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# Computer education and societal change

## History of early courses in computing in universities and schools in Victoria

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### Abstract

**Purpose** – It is widely acknowledged that the computer has caused great societal changes over recent years, but the purpose of this paper is to relate specifically to those due to the use of computers in education and teaching about computing. The adoption and use of computers in education was very much a socio-technical process with influence from people, organisations, processes and technologies: of a variety of human and non-human actors.

**Design/methodology/approach** – This paper makes use of actor-network theory to analyse these events and their educational and societal impact. Data were collected from published sources, interviews with those involved at the time, discussions and from personal experience and observations.

**Findings** – Computers have, of course, had a huge impact on society, but particularly in relation to the use of computers in school education there was a different societal impact. Some of this related directly to education, some to school administration and some to student attitudes, experiences and knowledge.

**Research limitations/implications** – The paper investigates the development of early courses in computing in universities and schools in Victoria, Australia. The paper does not, however, consider the use of computers in university research, only in education.

**Practical implications** – The paper describes the significant educational events of the era from punch-card tabulating machines in the 1930s to micro-computers in the late 1980s, and investigates the relationship between the development of courses in the Universities and those in the more vocationally oriented Colleges of Advanced Education. It examines whether one followed from the other. It also investigates the extent of the influence of the universities and CAEs on school computing.

**Social implications** – The advent of the computer made a significant impact on university and school education even before the internet, Google, Wikipedia and smart phones in the late 1990s and 2000s. Computers in schools cause a rethink of how teaching should be handled and of the role of the teacher.

**Originality/value** – This paper investigates the history of computers and education in both universities and schools in Victoria, Australia over the period from the 1930s to the early 1990s. It considers how and why this technological adoption occurred, and the nature of the resulting educational and societal change this produced. Primary and High School use of computers did not commence until the 1970s but prior to this there is a considerable and interesting history associated with the development of Higher Education courses relating to computing.

**Keywords** Business innovation, Actor-network theory, Education, Adoption, Human computer interaction (HCI), Innovation theory

**Paper type** Research paper

## 1. Introduction

This paper investigates the history of courses in computing in both universities and schools in Australia, concentrating on the state of Victoria over the period from the 1930s to the late 1980s. It considers how and why this technological adoption occurred, and the nature of the resulting educational and societal change this produced.

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Primary and High School use of computers did not commence in Australia until the 1970s but prior to this there is a considerable and interesting history associated with the development of Higher Education courses relating to computing. The paper does not, however, consider the use of computers in university research, restricting itself to education.

The adoption and use of computers in education resulted from the interactions of a number of people, organisations, processes and technologies. This was very much a socio-technical process involving interactions between various human and non-human actors, and this makes use of actor-network theory (ANT) (Callon, 1986; Latour, 1996; Law, 1991) most appropriate for its analysis.

In addition to examining the interactions involved in the creation and delivery of these courses, the paper questions the interrelationships between different types of higher education courses and how each of these affected what was done in schools.

## 2. Background: the state of Victoria, Australia

The Commonwealth of Australia is a federation of six states and two territories each operating largely independently. Although most university funding comes from the national government, state governments have responsibility for school education (Tatnall, 1992; Tatnall and Davey, 2012), but in matters that it considers to be of national importance, the Commonwealth Government sponsors and provides funding for specific school education projects such as the Commonwealth Computer Education Programme. This paper deals mainly with events in the state of Victoria which has a population of around 6 million. In 2015 Victoria now has nine universities and around 1,500 Government Schools as well as a number of Catholic and Independent schools making up around 30 per cent of the total student population.

Computer science courses in Australia began at the universities of Sydney and Melbourne in the early 1950s. Business computing courses soon followed in the Victorian Technical Colleges. Computing in schools began in the 1970s with developments in Victoria again being most significant. This paper concentrates on Victoria as a number of developments here were earlier and rather different to many other places and can add to the international story of computers and education. Another reason for concentrating on Victoria is that the author is from Victoria and has been involved in many of these developments over the years.

## 3. The beginnings of computing courses in Australia

All of Australia's early computers were based in the universities with CSIRAC, Australia's first computer[1] that became operational in 1949, coming into general use at the University of Sydney from 1951 to 1956 and later at the University of Melbourne until 1964, and SILLIAC in Sydney from 1954 (McCann and Thorne, 2000). From the mid-1950s a number of these computers were opened to general use, and practical training in programming was introduced at the Universities of Melbourne, Sydney and New South Wales (Pearcey, 1988). Early training courses, each of a few weeks duration, were offered in the programming techniques appropriate to each machine (Bennett *et al.*, 1994). Programming could be regarded as an articulation between people and machines (Law and Callon, 1988), and these courses could be seen as the beginnings of computer education in Australia.

Prior to the late 1980s Australia had a two-tiered system of Higher Education: "Universities" and "Colleges of Advanced Education" (CAE). After 1990, a series of mergers saw the end of the CAEs and the creation of a number of new universities.

Naming of these early institutions is, however, a little more complex as in the 1950s and 1960s many of the future CAEs were called "Technical Colleges", and in the 1970s and 1980s some became "Institutes of Technology". In this paper the terms: Technical College, Institute of Technology and College of Advanced Education can all be taken to relate to institutions of essentially the same nature. The paper will investigate the relationship between the development of courses in the universities and the CAEs. It will ask the question: did one type follow from the other?

Significant educational computing in Primary Schools and High Schools dates from the 1970s and came in two forms: teaching about computing and the use of computers to enhance learning in other subject areas. The paper will investigate the effect that the universities and CAEs had, or did not have, on each form of computing in schools, and how these forms of school computing related to each other.

## 4. Research framework and methods

In an investigation of socio-technical phenomena such as this, the use of ANT is most appropriate. ANT makes no distinction in approach between the social, the natural and the technological, and attempts to offer impartiality to both human and non-human actors by treating them fairly and in the same way. Callon puts it like this:

> The rule which we must respect is not to change registers when we move from the technical to the social aspects of the problem studied (Callon, 1986, p. 200).

In ANT an actor is any human or non-human entity that is able to make its presence individually felt (Law, 1987) by the other actors, and it is made up only of its interactions with these other actors. Law (1992) notes that an actor thus consists of an association of heterogeneous elements constituting a network and Callon (1986) argues that an actor can also be considered at times as a black box, as we do not always need to see the details of the network of interactions that is inside it.

ANT considers both social and technical determinism to be flawed and proposes instead a socio-technical account (Law and Callon, 1988) in which neither social nor technical positions are privileged and where nothing is purely social and nothing is purely technical:

> It makes sense to treat natural and social adversaries in terms of the same analytical vocabulary. Rather than treating, for instance, the social in one way and the scientific in another, one seeks instead to follow the fortunes of the network in question and consider its problems, the obduracy of the elements involved in those problems, and the response of the network as it seeks to solve them (Law, 1987, p. 4).

As the use of computers in education first involved their adoption in universities and schools, an approach to the investigation of technological innovation is appropriate here, and this research makes use of Innovation Translation, informed by ANT. "Translation", in this context, can be regarded as a means of obliging some entity to consent to a "detour" (Callon, 1986) that takes it along a path determined by some other entity, and Law (1987) uses the term "heterogeneous engineer" to describe the entity that designs and creates these detours and so encourages adoption. A heterogeneous engineer can be a person, organisation, idea, item of technology or any other entity. Callon (1986) proposes that the process of translation has four aspects or "moments": problematisation, interessement, enrolment and mobilisation:

- problematisation involves the heterogeneous engineer defining the nature of the problem so as to be seen by other actors as having the answer (McMaster *et al.*, 1997);

- interessement involves interesting and attracting an entity by coming between it and some other opposing entity (Law, 1986);
- enrolment occurs through a process of "coercion, seduction, or consent" (Grint and Woolgar, 1997), and, if all goes well, leads to the establishment of a solid, stable network of alliances (Singleton and Michael, 1993); and
- mobilisation locks in as the solution proposed by the heterogeneous engineer gains wider acceptance (McMaster *et al.*, 1997) through some actors working to convince others.

ANT has no unique set of methods with which it is associated, but makes use of many of the same qualitative techniques as ethnography and case study. In this study the research was qualitative in nature with data collected from published sources, interviews with those involved at the time, discussions and from personal experience and observations. The interviews were all conducted by the author.

## 5. Prehistory: courses on the use of punch-card tabulating machines in the 1930s

In the 1930s the widespread adoption of the accounting machine by businesses, including banks and insurance companies was propelled largely by IBM's commercial presence (DeLamarter, 1988) but also by a growing understanding of the business advantages of "automatic" data processing (Tatnall, 1993). From about 1935, several courses began to be offered in Victorian Technical Colleges in the use of punched-card operated accounting/tabulating machines. While these machines could certainly not be considered to be computers, techniques and training in their use offered a starting point for courses in computing. These courses were very much business-oriented in outlook and whilst not what we would now call computing courses, did lay some ground work for future courses in Business Computing (Tatnall, 1993). The first courses in the use of accounting machines were offered by the suppliers before being taken up as tertiary courses by the Technical Colleges that saw their role as primarily vocational. These courses introduced students to concepts such as the formal analysis of problems using techniques such as those of Organisation and Methods (O&M) and to programming. Their real importance to later courses in Business Computing was not so much the technology itself, but in its contribution to the way that business was to see possible uses for this technology, and to establishing that such courses could appropriately be offered in tertiary institutions.

Tony Montgomery, then from Monash University speaks of O&M in the 1960s, and remembers how some of the O&M symbols became standard IBM flowcharting symbols:

> O&M had diagrammatic representations of all manner of industrial processes and had as a sub-set of this a set of symbols, such as merge and sort, that were for information-flow (Montgomery, 1992).

He describes how the next phase before strictly computer-based systems analysis, was that which grew out of the pin-board plugging for accounting machines (Tatnall, 1993). There were some really quite effective card-processing systems of accounting machines and punch-card equipment that could do "quite nifty things" like searching, sorting, selecting on columns and selecting on values, just by plugging up the plug board:

> Good stuff but just a little slow. Of course, if you dropped a deck of cards you were in some trouble (Montgomery, 1992).

Important actors in this period included IBM, business such as the banks and insurance companies, accountants, the machines themselves and the Technical Colleges. IBM had problematised the use of punch-card accounting machines as necessary for efficient business data processing and had no difficulty in convincing others of this: very little interessement was necessary. The Technical Colleges accepted this problematisation and course development proceeded accordingly. Enrolment was complete but mobilisation to the university sector did not follow as this sector problematised its role as academic rather than vocational.

## 6. Early university courses in computing in the late 1940s and into the early 1960s

The first courses in what we might now call aspects of computer science were introduced in 1947 by Trevor Pearcey (the principal designer of CSIRAC) in the Department of Mathematics at the University of Sydney. The theory of computation, computing practices and theory of programming was very much a mathematical study and at that time to use a computer at all required knowledge of programming. Computing courses were typically offered in University Departments of Mathematics and had considerable mathematical influence (Tatnall, 1992; Pearcey, 1988). They were delivered on university first generation mainframes typically using punched-cards for input.

In 1956 CSIRAC moved from Sydney and was re-located at the University of Melbourne. Programming courses were given regularly in Melbourne from 1956, and in 1959 a subject in Numerical Methods and Computing was developed (also delivered by Pearcey) in the BA course in Pure Mathematics. During this period several university computer systems were opened to general use and courses involving practical training in programming and the application of computers were introduced in the universities of Melbourne, Sydney and New South Wales. In 1959 the first post-graduate diploma in Numerical Analysis and Automatic Computing was offered by the University of Sydney (Pearcey, 1994).

In the early 1960s the University of Melbourne established a Department of Information Science (Pearcey, 1988) and offered courses in the Theory of Computation, and Monash University set up a Department of Information Science in the Science Faculty and offered computer science in its science degree. It could be said that those involved in university computing at this time had little interest in the use of computers in business and saw computers primarily as large and powerful calculating machines for use in mathematics and scientific applications. In Australia's universities, business use of computers did not become a significant actor until much later, and business computing was certainly not enroled in university courses.

The computer itself was a significant actor in determining the nature and contents of computing courses. Changes in technology in the late 1950s meant that such courses typically moved from delivery on an institution's mainframe to one of its new mini-computers producing a fundamental change in the content and availability of computing courses, but the problematisation of computing as a form of mathematics was to continue well into the 1960s and to determine the nature of university courses in computing.

The literature shows that the situation in many other developed countries was rather similar, although in many cases a little later than Australia (Puigjaner, 2012; Impagliazzo and Lee, 2004; Raffai, 2006). One significant difference was in those countries, such as the USA, UK, France and Italy with a local computer industry (Bonfanti, 2012) where there was a relationship between the use of computers in university education and the computer manufacturers (Parnas, 1990; Balkovich *et al.*, 1985; Anthony, 2003).

## 7. Programmer-in-training and computing courses in the CAEs in the 1960s and early 1970s

In the early 1960s the Technical Colleges were typically still teaching about punched-card operated accounting machines. During this period, however, a significant happening in relation to computing in higher education was the entry of an important new actor: the Australian Commonwealth Government. This new actor was important because in the late 1950s it took the decision to computerise the operation of the Department of Defence and the Post Master General's Department (PMG), so creating a massive requirement for trained computing personnel (Maynard, 1990). As many other developed countries were also computerising government departments and so in a similar position these personnel could not be acquired from overseas but had to be trained locally.

At this time the universities were only just starting to come to grips with the issue of whether computing was a part of mathematics or should be considered as a new discipline (Tatnall, 2006). With courses which were quite theoretical in nature, relatively few staff and sparse facilities, the universities were largely unprepared for the demands of the Commonwealth which needed courses with a substantial component that was vocational in nature. The universities had little interest in providing such courses (Tatnall, 1993) so in 1960 the Australian Government's Commonwealth Public Service Board set up and commenced delivery of the Programmer-in-Training (PIT) scheme, initially of 12 weeks duration, as a temporary measure to alleviate the severe shortage of programmers and other computer professionals in Commonwealth Government departments. The PIT courses were oriented towards training staff in the establishment and running of commercial and administrative computing applications; a very different problematisation to that of university courses.

Although regarding this training as successful in providing a "crash computing course" (Maynard, 1990) the Public Service Board recognised a need to set up longer courses and began designing a full-year long Programmer-in-Training course. The first of these new PIT courses ran in 1965 and initially drew upon the Defence and PMG staff experience with both computerised, and existing non-computerised administrative systems for its delivery. Gerry Maynard (Maynard, 1990), who was then an O&M Inspector with the PMG describes this course as a "double-decker sandwich course of one year duration combining periods of formal classroom education with on-the-job training" (Tatnall, 1993). The PIT courses took over 20 hours/week of formal class time for a year and operated initially in Canberra and Melbourne (Pearcey, 1988; Maynard, 1990). The 46 week course covered the topics: Introduction to the course and the service; Computer equipment and techniques, Computer mathematics (statistics), Programming and Systems analysis and design.

One of the first educational institutions in Australia to adopt business computing as a priority was Caulfield Technical College[2] offering, in 1961, a Certificate of Accounting course and by 1967 a Diploma of Business Studies (Data Processing). Maynard, by this time a lecturer at Caulfield Technical College (Maynard, 1990) suggests that these courses were the forerunner of many of today's courses in Information Systems (Tatnall, 2006). From this period on, university and other higher education computing courses were seen to become "respectable" and were soon widely available. In Innovation Translation terms they had become enroled in many higher education institutions and mobilisation to others was well underway.

In 1962 Royal Melbourne Institute of Technology got its first computer – an Elliot 803, and in 1963 short evening post-diploma courses were offered at Caulfield Institute of Technology (formerly Caulfield Technical College) on Punched-Card Systems,

Accounting Machine Applications, Commercial Electronic Data Processing and Principles of Analogue Computing. Surprisingly, in that same year, a survey suggested that businesses in Victoria believed that they would need only ten programmers in the next ten years (Pearcey, 1988) – perhaps there would be no need for all these new computer professionals!

Other courses were introduced at this time at Caulfield Institute of Technology, Bendigo Institute of Technology and Footscray Institute of Technology. These courses had titles like: Diploma of Information Processing, Post Diploma of Electronic Computing, Associate Diploma in Accountancy (Data Processing), Certificate in Electronic Data Processing (Operating and Coding), Diploma of Business Studies (Data Processing), Information Processing Diploma and an Electronic Computing Post Diploma (Juliff, 1990; Juliff, 1992). It was clear that the Technical Colleges saw their role in computing as offering courses to meet the needs of business and industry rather than being purely academic in nature. The problematisation for their courses was clearly now to fill business needs.

In 1970 the Commonwealth Public Service Board decided to hand over the running of PIT courses to Caulfield Institute, Bendigo Institute, Canberra CAE and New South Wales Institute of Technology (Maynard, 1990), and this commenced in 1971. According to Greig and Levin from Caulfield Institute (Greig and Levin, 1989):

> The Public Service Board believed that the increasing use of sophisticated computer equipment at the colleges and their need for increasing numbers of trained "computer personnel" made such a development desirable (Greig and Levin, 1989, p. 7).

This development was very important as it could be seen as the beginning of higher education courses of business computing and information systems. In 1971 the new PIT programme supported 235 trainees Australia-wide (Philcox, 1978) and had the wider objective of providing trained computer personnel to industry as well as the Commonwealth and State Public Service (Pearcey, 1988). It comprised both full-time classes and on-the-job training. Computer education in the technical colleges had now been solidly problematised as training for business and government personnel and mobilised in most CAEs.

## 8. University and CAE computing courses in the 1970s and 1980s

From the early 1970s computing courses began to proliferate in Universities and CAEs using the more affordable mini-computers that had then become available. At this time, however, Chisholm Institute of Technology (the former Caulfield Technical College) like most other universities and CAEs was still using punched-cards for students to enter their programs before terminals became available. It was not until the end of the 1970s that micro-computers began to enter higher education institutions (Maynard, 1990). The interactions with computer courses due to each of these non-human actors produced substantial curriculum changes (Tatnall, 1993).

Although teaching in a mathematical form of computer science began in Australia's universities of the 1950s, CAEs courses in business computing only commenced in the 1960s. The growth in CAE courses owed a great deal to the Commonwealth Programmer-in-Training scheme which became the model for many future courses in business computing and was a very significant actor defining the problematisation of these courses. The reluctance of the universities to become involved in what they saw as little more than vocational training opened the way for the CAEs to develop this curriculum area. Peter Juliff (Juliff, 1990), an academic at Caulfield Institute of Technology and later Victoria College, suggests that university computer science was,

at this time, taught mostly by people whose primary love was mathematics and that this was the flavour that they gave to their courses. They saw no need for courses to be relevant to the "real world" and found little interessement to do this. The PIT scheme, on the other hand, was very business-oriented in design. It is thus clear that courses in business computing in the CAEs did not diverge from university computer science courses, but rather developed from those of the PIT scheme.

Around this time traditional business computing (later Information Systems) curricula were beginning to develop in the CAEs and most courses had a core of similar topics which were typically based around subjects related to Systems Analysis and Design, Database Design, Business Programming (which was typically done using third generation languages such as BASIC, COBOL or Pascal) and Systems Implementation. Many of these courses also had an introductory Computer Networking unit as well as one handling Computer Architecture. These units, often electives, were quite technical and delved well into the realm of computer science.

An important determinant of the nature and delivery of computing courses in this period was how students could enter programs and data: using punch cards or on a terminal. The available input device, be it punch cards or a terminal, was a very important actor and its interaction with students was significant.

Computer science, as distinct from mathematical computing, began to be taken seriously at Melbourne University only during the mid-1970s. Melbourne was then still disinterested in teaching about the commercial uses of computing so contributing little to this area, but by the early 1980s the Department of Computer Science, under considerable outside pressure, introduced a COBOL course "to make its students employable" (Wilde, 1992). At Monash University, Montgomery (1992) declares that in the 1970s the university sat somewhere between the computer science purists at Melbourne University and the Commercial Data Processing of CAEs like Chisholm (Caulfield). Montgomery was concerned with the question of where Commercial Data Processing ended and computer science started. One of the things that his department was doing was measuring the performance of each of the various file structures and trying to relate these measurements to a theoretical estimate of its performance in order to bring the two aspects of computing together with an academic and scientific flavour to produce an understanding of how to make information processing more efficient and more effective. La Trobe and Deakin, the newer universities, were less concerned with "pure" computer science (Woodhouse, 1992) and, like Monash, more interested in making computing courses practically useful. Business applications of computing had now become widely mobilised in higher education and by 1985 micro-computer adoption in tertiary institutions had become widespread (Tatnall, 2000).

## 9. The beginnings of computing in schools: 1970s and 1980s

It was in the early 1970s that school computing began when a small number of computers started to appear in Australian schools, typically resulting from the exposure of particular maths teachers to computing during their university studies. In 1972, for example, Burwood High School was loaned a PDP-8 computer by Digital Equipment (Salvas, 1985) and the following year McKinnon High School received an Innovations Grant to enable the purchase of an 8k Wang computer also used by teletype terminal access by Box Hill High School. These early computers were used by school mathematics departments and problematised almost exclusively for the teaching of programming (Salvas, 1985).

The biggest impact on schools at this time was introduction of the Monash Educational Computer System (MONECS). Before the advent of the PC it was impossible

for an average school to have hands-on access to a computer. In 1974 a group at Monash University produced a system using mark-sense cards that ran on a PDP-8 computer. Students devised their programs and marked their cards during their maths classes at school and their teacher would then later take the card deck to run at a nearby university campus (Davey, 1985). This allowed a class of 30 students to each get two programme runs in a one-hour period (Monash Computing Museum, 2003). The MONECS system was used to teach programming in FORTRAN or BASIC. At this stage, like the universities, schools saw computing as a branch of mathematics concerned with algorithm design and most teachers involved came from a maths/science background.

Another development at this time was experimentation by the Victorian Technical Schools with use of Control Data's "PLATO System" (Plato Learning, 2004) for computer-assisted instruction, mainly for the training of apprentices. The system was, however, very expensive and its use did not proceed.

Available technology was important in determining what could be done, and the arrival of the Apple II in 1977 saw the end of this period and the beginning of real advances in the use of computers in schools. Watsonia High School (where the author was teaching at the time) was one of the first high schools in Australia to obtain an Apple II computer (Tatnall and Davey, 2013). At around $2,000 for a 16k Apple II that used a tape drive (not supplied – you simply used your own cassette recorder) and a television (also not supplied) as a monitor, the Apple II was (almost) affordable for many schools. This was before the days of the ascendancy of the IBM PC, MS-DOS and the Apple Macintosh, and schools made use of the Apple II and a variety of other micro-computers.

In 1978-1979 the Victorian Education Ministry (Salvas, 1985; Tatnall, 1985) produced a plan for the introduction of computers to schools and it was not long before several different streams of computer education emerged so introducing a batch of new actors:

- computers across the curriculum – computer use in different subject areas;
- computer science;
- programming in mathematics;
- use of word processors by secretarial studies students;
- logo; and
- computer industry/business training in technical schools (Tatnall and Davey, 2004).

An important school curriculum support mechanism used by the Victorian Ministry of Education in the late 1970s and early 1980s was the Regional Subject Consultants who were practicing school teachers seconded from their schools, usually on a part-time basis (Tatnall, 2014). In this position they rarely had any interaction with school students, working instead to support the work of teachers and school principals in introducing and using computers[3]. There was a rapid increase in the use of micro-computers in schools during the 1980s.

In addition to MONECS and support mechanisms such as Regional Subject Consultants, perhaps the other most important developments in school computing in Victoria were support for school computing from the Commonwealth Government, and establishment of the State Computer Education Centre (SCEC).

### *9.1 Support for school computing from the commonwealth government*

In April 1983, the Commonwealth Minister for Education and Youth Affairs announced that the Government would set up a National Advisory Committee on Computers in

Schools to plan a Computer Education Programme. In its report Teaching Learning and Computers in Schools (Commonwealth Schools Commission, 1983) the Committee made comprehensive recommendations covering curriculum development, professional development, support services, software/courseware, hardware and organisation. It became a very important actor in school computing around Australia. The Commonwealth also provided $18.7m in funds to support these activities.

In the early 1980s the Victorian Ministry of Education created the SCEC to support and direct school computing. Financed through the Commonwealth and State Computer Education Programs, SCEC was set up in 1985 with twenty – seven full-time professional positions. SCEC played a significant role in setting the direction of educational computing in Victoria for the next three years: it developed policy, produced curriculum documents, evaluated and distributed educational software, evaluated computer hardware and produced the "recommended list" of computer systems for use in schools[4], facilitated interstate contacts and the sharing of resources, conducted professional development activities and generally co-ordinated computer education in the state (Tatnall, 1985).

*9.2 Australian computer manufacturers: microbee*

Australia's first mainframe computers including CSIRAC, SILLIAC and WREDAC (Deane, 2012) were made in Australia, but after that time there were few Australian manufacturers until CP/M micro-computer manufacturer Microbee appeared in the early 1980s. The Microbee was first available as a low price kit micro-computer before being sold as a desktop. It was widely adopted by education authorities in many states, but was not used to any great extent in Victoria. It could not be said that the existence of Microbee drove developments in computer education, but it did provide a useful tool to achieving this – it provided an interessement.

One of the significant issues in the early 1980s was that most educational software came from either the USA or from the UK, and came with associated cultural baggage. For example 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" (Tatnall and Davey, 2008). Educational support services in several states, including SCEC in Victoria soon began designing educational software for the computers most commonly used in schools, including the Apple II, Commodore 64, BBC micro, CP/M machines such as Micromation and the Microbee. Commercial educational software development soon followed.

Partly to combat this cultural bias and partly to stimulate local computer manufacturing the National Advisory Committee on Computers in Schools set up a project to design and build the "Australian Educational Computer" (Tatnall, 2013). Educational User Requirements and Educational Technical Requirements documents were produced by a committee of computer educators from around the country (including the author of this paper). Many of those involved in this project had thought that our educational computer would be manufactured by an Australian company such as Microbee. Times change and with the growing dominance of MS-DOS and the Apple Macintosh the project did not proceed.

*9.3 Computer Awareness Courses in Schools*

In 1980 in Victoria the Secondary Computer Education Curriculum Committee was formed with a brief for the production of Computer Awareness course guidelines,

the investigation of computer science as a discipline, the publication of computer education articles, the collection and propagation of public domain software and the provision of in – service education (Tatnall, 1992).

Although in developed countries around the world today secondary school students are very "aware" of information technology and its many use, this was not the case in the early to mid-1980s and Computer Awareness courses sought to address the twin problems of poorly prepared teachers and a mystical understanding of the nature of computers. Such a course would typically cover the following topics:

- how a computer works, computer programming, history of computing;
- business and commercial uses of information technology; and
- the social implications of increased use of computers.

Interestingly, although teachers of Mathematics were the prime movers in these early days, mathematics classes did not embrace computers into the later 1980s. What appears to have happened is that programmable calculators were seen as more relevant to teaching mathematics. In many cases the Mathematics teachers interested in school computing moved over to the teaching of computing: computer awareness or computer science, and gave up any attempt to use computers in mathematics, which today is a subject area in schools making little use of computers. The role of mathematics in the adoption of computers in schools appears to be a common phenomenon around the world as one article from The Netherlands notes:

> In addition in the participating schools mainly maths teachers appeared to be the early adopters of the new subject, because of their knowledge, experience and interest in information technology (Voogt and ten Brummelhuis, 2014).

Towards the end of this period a change occurred in the main human actors involved in schools: mathematics/science teachers moved away from involvement in school computing and their place was taken by commerce teachers who saw the computer primarily as a means of performing business calculations through the use of spreadsheets and accounting packages and for other business purposes such as word processing. To them, programming was of little interest.

### *9.4 School computer science courses*

In 1981, as a result of several years of effort by a group of CAE and university academics, computer science was first offered as a Year 12 Higher School Certificate (HSC) subject in Victoria, although personnel from the Ministry of Education had little involvement in determining the nature and content of this subject (Tatnall and Davey, 2010).

It is interesting to look at reactions to this new subject at the time from tertiary institutions, schools and the general public. Melbourne and Monash universities, which saw themselves as guardians of academic standards, rejected the subject, not allowing its inclusion in admission scores for their courses. Their stated reason for this was that the component of assessment allotted to formal examination was only 35 per cent (rather than the more typical 50 per cent). When pressed, some academics from these institutions admitted that they considered the subject of little serious academic worth, and "not an appropriate subject to study at a secondary school level". The newer universities (Deakin and La Trobe) and the CAEs did accept it as a valid study and parents, students and employers also readily accepted the value of HSC computer science (Tatnall and Davey, 2010).

Teachers, however, were not universally in favour of the new subject with some claiming it to be an elitist academic subject, too difficult for some students. Others noted that the ratio of girls to boys taking computer science was low and suggested that it was becoming a boys' subject. Perhaps the most damaging criticism though, came from those teachers who claimed that the presence of a specialist subject detracted from the use of computers across the curriculum as it put too great a strain on school computing facilities.

There were thus developing two opposing problematisations of school computing:

(1) the need to teach about computing; and

(2) the use of computers in other subject areas.

This was to significantly influence the future of computing in schools from this time on and into the 1990s.

## 10. The period from 1990 to the present: conflicting views

By the early 1990s the two opposing views of school computing: the need to teach about computing, and the use of computers in other subject areas had come to a head. Why this needed to be an either/or situation was never clear to some of us, but to those opposed to teaching about computing in any form it became a matter of principle and their problematisation was that computers in schools were simply tools to be used in many different subject areas. They formed a significant network of actors who saw no point in schools having anything to do with any form of computer science and argued that its existence would harm the use of computers "across the curriculum". Their interessement was strong and had the effect of enroling the Ministry of Education and a substantial number of teachers to the view that the computer was just a tool to be used for word processing, spreadsheets and other applications in various subject areas.

In relation to senior secondary school curriculum, a review in the early 1990s replaced the Higher School Commonwealth Computer Education Programme Commonwealth Computer Education Programme Certificate by the Victorian Certificate of Education that extended over Years 11 and 12. One of the consequences of this was that the subject "Secretarial Studies" (in which typing had been taught typing using electric typewriters) was considered to be dated and inappropriate, and was thus removed. This left a number of teachers of this subject in search of a new area in which to work. Word processing using computers seemed an obvious choice, but not computer science as teaching this involved skills that few possessed, leading to the demise of Year 12 computer science and its replacement by three more general subjects: Information Processing and Management, Information Systems and Information Technology in Society.

In the 1990s computing curriculum continued to grow in the universities and at the start of this period 1,400 students were studying computing related subjects in Victorian universities. What happened in universities and schools after this time with the advent of the internet, Web, online learning, laptops, tablets and smart phones and social media is beyond the scope of this paper.

## 11. Conclusion

In this paper the three strata of the Victorian education system have been traced in the decades from 1930 to the early 1990s. After some preliminary courses on punch-card accounting machines by the Technical Colleges, computing proper started in the universities in the 1950s. It is interesting to note the different approaches to computing

by the CAE sector and the universities: the first seeing, and problematising courses in computing through a vocational lens and the other being more interested in pure, mathematical computer science. The universities and the CAEs thus had little influence on each other until the 1970s. Courses in business computing in the CAEs did not diverge from university computer science courses, but rather developed from those of the PIT scheme. It can also be concluded that the different origins of computing in CAEs and Universities lead to a distinct divergence, at this time, between computer science at Universities and business computing (Information Systems) in CAEs.

Schools in Victoria readily adopted the relatively low-cost micro-computers available from the late 1970s and their use of computers blossomed in two different directions that could loosely be called: "computer science" and "computers across the curriculum". The forces acting to shape school computing were largely unrelated to any direct influence from the tertiary sector, except that most of the teachers involved in the early use of computers in schools had some initial contact with computers in their university education. One important influence though, was the significant teacher professional development education provided by faculties of education in the 1980s.

The advent of the computer made a significant impact on university and school education even before the internet, Google, Wikipedia and smart phones in the late 1990s and 2000s. Computers courses in universities and CAEs were instrumental in leading to discussion of the role of higher education: vocation or otherwise. Computers in schools cause a rethink of how teaching should be handled and of the role of the teacher.

Computers have, of course, had a huge impact on society, but particularly in relation to the use of computers in school education there was a different societal impact. Some of this related directly to education, some to school administration and some to student attitudes, experiences and knowledge. One change due to the use of computers in schools is in the format of school reports – now computerised, and many other school administrative matters (Tatnall and Tatnall, 2014) that are now done online. Many parents will readily acknowledge that their children picked up more about the use of computers, and at a greater rate, than they did. This often had an intergenerational education affect (Tatnall, 2014) where children were able to teach their parents, and sometimes their teachers about how to use this technology. The use of computers in education has resulted in considerable societal change.

Computing courses and the use of computers in other areas of school education in the 1980s had a profound effect on education in Victoria and some important lessons can be learned from these experiences for possible future technological developments in education. For any new development to be successful it must first be adopted and looking at the actors, interactions and networks formed may improve the chances of future adoptions. Using ANT to investigate these interactions can, not only provide a better understanding of why things happened as they did, but also guide how future educational technological developments should be handled.

## Notes

1. CSIRAC (or CSIR Mk1 as it was then called) was arguably the world's fourth of fifth digital electronic stored-programme computer.
2. After a series of amalgamations Caulfield Technical College became Caulfield Institute of Technology and then went on to become a part of Monash University.
3. The author of this paper was a Computer Educational Curriculum Consultant during this period.
4. The author of this paper worked at SCEC during this period as Educational Computer Systems Analyst and produced this list of recommended computers for schools.

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