy disk had not yet arrived, and

it used a television set as a monitor. At around $2,000 for a 16k Apple II (tape drive and TV set not supplied), this machine was affordable by schools.

The State of South Australia was the first to become seriously involved in Computer Education in the late 1960s when the Education Department set up of the Angle Park Computing Centre (APCC) in Adelaide to offer shared computing facilities to schools. Tasmania also had an early involvement with educational computing in the mid-1970s by setting up a state-wide timesharing network for educational purposes (TASNET) and the Elizabeth Computer Centre (ECC) in Hobart.

Recommended Computer Systems of State Educational Authorities

Today there are really only two types of computer systems in use is Australian schools: the Windows PC and the Apple Macintosh, but in the early 1980s a bewildering number of microcomputers had begun to appear. In 1982, for example, these included: Apple II, Tandy TRS-80, Commodore VIC-20, Acorn BBC, Microbee (this was an Australian designed and built CP/M computer), Atari 400/800, Cromenco, Osborne, Sinclair ZX80 and XZ81, Sinclair Spectrum, Sorcerer, Altos, Franklin ACE, DEC Rainbow and Hitachi Peach. (Although the IBM PC had been released by this time it did not appear in Australian schools until later.) By the end of 1984 the Commodore-64, SEGA, Amstrad, Spectravideo, Apricot, Micromation, Pulsar and Olivetti had appeared. (Although released at about this time the Apple Macintosh did not begin to gain a significant foothold in Australian schools until 1986.)

As the number of microcomputers on the market skyrocketed, education authorities started to see a potential infrastructure problem in servicing the schools that purchased these machines. One problem with using many of these early microcomputers in schools was that while you could show the students what a computer was, and even look at the electronics inside, you could not do much with them apart from programming and playing computer games as there was not much suitable software available for use in the school classroom. This led each State to recommend specific computer systems that it would support, both with purchase funds and with software development. Only these computers on their recommended lists would then be supported.

In the early 1980s the Commonwealth Government had not yet become involved, but each State adopted a policy to recommend specific computer hardware for use in its schools. The question then was: how would this be done? The process of evaluating computing systems and recommending that preferred supplier status be conferred on a particular company needed to be done centrally and required each State to set up some form of ‘centre of expertise’ to do so. In Victoria the Ministry of Education set up the State Computer Education Centre (SCEC) to draw specifications and to call for expressions of interest from computer companies to become a preferred supplier. The 1986 specifications document listed Ministry curriculum policy priorities for the use of computers in schools as including: activities to enhance the learning process, the influence of computers on society, information access and computing as a discipline [4]. It went on to specify the software applications envisaged for these recommended systems, along with the expected hardware capabilities needed to perform them. These applications included: word processing, database management, spreadsheets, graphics, expert systems, telecommunications and control technology. Suggested problem solving and courseware applications included: adventure games, logic games, Logo, simulations, information retrieval systems, computer controlled experiments, packages to assist in the collection and simple analysis of data, computer aided instruction and drill and practice (seen only as a limited application). Programming was

still seen as important, and the availability of a range of high level structured programming languages such as Pascal, Logo and Structured BASIC was required. Access to machine level languages was seen as desirable. As some school studies are designed to introduce students to skills necessary for use in the workplace, applications such as control of CNC machines, computer electronics, secretarial studies and accounting were also required. *S*tudents with learning or other disabilities were not forgotten and possible modifications to standard configurations included: special keyboards or switching devices, large character visual displays, synthesised voice output and special software applications for these students. The needs of other disadvantaged groups, and of girls, were not mentioned in the document [4].

Software Development

The state computer education centres were set up to support computer *systems* not just hardware, and software development thus constituted an important role. Programming was now not considered as the only possible use of a computer and educational software began to become more important. In the early stages software from organisations like the Minnesota Educational Computing Consortium was utilised, but education authorities saw a need to develop *Australian* educational software. Both APCC and ECC were involved in software development, the Angle Park operation in particular developing a large amount of software for BBC computers.

A significant early problem encountered was the diversity of available types of microcomputer, compounded by each Australian state controlling its own school education system, which made software support difficult to achieve. This also meant that co-operation between the states was not to be taken for granted. In the early 1980s the states of Tasmania, South Australia and Western Australia, however, began to cooperate in computer education by setting up the TASAWA consortium to facilitate sharing the development of software and curriculum materials. This was enabled by their common use of Acorn BBC computers. Many of the other states used primarily Apple II or Microbee computers.

The TASAWA states thus set the early direction of computer education in Australia as one that involved *guidance* from a centrally funded 'Computer Education Centre', occupied in writing software and related curriculum materials, running professional development activities and acting as a centre of expertise for schools. By the mid-1980s other states had all set up their own Computer Education units to provide support of this type [1]. Apart from drawing up the list of recommended computers, in Victoria SCEC's role was also to provide support for curriculum, software production and teacher professional development. It did not develop its own software but partnered with Prologic Inc. in this process.

Recommendations in all Australian states

The specification and recommendation process in all states was quite similar, and by the end of 1986 the recommended systems in each state were as follows:

Table 1: Recommended Computer Systems in each Australian State and Territory in 1986

State/Territory	Recommended Systems
New South Wales (Computer Education Unit)	Microbee, Apple //e, Apple //c, Apple Macintosh, BBC Model B, IBM JX, Tandy 1000, Sperry PC
Victoria (State Computer Education Centre)	Apple //e, Apple Macintosh, BBC Master 128, BBC Model B, Microbee, IBM JX, Pulsar 7000-9000
Queensland (Computer Policy Advisory Committee)	Apple //, BBC Model B, Microbee, Tandy TRS-80, Commodore C64
South Australia (Angle Park Computing Centre)	BBC Model B, Apple //e, Commodore C64, Amstrad 128
Western Australia (Schools Computing Branch)	BBC Model B, Microbee
Tasmania (Elizabeth Computer Centre)	BBC Model B, Apple //e, Olivetti M24
Australian Capital Territory (ACT Schools Authority)	Apple //e
Northern Territory (Mathematics and Computer Education Unit)	Apple //e, BBC Model B, Commodore C64

The Commonwealth Schools Commission National Advisory Committee for Computers in Schools

In a February 1983 report, the Commonwealth Schools Commission expressed the view that "*the development of a satisfactory program of computer education in Australian schools was of fundamental importance to Australia's future*" and *"... that the Commonwealth should commit itself to the development of a national computer education (or schools computing) program for all Australian schools, commencing in 1984.*" [5 :1]. Following this, in April 1983 the Minister for Education and Youth Affairs, announced that the Government would fund the Commonwealth Schools Commission to set up a National Advisory Committee for Computers in Schools (NACCS) to provide advice on the implementation of the $18 million National Computers in Schools Program that was going to approach computer education in terms of a broad educational program, rather than simply as an exercise in hardware provision.

Membership of NACCS included representatives from the Education Departments of each Australian State and Territory (Queensland, New South Wales, Victoria, Tasmania, South Australia, Western Australia, Australian Capital Territory and Northern Territory), parent organisations, teacher unions, equal opportunity organisations, Catholic Schools, Independent Schools, State School organisations, Universities, the Commonwealth Schools Commission and the Commonwealth Department of Science and Technology. In its report *Teaching Learning and Computers in Schools*, presented in October 1983, NACCS made comprehensive recommendations covering curriculum development, professional development, support services, software, hardware and organisation, most of which the Schools Commission endorsed and the Government accepted. In the period 1984-86, the Commonwealth Government provided funds to support the program which it stated should not be limited to the provision of hardware and that: "*The primary responsibility for deciding on the allocation of resources*

among the program components should rest with the states, systems or schools as appropriate" [5] rather than with the Commonwealth through the establishment of a co-ordination mechanism at regional, state and national levels. Attention was also given to community involvement and to access, equality and equity including the needs of girls and students from disadvantaged groups.

Before the commencement of the Commonwealth program, financial resources for computer education had been small, and the input of money and directions from NACCS had a profound effect on the entire Computer Education Program. This effect was felt mainly in the provision of money for computer hardware and professional development programs, but also in the provision of a coherent national computer education policy [1].

The report noted that: "*The widespread availability of a variety of hardware has opened up opportunities for school use of computing that have not previously existed, but at the same time has caused a number of problems*" [5 :43]. It went on to describe these problems as the diversity of incompatible hardware and software leading to subsequent difficulties in the provision of appropriate professional development for teachers and for support services. Its proposed solution to this problem was that: *"... it is necessary to adopt a short-term policy aimed at encouraging a limiting of proliferation of purchase of computer types, whilst addressing the issues of curriculum and professional development*" [5 :43]. The proposal was to recommend that Commonwealth funds be provided for only a small number of computer systems: those on the 'recommended list' drawn up by any each state [6]. Only these would then be supported by the program. Its longer term proposal was for a development project to design and build an 'Australian Educational Computer'. This presented both an educational need and a business opportunity and reflected several other countries that had already decided to design and build their own school computers. In each case they saw a solution to this educational need in writing their own educational software for these computers, and the business opportunity in having the new computers designed and built locally [7].

Computers in Other Countries Specifically Designed for School Use

As Canada, New Zealand, Sweden and the UK had all designed and produced computers specifically for educational use it was thought that a similar approach would be worthwhile in Australia. In the UK and in New Zealand, the developments were essentially by private industry, and produced the Acorn BBC microcomputer and the Poly, respectively. In Sweden it was driven by the government and the major goal was to assist local industry. The process in Canada was rather like that proposed for Australia and resulted in the development and production of the ICON computer [7].

The Acorn BBC Computer (UK)

Acorn Computers was a British computer company established in Cambridge in 1978. Its first computer, the Acorn Atom, became available in 1979 and had the great advantage over to its competitors of high resolution graphics capabilities. This machine sold in kit or ready-assembled versions and was produced primarily for the education market. It was the ancestor of the BBC computer [8].

In the early 1980s the British Broadcasting Corporation (BBC) started work on the *BBC Computer Literacy Project* [9] in response to public reaction to a BBC TV program called *The Mighty Micro* which predicted the coming computer revolution. The BBC wanted to base this project around a microcomputer that was capable of doing the things it wanted to demonstrate in its forthcoming series: *The Computer Programme*. These included: programming, graphics, sound and music, teletext, communications,

controlling external hardware and artificial intelligence [9]. It had noted that with the availability of a growing number of powerful and increasingly less expensive microcomputers on the market it would soon be feasible for many people to purchase their own computer at an affordable price [8]. After BBC discussions with several British computer companies, Acorn won the contract to provide this computer [7] and the Acorn Proton (successor of the Atom) became the Acorn BBC Model A which was based on a 6502 processor and had 16k bytes of RAM. The Acorn BBC Model B followed in 1982, also based on the 6502 but with 32k bytes of RAM and extra connectivity [8]. Acorn also produced a less expensive version called the Acorn Electron and later BBC models followed including the BBC Model B+ and the BBC Master.

The BBC Model B quickly became very popular in the UK and was widely used in its schools, but didn't have much success in other markets as even though it did have great features it was seen as too expensive. A brief attempt was made to market the machine in the United States but ultimately this failed. Australian schools, however, made very good use of the BBC Model B which was marketed at a similar price to the Apple //e, particularly in several States (as discussed earlier).

The Poly (New Zealand)

The Poly was designed in 1980 at Wellington Polytechnic (hence its name) in New Zealand as a teaching machine intended for use in computer assisted learning [10, 11] and to fill a niche market in education. Poly-1 was a networkable machine based on the Motorola 6809 processor and came with 64k bytes of RAM and a video card to display graphics on a colour TV monitor [10]. Due to considerable interest in the Poly by the New Zealand Minister of Education, the Government's Development Finance Corporation set up a partnership with Progeni Computers [12] to form Polycorp which then took over final design and production of the Poly which became available in 1981 and continued until 1989.

Course materials were produced and refined by a team of New Zealand teachers for a variety of applications under direction from the Education Department and Polycorp and the Design School at Wellington Polytechnic worked on performance issues and design criteria. The Poly was probably the first microcomputer specifically designed for educational use. Smythe [11] and Harpham [12] claim that it was eighteen months ahead of the Acorn BBC computer which became so important in the education sectors of the UK and Australia. Poly was presented as "*a reliable, robust, networked teacher and student-friendly closed system specifically designed to deliver computer assisted learning across curricula as well as computer awareness, computer studies and support for school administration*" [11]. Polycorp had worked towards getting assistance from the New Zealand government to purchase 1,000 Polys per year for five years but this fell through due to a change of government priorities. This was unfortunate as with government support Poly could probably have become more significant on the world scene. Although several thousand Polys were sold, when Apple gave each New Zealand school a free Apple II computer its market evaporated. The main problem with Poly was its cost of around NZ$8,000 which was considerably higher than competitors. As a price comparison, at that time an Apple II cost NZ$1,200, BBC Micro NZ$1,595, an Atari 800 cost NZ$2,695 and a Commodore VIC20 NZ$899 [13]. Ironically the major sales of the Poly were not in education. One important sale was to the Chinese Government which needed a separate graphics processor for Chinese characters and another was to the Australian Army.

The Compis (Sweden)

In 1981 the Swedish government began a program for a Swedish School Computer [14] with two goals: to give industry in Sweden an opportunity in the development of new technology, and to provide

Swedish schools with modern, inexpensive computers. This project was not seen by all Swedish politicians as being appropriate but proceeded nevertheless and the Board of Education made funds available to the Board for Technical Development to proceed in drafting specifications. These were completed in 1982, tenders call for its manufacture, and a Swedish computer company appointed. The development process encountered a number of technical problems, particularly related to its microprocessor, operating system and cost, but was completed in 1984. Although over 25,000 Compis computers were put into schools it was never a market success, and production ceased in 1988 [14].

The ICON (Canada)

The numbers of computers in Canadian schools began to increase substantially in the late 1970s and it was clear that some sort of orderly development was needed. In Ontario in 1981 the Minister of Education, speaking at a Business and Industry Liaison Committee seminar remarked that: "*The Educational and training systems and the industrial sector must not see themselves as separate entities, but as partners in Ontario's future …"* [15]. A little later she announced a need for computer literacy for all students and set up an Advisory Committee on Computers in Education [16] that would, amongst other things, draw up plans for an educational computer to become the standard in Ontario schools [16]. A series of meetings with local industry groups then considered the design of a government-approved educational computer. These meetings resulted in the government letting a contract to the Canadian Advanced Technology Association to produce functional specifications [16]. This initiative had a dual purpose: to create a microcomputer explicitly designed for the Canadian educational environment, and also to stimulate growth in the Ontario and Canadian electronics industries [17].

In 1983 the Ontario Ministry of Education released its set of functional requirements for an educational computer that set high standards and, at the time, were probably beyond the state of the art for school computers. They included high resolution colour graphics and sound synthesis capabilities, 64k of RAM and a local area network form of architecture [16]. The new computer was to be a combined unit, with the screen, processor and keyboard all in a single case. It was also to include a trackball.

Soon the Canadian Educational Microprocessor Corporation, which was later to join with Burroughs, developed a prototype ICON computer to meet the Ministry's specifications. (Later, when Burroughs and Sperry merged to form Unisys the computer came to be known as the Unisys ICON.) The ICON system was designed around the 80186 microprocessor and based on a workstation/file server architecture with no local storage on the workstations. The operating system, QNX, was Unix-like. The Ontario Ministry of Education sponsored the production of educational software and agreed to subsidise 75% of the cost to schools of these machines so reducing its cost to about $700. The first machines began appearing in Ontario schools in 1984.

One significant problem with the ICON though was the lack of suitable educational software. While there was a large amount of available software for the Apple II and the Commodore PET, the ICON was compatible with neither and so needed its own custom written software. The original idea had been to let teachers create and share their own software applications, but this concept was quickly rejected as unsuitable. In the short term most ICONs were used to teach programming and a number of programming languages quickly became available. In the longer term when MS-DOS had become common it became possible to run an emulation that allowed a variety of this software to run on the ICON. The question then arose: if all that the ICON was doing was to run MS-DOS software then why not

just use one of the MS-DOS computer that were available at a much lower price? The Ministry ceased all support for the ICON in 1994. Analysing this period, educational researcher Mangan remarks:

> *"Bette Stephenson favoured top-down decision making and as a result got trapped by her tunnel vision. Her ICON computer fiasco drained millions from the provincial treasury and created a while elephant scorned by Boards and shunned by teachers."* [18 :275]

Building the Australian Educational Computer (AEC)

The National Advisory Committee for Computers in Schools had noted these overseas developments and considered the advantages of Australia having its own educational computer. There were two principle reasons for wanting to develop an educational computer in Australia:

1. So that Australian school children would have access to suitable, well designed technology, and
2. To provide a development and manufacturing opportunity for Australian industry.

It was clear that good educational software was needed and that this would have to be developed. While computers like the Apple II and Commodore had a significant amount of software that could be considered for use in schools there was a cultural issue as what software there was often had an American outlook. One example of this was the Apple II simulation game 'Lemonade', based on making and selling lemonade from a street stall. While this had some merit in terms of teaching students about mathematics and one aspect of doing business, lemonade stands are almost unknown in Australia. Also, while Americans may 'root' for a sporting team this word has quite another meaning in Australia and the word 'barrack' is used instead. Another slightly later example is the 'Trash Can' on the Apple Macintosh. In Australia we put our waste in a 'Rubbish Bin' [3].

NACCS was clear that in the longer term there was a need for Australia to develop an educational computer system of its own and its report argues that this could best be achieved by the Commonwealth Schools Commission and the Department of Science and Technology co-ordinating and funding research and development of educational requirement specifications as follows:

> *"To meet the long term requirements of schools computing activities in Australia, it is considered essential to embark on a national research and development project that will ensure that appropriate computer systems are available. This ... will involve:*
>
> - *the research and preparation of a set of Educational User Requirements. This is a statement of agreed educational needs to be met by the computer systems;*
> - *the development of a set of Educational Technical Requirements based on the Educational User Requirements. This is a statement of the function, main features and performance required by the user for a system which can reasonably be expected to be available to satisfy the requirements in the planned time period;*
> - *a System Concept Study which involves research and analysis of all practical alternatives to satisfy the Educational Technical Requirements. It includes consideration of development and production options and use of existing items either as they are or in modified form;*
> - *if no existing items satisfy the Educational Technical Requirements, then a development proposal leading to the design and development of appropriate systems is required."* [5 : 44]

The idea was that the Commonwealth Schools Commission be responsible for the production of an **Educational User Requirement** and an **Educational Technical Requirement**, while the Department of

Science and Technology take charge of the **Systems Concept Study**. If no existing computers were to satisfy the Educational Technical Requirements then the Department of Science and Technology would draw up an **Australian Design Specifications** and arrange for the manufacture of pilot and prototype systems [5].

Determining the Educational User Requirements

An Educational User Requirement Working Party composed of educators was appointed by NACCS early in 1985 and set to work to consider and articulate the educational assumptions underlying learning situations in Australian primary and secondary schools. In its interim report it stated that:

> *"The emphasis in efforts to integrate information technology in the curriculum should be placed on developing inquiry and problem-solving ... In this way information technology will not be seen as applicable exclusively to any one curriculum area, but as a tool for establishing meaning and communication, for classifying and ordering data and experiences and for opening up new approaches to learning"* [5 :25]

The report considered developmental characteristics of school children and learning situations in which computer use was considered appropriate, then attempted to draw up user requirements from each of these. The report gave examples of the learning activities in schools as including: use of computers as a tool in existing subject areas and in Special Education, studying computer science, co-operative large group and project group use. An example is the user requirement for project group use:

> *"As well as flexibility of use, a major user requirement of this task-oriented learning environment is speed. ... A further user requirement is the capacity of the software to allow quick and easy interchange of information between applications …"* [19 :13]

In its summary the report highlighted several critical user requirement issues to be taken into consideration by the Educational Technical Requirement working party:

- The needs of various different users.
- The nature of the physical, school and classroom environment.
- The variety of applications.
- A consideration of modularity, expandability, entry cost, user interface, robustness, reliability, portability, compatibility and adoption of current recognised standards. [20]

The Educational Technical Requirements

The Education Technical Requirement Working Party was set up in 1985 as an 'expert' committee with membership reflecting the range of relevant groups and interests from around Australia. (As previously mentioned, I was a member of this committee.) Its report to NACCS was published in March 1986 and contained two main sections [20]:

- The Technical Requirement which gave detailed coverage to: user interface, input devices, output devices, processing resources, networks, telecommunications and system requirements.
- A section dealing with possible implementations of these requirements to satisfy at least three types of use:
    - Personal,
    - Classroom,
    - School-Wide.

These could be catered for by a family of compatible systems having a common user interface, and that at some stage in the future the way should be left open to connect these systems to computing facilities at the district, regional, state or national levels.

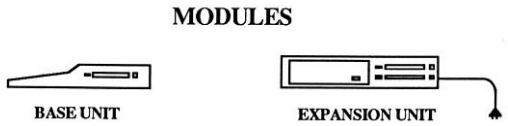

Figure 1: Base Unit and Expansion Unit (- figure adapted from [20])

Personal System

A Personal System should be transportable and battery powered so that it could be used by students in a classroom, in the school grounds, at home, on the bus when travelling, or anywhere else required. It was considered likely that use by an individual student for word processing would be its major application, but that it would also be used to perform applications such as use of spreadsheets, educational simulations and manipulation of small databases. This system would need to be totally upward compatible with classroom and school systems. While it was considered desirable that these systems be portable the cost of LCD screens at this time was prohibitive and so a transportable option using a normal CRT screen was also offered [20].

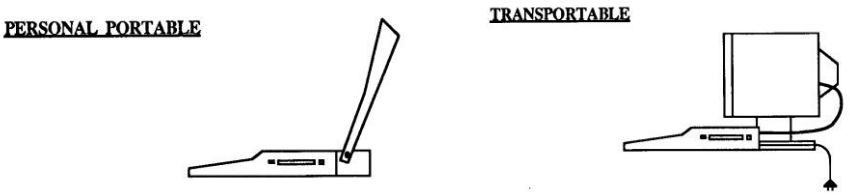

Figure 2: Personal Systems (- figure adapted from [20])

Classroom System

This would be the system normally used in school classrooms and so would not need to be portable. It should be able to be configured to perform a much wider range of tasks that the Personal System, including all those currently asked of school computers, being easily expandable with plug-in cards or the connection of external expansion units.

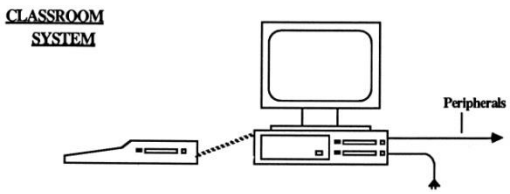

Figure 3: A Classroom System (- figure adapted from [20])

The provision of colour monitors to which a Personal System could be connected would be one variant of this implementation, whilst another may include the attachment of an external expansion unit [20].

School Systems

A School System was seen to comprise a network to enable Personal and Classroom Systems to be connected to devices such as printers, mass storage, special purpose peripherals and remote computers. It was envisaged as a transparent system with a number of connection points in each classroom and around the school so that students could plug in Personal Systems to use a printer or to up or down-load

software or perhaps an assignment. A number of Classroom Systems could be connected to the School System to facilitate use of software, sharing of resources and the sharing of common data. At any time the School System could be decomposed into its individual modules to form a number of Classroom and Personal Systems [20].

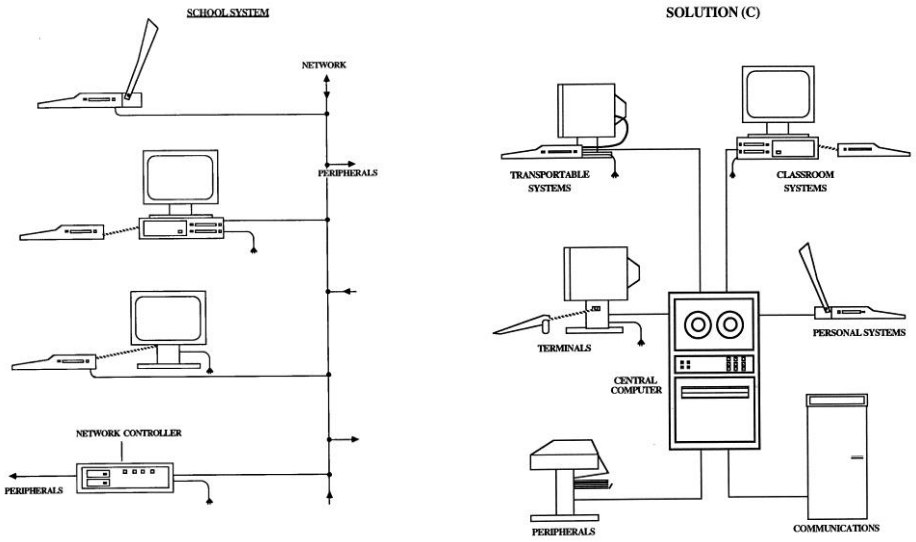

Figure 4: Two options for a School network using common base units. The second option (Solution C) is for a larger systems connected to a central computer (- figure adapted from [20])

A scenario envisaged for the future was one where each student would have their own Personal System. This would revolutionise the education system and make many of the dreams of computer educators possible. These Personal Systems would be built on contract for the government and purchased, perhaps on a long term leasing basis by individual students. Classroom and School systems would be purchased by schools using government funds [20].

The End of Development of the Australian Educational Computer

After publication of the Education Technical Requirements, the next step in the process should have been setting up a System Concept Study by the Department of Science and Technology, followed by a Development Proposal, but at this stage the project ran out of steam. The three years of funding for the National Computer Education Project was at an end, no further funds were made available by the Department of Science and Technology and work on the Australian Educational Computer ceased. Those of us involved in this project had tacitly assumed that the final version of our educational computer would be manufactured by an Australian company such as Microbee, as part of the idea of building this machine was to stimulate the Australian computer manufacturing industry. It is not clear why this aspect of the project did not receive further support or why government priorities changed.

Although we all were, at the time, disappointed by the decision not to proceed, in the light of later developments we were perhaps relieved not to have created a white elephant like the ICON in Canada, as even as the Working Party was finalising its report new entrants to the personal computer market were extending the state of the art and rapidly progressing beyond its recommendations. The Commodore Amiga and Atari ST computers were released in the latter half of 1985 and took the expectation of colour displays and graphic capability beyond what the Working Party had envisaged. It had thus begun to become clear to Education Authorities that the Australian Educational Computer, if

built, might soon be surpassed by other computer developments. The dominance, within a few years of the Apple Macintosh and MS-DOS (- later Windows) PC meant that this was prediction was probably correct.

People, Co-operation, Conflict, Funds, Ideas and Governments

The case of the Australian Educational Computer involves state governments, the national government, various government departments, education authorities, committee members, reports, specifications documents and the computer industry. Interactions between these actors led to the development of the specifications for this computer, but not to its construction. A number of studies have been undertaken on innovations that did not ultimately succeed or move to completion [21-23]. Latour [21] tells the story of 'Aramis', a revolutionary guided-transportation system intended to be part of the Parisian Metro in the 1970s. He investigates the parts played by both human and non-human actors and the associations and interactions between them. Latour concludes that the reasons for Aramis' failure are complex and involve technical problems, infrastructure issues, disagreements, lack of political will and many other factors. Accounts of other failures of technological innovation often indicate similar complexity and that more than one single factor was the cause.

Accounts of political interactions within government on matters like this often highlight internal conflicts and political and ideological disagreements. This was the case with Compis [14]. Interactions between local and national governments also often indicate frictions and differences of approach along with differences of views between these bodies [24], but in the case of the AEC none of these internal or external differences were apparent. The funds were to come from the Commonwealth Government, but most of the decision making came from representatives of state governments who had ultimate responsibility for education in their schools. The available evidence shows no significant disagreements or conflicts. Overall the Computer Education Program proceeded well, and many computers were put into schools, much educational software was developed and many teachers presented with meaningful professional development opportunities. The problem was that this was not extended to construction of the AEC. It is not entirely clear, as no documentary evidence seems to exist, but it appears that its non-development may have been due to the Commonwealth Department of Science and Technology not wanting to commit the extra funds for its part in the project in a time of tight budgets.

This exercise was not really about standardisation [25]. There was no intention indicated by either the national or state governments to force the adoption of the AEC in order to achieve standardisation. In fact the prevailing political climate for education, both nationally and in the states, was to allow schools as much freedom as possible. Issues of software compatibility within and between the states were important, but issues of teacher professional development and school support would not have been solved by standardisation.

Some projects involving both government and industry highlight the advantages resulting from this, while other show frequent disagreements and changes in priorities making success doubtful. Development of the Compis, Poly and ICON computers had as much (if not more) to do with support for the local computer industry as for education. On the other hand the BBC computer's success was primarily due to its support by BBC television.

Development of the Australian Educational Computer was almost entirely an education exercise, as industry was not involved in producing either the Educational User Requirements or the Educational

Technical Requirements documents. The local computer industry had very little involvement up to the stage of its discontinuation and so did not affect the outcome at all. Had funds for development been available this would, of course, have been different. Unlike some of the other countries developing school computers, in Australia the primary objective really was education and the local computer industry was very much a secondary consideration. It is remarkable that this really was a team exercise and that no particular or prominent individuals stood out or made their presence felt. Perhaps though, this was a factor in its demise.

Latour [21] argues that Aramis was not seen as being 'real' at the beginning of its development. Neither it, nor the Australian Educational Computer could possibly be real in the beginning as they did not then exist for people to see and to evaluate whether they might be something they could use. In his second law, Kranzberg's [26 :548] suggests that "*Invention is the mother of necessity*". In this case the invention unfortunately failed to create such a necessity. Perhaps if one or more prominent individuals had been prepared to speak out passionately for building the Australian Educational Computer so making it real and creating a necessity, then its future might have been quite different.

Conclusion

Today the decision schools make in choosing which type of computers to use is between a Windows PC and a Macintosh. There is plenty of software of all types available for each, and even a certain measure of software compatibility between them. As this article pointed out, the situation in the early 1980s was quite different. There was a great deal of enthusiasm for the potential of computers to improve learning in schools, and a wide range of relatively low cost microcomputers available for this purpose. It was into this scenario that the Commonwealth Schools Commission set up NACCS and gave consideration to the support problem as something had to be done in restricting the range of school computers to make it possible for the various State education authorities to support them with software and teacher professional development.

NACCS looked with interest at what was happening in New Zealand, Sweden, Canada and the UK in developing their own educational computers, and proposed that something similar would be appropriate in Australia. With hindsight, perhaps this proposal was over optimistic. Perhaps with hindsight and the knowledge that all but the PC and Macintosh would soon disappear the proposal was inappropriate, but at the time it made good sense.

In retrospect, was the Australian exercise at developing its own educational computer a waste of time and money? Perhaps the answer in one sense is that it was. Although possibly representing a missed opportunity, the demise of the AEC had very little overall impact on computer education in Australia. After the Windows PC and Apple Macintosh came to dominate the market in the early 1990s, and application software for word processing, spreadsheets and database management came to be the dominant educational applications, foreign culture and language in educational software was no longer much of a problem. On the other hand, the various reports and the specifications documents published by the two working groups are of value, even today and the exercise undertaken in discussing and determining the relevant purposes for which computers could be used in schools was in itself worthwhile and had long lasting consequences. Also the interstate connections forged during the process of researching and writing these reports was worthwhile.

If the project had been undertaken a few years earlier, like those in the other countries, perhaps it would have continued, but by the late 1980s the windows of opportunity for a national solution was gone. Given the benefits of hindsight it was probably a good thing that the project stopped when it did. It was probably a good thing that the project did not continue to the stage of manufacture of a computer that would probably have become obsolete in a few years. Would this project have helped to stimulate the Australian computer industry? Would it have made it possible for schools to easily transition to the computers we have today? These are, of courses, questions to which we have no answers.

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