STREAMS IN THE HISTORY OF COMPUTER EDUCATION IN AUSTRALIA

An Overview of School and University Computer Education

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Abstract: In world terms, Australia moved into the educational computing, both at the Higher Education and School levels, very early. This paper looks at how university subjects, and later how whole courses in computing evolved in Australia and how these had very little effect on the later use of computers in schools. We briefly examine how computers were first used in schools, and the influences that put them there and decided how they could be used. We relate an established a model of the growth of academic subjects to the emergence of the discipline area of computing, and in particular, to the Victorian Year 12 Computer Science subject.

Key words: Computer science; Information systems; Computer education; Computers across the curriculum; School computing; University computing.

1. INTRODUCTION

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 the individual State; the Commonwealth Government being limited to co-ordination, leadership and the funding of specific projects. While also considering Australia-wide issues, this paper will concentrate its perspective on the state of Victoria.

In this paper we will provide an overview of the evolution and history of the various streams of educational computing in Australia: University-level Computer Science and Information Systems courses, Primary and Secondary School courses teaching about computing, and the use of computers in other

school subjects. Owing to space restrictions, the paper will not address the use of computers in Educational Management at university or school level.

To model the development of the discipline area of Computing we will make use of work by Layton (1972) who wrote on the evolution of subjects within the school curriculum. In Layton's first stage of curriculum development, enthusiastic teachers bring 'missionary enthusiasm' to their task, and justify the new subject on grounds of 'pertinence and utility'. Evolution then occurs into a second stage where a tradition of 'scholarly work' emerges and trained teachers take over its delivery. Greater thought is given to the selection and organisation of subject matter so that this is consistent with the 'internal logic and discipline' of the new subject, rather than just being *useful.* In Layton's third stage complete standardisation, even approaching stagnation, occurs. Subject content is now determined largely by specialist scholars, not on the basis of its utility, and the students have no choice but to accept this (Tatnall, 1993). Although designed to explain evolution of single subjects at the school level we will show how this model can be closely identified in the history of educational computing in Victoria, and applied to the emergence and development of the Computing discipline.

2. UNIVERSITY COMPUTING 1947-1965

In world terms, Australia made its move into computing early. The CSIR Mk1 (CSIRAC), built by Trevor Pearcey and Maston Beard in the late 1940s was Australia's first internally-stored-program computer and is acknowledged to be the world's fourth. Australia had been well placed for an entry into 'the computer age', with a significant manufacturing base for the high technology of the day: the vacuum tube. Combined with expertise in television and radar developed during the 1930s and 1940s this was a critical factor (Pearcey, 1988).

In 1947 the University of Sydney's Department of Mathematics, introduced a course in *The Theory of Computation, Computing Practices, and Theory of Programming* – the first such course in Australia (Pearcey, 1988). At that time, of course, to use a computer at all required knowledge of programming. It was several years before computing was seen anywhere other than statistics and mathematics departments (Pearcey 1988; Tatnall 1992). Programming courses were given regularly in the University of Melbourne from 1956, and in 1959 a subject in *Numerical Methods and Computing* was developed. Undergraduate courses in *Theory of Computation* commenced in 1964 with the establishment of the Department of Information Science (Pearcey, 1988).

In the late 1950s the Commonwealth Government took a decision to computerise the operation of the Department of Defence and the Post Master

General's Department (PMG), creating a massive requirement for trained computing personnel. At this time the universities were only starting to come to grips with the issue of whether computing was a part of mathematics or should be considered as a new discipline. 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 the *Programmers in Training* (PIT) scheme 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 for the establishment and running of commercial and administrative computing applications. After several years of operation responsibility for running the PIT courses was transferred completely to the tertiary education sector, and set the style for many of the courses later offered in the Colleges of Advanced Education (CAE)[2].

In the early 1960s, and almost in unison, several key personnel moved from industry to academia to they set up computing courses. Gerry Maynard, coming from the PMG, took up a position at Caulfield Technical College (CTC) and Donald Overheu, from Weapons Research Establishment moved to the University of Queensland. Jack White, Westy Williams and Brian O'Donaghue left the Commonwealth Public Service Board to take positions at CTC, Bendigo Technical College, and RMIT respectively. One of the first educational institutions in Australia to adopt computing as a priority was CTC[3]. As early as 1961 CTC had offered a *Certificate of Accounting (DP)* course and by 1967 the *Diploma of Business Studies (Data Processing)* commenced as what Maynard suggests was the forerunner of many of today's courses in Information Systems. Maynard (1990) claims these courses to be the *first* electronic data processing courses in Australia.

3. COMPUTING BEFORE THE PC: 1965-1977

From 1965 university computing courses became 'respectable' and were soon widely available. In 1969 *Computer Science* was offered in Monash University's science degree. Changes in technology meant that such courses typically moved from delivery on an institution's mainframe to one of its

[2] Australia then had a dual system of tertiary education consisting of Colleges of Advanced Education and a small number of Universities, which later merged to the current Universities.

[3] After a series of amalgamations CTC became a part of Monash University.

new mini-computers producing a fundamental change in the content and availability of computing courses. These courses then proliferated at the Universities and CAEs and by 1975/1977 Monash and Latrobe Universities were offering a Post-Graduate Diploma in *Computer Science*.

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 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). In 1973 McKinnon High School received an Innovations Grant to enable the purchase of an 8k Wang computer costing over $10,000 (AUS) and requiring an annual maintenance contract of 15% of the purchase price. Because of this high maintenance cost Box Hill High School agreed to share the use (and costs), each school having access to 4k memory. Box Hill used a Teletype terminal with a paper tape reader and accessed the computer via a dedicated telephone line, but this arrangement was soon seen to be unsatisfactory. These early computers were used by mathematics departments almost exclusively for the teaching of programming (Salvas, 1985).

The biggest impact on schools however, was introduction of the Monash Educational Computer System (MONECS). Before the advent of 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 allowed a class of 30 children to each get two 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 schools saw computing as a branch of mathematics concerned with algorithm design.

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 for training of apprentices and other possible applications. The system was, however, very expensive and did not proceed. The arrival of the Apple// in 1977 saw the end of this period and the beginning of real advances in the use of computers in schools.

4. IMPACT OF MICROCOMPUTERS: 1977-1990

In this period most of the current computing curriculum in schools and universities was determined. Although some interesting changes occurred in university curriculum at this time, we will concentrate on school computing which the PC made both affordable and useful. We will begin in 1997 when Watsonia High School (where both authors were then teaching) obtained a curriculum innovation grant to purchase an Apple// computer.

4.1 The Advancement of School Computing

In the late 1970s the number of microcomputers in Victorian schools grew rapidly but without any central direction from education authorities. In 1980 Anne McDougall was commissioned to report on how computers were then being used in schools and the possibilities for future use (McDougall 1980). A few years later the Commonwealth Government noted the importance of introducing computers into schools and set up a committee to report on how it might help to provide funding (Commonwealth Schools Commission 1983). One result of the Commonwealth involvement was funds to set up State Computer Education Centres in those states not already having them. These Centres aimed to provide both support and professional development to teachers involved in computer education.

Four streams of computer education soon emerged: Subject use across the curriculum, Computer Science, LOGO, and computer industry/business training in Technical Schools. One of the early curriculum directions was 'computers across the curriculum' and Apple// software like: Lemonade, Hammurabi, and the First Fleet (convict) database showed the possibilities here. Several Subject Associations showed an early interest, particularly the Mathematics, Science and Commercial Teachers' Associations, and a new subject association: the Computer Education Group of Victoria (CEGV) was set up.

4.2 Hardware Brand Wars

There was little software compatibility between the early types of PC used in schools and so it made a big difference to a school's computer education curriculum whether it used Apple//, BBC, Microbee, IBM or Macintosh computers. One of the functions of the State Computer Education Centres was to control the proliferation of these brands by supporting only a limited number on a 'recommended list'. Like several other countries, Australia even commenced a project to design an Australian Educational Computer (Tatnall, 1990), which fortunately (in retrospect) did not proceed past the design stage. Recent developments have seen the rise to dominance in schools of the IBM-compatible PC (Windows) and the Apple Macintosh.

4.3 The Birth and Death of HSC Computer Science

In many school systems the 'worth' of a subject is measured in its interaction with the final year of schooling (Year 12) as many ascribe special importance to those subjects that are seen as valid preparations for tertiary study. In 1981, as a result of many years of effort by a group of academics,

Computer Science was first offered as a Higher School Certificate (HSC) subject in Victoria (Tatnall, 1992). It is interesting to look at reactions to this new subject from tertiary institutions, schools, and the general public. Melbourne and Monash universities, which saw themselves as guardians of academic standards, initially 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%. When pressed, several 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' (Tatnall, 1992). They would often state that they would prefer to have a student with no knowledge of computing whom they could introduce to computing concepts, rather than one 'who had learned bad programming in BASIC'. The fact that the Computer Science subject had been specifically constructed to address this particular concern by the study of top-down design and structured programming missed their notice.

Parallels can be drawn between the introduction of Computer Science and that of Geography in English schools as described by Goodson (1987). An interesting variation is the reaction to the subject by tertiary institutions in Victoria. The 'traditional' universities, which had been offering a highly abstract version of Computer Science for some time opposed introduction of the new subject at secondary school level, claiming that the concepts were above what could be understood by 17-year-old students. The CAEs on the other hand, were generally quite supportive after fighting their own battles with the universities on the place of computing some years earlier.

Parents, students and employers readily accepted HSC Computer Science, and student numbers taking the new subject increased rapidly. Teachers, however, were not universally in favour. Beginning from about the mid-1980s, when Computer Science was still in rapid growth, a number began to question its place. Their arguments had several strands. Firstly, some claimed that Computer Science was an elitist academic subject, too difficult for some students, and so should not be supported (- it is interesting to note that this was exactly opposite to the view earlier held by Melbourne and Monash universities). Others noted that the ratio of girls to boys taking Computer Science was almost as low as that for physics, and expressed concern that it was becoming a *boy's subject.* Perhaps, however, the most damaging criticism came from those teachers who claimed that the presence of a specialist subject detracted from the move to encourage the use of computers *across the curriculum.* Their argument had two parts. Firstly, they argued that the demands made on school computing facilities by Computer Science classes made it difficult for others to obtain adequate access to the machines. While containing some truth, this argument misses the point that in most cases the reason that the school had purchased a number of

computers at all was to support the teaching of Computer Science. Secondly, it was argued that the existence of a specialist subject would mean that teachers of other subject areas would not bother to include any mention of computing, considering it covered elsewhere. A number of teachers saw Computer Science and computers *across the curriculum* as adversaries and it took some time before these points of view were reconciled. In 1990, however, changes in the structure of the Year 12 curriculum led to the replacement of *Computer Science* with a much more general subject largely based on PC applications, called *Information Technology.*

5. THE PRESENT: 1990-2004

Changes to the structure of the Year 12 curriculum resulted in the introduction of three new IT subjects: *Information Systems, Information Processing and Management* and *Information Technology in Society.* This process also resulted in a decrease in any links between secondary curriculum and the universities. At this time several other subjects were made redundant. A study of particular interest here was *Secretarial Studies* which had been a vocational subject preparing (mostly) girls for entry into office and administrative jobs, but the idea of teaching typing on typewriters was seen as anachronistic. The numerically large and influential number of teachers made redundant in this process produced a pressure group and since these teachers had been moving to electronic typewriters, the best way of occupying them seemed to be to make them IT teachers. This move of Secretarial Studies teachers into Computing can still be seen in the nature and scope of the studies in the final school year.

The 'Computers across the Curriculum' group continued to influence the way computers were used in secondary schools, an interesting example being that of mathematics. In mathematics every year level was required to add computer-based learning of some land into the curriculum. In 1999 it was found that computing resources in schools were not up to this demand, and a trial at using computers in the examination system failed. Mathematics teachers found the solution to this in relatively inexpensive graphics calculators and use of Excel and Mathematica in schools decreased to zero.

The other phenomenon of the nineties was the Internet and a Government initiative connected all schools to high-speed Internet lines, using a satellite for remote areas. School libraries now boast multiple Internet lines and the Internet intrudes into most social science subjects as a research tool.

6. CONCLUSION

Perhaps because of its early entry, the introduction of computers into all levels of education in Australia occurred very early in a global sense. The story of educational computing has generally followed the path suggested by Layton (1972) and we can see that there have been two important driving forces. The first is the force of the individual: the effect of people like Trevor Pearcey in Universities, and of the MONECS system in high schools can be clearly traced. The second influence is that of government, as initiatives like the funding of teacher training and support units made for rapid progress in computing curriculum. In Victoria, government had an influence through the way it allowed teachers to experiment. Curriculum 'frameworks and guidelines' laid out what students should achieve rather than how to achieve the intended outcomes. This climate of freedom has allowed individuals in schools to develop programs different from many others.

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