DOCUMENT RESUME

ED 312 989 IR 014 009

AUTHOR Wallace, Andrew R.
TITLE The Use of Computers in Australian Schools: Six Years of Pragmatism.
PUB DATE Apr 89
NOTE 32p.; Paper presented at the Annual Meeting of the American Educational Research Association (San Francisco, CA, April 1989).
PUB TYPE Information Analyses (070) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; Computer Software; *Educational Innovation; Elementary Secondary Education; Foreign Countries; *Microcomputers; Professional Development; Resource Allocation; Sex Differences
IDENTIFIERS *Australia

ABSTRACT

Schools throughout Australia both teach about computers and use computers as a medium for teaching at all levels of the educational system, but teachers use the computer to support existing pedagogic practice rather than looking to the computer as an agent of curriculum change. Drawing in a descriptive way upon a number of recent studies and proceedings of the Australian Computers in Education conferences for the last 5 years, this paper examines the processes behind the development of classroom computing as it now exists, documents the extent of changes that the technology has brought to Australian schools, and draws parallels with the experience of schools in the United States. Major sections of the report focus on: (1) the beginnings and contexts for innovation; (2) the phenomena of innovation; (3) innovation and professional development; (4) inventory of an innovation; (5) the innovation and the student body; and (6) innovation futures. Tables of statistical data are included throughout the discussion, and eight appendixes provide additional data. A 23-item bibliography is also included. (GL)

The use of computers in Australian schools: Six years of pragmatism.

Paper presented at the annual meeting of the American Educational Research Assoc., San Francisco. April 1989.

Abstract

Computers are a fact in Australian schools. We have significant numbers of machines available, and a changed lexicon to go with it. Schools across the nation "teach about" and "teach through" computers at all levels of the education system.

It has been suggested that we have seen a revolution with the introduction of the computer to our schools. The reality appears to be a little different. It is more like a revivification. In a sense, the McLuhanistic truism "The medium is the message" applies. Teachers are using the technology, but often to support existing pedagogic practice, rather than looking to the computer as an agent of curriculum change. An understanding of the processes behind the development of classroom computing as it now exists, offers interesting an perspective upon future directions, and the place of curriculum planners in future computing in Australian schools.

Andrew R. Wallace.
School of Education,
Riverina Murray Institute of Higher Education,
P.O. Box 588, WAGGA WAGGA, N.S.W. 2650.
AUSTRALIA. Phone: (069) 222375.

Introduction

In the initial General Policy Statement (1983, 2) regarding computers in schools in New South Wales, the Minister for Education Mr Mulock began his introduction with the following words:

> ..... To an ever-growing extent, computers affect us all.
>
> In recent years computers, and the technologies which depend on computers, have influenced us in the work place, in shops and supermarkets, and even in the home. Their effects on society are significant, and sometimes subtle. As agents of change in society they can not be ignored.

The minister, having justified the place of computers in schools in accord with the wider use of the computer in society then turned his attention to the way computers "have the potential to influence education".

In the Report of the House of Representatives Standing Committee on Employment, Education and Training (Federal Government) released in February of this year, the word "revolution" was used to describe the process which has occurred since that time. Certainly the revolution in our wider society has been translated into the classroom, but the extent to which education has been revolutionised is a major theme of this paper. It certainly has brought with it a new jargon, and has been responsible for significant changes to curriculum, often in ways which were not envisaged in 1983.

Yet it is difficult to think of a single revolution as having taken place, or indeed of a single classification for the innovation at the school level. The changes have taken place at a number of levels within the system, defying simple description. Indeed, in seeking to classify what seems to have happened, one is reminded of Foucault's (1973, xv) exposition of the extraordinary example of a classification of animals in a Chinese encyclopaedia:

> Animals are divided into -
>
> > a) belonging to the emperor, b) embalmed, c) tame, d) sirens, e) sucking pigs, f) fabulous, g) stray dogs, h) included in the present classification, i) frenzied, j) innumerable, k) drawn with a very fine camel hair brush, l)et cetera, m) having just broken the water pitcher, n) that from a long way off looks like flies (in Bigum 1987, 10).

Bigum, in using Foucault's work, went on to discuss the extent to which classifications reflect a culture. One could also argue however in the context of computers in education that, whilst the word "computer" is applied to a variety of meanings and settings, the reality is that drawing common treads across the innovation is indeed problematic. The discussion of computers in education does not centre on a single phenomena, but on a series of technologies, machines and purposes. It is not a single innovation. Even the same type of software has alternate uses within the education system (e.g. "word processing", which has distinct meanings and purposes for administration and the classroom, and between different areas of the curriculum).

This paper attempts to document the extent of the changes this flexible technology has brought to our schools. As insufficient material existed for a more detailed meta-analysis this paper draws in a descriptive way upon a number of recent studies, as well as an analysis of the proceedings of Australian Computers in Education conferences of the last five years. It basically documents some of the progress of the computer revolution in Australian schools, drawing parallels with the experience of schools in the United States.

Beginnings and Contexts for innovation

The development of computing in the Australian context involves a basic interplay of Federal and State governments. The Federal Government provides significant levels of funding for computers in education, as well as leadership and co-ordination functions. Each state however has a separate and autonomous education system, with internal administration, policy development units, funding, curriculum and staffing. Finally schools have varying degrees of autonomy, the extent of which depends upon the State system to which they belong.

The story of computing developed mainly from the Federal arena, with the recommendations of the Schools Commission in 1983. This body called upon the Federal Government to facilitate the evolution of a substantial and co-ordinated programme (including the injection of $125 million over 5 years and the establishment of the NACCS - National Advisory Committee on Computers in Schools). In reality $18 million was allocated in 1984 for the development of computing in Australian secondary schools as part of a three year programme. The programme was developed concurrently with the expanded consideration of other issues in Australian education, including those of equity, gender, and retention rates. Partially as a result of this shared time line, the issues of equity and gender in particular have become base-line issues in the implementation of computing in schools.

Individual State Departments of Education reacted to the Federal initiatives, developing policy and implementing programmes, allocating funds, and generally establishing priorities for resource allocation and distribution. Curriculum development occurs almost entirely at the State level. Some states had already begun to develop computer programmes for their schools before 1983, based upon their own initiative and funding. State Departments of Education have made decisions about software and hardware, including what support will be given to schools (i.e. the brands of micro and peripherals for which they will negotiate special prices, and support with a variety of services including maintenance, teacher inservice and possibly in-house software development or special purchase).

Anderson (1984 in Fitzgerald et al 1985, 6) points to four major differences between the states in terms of the implementation of the innovation. These include:

1. Length of time and support of the programmes
2. Degree of centralisation of control over curriculum and purchase
3. Range of equipment provided or recommended to schools
4. Extent of subsidies for the purchase of equipment

In the case of New South Wales, decisions at the Federal level resulted in the establishment of the Computer Education Unit (CEU) in 1983, initially with a staff of six people to oversee the development of computing in government schools. Similar units were established in each state, the size, purpose and internal structure of each being determined by individual state priorities and policy decisions.

Details of computing in each state back in 1983 were provided in papers presented at the Australian Conference for Computers in Education in that year. A summary of these papers is presented as Appendix 1 at the end of this paper. At that time a variety of machines were being used, and most states saw a need for a priority to be given to hardware acquisition and the training of teachers.

A separate private school system also operates, and has received some funding for the development of computing.

The phenomena of innovation

Unfortunately the development of computing in Australian schools can not be seen as a carefully planned and orchestrated phenomena. The reality is very different not only reflecting the multiplicity of revolutions, but an almost unique set of uptake phenomena. Despite expenditure in teacher inservice, one finds that the professional development of teachers in computing has basically been a case of teachers teaching themselves (Bigum 1987, 17). This self teaching has often been associated with high levels of anxiety (Grundy et al 1987, 54), with obvious implications for the degree to which the innovation has been accepted.

There has been a liberal mix of competing state initiatives by individual teachers, subject area specialisations, and individual schools - often a competing range of policy and practice options (Kemmis 1987, 285). It often remained the preserve of male "technical buffs" in the early days, with their "primitive" machines (Bigum 1987, 19) better suited to maths and science. To an extent these days are still with us.

In the classroom itself, changes have varied. Kemmis (1987) points out that psychologically based theories of educational computing have not been significant in the development of computing in schools. Justifications for the use of the computer in the classroom tend to be at best glib reflections on society and on learning theory.

Generally the discourse on the use of the computer in the classroom has been captured by the technologists, commercial and special interest groups, and enthusiastic individual teachers. It seems to lack the kind of generally accepted rationale found in many other areas of the curriculum. It tends to be a pragmatic innovation, often simply couched in terms of the experience of many teachers about "what works" (Kemmis 1987, 290). It is a case of "suck it and see", which has serious implications for the management of this innovation.

Innovation and professional development

Considerable funding has been available for the development of introductory and more advanced courses for the more formal training of teachers in computing. Teacher Inservice programmes have however been seen as largely ineffective (Davis 1986 in Grundy et al 1987, 43). Major problems include the lack of resources back at school, and the limited time available to become effective in the new technology. Although most teachers are not critical of inservice activities, there seems to be a general feeling that school based activities may be preferable (Grundy et al 1987, 61). Certainly this may help in the control of one of the major factors limiting the implementation of computers into schools, that of the fear of a loss of authority and control often seen by teachers in using machines in the classroom.

The majority of teachers have no formal training in computing, with only 19% claiming that they had been to substantial inservice courses, while 12% have relevant tertiary backgrounds (Fitzgerald et al 1985, 20). To further exacerbate problems of qualification, the best qualified teachers tend to leave for the corporate world, with the draw of higher salaries and better working conditions.

Yet the level of uptake of computing by teachers is significant. Fitzgerald (et al 1985, 25) found that 50% of teachers claim to be regular users of computers (see Table 1 below), which compares very favorably with the Becker (1986a, 4) figure of 25% for the United States, although the definition of "regular" may well vary. The Australian study also found that the highest ratio of users were in primary schools (i.e. similar to results for the United States - Becker, 1986a, 4), with more females using computers than their male colleagues. Females see value in using computers with younger children than do their male colleagues (Fitzgerald et al 1985, 26). On the other hand, male teachers tend to use the machines more often (Fitzgerald et al 1985, 20). Further, 67% of Computer co-ordinators are male, with an average age 35 years. Significantly, in the secondary school setting 72% come from maths/science backgrounds.

Table 1. The Percentage of male and female respondents as users of computers, in or out of the school setting.

	Irregular or non-users		Regular users		
	Male %	Female %	Male %	Female %	Total %
Student	13	18	37	32	100
Parent	27	41	22	10	100
Teacher	23	27	22	28	100
Total	19	28	30	23	100

Source: Fitzgerald et.al 1985, 25

Teachers with interests in the use of computers in education meet annually at the Computers in Education conferences, held in each state and Federally. While there were significant differences between the conferences, especially between Federal and State meetings, analysis of the papers presented over the period since 1983 revealed some interesting trends, which are given in Tables 2 and 3 below.

A summary of an analysis of the background of presenters of papers at these conferences is presented as Table 2. There have been changes in the percentages of papers presented by identified groups of educators, with the growing importance of preschool, primary and special education, and a declining proportional representation of secondary and tertiary educators. These trends may give some indication of the growth of computing into new and non-traditional sectors of education. The table may also indicate where leadership in computing is now coming from, with the significant role of the education systems own consultants, rather than the traditional areas of secondary education and tertiary institutions.

Table 2. Presenters at Australian Computers in Education Conferences at State and Federal Levels.

Source of speakers with a high level of involvement at conference:

* Curriculum consultants (particularly at state conferences)

During 1983-88 the following groups made major contributions, but the relative number of papers presented by them declined:

* Secondary teachers - declining as a total of all presenters
* Tertiary - declining - declining as a total of all presenters, although still well represented at the Federal conferences.

In the period the following groups became more involved:

* Primary teachers
* Preschool teachers

Groups maintaining a low level of involvement:

* Special education teachers (increasing at Federal conference)
* Outsiders (e.g. software manufacturers)

Further details of these trends are presented as Table 3, which looks specifically at the Federal and New South Wales conferences. The State conferences are different in nature to the Federal conference, being "grass roots" oriented and less "academic" in purpose. The declining influence of the tertiary educators is particularly evident at the state level. Again this may reflect the trends in leadership in school computing. There is strong evidence that the speakers are basically those who have "sucked it" and seen!

Interestingly, an analysis of Computers in Education Conferences reveals that, with some variations, approximately 60:40 of presentations involving males:females, a change of approximately 10% from the 70:30 ratio of 1983.

Table 3. Background of presented at Computers in Education Conferences (given as percentage of all presentations).

i. Australian conferences.

	1983	1984	1985	1986	1987	1988
Consultant	30	17	13	26	20	25
Pre-school	0	0	0	3	0	0
Special Ed	0	1	5	1	4	2
Primary	7	5	0	1	0	2
Secondary	7	7	10	14	14	9
Tertiary	24	62	59	51	52	53
Other	22	8	13	4	10	9

ii. New South Wales conferences

	1983	1984	1985	1986	1987	1988
Consultant	No data	17	54	37	29	48
Pre-school	-	0	0	0	2	0
Special Ed	-	1	0	0	0	0
Primary	-	5	8	12	17	25
Secondary	-	7	27	26	17	8
Tertiary	-	62	11	19	26	17
Other	-	8	0	6	9	2

Inventory of an innovation

As in the work of Becker in the United States, some studies have been done into the nature of computing in schools, and into the equipment and software available to teachers. In Table 4, based upon a sampling of schools across Australia in 1985, the percentage of each type of computer available to teachers in each state is indicated. The survey was reported by Fitzgerald (et al 1985), and involved a proportionally stratified sample of 1000 schools, comprising metropolitan and country schools, primary and secondary schools, and samples from Government Catholic and other independent schools.

Table 4. Percentage distribution of computers by state (based on numbers reported in an Australia wide survey).

Computer	N.S.W.	Vic.	Qld.	Tas.	S.A.	N.T.	W.A.	ACT.
Apple	37	36	52	25	18	38	4	56
Macintosh	2	0	1	0	3	0	1	0
Microbee	32	3	9	2	0	3	19	1
BBC	2	8	3	54	13	6	34	2
Atari	5	1	0	0	0	3	0	0
IBM	1	0	0	0	0	0	0	0
Tandy	3	4	11	0	3	3	5	0
Ohio	0	0	2	0	1	0	0	0
Commodore	8	32	6	3	57	29	12	1
Others	10	15	16	15	6	18	23	0

Source: Fitzgerald et.al 1985, 21

The following general trends can be noted from these Australian figures:

* Major computers include Apple II, BBC, Commodore and Microbee

* Significant differences exist between states in terms of the microcomputers used, and the relative proportions of each model used within schools.

* In most states two computers dominate the microcomputer resources, one of which is relatively more expensive (e.g. Apple II, BBC), while the other is a less expensive model (e.g. Commodore, Microbee).

  Further details of the available microcomputers in New South Wales schools are provided as Appendix 2. In New South Wales the Apple II and the Microbee are the dominant machines, and between them they account for 85% of all units in schools.

  Of the funds allocated to the purchase of computers in New South Wales (according to Appendix 2), 59% has been used for the purchase of the Apple II computer (but only accounting for 40% of the units to be found in schools). Microbee, an inexpensive Australian machine, accounts for 32.0% of the funds expended, but 45.0% of the microcomputer units available in schools. The Microbee holds the dominant position in Primary school computing. Becker (1986a, 9) found a similar distribution of cheap and more expensive computers in American schools.

* Fitzgerald (1985, 23) also reported in the study that schools were asked to indicate where computers had been located. Some schools had computers in more than one room or configuration. These responses are summarised as:

Computer laboratory	44%
Normal classroom	43%
Mobile machines	30%

  Becker (1986, 8) found that school computers were housed in laboratories in the schools of the United States in the following proportions: primary 30%, middle school 62%, secondary 69%.

The full census of computers in the government schools of New South Wales gave indications of the extent of the growth of computing in schools, and the current distribution of computers among them. Table 5 is based upon figures supplied by the New South Wales Department of Education from their 1986 census of all government schools (response rate of 98%).

Table 5. Computers in N.S.W Schools (1983-86)

School Category	Number of schools	Numbers of computers 1983	1986	Increase 83-86	Average per school 1986
Special schools	161	No details	181	No details	1.1
Central schools	64	85	486	5.7 X	13.2
Primary schools	1650	572	5643	9.9 X	3.4
High schools	377	1443	5625	3.9 X	15.0
TOTAL	**2252**	**2100**	**11935**	**5.7 X**	**5.3**

Source: After Department of Education 1988, pp 6-7.

The following trends should be noted from these New South Wales figures, and allow some interesting comparisons to be made with the data obtained by Becker from schools in the United States:

* Primary schools include in their number many very small schools, particularly in country areas (i.e. 85% of the N.S.W. schools in the smallest classification are located in wholly rural education districts). There is an average of 3.4 computers per school in New South Wales.

  Becker (1985b, 6) found an average of 5.0 computers for elementary schools in the United States (with elementary schools of less than 300 pupils having an average of only 3 computers). One suspects that averaged figures for Australia and the United States may be very similar. In New South Wales 79.2% of schools have populations of under 450 students. A regional breakdown of the location of schools of each size, together with the percentages having at least one computer is given as Appendix 3.

* While no data is available to allow a correlation of the relative sizes of secondary schools to the number of computers available, it seems that computing in the secondary schools of New South Wales may be similar to United States counterparts. Becker (1985b, 6) reported medians of 28 machines for schools of over 1000 students, 17 for schools of 500-1000, and 9 for secondary schools of less than 500 students. Fitzgerald (1985, 19) indicated a average size of 752 pupils, and that the average number of computers was 14.

Becker (1985, 5) indicates that in United States 93% of secondary schools have at least one computer, while for elementary schools the figure is 85%. Detailed figures for New South Wales are provided as Appendix 3, and these figures indicate rates of 100% and 80% respectively for secondary and primary schools in that state. Interestingly Fitzgerald (et al 1985, 19) found similar or higher rates of computer ownership among private schools than within the State system.

* Special schools were not considered in the Becker study. These schools are invariably small, although the use of computers to supplement curriculum has become significant.

* Central Schools are usually small comprehensive country schools. They must cater for primary and junior secondary classes, and indicate significant growth in terms of the number of computers available - now almost the same average as for full high schools.

* Over the period 1983 to 1985 the number of computers in American schools grew by four times (Becker 1986, 1) while those in schools in New South Wales grew by 5.7 times over the period 1983 to 1986. This growth partially reflects a three year hardware grant programme for secondary schools which culminated in 1986.

* Significant grants (in excess of $3 million) have been made within New South Wales schools since the survey of 1986, and including hardware grants of $2.5 million for primary schools in 1987.

* Fitzgerald (1985, 19) found that 66% of computers in schools were funded purchases, often at prices of around $1656 in 1985 (i.e. the cost of an AppleII, or a BBC machine).

* The Survey of schools in New South Wales in August 1986 also revealed an average of 3 or 4 printers for each high school in the state and 1 printer in other schools, which is similar to the USA (Becker 1985b, 7). Modems can be found in one third of high schools, but only one in twelve of the other schools. In the USA one quarter of secondary schools have modems, while only 7% of elementary schools do so (Becker 1985b, 7).

  The study did not investigate the reasoning behind the selection of modems. Decisions not to buy modems are often more influenced by the availability of telephone lines than by cost or the educational value of that technology. State Departments of Education have set up programmes to support computer communication, including the use of Department owned and operated bulletin boards and mail facilities in some states, and public systems in others.

  Further details of the stocks of peripherals in New South Wales schools are to be found in Appendix 4.

* To a significant extent the collections of software which schools have built up now tends to dictate the school's choice of additional hardware.

* The Standing Committee of the House of Representatives (1989, 48) recommended the need for states to look more carefully at Australia wide standardisation of machines, peripherals and software allowing savings to be made in service provision, and the development of Australian software.

These same studies also looked at software usage. Table 6 draws from the New South Wales survey and indicates some significant differences between computer usage in primary and secondary schools. The use of the computer in the primary schools revolves around mathematics, English, reading and writing programmes, and in the social sciences. In the secondary school the study of the machine itself becomes more important, as do the specialist areas of secondary curriculum.

Table 6. Major curriculum areas which use computers in New South Wales State Schools.

SUBJECT AREAS	High %	Primary %
Major areas		
Computer education	93	-
Math	88	88
English / Language	71	80
Reading	-	72
Writing	-	67
Science	63	9
Social Science or Studies	62	45
History	43	-
Industrial arts	30	-
Minor areas		
Agriculture	13	-
Music	13	9
Poetry	-	11
Home Science	11	-
Art / Craft	11	12
Library	-	8
Modern languages	10	-
Health education	6	1
Other	25	11

Source: Department of Education.1988, pp 6-7.

A translation of Table 6 into software packages in curriculum reveals the central importance of word processing, followed by Logo, mathematics, adventure games and simulations. This can be seen by an examination of Table 7, which reflects detailed figures available as Appendix 5. The table summarises the processing of school responses to an open ended question asking schools to list the five dominant pieces of software in use in their schools.

Table 7. Software Usage Ranking in N.S.W. Schools

Rank	High	Central	Primary	Special
1	Word processing	Word processing	Word processing	Mathematics
2	Graphics	Graphics	Mathematics	Graphics
3	Database	Mathematics	Simulations	Word processing
4	Mathematics	Logo	Graphics	Reading
5	Logo	Databases	Reading	Simulations
6	Simulations	Adventure games	Logo	Spelling
7	Reading	Simulations	Spelling	Logo
8	Spelling	Reading	Adventure games	Adventure games
9	Writing tools	Spelling	Writing tools	Keyboard skills
10	Adventure games	Keyboard skills	Databases	Writing tools
11	Spreadsheet	Spreadsheets	Keyboard skills	Databases
12	Communications	Writing tools	Communications	Communications
13	Keyboard skills	Communications	Spreadsheet	Spreadsheet

Source: After Department of Education 1988, pp 6-7.

An examination of the conference proceedings extends these insights by indicating changes over time. These are summarised in Table 8. The data indicates the continual strength of databases and wordprocessing, and of teacher inservice as an issue of interest. The use of the computer in the constructivist teaching and learning framework seems to dominate, rather than the use of the computers as a tutor, under various CML regimes.

Table 8. A summary of trends in educational computing evident in Federal and State conference papers 1983 to 1988.

Usage areas showing increases in the number of papers presented:

* Databases
* Communication (use of modems)
* Desktop publishing
* Computers in music
* Robotics

Usage areas showing continuing high level of support since 1983

* Wordprocessing
* Teacher inservice

Usage area which now attract fewer papers than in the past:

* School administration
* Problem solving and Logo
* Computer programming

Areas continuing to generate little discussion as papers subjects:

* Equity issues
* Expert systems (papers only from tertiary educators only)

The summary found in Table 8 is based upon the figures presented as Table 9. The figures were obtained by calculating the percentage of papers at each conference dealing with each topic. (N.B. a numerical count was not used, as it would yielded data which partially reflected the size of the conferences themselves, introducing an element of distortion into the trends evident).

General observations which can be made from the data include:

* Databases have maintained a strong presence at both the Federal and State conferences

* Computer communication may have peaked as an issue in Australian schools, following a number of significant pilot studies involving international as well as national and state level exchanges. The technology has been used in a variety of curriculum areas, as well as by teachers for curriculum and other support.

* Wordprocessing has had a very strong presence in primary schools for process writing, with less involvement from secondary schools. As indicated in Table 7, it remains the major software package used by schools.

* School administrative use of computers has declined dramatically as a topic at the Computers in Education Conferences. This partially reflects the separation of educational and administrative computing functions by state Departments of Education at the policy and administrative levels.

* Gender equity has received very little attention. All presentations on the topic have been by female speakers.

* The excitement expressed by the conferences in 1984 and 1985 for the use of the computer in problem solving has not been sustained. Various suggestions, including the relative difficulty found by teachers in developing the ideas in the classroom, and the integration of problem solving into the curriculum have been proposed as possible explanations for these observations.

* Logo has maintained a strong presence, partially because new uses for it are continually being "found" e.g. logo in music, robotics (especially lego). Logo seems to have a particularly strong representation in the conferences of the state of Victoria, partially because of the influence of a number of individuals who are interested in or are researching the use of this learning environment. Some concerns have however been expressed about the extent of the use of Logo in Australian schools, with many teachers not going past simple turtle graphics and finding few gains in doing so. Fitzgerald (et al 1985, 3) went so far as to suggest that there were initially many "wild claims" about Logo, which could not be sustained. Table 7 however suggests that Logo is still widely used.

* Teacher inservice training and the professional development of teachers remains a significant issue, especially at the Federal level. Larger numbers of presentations at the 1983 and 1984 conferences reflected the generation of a number of tertiary courses, particularly at the Graduate Diploma level at that time.

* The new areas of desk top publishing, robotics and computers in music have drawn attention in the last three years.

* Papers on the teaching of programming have progressively declined since 1985. The slight increase in attention to the subject in 1988 reflects the release of syllabus documents for Years 7-10, and Years 11-12 at that time in New South Wales.

  The implications of these documents in New south Wales is however a matter of concern, as these syllabuses will place additional pressure upon the limited computer resources, and may lead to the denial of access to computers by other curriculum areas in secondary schools.

Table 9. Software usage as reflected by Federal and State conference papers 1983 to 1988. (as percentages of papers presented at each conference)

Year	1983	1984	1985	1986	1987	1988
Databases	6.8	2.7	5.7	4.1	11.1	8.4
Communication	3.4	2.1	5.7	4.1	6.5	3.2
Wordprocessing	0.0	5.4	6.6	4.8	7.1	2.1
School administration	3.4	4.1	1.0	3.2	0.5	1.1
Gender equity	0.0	1.4	2.9	2.4	0.5	2.1
Problem solving	6.8	11.5	14.3	4.1	4.3	6.3
Logo	5.1	12.1	10.5	12.1	8.2	9.5
Professional devel.	6.8	8.1	4.8	4.1	2.7	4.2
Desk top publishing	0.0	0.0	0.0	0.0	2.1	1.1
Computers in music	1.7	0.0	0.9	0.0	1.1	4.2

Fitzgerald (et al 1985, 27) found that primary schools reported increases in the use of Logo, word processing, and in curriculum areas other than maths and science over time. That study also found increases in the use of simulation, gaming, and graphics packages. Decline in programing, spread sheets and Computer Managed Learning were evident.

At the secondary level, Fitzgerald (et al 1985, 27) reported increased usage of the word processor, of the computer as an "intelligent" tutor, Logo, databases, spreadsheets, and work in curriculum areas other than maths and science. Declines were evident in the spread of computer clubs, computer awareness classes, programming and Computer Managed Learning.

Some 40% of Australian schools owning computers have developed administrative functions using the computers, while 19% have developed uses in the library (Fitzgerald et al 1985, 23).

The Fitzgerald research into software usage at the Federal level also looked at the perceptions of parents, teachers and the school authorities. The ranking of the areas of curriculum deemed most appropriate by each group is given in Table 10, and allows some

interesting comparisons to be drawn. Significant differences can be found between the three groups on the table, especially in regard to the teaching of programming which was ranked very highly by parents, but not by schools and teachers (one should however remember that no distinction has been made in the table between primary and secondary schools, where programming is a major teaching area Fitzgerald et al 1985, 23).

Other areas of difference include the importance of using the computer in the language arts - ranked highly in schools (in fact the major use for school administrators), but far lower by parents. Significant differences were also evident in terms of administrative tasks, which are given a relatively low ranking by schools, and remediation which was given the lowest ranking of any by the parents.

Table 10. Advantages of introducing computers

Advantages	School		Teacher		Parent	
	Rank	Mean	Rank	Mean	Rank	Mean
Developing language and written skills through word processing	1	5.2	4	4.8	7	4.6
As information source (e.g. library support, databases)	2	5.0	1	5.2	1	5.6
Learning and skills through simulation and educational games	3	4.8	4	4.8	5	4.8
Help students having problems with normal class-work	4	4.7	7	4.7	9	4.1
Practicing concepts and skills (e.g. drill and practice)	4	4.7	4	4.8	6	4.7
Administrative tasks (e.g. time-tabling, records)	6	4.6	2	5.1	2	5.3
Use in special education	6	4.6	3	4.9	4	4.9
As a basis for helping students gain a deeper understanding of school work	8	4.3	8	4.2	8	4.3
For teaching programming	9	3.7	8	4.2	3	5.0

Source: Fitzgerald et.al 1985, 30

Bigum's (1987, 21) observations are also interesting. He claims that currently those who teach "about computers " are winning out over those who wish to use computers for more general curriculum, partially because of the pressure on available machines and general limitations to resources and partially because of the time required at the machines for such courses. There is some concern that these trends may be observed in New South Wales, where computer studies courses have just been introduced and the pressure on available resources in likely to increase.

An interesting sidelight has been that of the teaching of keyboarding skills, which remains largely unquestioned (Bigum 1987, 23). The call for the development of these skills continues to extend further back into the primary school (Groundwater-Smith 1987, 32). Similar trends have been observed in the United States (Becker 1986a, 9).

The conference papers were also analysed to see what education levels and types of education appear to be dominating the changing patterns of school level computing. This work is summarised as Table 11 (an amplification of the kind of data presented as Appendix 6 which details figures for the Australian and New South Wales conferences). This table shows a general concentration on issues which are not related to specific education levels e.g. general discussions of types of software. It also indicates the strengthening of primary, special and preschool education, at the expense of secondary and tertiary education.

Basically this table reinforces the notion that computers are being used in wide areas of curriculum, and increasingly in the pre-secondary school systems. These details, when added to the data already presented, gives a picture of possible future directions for computer usage in curriculum. Additionally, the dominance of the computer consultant (i.e. people seconded from the classroom by the Departments of Education to support school development in computing) will continue to reinforce this leadership from a classroom base. These are the people who work with teachers on a daily basis, providing support and expertise to help teachers develop computing within their own teaching environments, as well as playing a significant role at the conferences (see Table 3).

Table 11. Topics and Presenters at Computers in Education Conferences at State and Federal Levels.

Topics most commonly presented

* General curriculum issues (50% of papers at many conferences)
* Secondary school issues (although declining)

Topics least commonly presented

* School administration using computers
* Preschool education (although a growing area)
* Special Education (although growing)
* Teacher inservice
* Primary school education (although growing quickly)
* Tertiary (declining after a peak in 1984)

In reflection then, computing in schools has principally been a simple extension of current teaching practice. Much of the leadership is coming from classroom practioners, often selected by respective Departments of Education for the computing which they have been seen to engaged in at their own respective schools. The leadership does not come from tertiary educators directly, nor from leaders in curriculum theory and practice.

A further issue concerns the extent to which the selection and use of software simply reflects current classroom practice. As Groundwater-Smith (1987, 28) points out, curriculum decisions are in reality inextricably linked to teachers personal views of pedagogy - how teachers teach and learners learn. Thus a believe in the "process of learning" may inevitably lead to the dominance of generic software (such as databases, spreadsheets and Logo) in some schools, as the experience is of key importance in the construction of knowledge (Kemmis 1987, 280). Teachers with a behaviouralist perspective may look to drill and practice or tutorials as an appropriate use of the computer.

A simple analysis of software usage may thus say more about existing teaching practice than it does about the educational merits of the software itself. One is left to ponder wether an analysis of software usage by schools really contributes anything to a debate about the perceived merits of software at all, or the extent to which there is any revolution taking place in the classroom.

Certainly the computer allows teachers the opportunity to possibly look more critical at their own philosophy of education (Groundwater-Smith 1987, 41). Kemmis (1987, 272) suggests that teachers are beginning to change their understanding of the new technology, which is opening broader issues of educational practice through using the computer.

One might therefore suggest that we have a need for an adequate theory of articulation as we can not assume adoption of the new technologies by our schools. As professionals in the area, we have probably given insufficient thought to how the innovation can be secured in an appropriate way, by working towards the development of an appropriate philosophy and educational justification for the use of the computer in our classrooms. Are we sure that there has been change, or have we no appropriate ground for the kind of innovations in education which we believe the computer is capable of delivering? Should we be talking about the word "revivification", rather than the word "revolution" suggested by the Parliamentary Standing Committee? We will revisit this theme at the conclusion to this paper.

The innovation and the student body

As indicated earlier, the movement towards the adoption of computing in schools occurred concurrently with the general development of policy to promote equity of access to and outcomes from the education system. Girls appear to be disadvantaged in terms of both access to computers, and in the nature of the computing in which they are engaged. Some of the reasons given for these differences between boys and girls at the computer are listed as Appendix 7.

A meta-analysis of this important area was carried out by Fitzgerald (et al 1985, 7), but this yielded few valid studies for that purpose. In fact Fitzgerald went on to lament the paucity of empirical research on this important area. Interestingly, the topic has received scant attention at the Computers in Education Conferences too, as indicated by Table 8.

A number of points can be made about current classroom practice and student use of computers from the research of Fitzgerald (et al 1985, 42), where regard was also paid to the gender issue:

* A greater usage of the computer by boys than girls, although the levels of significance were interesting:

Situation	Chi sq	df	p
In class	15.01	4	0.004
Out of class	70.52	4	0.001
At home	80.34	4	0.001

* Boys appear to have used computers for longer periods of time that girls, with significant differences in the numbers of students who had experience in the use of computers for more than three years.

* Fitzgerald (et al 1985, 33) found stronger evidence to support a contention that high achievers use the machines more than low achievers (Chi sq 64.32, df=2,

p = 0.001). It was also found that young students are more likely to use the computers than the more senior grades (Chi sq 227.8, df=3, p=0.001).

* It has been suggested that boys do better than girls at computing because of their superior mathematics ability, but Fitzgerald (et al 1985, 39) found a more general correlation between children using computers and overall ability at school work.

* There seems to be little difference between computer usage on socio-economic grounds, except for home usage (Fitzgerald et al 1985, 33).

* Fitzgerald (et al,1985, 25) looked also at the percentage of parents who were also computer users. It was found that 22% of fathers were regular users, but only 10% of mothers (see Table 1). Yet although there was general strong support for the use of computers in schools, female parents of primary kids were the most supportive of all (Fitzgerald et al 1985, 26).

* Table 12 indicates computer usage rates for students based upon the survey of Fitzgerald (et.al 1985, 33). It should be noted that 54% of students use computers in class at least once per week, with smaller percentages using computers at school but out of class (25%), and at home (27%).

Table 12. Percentages of student using computers.

	In class activities	In school but out of class	At home
Never	25	50	58
Very rarely	21	26	15
Once a week	31	11	6
Few times a week	19	8	10
Almost daily	4	6	11

Source: Fitzgerald et.al 1985, 33.

Innovation futures

Fitzgerald (et al 1985,31) included a table summarising the major problems seen by parents, teachers and students in the introduction of computers to schools. The table is reproduced as Appendix 8, and shows considerable agreement among those canvassed. Basically the problems perceived by the respondents fell into two broad groups - staff development and the adequate provision of software and hardware. A consideration of the future development of computing in schools can not be contemplated without careful consideration of these issues, and is an appropriate place to conclude this discourse on developments in computing in Australian schools.

The first identified area of concern, that of the professional development of teachers proved to be a significant issue in the report of the Standing Committee of the House of Representatives (1989, 84). This report highlighted the problem and suggested that additional government funds were needed. It also raised the need to encourage teachers to pursue further studies through a series of incentive schemes. Further, it suggested that teachers should be rewarded for obtaining formal qualifications, and that study leave should be provided for teachers who were prepared to study the new technology in such a manner. No such scheme currently exists.

As an indication of the extent of the professional development problem, an examination of Table 1 reveals that 50% of all teachers are not using computers, despite the six years of effort by Federal and State governments to provide courses and machines. If the sole purpose of computing in schools was to study the machine itself, then a small number of suitably qualified and specialised teachers would be sufficient and the figure of 50% would not be a matter for concern. Parents, and one suspects the wider community, certainly see the computer in schools as an object of study, rather than as a support for general curriculum (see Table 10), but this view is not shared by the majority of the teaching profession. Teachers are more concerned with the use of computers to support curriculum practice, rather than a object of study.

While the development of universal computer literacy among the teaching profession is unrealistic, there is general acceptance that despite the growth of computing in schools over the last 6 years, that present levels of usage are too low. The development of computing expertise in the teaching profession is problematic however, and some of the issues involve have been raised in this paper. The major considerations are presented below in summary form.

* Wright (1983,8) suggested in 1983 that the computer is "a novel tool to accomplish traditional tasks". There is certainly evidence that this remains the situation in 1989, and leads to agreement with Kemmis's contention (1987, 281) that computers are allowing teachers to continue, and in some cases extend current curriculum practice, but with no theoretically-based aspirations about improving the process of learning.

* The future of computing in schools is likely to be practical and down to earth, as has been the progress of the innovation up until now. If the innovation is to endure as a vital part of school curriculum, then system level curriculum planning may need to start by looking more carefully at current classroom practice, and developing a coherent approach to computing across curriculum areas as a result. To extend the ideas of Kemmis (1987, 281), it appears that the innovation will only imbed if it is tightly related to current teaching practices.

  Further, the enormous potential of the computer to support constructivist views of teaching and learning (using databases and other application software) may only be reached when teachers themselves begin to practice such pedagogy in their own classrooms. To a large extent we still know too little about what teachers actually do in the classroom, as opposed to what they claim to be doing at public occasions such as the conferences analysed for this paper.

  Ultimately we find that we are talking about revivification and not revolution. It seems that the computer is moving very slowly in actually changing pedagogy. The use of the computer in curriculum is only reflecting current teaching practices, despite some rhetoric to the contrary.

* School computing is developing in a vacuum, based upon the "suck it and see" model of evaluation and implementation. This almost scatter-gun approach to the development of computing in curriculum not only reinforces the many-faceted nature of the innovation, but exacerbates any problems of directionlessness which result.

  To be fair, some of this almost random development is greatly influenced by the development and release of new hardware and software, but one can remain critical of the general lack of coherence of the development of computing in curriculum. The lack of a solid theoretical or philosophical background for this innovation has largely lead to a trivialisation of the innovation during implementation and evaluation, and threatens the long term viability of the introduction of the computer as a powerful curriculum tool. While one can certainly argue that theoretical

constructs can follow practice, there does seem to now be a case for some reflection on what has happened, and an attempt made to develop some formal structures which tie the computer into classroom learning and practice.

So, it would seem that the professional development of teachers is not simply a matter of teaching how to use computers and software. It needs to develop from a considered rationale, with roots implanted in existing teaching practices.

Professional inservice remains an essential aspect of the effective translation of the innovation into Australian classrooms. However, more of the same is not good enough for the successful adoption of computers into curriculum in the next period of six years. The pragmatism of the last six years needs to be understood, and dealt with in appropriate measure.

The second issue is that of hardware and software support. The Standing Committee of the House of Representatives also concerned itself with this issue, and recommends that "sufficient funds should be provided to meet the OECD target of one microcomputer per ten students by the commencement of the 1992 school year" (1989,10). Such calculations are in line with those of Becker (1986, 3), who suggests a computer to student ratio of 1:12 is needed to provide 30 minutes of computer time per week to each student in a school.

In a recent decision by the new Minister of Education in New South Wales, money is to be made available for the purchase of computers, using funds redirected from the savings made by reducing the number of teachers in the state by some 2000. This decision has, understandably, not been well received by the electorate, and may actually be counter productive in the school environment, where significant numbers of teachers still do not accept the inclusion of computers in the curriculum. The funds are to provide the equivalent of one computer in every primary classroom, and an additional 15 computers in every secondary school. He has also allowed funding for the appointment of computer co-ordinators in each school.

The future of computing in Australian schools is thus probably bright. The additional funding provided by State and Federal governments will ensure that the patterns established over the last six years can continue. Yet therein lies the dilemma. While computers are now widely distributed in Australian schools, in proportions somewhat similar to American schools, we still have a long way to go before the full potential of the computer is reached in our curriculum. In the past six years teachers have "done it their way", and it now remains for curriculum planners to develop the structures to allow this progress to rationalise future uses of the computer as an integral part of school curriculum, possibly with a little less of the pragmatism which has guided the development thus far.

Appendix 1. Computers in education - the 1983 perspective.

1. Western Australia (Penter 1983, 97-99)

* Microbee (a cheap Australian designed and manufactured machine). welcomed as alternative to the more expensive British BBC micro.
* In-house software development seen a priority.
* A major concern was expressed for teacher inservice.

2. Northern Territory (Barnsley 1983, 100-101)

* Ties between computers and the math/science curriculum areas had just been broken.
* Need for inservice set as a priority.
* Primary school were emphasizing computer awareness.
* There were 250 computers in Departmental schools (secondary having two each, and most urban schools having at least one)
* Major computers used include the Vic 20, BBC and Apple II.

3. Tasmania (Brownell 1983, 102-105)

* The major computing centre had been establishment (the Elizabeth Centre in Hobart).
* Inservice involved 70 hour courses plus printed materials.
* The development of in-house software seen as a priority, especially for the TASNET system (State-wide computer link). More support staff were however urgently needed, especially for planned software development.
* A syllabus for computer studies, especially for years 11 & 12 was under development.

4. Australian Capital Territory (Dunkley 1983, 106-107)

* Curriculum is developed by each school, so no curriculum documents exist for the whole territory.
* School authority has no policy on computers in curriculum.
* Senior High Schools (colleges) were already connected to a PDP 11/60, and many also had microcomputer facilities. Computers were used mainly for teaching computer science or maths.
* A syllabus was to be developed for Colleges (Years 11 &12).
* In primary schools the Apple II was the most common machine, these being used for Logo, and general curriculum support.
* The system was hampered by staff expertise - call for inservice.
* A Graduate Diploma was about to be taught to teachers interested in computers at the Canberra College of Advanced Education.

Appendix 1. (Continued) Computers in education - the 1983 perspective

5. South Australia (Sandery 1983, 108-110)

* The Angle Park Centre had been set up to co-ordinate the development of computing in the state. It was equipped with an IBM 4331, 20 BBC microcomputers and 10 Apple II
* Many schools had LAN systems, based around Tandy, Vic 20, Apple II, or BBC microcomputers
* Computer Awareness, and Computer Studies were taught in years 11 and 12
* Some software development for administration had taken place.
* A Graduate Diploma was about to be taught to teachers interested in computers at the South Australian College of Advanced Education.

6. New South Wales (Smith 1983, 111-115)

* The first policy document was released in October 1982.
* Some interest in CAL, and a lobe was being taught in the maths course in computing.
* The Department saw a need for the development of a compulsory computer awareness course, and a computer studies syllabus for Years 7-10, and 11-12. (N.B. the Computer Awareness Syllabus was developed in 1985, while the Computer Studies documents were released in 1988).
* A priority for inservice training for teachers was noted. Consultants were to be seconded for this purpose.
* The Government agreed to support only two computers - the Microbee and Apple II
* A total of 78% of secondary schools had at least one microcomputer when a tally was made in 1982.

7. Victoria (Inchley 1983, 116-118)

* A committee was established to examine developments in Primary and Secondary schools.
* Consultancy support was to be provided at the centre and at regional centres.
* Emphasis was to be on given to cross curricula uses of the microcomputer.
* An administrative package was to be developed for the microcomputer, but this work was to receive a low priority.
* The inservice training of teachers was a priority, and was to be regionalised.
* The main computers used in schools were the Micromation and Option II, Apple II, Cromemco, Vic 20, and Microbee microcomputer.

Appendix 2. Computer Systems in N.S.W Schools in 1986.

a. Numbers of computers in each category.

Category	Central	Special	Primary	High	Total	Percentage Value	Percentage Units
Apple II	275	102	1485	2945	4807	59.0	40.0
Apple Mac	3	2	6	33	44	1.0	0.4
Atari 800XL	19	4	292	126	441	3.0	4.0
BBC Model B	0	6	115	90	211	2.5	2.0
Microbee	174	56	3368	1765	5363	32.0	45.0
MS DOS machines	2	4	28	88	122	2.0	1.0
Others	13	7	349	578	947	N/A	N/A

Source: Department of Education 1988, pp 6-7.

b. The percentage of schools using the major two microcomputers (expressed as a percentage of all schools in each category)

Category	Central	Special	Primary	High	Total	Percentage Value	Percentage Units
Apple II	57	56	26	52	40	59.0	40.0
Microbee	36	31	60	31	45	32.0	45.0
Combined total	93	87	86	83	85	91.0	85.0

Source: After Department of Education 1987, 4.

Appendix 3. The percentage of schools responding to the survey with at least one computer as grouped by education administrative regions for the state of New South Wales.

			Primary schools						
Region	**Cen.**	**Special**	**P1**	**P2**	**P3**	**P4**	**Prim.**	**Sec.**	**Total**
CITY REGIONS									
Hunter	100	56	92	81	77	67	79	100	81
Met East	100	45	60	76	75	100	72	100	74
Met North	-	62	98	94	87	100	95	100	93
Met South West	-	47	80	83	62	-	79	100	81
Met West	-	75	87	78	79	75	82	100	85
COUNTRY REGIONS									
North Coast	100	55	95	91	82	74	83	100	85
North West	100	57	100	100	90	79	89	100	91
Riverina	100	86	100	92	86	77	86	100	89
South Coast	100	54	92	84	80	89	85	100	86
Western	100	71	100	100	98	85	93	100	94
STATE	100	57	87	85	83	80	84	100	85

Source: After Department of Education 1987, Appendix 2.

Appendix 4. Peripherals in N.S.W Schools in 1986

School Category	Primary schools Class 1	Class 2	Class 3	Class 4	High schools	Total
Printer	536	720	401	174	1344	3175
Koala pad	13	13	11	2	31	70
Light pen	7	8	-	-	18	33
Concept keyboard	3	8	5	5	3	24
Plotter	3	3	1	-	31	38
Powerpad	6	18	8	2	22	56
Modem	42	54	37	16	115	264
Bitstick	7	16	7	9	26	65
Mouse	44	51	27	15	174	311
Turtle robot	9	24	14	6	11	64
Other	21	16	11	13	58	119
Total number of schools	336	669	549	291	377	2252

Source: After Department of Education 1987, 5.

Key to the size of Primary schools:

Class 4	29 pupils or less
Class 3	29-159 pupils
Class 2	159-450 pupils
Class 1	450 + pupils

Appendix 5. Summary of software, based upon the selection by schools of the five most important packages currently used.

Category	Central	Special	Primary	High	Total
Word processing	28.5	11.4	17.3	28.5	19.9
Mathematics	8.5	19.2	17.0	5.2	14.3
Graphics	14.4	12.9	8.3	14.3	10.0
Simulations	5.9	6.7	8.7	5.0	7.8
Logo	8.5	3.3	6.7	9.8	7.3
Reading	3.0	7.0	7.8	3.5	6.7
Spelling	1.5	5.2	6.1	0.8	4.8
Databases	6.7	0.4	1.5	10.8	3.6
Adventure games	6.3	2.2	1.9	0.6	1.8
Keyboard skills	1.1	1.5	1.3	0.0	1.1
Writing tools	0.4	0.7	1.5	0.8	1.3
Spreadsheets	1.1	0.0	0.0	0.6	0.2
Communications	0.4	0.0	0.1	0.1	0.1
Unclassified	13.7	29.6	21.5	19.9	21.2

Source: Department of Education 1987, 6.

Appendix 6. Topics for papers presented at Computers in Education Conferences. (expressed as a percentage of all papers presented).

* **Australian conferences**

Year	1983	1984	1985	1986	1987	1988
Primary	11.9	8.1	8.3	22.6	6.4	10.4
Secondary	18.6	9.5	22.2	12.9	19.1	14.6
Tertiary	6.8	23.0	19.4	6.4	4.3	8.4
Preschool	0.0	2.7	2.8	0.0	6.4	6.2
Special Ed.	0.0	2.7	5.6	4.8	6.4	2.1
General issues	61.0	48.7	41.7	51.6	53.2	58.3
Administration	1.7	2.7	0.0	1.6	0.0	0.0
Professional dev.	0.0	2.7	0.0	1.6	4.3	0.0

* **New South Wales conferences.**

Year	1983	1984	1985	1986	1987	1988
Primary	No data	8.1	8.0	16.1	18.6	16.7
Secondary	-	9.5	32.0	25.8	16.3	22.9
Tertiary	-	23.0	0.0	4.8	0.0	2.1
Preschool	-	2.7	0.0	0.0	0.0	0.0
Special Ed.	-	2.7	4.0	1.6	2.3	4.2
General issues	-	48.9	52.0	45.1	60.4	50.0
Administration	-	2.7	0.0	4.8	0.0	2.1
Professional dev.	-	2.7	4.0	1.6	4.7	4.2

Appendix 7. Possible variables influencing the gender use and attitude towards computers.

* Girls prefer to work towards a goal, while boys are just happy to play with the machine (Lawrence 1985, Sanders 1985 in Willis, S., 1987 p 1970)

* Machine more often seen as being male in nature (Fitzgerald et al 1985, 40)

* Computer hackers, and those in power positions in computing tend to be male

* Video games tend to be developed for the male market, with male language

* Girls tend to be less interested in visual stimulus, preferring visual feedback

* Girls in middle school more "social", preferring people to things

* Girls see the value of computers, but prefer group work to individualised instruction in front of a computer screen. Fitzgerald (et al 1985, 43) found some meta-analysis support for such a contention.

* Males more aggressive for computer time, however this dissipates with age

* Girls more likely to "give up", as they believe that they will receive social approval (i.e. for being in a helpless state). This factor is strongest during puberty (Fitzgerald et al 1985, 41)

* Girls avoid competition, as they may appear less feminine, and unattractive to males (Fitzgerald et al 1985, 41)

* Girls see less place for computers in the future lives

* Computers use spatial skills - more prevalent in males (Fitzgerald 1985, 41)

* The nature of mastery is different - boys take control while girls negotiate - soft mastery (Fitzgerald et al 1985, 42)

* Software is too aggressive, a statement for which there is little Australian evidence, and boys are more competitive.

* There are computer users who are male and female teachers, but male teachers occupying the key positions, creating stereotypes (Fitzgerald et al 1985, 43).

* Boys and girls rate computer activities among their **preferred** activities at school, but more girls than boys related computer activities among the **least** preferred activities. (Fitzgerald et al 1985, 25)

* Students rather than parents of teachers believe that males are better with computers than are the girls. (Fitzgerald et al 1985, 27).

* Parents see more technical future for boys than girls, and are therefore more likely to send boys to computer camps (Fitzgerald et al 1985, 42).

* More fathers than mothers use computers at home, providing role models for children (Fitzgerald 1985, 42)

Appendix 8. Major Problems of introducing computers

Problem	School		Teacher		Parent	
	Rank	Mean	Rank	Mean	Rank	Mean
There are not enough computers available in classrooms	1	5.3	1	4.8	1	4.6
Insufficient funds available for the purchase of equipment	2	5.1	5	4.2	3	4.4
Lack of suitably trained teachers, especially to act as resource people	3	4.7	3	4.4	1	4.6
Teacher education institutions are not are not providing adequate preparation	4	4.4	2	4.5	4	4.3
Very little is known about how children learn when using computers	5	4.0	6	3.9	6	3.9
Lack of inservice course on using the computer in the classroom	5	4.0	4	4.3	5	4.0

Source: Fitzgerald et.al 1985, 31

Bibliography

Barnsley, R., 1983 Education computing in the Northern Territory
in Proceeding so Australian Computer Education Conference 1983
Melbourne: Computer Education Group of Victoria. pp.100-101.

Becker, H.J.,1985a How schools use microcomputers: summary of the First National Survey.
Baltimore: Johns Hopkins University

Becker, H.J.,1985b The Second National Survey of Instructional Uses of Computers: A preliminary report.
Paper presented to World Conference on Computers in Education, Norfolk Virginia, August 1985.

Becker, H.J.,1986a Instructional use of school computers - Report form the 1985 National Survey. Issue No.1.
Baltimore: Johns Hopkins University

Becker, H.J.,1986b Instructional use of school computers - Report form the 1985 National Survey. Issue No.3.
Baltimore: Johns Hopkins University

Brownell, S., 1983 Education computing in Tasmania
in Proceeding so Australian Computer Education Conference 1983
Melbourne: Computer Education Group of Victoria. pp.102-105.

Bigum, C., 1987 Architects or Bees?
in Coming to terms with computers in schools:
Report to the Commonwealth Schools Commission
Melbourne: Deakin University Press

Dunkley, J., 1983 Education computing in the Australian Capital Territory
in Proceeding so Australian Computer Education Conference 1983
Melbourne: Computer Education Group of Victoria. pp.106-107.

Fitzgerald, D., Hattie. J., Hughes, P., 1985
Computer applications in Australian Classrooms
Canberra: Australian Government Publishing Service

Groundwater-Smith, S., 1987 The curriculum implications
in Coming to terms with computers in schools:
Report to the Commonwealth Schools Commission
Melbourne: Deakin University Press

Groundwater-Smith, S., & Bigum, C., 1987 Introduction
in Coming to terms with computers in schools:
Report to the Commonwealth Schools Commission
Melbourne: Deakin University Press

Grundy, S., Evans, P., McKenzie,D., 1987 Teaching Teachers
in Coming to terms with computers in schools:
Report to the Commonwealth Schools Commission
Melbourne: Deakin University Press

House of Representatives Standing Committee on Employment, Education and Training
An Apple for the Teacher: Choice and technology in Education
Canberra: Australian Government Publishing Service. 1989

Inchley, G., 1983 Computers in Education : State of the art in Victoria
in Proceeding so Australian Computer Education Conference 1983
Melbourne: Computer Education Group of Victoria. pp.116-120.

Kemmis, S., 1987 How school computing is changing education
in Coming to terms with computers in schools:
Report to the Commonwealth Schools Commission
Melbourne: Deakin University Press

Kemmis, S., 1987 School computing and educational reform
in Coming to terms with computers in schools:
Report to the Commonwealth Schools Commission
Melbourne: Deakin University Press

New South Wales Department of Education 1983
Computers in Schools: a general policy statement
Sydney; Government Printer

New South Wales Department of Education 1987
Report on Computer Education in NSW Government Schools
Sydney; Government Printer

Penter, K., 1983 Education computing in Western Australia
in Proceeding so Australian Computer Education Conference 1983
Melbourne: Computer Education Group of Victoria. pp.97-99.

Sandery, P., 1983 Education computing in South Australian schools
in Proceeding so Australian Computer Education Conference 1983
Melbourne: Computer Education Group of Victoria. pp.108-110.

Smith, P , 1983 Education computing in New South Wales Government Schools
in Proceeding so Australian Computer Education Conference 1983
Melbourne: Computer Education Group of Victoria. pp.111-115

Willis, S., 1987 Access to the program by girls and disadvantaged groups
in Coming to terms with computers in schools:
Report to the Commonwealth Schools Commission
Melbourne: Deakin University Press

Wright, D.A., 1984 Instructional use of computers in public schools
Washington DC: National Centre for Education Statistics