NEW SOUTH WALES

PERFORMANCE AUDIT REPORT

DEPARTMENT OF EDUCATION AND TRAINING

Using computers in schools for teaching and learning

AO

The Audit Office of New South Wales

Performance Audit Report

Department of Education and Training

Using computers in schools for teaching and learning

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Executive Summary

Executive summary

Policy goals

The NSW public school system comprises more than 2,200 schools, 750,000 students and 50,000 teachers.

The Government's Computers in Schools Policy[1] outlined the following long-term goals:

- every child should be familiar with computers as a normal educational tool
- the use of computers across all subjects should be optimised
- computers should help to achieve educational outcomes more efficiently and with greater quality
- students should develop analytical, organisational and problem solving skills to cope with expanding access to computerised information.

Expenditure on the Computers in Schools Program (for public schools) in its first four years was $170.6m, and the budget for the Program in 1999-2000 was $92.8m. Implementation of the Program State-wide for such a large system has represented a significant logistical and management challenge. (As this report went to print, future funding was announced in the 2000-2001 State Government Budget. This is reflected in the Department's response.)

The audit

This audit considered:

- the logistics of putting computers in schools
- the use of computers for teaching and learning.

The audit involved:

- more than 30 person days spent on site examining in detail the use of computers at four primary and four secondary schools
- interviews with relevant officers of the Department of Education and Training and other experts, including teacher training faculties of major Sydney universities
- file and document examination
- extensive international literature review, focusing on academic research into computer technology and teaching and current practices in other jurisdictions.

[1] Announced in the Government's (then opposition's) 1995 election Statement on education.

The audit recognises that the Program is ongoing. This report represents a snapshot at a point in time, with the aim of assessing progress to date against the Department's expectations and identifying issues which need to be considered in determining the future direction of the Program.

Audit opinion

Realisation of the Government's objectives for integrating computers into the school environment is a major change that will take some time to achieve. The logistics of equipping schools with computers and making them operational have been approached energetically by the Department. Four years into the Computers in Schools Program, student and teacher access to computer hardware, software and the Internet is now substantially greater and teachers are now better placed to integrate computers into teaching and learning. But while much has been achieved there are significant challenges that still remain.

It was observed that much of the responsibility concerning the use of computers in schools rests with schools themselves. The Department correctly considers that computers are a fundamental component of the education system, with more far reaching consequences than most other categories of acquisitions which schools may make. Given this, in allowing schools considerable freedom in integrating computers into teaching and learning, the Audit Office considers that access and equity issues should be closely monitored. Limits on the extent of variation between schools may be an issue.

For example, the Audit Office observed that computer to student ratios are greatly uneven, largely due to differences in discretionary resources which some schools have been able to utilise to supplement resources received through the Program. The same can be said for local area networking, peripheral equipment and technical support.

More importantly, however, the greatest challenge for the Department is now the integration of computers into teaching and learning, which is still at an early stage. After four years of the Program, this still represents a major cultural and operational challenge for the Department to resolve.

Computer use by teachers for teaching and learning at the schools visited varied significantly. Anecdotal evidence suggests that a similar amount of variation exists across other schools.

Program implementation

The Computers in Schools Program was introduced in 1995-96 when the computer to student ratio in NSW public schools was approximately 1:20.

The Department articulated the Computers in Schools Program in a number of documents and technology outcomes are being included in each new syllabus as it is developed.

By the end of 1999:

- 77,000 computer units had been distributed to schools and the ratio of computer units to students was better than 1:11 in all schools. The ratio in small schools and Schools for Specific Purposes was significantly better. The Government is committed to reducing the ratio (ie providing more computers per student) further during its second term
- all schools had been connected to the Internet and most had access to the Department's wide area network
- all schools had received a technology grant which they could use for infrastructure or training
- an annual computer coordinator allowance is provided to all schools
- 15,000 teachers had received training in the use of computers for teaching and learning through the centrally coordinated Technology in Learning and Teaching (TILT) course
- forty district technology advisers had been appointed
- curriculum support documents had been produced and provided to teachers and curriculum support information is available at Departmental web sites and on CD-roms.

Devolution to schools

The Department devolved responsibility to schools to determine how to make best use of the computers and other resources provided to them under the Program. This included decisions about what additional infrastructure and support schools would provide from their operational grants and other school funds. The Department has a general, long standing philosophy that within a State-wide framework, educational decisions are best made by schools, reflecting local needs, priorities and resources.

To support schools in this process, schools have received advice and support from the district-based technology advisers, training and development and curriculum coordinators, all of whom are briefed on the Program. Schools and teachers are guided in their decisions by curriculum documents, professional development activities, advice from district personnel including technology advisers and a central help desk. In addition to the curriculum

documents provided to schools, a set of curriculum implementation packages has been distributed to District Offices.

Under this devolved approach, the Department considers that variations are appropriate and innovation is encouraged.[2]

Variation between schools and teachers

Nevertheless, the variation between similar types of schools visited in terms of infrastructure, support and use of computers for teaching and learning was significant.

There was substantial variation in the level of computer hardware, software, technical support and local area networking in the schools visited. For example:

- the computer to student ratio ranged from 1:12 to 1:6
- access to peripheral and other computer equipment and the amount and type of software available to students differed markedly between schools
- the level per computer and approach to technical support varied markedly, although all schools visited indicated that technical support was inadequate and presented an impediment to effective use of computers
- the extent of local area networking ranged from almost all computers to none[3]
- the design and installation of some local area networks was by professionals with others by volunteers.

There was also substantial variation between the schools visited in their approach to using computers for teaching and learning. The primary schools tended to exhibit a more student-centred approach than secondary schools. The student-centred approach was characterised by student collaboration, construction of knowledge by the student and a cross-curricula focus. The traditional approach was characterised by use of the computer for enhancing research capabilities and presentation.

The Audit Office also observed significant variation between teachers in the way they and their students used computers and in their extent of computer use. Some teachers make little or no use of computers for teaching and learning. Others make extensive use of computers and a wide array of computer functions.

[2] The Department also advises that deliberate decisions were taken to provide more Program computers to Schools for Specific Purposes and small schools.

[3] Local area networks and multi-point Internet access are considered by schools and experts to substantially increase the functionality of computers.

Reasons for variation

Reasons for the variation included:

- Leadership. Some schools exhibited a clearer 'vision' for using computers than others. This tended to be where the principal, computer coordinator or another staff member had enunciated and reinforced such a vision and the school had put in place supporting strategies. On the other hand, during school visits several principals and teachers expressed uncertainty about the Department's expectations for using computers and in particular for integrating computers into the curriculum.

- Additional sources of funds. Some schools had significantly greater capacity to fund hardware, software, local area networks, consumables, additional support etc than others. Schools that received high levels of voluntary parental/community contributions were well placed to advantage their students with better computer facilities. Also, schools which received special funding, such as Disadvantaged Schools Program funding, had some funds for this purpose. However, the schools which fell into neither group relied mostly on funding from the Program. These schools generally had less computers available for their students, and less effective set-ups for using computers. There is likely to be a large number of schools in this latter category.

- School specific factors. Resourcing does not generally acknowledge such factors as school location, layout, design, geography, age, facilities etc, which impact on the costs and complexities of computing initiatives for individual schools.[4] Some other factors were not within the capacity of an individual school to address, such as classroom size.[5]

- Knowledge of the school community. Knowledge about technology and how to use it for educational purposes varied between school communities and individual teachers. Written guidance available to schools was limited. Whilst not the only source of advice, much reliance was placed on district technology advisers. Each technology adviser was required to support approximately 55 schools on average. The schools visited reported that they needed more assistance than the technology adviser was able to provide.

[4] For example, the costs of security, re-wiring, refurbishment and network cabling.

[5] Several classrooms in some sample schools appeared too small to house both students and more than one or two computers.

- Primary or secondary school. The underlying reasons for the variation between primary schools and secondary schools were not clear, but the subject-oriented periods characteristic of secondary education may provide some explanation. The Department advises that it is undertaking a number of significant initiatives concerning the structure of secondary education and the use of information and communications technologies in any future structures.

Clearly, there will be some variations that are acceptable and innovation is to be encouraged. Equally, some variations will be problematic. The visits to schools suggest, however, that the issue of equity is a matter which the Department needs to monitor and take corrective steps should those variations go beyond acceptable limits.

Standards, systems and accountability

The Audit Office considers that under the approach developed and implemented by the Department, it is necessary to:

- establish standards and an acceptable range of variation
- put in place systems which provide the data to allow the Department to make informed judgements about
  - the need for schools to be helped to take remedial action
  - achievement of the Government's longer term objectives
  - future Program directions
- ensure that principals and teachers understand system expectations and are held accountable for the efficient and effective use of computers for teaching and learning.

At present, standards, systems and accountabilities require some further development. The Department has put in place several initiatives which should over time put it in a better position to make informed decisions about the deployment and use of computers for teaching and learning. Initiatives in this area are for the most part at an early stage, but the rate of development has noticeably increased over the last twelve months. The development of standards and systems to collect relevant data needs to remain a focus for the Department. Similar programs in other States offer approaches worthy of examination.

The establishment of 'minimum competencies' for teachers in the use of computers for teaching and learning is illustrative. The Department now requires that all new graduate teachers (from NSW and ACT universities) have minimum competencies. However, discussions with the education faculties of the universities suggest that there are differences in their understanding of the Department's requirements and in

interpretations of the skills required of new teachers. The Audit Office considers that there is a need to specify these competencies more clearly and the way they are to be measured. Consideration should also be given to expanding the application of minimum competencies to teachers already within the system, perhaps by linking them to promotional opportunities. Minimum teacher competencies are in place in some other States and overseas jurisdictions.

Hardware and infrastructure strategy

An early priority of the Program was to provide basic hardware and infrastructure to schools. Without sufficient infrastructure, training and development and content provision would not be effective. Once the infrastructure is in place teachers and students require time and support to develop the skills and confidence to effectively use the resources at hand.

The Department's approach to making computers available to schools has had a number of advantages. The negotiation of State-wide contracts has resulted in economical pricing of computers. Leasing allows computers to be kept up-to-date. The requests for tender specified modern, multi-media computers which have not become redundant before scheduled replacement. The flexibility to combine computer units to obtain laptops or file servers is strongly supported by school communities

The Department also allowed schools to choose the computers they wanted from among the accepted tenders. This allowed schools to choose an Intel supplier from a limited range or to select Apple. Whilst this approach is strongly supported within schools, it only requires schools to consider the type of computers to be chosen and not cost.[6] In the early stages of the Program, the difference in cost between Apple and Intel computers was significant. This difference is now less significant, with each having some products cheaper than the other.

[6] In addition, the multiple operating systems used to operate the different computers contributed to the need to train staff and provide support for multiple computer environments and the need to retrain students who move between schools with different operating systems. Whilst not a major issue in the Department's view, it is apparent that this added another issue to an already difficult implementation program.

The Department has State-wide licensing arrangements with a number of software suppliers. In particular, it has recently negotiated a State-wide licensing arrangement for a range of Microsoft applications which will form a core of software for schools. The Department should continue to expand such arrangements. Improvements to data gathering systems should over time offer better information to guide activities in this area.

Teacher development

The TILT course has provided training to 15,000 NSW public school teachers and has won several awards. Curriculum support is considered by teachers to be of good quality. The main issue with both is quantum. For example, TILT covers a large amount of material in thirty hours and cannot be expected to transform a beginning user into a teacher able to use computers effectively.

There is evidence to indicate that change to teaching and learning practices is occurring, albeit at different rates. In the schools visited, it was clear that some teachers have a long way to go before they achieve the level of skill in using computers for teaching and learning of some of their colleagues.

The Department needs to consider whether the current rate of change is meeting its expectations (and perhaps also to identify areas of leading and lagging progress). It also needs to consider when an acceptable minimum level of infrastructure will be in place so that it might begin to shift the balance of resourcing towards professional development and curriculum and teaching support. Plans to offer TILT to a further 10,000 teachers and TILT plus (which goes beyond TILT skill levels) to 15,000 teachers have been announced recently. At present, however, the funding of hardware accounts for approximately two thirds of Program expenditure.

There appears also to be a need to make teachers aware of the possibilities of technology itself to be used for professional development. The Department is increasingly using technology in this way. The access to information and communication brought by Internet connection offers teachers enormous resources for personal professional development. Few teachers in the schools visited were making substantial use of the Internet for such purposes.

Visits to schools and research by the Department suggest that the effectiveness of TILT increases if the school environment is supportive of integrating computers into teaching and learning. In-school professional development programs are a feature of such supportive environments. In recent years, global budget allocations for in-school professional development have been reduced.

School visits and research suggest increasing teacher access to computers should raise teacher competency. Subsidisation of computers for teachers occurs elsewhere.[7] Options should be examined, in particular the linkage of subsidies to competency.

[7] Most of the teachers spoken to in site visits did not avail themselves of current 'salary sacrifice' arrangements. They were considered to be an insufficient incentive to obtain a computer.

Recommendations

1. Accelerate the development of standards, information systems and accountabilities which enhance the Department's abilities to:
   - ensure the Department's expectations regarding the deployment and use of computers for teaching and learning are understood and accepted at all appropriate levels within the organisation
   - monitor teacher, school and system progress
   - ensure variations between schools and teachers remain within acceptable ranges and that equity is not compromised
   - determine what, if any, changes to the Computers in Schools Program may be required into the future.

2. Consider when sufficient infrastructure may be available to schools to allow additional resources to be channelled to the development and technical and teaching support of teachers and principals.

3. Ensure the decisions about the acquisition, distribution, deployment and use of computers for teaching and learning balance the benefits of diversity and choice with the potential costs that a decentralised approach may bring in some circumstances.

Response from the Department of Education and Training

Thank you for the opportunity to respond to the Computers in Schools Performance Audit Report. The Department's response is attached.

Yours sincerely

(signed)
Ken Boston
MANAGING DIRECTOR OF TAFE NSW
DIRECTOR-GENERAL OF EDUCATION AND TRAINING
18 May 2000

Introduction

The Computers in Schools Program was introduced by the New South Wales Government on taking office in 1995 as a key initiative to enhance the quality of school education services and to prepare students for the global and technological challenges of the 21st century. This innovative and imaginative Program featured a range of specific initiatives designed to meet the Government's clearly articulated objectives.

The initial four-year Program provided for:

- the distribution of 90 000 leased computers to schools to achieve a computer to student ratio in government schools of 1:8
- training of 15 000 teachers in the use of technology in the classroom
- the appointment of 40 technology advisers to District Offices
- the connection of all schools to the Internet
- the development of curriculum support materials to support teachers in integrating technology into their teaching practices
- computer coordination support for schools.

More recent enhancements to the Program will result in almost $500 million being expended over the next four years. The computer leasing arrangements ensure that schools have the most up-to-date technology available on the market, while the distribution of a further 25 000 extra computers over the next three years will result in further improvements in the computer to student ratio.

Additional funding to be provided for cabling in 2000/01 will enable all government schools to establish local networks, giving them the flexibility to use computer equipment in ways that best suit their individual needs. With almost $17 million being provided over the next four years for teacher training in technology, around 40 000 teachers will have been trained in the use of technology by 2003.

When the Department of Education and Training embarked on the implementation of this Program, there was a recognition that there would be a need for fine-tuning and directional shifts in order to take account of ongoing technological change, the availability of resources, local conditions and the specific needs of individual school communities. The flexibility inherent in the Program in areas including equipment choice and use of technology has been an important feature which has been fundamental to the success of the Program.

During the course of the Program, the Department has consulted widely and regularly with the various stakeholders. In particular, principals and parent and community groups have had input into decisions made in relation to the method of distribution of resources under the Program and the flexibility needed in respect of equipment choice and application of resources to suit local needs. The Department considers that the Program would not have met with the same degree of success if there had been the need for rigid adherence to a limited range of computer equipment or undue restrictions on the way in which schools could apply their computer coordination resources.

Devolution and variation

The Department acknowledges that there are differences in the computer to student ratio across the New South Wales public school system. While the distribution of computers under the Computers in Schools Program has been undertaken according to the relative size of each school, there are several factors which have impacted on the situation. These can be summarised as follows:

- While many schools had been proactive in acquiring computers prior to the inception of the Computers in Schools Program, this was not the case for all schools. School based purchasing decisions in relation to computers have varied according to the priorities of individual schools as well as each school's financial position which can be influenced by a range of issues such as community funding support, access to business sponsorship, entitlement to support program funding, etc.
- The first rollout of computers under the Computers in Schools Program had regard to the level of computer resources already held by individual schools. However, because there was such a wide variation in the age and quality of this equipment, school and parent representatives strongly supported a change in the computer distribution rollout method with the result that it was converted to a largely per capita approach. Those schools, which had earlier decided to make computers a spending priority at the expense of other school resources, considered that they had been penalised by the initial approach to the rollout.

- Consequently, the per capita distribution method was put in place to ensure an equitable distribution of computer equipment sourced from the Computers in Schools Program. While there are differences in the computer to student ratio across the public school system it is also true that no two schools are alike in terms of resources and facilities. Deficiencies in one area of a school's infrastructure are often offset by advantages in another area. This is a well-known characteristic of a public school system which has been in existence for 150 years. Whilst there is a vast array of programs targeted to address specific disadvantages experienced by individual schools, the achievement of a completely level playing field for more than 2 200 individual school sites scattered throughout NSW represents a considerable challenge. The Department does have a long standing philosophy that educational decisions are best made by schools, reflecting local needs, priorities and resources. However, the Department provides a State-wide framework within which each school has to operate. For example, resource materials have been developed to assist teachers and school communities to make sound decisions regarding the use of new and refurbished facilities, the management and use of networks and the development of effective plans to support the integration of technology across the school.

During the first years of the Computers in Schools Program the emphasis has been on the provision of the necessary infrastructure to enable teachers and students to begin to explore the possibilities of enhanced teaching and learning activity. Initial Training and Development, and Curriculum Support initiatives provided the vehicles for changes in practice to commence.

Teachers and students require time and support to develop the skills and confidence to effectively use the resources at hand. The long-term nature of such change is acknowledged in the Audit Report. It is reasonable to expect that there will be wide variation in the use of technology at this time. The Department will continue to carefully guide the implementation of technology into schools in light of the evolving research and evidence obtained from other educational systems to ensure that any variation between schools remains within acceptable limits.

Setting expectations and monitoring progress

Since the Program's inception, the Department has provided advice to schools through a range of documents outlining the overall plan for the Computers in Schools Program and explicit information on organisational and management strategies that maximise the value of computer resources in schools.

The Department has clearly articulated expectations for student learning. More than 77 000 copies of the Primary and Key Learning Area (KLA) specific documents have been distributed to schools so that all teachers have access to documents relevant to their teaching area. These documents outline the capabilities which students are expected to develop and contain KLA-specific examples of how the capabilities may be achieved through the Computers in Schools Program. These resources continue to be reviewed, updated and distributed online throughout the NSW public school system. This level of support for individual teachers is unique in Australia. Nowhere else has such a comprehensive set of resources been provided to every teacher.

As students at all stages of schooling gain experience in the use of a range of technologies, it will be necessary to regularly revise the level and quality of expected skill development. Similarly, as the range of technologies changes, so too will some skill requirements. This is a rapidly changing environment where outcomes that are too rigidly specified in the early stages of the Program may inhibit rather than promote student development in later years.

Expectations of teacher capability and computer competencies are articulated in the report *Computer Proficiency for Teachers* developed by the Ministerial Advisory Council on the Quality of Teaching in 1997. All proposed university pre-service training programs are currently assessed by the Department to ensure they meet these competencies. From 2000, graduates entering the teaching service must be equipped with the skills identified in the Report to qualify for employment as a teacher with the Department.

The Review of Teacher Education in NSW, currently being undertaken by Dr Gregor Ramsey, has amongst its areas of focus a requirement to provide advice on the implications of technology for initial and continuing teacher education. The terms of reference for the Review specify that it "will advise on the extent to which current teacher education programs prepare teachers adequately for the likely future demands of their employment. It will focus on teacher abilities such as being ...skilled in the art and science of teaching including the use of modern technologies relevant to teaching". The Review is expected to provide its report to the Minister by mid 2000.

Technology is an integral part of the Department of Education and Training's strategic planning and there has been a strong focus on technology in each of the Department's annual planning documents since 1996. These documents identify the key strategic initiatives for school education each year and provide a framework for system-wide planning, monitoring and reporting.

The development by the Department of an *Information and Communications Technologies (ICT) Strategic Plan (2000-2003)* will further reinforce the significance of technology in the Department and provide a planning framework for all schools. The key priorities of the ICT Strategic Plan include the provision of online learning, the

enhancement of the computer capability of students and staff, the use of computer-based technologies in all aspects of teaching and learning, the implementation of e-business solutions to improve services to students, staff and the community, and the management of technological infrastructure.

All schools have provided information on the use of computers for teaching and learning as a component of their Annual School Report which includes details of the ways in which teaching practice and student learning have been enhanced by the use of technology. Further data will become available with the introduction of State-wide computing skills assessments for all Year 6 and Year 10 students.

The Department closely monitors Internet traffic and school level use of the network and through this process, is able to identify schools requiring additional support in order to maximise the use of the facilities provided under the Program.

Supporting the integration of computer-based technology into teaching and learning

There is extensive research indicating that sustained change only occurs when support is provided over a significant period of time, allowing participants sufficient time to experiment, become accustomed to and comfortable with each stage of their changing practice. The successful transition of learning to incorporate significant use of computer-based technologies is a long term process which has major implications for issues such as teacher development, curriculum support and leadership.

Teacher development

More than 15 000 teachers have been trained in the use of computer-based technology in teaching and learning (TILT) over the first four years of the Program. TILT is designed to meet the needs of teachers who have little or no experience in the use of technology in the classroom. In addition to the training, all TILT participants receive 3 days relief from teaching during which time they can request the support of the TILT facilitator. The TILT Program is a world leader in its field with strong interest being shown in the materials by other Australian States and Territories and from the non-government school sector.

Additional training for teachers, educational leaders and school administrative and support staff will target specific aspects of the use of computers in schools. Over the next four years, a further 10 000 teachers will undertake TILT training and an additional 15 000 teachers will participate in training in advanced and specialised computing skills (TILTPlus). TILT graduates will be eligible for a TAFE Level II Certificate in Information Technology.

TILT Programs will be delivered via CD-ROM and other electronic means to teachers who wish to access the training program by other than face to face delivery. Additional training packages will be provided for early childhood and special education teachers while KLA specific TILT courses are being developed in maths, science and computing studies. Vendor-accredited training will also be provided for teachers.

Leadership support

The existence of effective leadership and a school culture which is conducive to technological change are fundamental to the Program. To this end, school principals are being provided with a range of resources to assist them in making sound decisions on the implementation of technology in the school.

On-line training for principals is currently being trialed in ten districts. The training is designed to assist educational leaders to develop a critical and practical knowledge of the use, management and future of technology in teaching, learning and administration

Curriculum support

The production of electronic curriculum support materials is a major priority for the Department, designed to enrich the capacity to provide dynamic and effective professional development and resources across the curriculum. A range of world-class and award-winning products has been developed in civics, languages, Olympic education, literacy and support for the Higher School Certificate.

The ongoing development of the Department's Internet site will enhance access to online curriculum resources and training and development opportunities.

To support teachers in changing their teaching practices through the use of technology, the Department has developed a variety of curriculum resources, which will continue to be upgraded on the basis of the outcomes of school based and independent research projects.

Additional materials are being developed to further promote the use of the Internet in teaching and learning and to address priority areas such as class management, early childhood and changes in the school environment.

Technology support

A technology adviser is employed in each of the Department's forty District Offices to support district curriculum consultants in assisting teachers on how to use technology to enhance their teaching programs. Technology advisers also provide technical support and are able to provide local assistance to schools in the development of

technology plans, acquisition of computer-based technologies and networking.

Computer coordination allowances have been provided to schools to assist with the integration of technology into the school. The allowance may be used for a variety of technology related activities including staffing, training, contract services, cabling, etc. The flexibility provided through this funding approach was strongly advocated by the Primary and Secondary Principals' organisations.

Hardware and Infrastructure

The NSW Government's Computers in Schools Program continues to set the standard for other Australian States and territories in the provision of hardware to schools.

All NSW government schools were connected to the Internet by December 1996, well ahead of any other State or territory. Students and teachers in NSW government schools were amongst the first in the world to have this level of access to support their teaching and learning programs.

To support teachers and students in using the Internet for teaching and learning, the Department trained an Internet contact person in each school, distributed curriculum and training and development materials to assist teachers in how to use the Internet in teaching and learning, established a help desk service, developed the *Network for Education* website and published Internet site reviews in a range of departmental publications. The Department also provided subsidies to schools that did not have access to the Internet at the cost of a local call.

The Department is in the final stages of connecting all schools to its wide area network. This initiative provides enhanced access to the Internet, creates opportunities for the Department to implement e-business solutions for schools and allows technology-based monitoring systems to be used to analyse computer usage in schools.

The Department has provided computer network links to support school administration and library management and to increase access to the Internet for students. Additional grants have been provided to schools to assist with electrical work and additional network cabling.

The Department has secured corporate software licence agreements with Novell and Microsoft for their network operating system software to be provided at no cost to schools. The corporate software licence with Microsoft covers office software, CD-ROM based encyclopaedia products and computer-based training for teachers. In addition, preferential pricing agreements with a range of other companies have been established for the provision of educational software at reduced prices to schools.

The Performance Audit Report acknowledges that these initiatives have had considerable success in accelerating the integration of computer-based technologies into teaching and learning in NSW government schools.

Program resourcing

The leasing cost of computer equipment represents a very significant component of the overall Program. The pie-charts which appear on Page 24 of the Audit Report indicate that expenditure on computers during the period 1995/96 to 1998/99 accounted for 30 per cent of the total Program expenditure while the budget for the Program in 1999/2000 provides for 56 per cent of total funds to be spent on computers.

While the increased proportion of funds to be spent on computers in 1999/2000 reflects the pattern of the rollout of the 90 000 computers to schools, the Audit Office appears to be drawing attention to the increasing amount being spent on computers relative to other components of the Program. In this regard, the Audit Office States that:

> *There is strong support among leading experts for at least 30% of technology expenditure in schools to be on training and development and 15% on technical support. Many experts, however, consider this conservative and that a much higher proportion of expenditure on these elements was warranted.*

There are two ways in which this aspect could be addressed. The first is for computer leasing costs to be reduced by scaling back the number of computers being distributed to schools under the Program. This approach would not be supported by schools. The alternative approach would be to increase the overall level of funds available for the Program to provide for increased levels of training and development and technical support. Obviously, the provision of additional funding for this major Program which already involves expenditure of almost $500 million over the next four years, is a matter for the Government to consider in the context of the overall State Budget.

1. Introduction

1. Introduction

1.1 Overview

The NSW public school system comprises more than 2,200 schools (in 40 districts), 50,000 teachers and 750,000 students.

Policy objectives

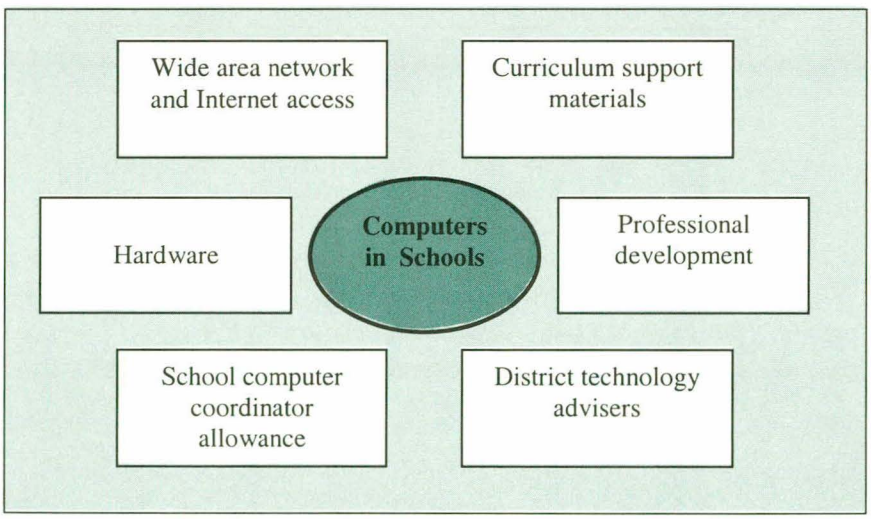
The NSW Government's Computers in Schools policy is based on four long-term goals:

- every child should be familiar with computers as a normal educational tool
- the use of computers across all subjects should be optimised
- computers should help to achieve educational outcomes more efficiently and with greater quality
- students should develop analytical, organisational and problem solving skills to cope with expanding access to computerised information.

The Computers in Schools Program commenced in 1995, following the election of the new Government. Prior to the Program, the State-wide computer to student ratio was 1:20 and less than one third of one percent of education funding was for computers in teaching and learning.[8]

Policy means

Major components of the Computers in Schools Program[9]



[8] Department of School Education, Preparing Students, Teachers and Schools for the New Millennium: a report on Information Technology in NSW Schools, NSW, 1997.
[9] As it applies to public schools.

Under the Program:

- 77,000 computer units have been distributed to NSW public schools
- 15,000 teachers have received Technology in Learning and Teaching (TILT) training
- curriculum support materials have been developed and provided to teachers
- forty district technology advisers have been appointed
- all schools have been connected to the Internet and most have access to the Department's wide area network
- a computer coordinator allowance is provided to all schools.

Expenditure on the Computers in Schools Program (for public schools) in its first four years was $170.6m, and the budget for the Program in 1999-2000 is $92.8m. Expenditure by the NSW Government on school education in 1999-2000 will be approximately $4 billion. In 1999-2000, the Program as a proportion of overall spending on public schools will be more than 2%.

Computers in Schools Program				
Expenditure				Budget
1995-96 $'000	1996-97 $'000	1997-98 $'000	1998-99 $'000	1999-2000 $'000
1,807	39,577	57,674	71,484	92,821

Source: Department of Education and Ttraining.

The Computers in Schools Program has developed and been amended and refined over time as issues have been identified by the Department. The Program is also ongoing, as evidenced by further initiatives announced by the Government in *Preparing for the Future: Labor's Computers in Schools Plan, 1999*. These initiatives are highlighted throughout the report.

Implementation of the Program State-wide for such a large system has represented a significant logistical and management challenge for the Department.

1.2 Objectives, scope and methodology

Audit objectives

The objectives of the audit were to assess the extent to which:

- computer technology and associated technical and curriculum support, were efficiently and effectively provided to NSW public schools
- the use of computer technology had become assimilated into teaching and learning in NSW public schools.

Audit scope

The audit focused on:

- the selection, acquisition and distribution of computer technology to NSW public schools for the purposes of teaching and learning
- the professional, curriculum and technical support provided to NSW public schools and teachers to assist in setting-up, maintaining and using computer technology for the purposes of teaching and learning
- the utilisation of computers in NSW public schools for the purposes of teaching and learning.

The audit did not seek to measure the impact of computer technology on student technological capabilities or outcomes in key learning areas.[10]

Audit methodology

A case study approach was used to review a sample of four primary and four secondary public schools.

More than 30 person days were spent in schools examining the use of computers in detail. Site visits were conducted in the middle of 1999. During the site visits the team conducted discussions with staff, observed facilities and practices and reviewed relevant documentation.

Site note reports were prepared for each school. These provided a detailed account of current practices and arrangements within the schools.[11]

[10] Rather, it examined in part whether the Department was in a position to assess these.

[11] The team also visited two rural schools to assess whether issues identified in the case studies were similar for rural schools and to determine if any specific rural issues had been overlooked in the case studies. Information from these schools is not presented as case study evidence, as they were not examined in as much depth as the other schools visited. The visits, however, confirmed the observations in the other schools and highlighted some rural isses dealt with elsewhere in this report.

References in this report to school visits and case study material titled 'Schools in action' refer exclusively to this actual research by the Audit Office. Generalisations about the complete school system cannot be made from this evidence. However, the visits represent a meaningful cross-section of schools, and anecdotal evidence suggests that these schools are not atypical.

In addition, the audit has involved:

- interviews with relevant DET officers and other experts, including senior staff of teacher training faculties of major Sydney universities
- file and document examination
- extensive international literature review, focusing on academic research into computer technology and teaching and learning, and current practices in other jurisdictions
- examination of practices in the non-government sector, not for the purposes of benchmarking but to gain a full perspective on possible approaches.

1.3 Acknowledgements

The Audit Office gratefully acknowledges the cooperation and assistance provided by representatives of the Department to the audit team: Sonia Danzo, Rod Longford and Stephen Horne.

1.4 Audit costs

The total cost of the audit to date of tabling was $285,667. The cost includes an estimate of $8,500 for printing, $842 for travel, $945 for consultants and $18,110 for time spent by staff for which no compensation was made.

2. Program Components

2. Program[12] components

2.1 Roll-out of computers

Features of the roll-out of computers included:

- centralised tender approach for the acquisition of computers
- computers leased to ensure currency
- new, modern, multi media computers
- ability for schools to combine computer units to obtain laptops or file servers (in more recent phases of the roll-out)
- schools can choose which type of computer operating system they prefer (ie Apple or Intel)
- 77,000 computer units provided to schools.[13]

Computer roll-out				
Expenditure				Budget
1995-96 $'000	1996-97 $'000	1997-98 $'000	1998-99 $'000	1999-2000 $'000
0	1,098	13,343	37,582	52,102

Source: Department of Education and Training.

2.2 Connection of schools to the Internet and the Department's wide area network

The Program provides all schools with:

- single dial-up point of access to the Internet (initially)
- ISDN line, basic network components and professionally installed network link between administration and library areas (nearing finalisation)
- basic local area network infrastructure on which they can expand.

[12] Initiatives announced but not fully implemented are referred to in later chapters.

[13] Schools may supplement Program provided computers from their own resources. Schools are able to obtain Program-equivalent computers from government contract for the same price as Program computers but are not required to do so.

Internet				
Expenditure				Budget
1995-96 $'000	1996-97 $'000	1997-98 $'000	1998-99 $'000	1999-2000 $'000
524	20,148	12,177	9,987	9,436

Source: Department of Education and Training.

2.3 Technology grant

The technology grant was:

- a once-off payment to support technology in schools
- for cabling, electrical wiring or technology training and development
- funded from savings due to slower than expected expenditure on computers.

Technology grant				
Expenditure				Budget
1995-96 $'000	1996-97 $'000	1997-98 $'000	1998-99 $'000	1999-2000 $'000
0	8,294	7,920	198	0

Source: Department of Education and Training.

2.4 Computer coordinator allowance

A computer coordinator allowance is:

- provided annually to all schools
- to be spent on technical support or any other technology-related purpose
- calculated on the number of teachers in the school.

Computer coordinator allowance				
Expenditure				Budget
1995-96 $'000	1996-97 $'000	1997-98 $'000	1998-99 $'000	1999-2000 $'000
0	0	13,534	14,013	24,980

Source: Department of Education and Training.

2.5 Technology advisers

A technology adviser has been appointed to each district (40) to, inter alia:

- assist schools in developing technology plans to support school and State-wide priorities
- provide technology advice to schools on local area networks, computer hardware and software, communications and technology
- assist with the implementation of State-wide technology priorities
- assist curriculum advisers with the technical aspects of incorporating technology in teaching practices
- plan, prepare and deliver technology training within schools and districts
- provide district office technology support
- provide advice to schools on information management.

Technology advisers				
Expenditure				Budget
1995-96 $'000	1996-97 $'000	1997-98 $'000	1998-99 $'000	1999-2000 $'000
430	3,134	2,850	3,255	3,304

Source: Department of Education and Training.

2.6 Training and development and curriculum support

Fifteen thousand teachers have undertaken Technology in Learning and Teaching (TILT). TILT:

- is designed for teachers not currently using technology in the classroom[14]
- is delivered by trained TILT facilitators through 6 x 2 hour small group workshops
- includes 6 x 1 hour videos (originally delivered as satellite broadcasts)

[14] The TILT components are: Powerful tools to enhance teaching and learning; Internet-Beyond the classroom walls; Computers and related technologies; Software; How can I do this in my classroom?; and Future Directions.

- participants receive three days relief from teaching during which time they can request the support of the TILT facilitator
- offers additional support for participants via a home page[15] and hub groups.

Curriculum support initiatives include:

- a set of curriculum support documents to assist teachers with the integration of computer technologies into teaching and learning across all key learning areas. These aim to:
  - assist teachers to design learning experiences for their students that utilise the computer as one of a number of educational tools in their classrooms
  - support the TILT teacher professional development programs[16]
- *connect.edu*, which provides teachers with information concerning the use of the Department's Internet service, teaching ideas and sample learning experiences focusing on the development of information skills to assist students in making appropriate use of the Internet for learning
- curriculum based telecommunications projects to provide teachers and students with collaborative tele-communications experiences
- reviews of key learning area and subject related Internet sites which teachers can use in the development of learning experiences
- CD ROMs for use in teaching and learning
- NSW HSC On-line which provides students and teachers with HSC resources such as tutorials, sample examinations and study methods and is linked to other educationally relevant web-sites.

Training and development and curriculum support				
Expenditure				Budget
1995-96 $'000	1996-97 $'000	1997-98 $'000	1998-99 $'000	1999-2000 $'000
854	6,903	7,850	6,450	3,000

Source: Department of Education and Training.

[15] The page contains facilities for locating information and training material, and facilities for seeking technical assistance and contacting others.

[16] The documents include an integrated primary document, and one for each of the eight key learning areas in secondary schools, ie Creative Arts; English; Human Society and its Environment; Languages Other Than English; Mathematics; Personal Development, Health and Physical Education; Science; and Technological and Applied Studies.

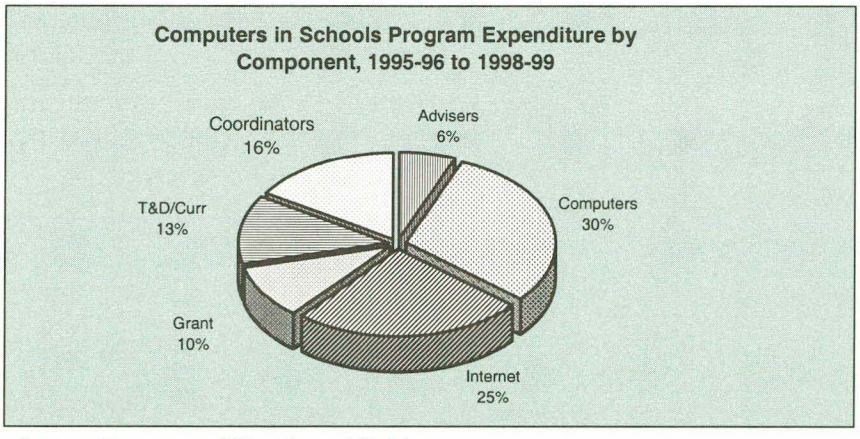
2.7 Aggregate expenditure and budget

Expenditure by the NSW Government on school education in 1999-2000 will be approximately $4 billion. Expenditure on the Computers in Schools Program (for public schools) in its first four years was $170.6m.

Computers in Schools Program				
Expenditure				Budget
1995-96 $'000	1996-97 $'000	1997-98 $'000	1998-99 $'000	1999-2000 $'000
1,807	39,577	57,674	71,484	92,821

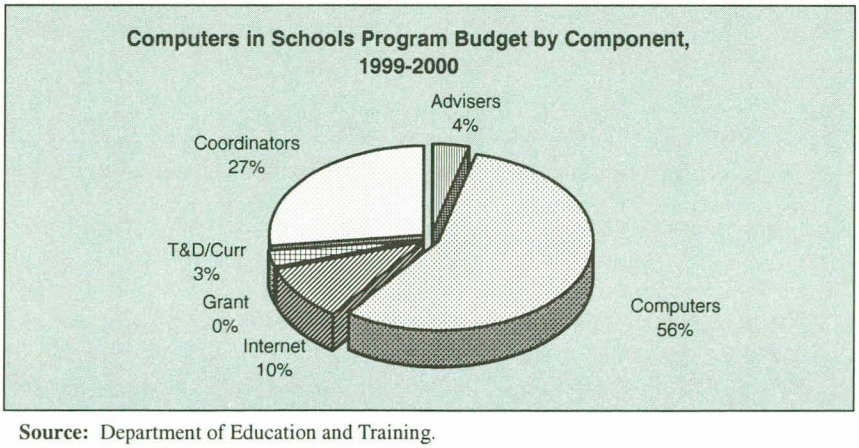
Source: Department of Education and Training.

Over the four years of the Program from 1995-96 to 1998-99, 65% of recurrent expenditure has been on computers, Internet connections and access and the technology grant.



Source: Department of Education and Training.

The budget for 1999-2000 provides for 66% of expenditure to be on computers and Internet connections and access.



Source: Department of Education and Training.

Research

There is strong support among leading experts for at least 30% of technology expenditure in schools to be on training and development and 15% on technical support. Many experts, however, consider this conservative and that a much higher proportion of expenditure on these elements was warranted.[17]

Schools in action

All schools indicated that the Program did not provide sufficient technical support and that this presented an impediment to effective use of computers. A common response from teachers was that they were reluctant to use computers without having adequate technical support at their disposal. Some schools provided additional technical support from their own funds.

The observation that professional development is below better practice levels is supported by the findings of a recent report into computers in education prepared for the Commonwealth Department of Education, Training and Youth Affairs.

Research

Recent professional development has not occurred evenly across the States and Territories. More teachers in Tasmania (91%), Western Australia (86%), South Australia (85%), Victoria (82%) and Queensland (76%) reported they had received professional development in the last two years, and fewer teachers in NSW (68%) reported they had done so.[18]

The Department advises that:

- an early priority of the CISP was to provide basic hardware and infrastructure to schools. Without sufficient infrastructure, training and development and content provision would not be effective
- once the infrastructure is in place teachers and students require time and support to develop the skills and confidence to effectively use the resources at hand. The Department considers this is occurring in schools.

[17] For example, President's Committee of Advisers on Science and Technology, Panel on Education Technology, *Report to the President on the Use of Technology to strengthen K-12 Education in the US*, March 1997.

[18] Australian Key Centre for Cultural and Media Policy, *Real time – Computers, Change and Schooling*, October 1999, p 179. Survey undertaken in May, 1998.

2.8 Audit conclusion

All indications are that the proportion of computing resources going to training and development, curriculum and technical support are below better practice levels.

The Audit Office acknowledges the long-term nature of change embodied in the integration of computers into teaching and learning. It also considers that there is some validity in the view that hardware is necessary in order for training and curriculum support to be effective.

At some point, a shift would be expected in focus from hardware to human resources. This is yet to occur. The proportion of Program funds for training and development and curriculum support have declined in 1999-2000 whereas funds for hardware have increased.

The proportion of Program resources being allocated to training and development and curriculum support may be a factor in differences between teachers and in the relatively slow speed of change to teaching and learning practices identified in subsequent chapters.

3 Program Philosophy

3 Program philosophy

3.1 Devolution to schools

The Department:

- devolved responsibility to schools to determine how to make best use of the computers and other resources provided to them under the Program, including decisions about what additional infrastructure and support schools would provide from their operational grants and other school funds
- has a general, long standing philosophy that within a State-wide framework, educational decisions are best made by schools, reflecting local needs, priorities and resources
- considers that a devolved approach results in variations and encourages innovation.[19]

Audit observation

The Audit Office considers that under a devolved approach as implemented by the Department, it is important to:

- establish **standards** and acceptable limits upon variation between schools
- ensure that principals and teachers understand system expectations and are held **accountable** for the efficient and effective use of computers for teaching and learning
- put in place **systems** which provide the data to allow the Department to make informed judgements about
  - the need for schools to be helped to take remedial action
  - achievement of the Government's longer term objectives
  - future Program directions.

3.2 Standards and accountabilities

To support schools in implementing the Program:

- the Department has articulated the Computers in Schools Program in a number of documents and technology outcomes are being included in each new syllabus as it is developed
- there has been a strong focus on technology in each of the Department's annual Agenda documents since 1996[20]

[19] DET's response to Audit Office issues paper, January 2000.

[20] Agenda is the Department's key planning document for the public school sector.

- schools have received advice and support from the district-based technology advisers, training and development and curriculum coordinators, all of whom are briefed on the Program
- schools and teachers are guided in their decisions by curriculum documents, professional development activities, advice from district personnel including technology advisers and a central help desk. In addition, a set of curriculum implementation packages has been distributed to District Offices.

School visits by the Audit Office indicated that some school communities are not as clear as others about the Department's requirements for, and how to make effective use of, computers for teaching and learning.

Schools in action

Some principals and teachers were confident that they knew how to make effective use of computers for teaching and learning, and that they were moving to put their theories into practice.

Several principals and teachers, however, were less confident that the approach they had adopted was effective. They were uncertain about the Department's expectations for using computers and in particular for integrating computers into the curriculum. They sought more direction and guidance from the Department.

A recent major Australian study found a relationship between student information technology skills and school and personal factors.

Research

The study demonstrated a number of disparities in students' information technology skills according to school type, size and sector, location and income area and according to students' socio-economic status, cultural background and ethnicity.[21]

Audit observation

The finding of this study that disparities in student technology skills are related in part to the type, size, location and income area of their school needs to be explored by the Department and, if verified, addressed.

[21] Australian Key Centre for Cultural and Media Policy, *Real time – Computers, Change and Schooling*, October 1999, p xxviii.

3.3 Monitoring, evaluation and planning

Monitoring and evaluation initiatives include:

- surveys of TILT participants
- research into user views of curriculum support documents
- a requirement for schools to report technology achievements and identify areas for further attention in school annual reports. These areas are then incorporated into the school's plan for the following year
- monitoring Internet traffic generated by schools, with results aggregated for monitoring and evaluation purposes
- the document *Preparing Students, Teachers and Schools for the New Millennium*, published in 1997, which described the Department's achievements in implementing the Government's technology initiatives.

Schools in action

Schools advised that they were not required to provide any data to the Department on either the deployment or use of computers for teaching and learning. Some, however, indicated that they included statements about computers in their school annual reports. They did not consider this 'data' however and had not contemplated its use for monitoring and evaluation.

The quality and rigour of technology planning also varied between the schools visited.[22] Schools indicated that planning was hampered by the lack of an overall plan from the Department for the Computers in Schools Program and lack of certainty and predictability in Program resources and directions. Schools were concerned that they were required to make planning decisions before they knew what the Program would provide for the coming period.

The Audit Office is advised that the extent of performance information presently available from the Department has contributed to NSW Treasury commissioning the Board of Studies to undertake a study to identify the theoretical educational benefits of using computers in the curriculum.

[22] This is in line with findings by the Audit Office about inconsistency in school planning outlined in the performance audit report, *The School Accountability and Improvement Model.*

Audit observation

The Department's efforts at monitoring and evaluation are at an early stage. For example:

- there is as yet little consistency and comparability between the annual reports of schools and the School Accountability and Improvement Model requires further development before it represents a systematic approach to planning, monitoring and evaluation. As a result, aggregation of report comments does not give a comprehensive picture of progress in meeting the Government's objectives
- the document *Preparing Students, Teachers and Schools for the New Millennium*, published in 1997, does not provide comprehensive data on progress towards achievement of the Government's longer-term goals.

The Department may have been in a better position to report on progress against the Government's long-term goals if a proposal made in the planning stages of the Program to undertake a longitudinal analysis had been implemented.[23]

Documents

Department files indicate that in the early stages of the development of the Program, the need for a longitudinal analysis of Program outcomes was identified. Work was commenced and the item appeared on steering committee agenda and in steering committee minutes. A proposal was developed, but the item dropped off subsequent agenda without explanation. The reasons for this decision were not clear from the Department's documentation.

3.4 Practices in other States

The Audit Office has identified similar programs in other States that it considers to offer examples which the Department could use to further clarify its expectations of schools and teachers.

[23] The Department advises that some data was collected through quality assurance reviews. Such data was not comprehensive and did not cover all schools. These reviews were discontinued and replaced by the School Accountability and Improvement Model, incorporating annual school reports.

Interstate

Education Queensland – Schooling 2001

The Schooling 2001 project of Education Queensland incorporates:

- a policy statement which includes accountabilities and priorities
- an outline of principles underlying the use of computers in learning
- articulation of key result areas for the project with goals for each
- a learning technology steering committee which guides and monitors the implementation of the project
- systemic targets for 2001 with interim targets for 1998-99
- identification of learning technology as one of the studies priorities in the Department of Education Corporate Plan 1995-1999
- establishment of minimum standards for teachers in the use of computers in learning
- a registered enterprise agreement which recognises the need for teachers to develop competencies in a combination of school time, pupil-free days and outside school hours.

This framework should allow an assessment of both:

- changes in student learning outcomes
- performance regarding program or initiative outcomes which should contribute to improvements in learning outcomes.

Education Victoria - Learning Technologies in Victorian Schools, 1998-2001

The statement sets out the overall objectives for schools and maps a strategy for schools to work towards incrementally. The statement:

- offers a framework for activities and efforts in the learning technologies area
- sets targets for achievements by students, teachers, principals and school communities
- addresses the issue of accountability
- outlines requirements for the development by schools of a learning technology plan and implementation strategy and State-wide mechanisms to support the implementation of learning technologies in schools.

The Education Department of Western Australia – Technology Package
All public schools receive a package which includes: • a strategic plan for the technology program • technology guidelines • a matrix (one page) which outlines key features of development stages from beginning to advanced, including program goals.

Education Victoria – Accountability
• General Managers (Schools) negotiate an appropriate focus on learning technologies with school principals, compatible with the *Learning Technologies in Victorian Schools, 1998-2001* statement and overall direction for each school. General Managers ensure these directions are reflected in the principals' professional goals • Schools are required to include a clear statement on the role of learning technologies in the development of improved learning outcomes for students in their school charters • An 'understanding and commitment to the use of learning technologies' is included in the criteria for selection of principals • 'Learning technologies and use' are part of the annual review and performance management process for school staff.

Some other States require schools to develop computer technology plans, and provide guidelines/checklists.

Vic	Schools must implement a plan which contains achievable targets for schools to reach by the year 2001. A guide on how to develop a plan has been made available to schools.
Qld	All schools must have a 3-5 year technology plan. Schools are provided with a framework that is used as a checklist to assist in developing their plans.
WA	All schools must have a 4 year strategic plan (before they can access their technology grants) and an annual plan. A guide on how to develop a plan has been made available to schools.

3.5 Recent initiatives

The Department has a number of initiatives in train or planned.

Recent initiatives/announcements
• State-wide external computing skills assessments for all year 6 and 10 students are being developed in line with a specific Government commitment. The date for implementation, and skills to be tested, are yet to be determined.
• Resource materials to assist teachers and school communities make sound decisions regarding the use of new or refurbished facilities are being developed. These will specifically address issues in the management and use of networks and network resources.
• Further development of school annual reporting is under way.
• Development of an information technology strategy for the Department is progressing.
• The Department is putting in place technology-based monitoring systems to allow analysis of aspects of computer usage in schools.
• Further research into how to make effective use of computers for teaching and learning is being undertaken.

Audit observation

When implemented, the skill testing initiative may provide some useful information on the skills of students in the use of computers at key points in their education. Assessment of change, however, may be impeded by the lack of baseline data against which to compare current skills.

3.6 Audit conclusion

The Department has articulated its requirements in several ways, but some teachers and principals require further guidance and assistance.

It is important that the Government, Parliament and the public understand what has been achieved from the investment in computers for teaching and learning. At present, information to enable such an assessment is patchy. It is also important for the Department to make decisions about Program matters based on reliable information.

Standards, information systems and accountabilities require some further development. There is a need to ensure that variations between schools remain within acceptable ranges.

The Audit Office acknowledges that there may be practical problems in disentangling the impact of computers on student learning outcomes in key learning areas from other system, school and teacher initiatives. Nevertheless, programs in other States offer approaches worthy of consideration for application in NSW.

The Department is developing several initiatives which should over time put it in a better position to make informed decisions about the deployment and use of computers for teaching and learning. Some of these draw on interstate examples. Initiatives in this area are for the most part at an early stage, but the rate of development has noticeably increased over the last twelve months. The development of standards and systems to collect relevant data needs to remain a focus for the Department.

4. Putting Computers in Schools – Program Implementation

4 Putting computers in schools - Program implementation

4.1 Computers

When the current Government came to office in 1995, the ratio of computers to students across the State was approximately 1:20.[24]

The first phase of the Computers in Schools Program was aimed at reducing the computer to student ratio to 1:14 or better in every public school (ie increasing the number of computers per student). The distribution took into account the existing number of computers in schools used for teaching and learning.

Documents

This approach was consistent with the Government's policy at the time and was endorsed by a committee including representatives of primary and secondary principals. The distribution attracted some criticism particularly where schools believed they had been disadvantaged by having purchased or leased large numbers of computers from departmental, school or school community funds prior to the commencement of the Program.[25]

In response to this criticism, the Department changed the distribution to a per-capita model, based on the number of students enrolled. The Department considered that this approach:

- removed the need to consider non-Program computers
- did not penalise schools that had invested in technology
- provided a clear, verifiable basis for determining each school's entitlement.[26]

The Department acknowledged the potential drawback that the model did not recognise the socio-economic differences which exist between schools, but offered the counter argument that:

> ...this is generally how the school global funding model operates, in that, each school's operations grant is based on school size measured in terms of student and teacher numbers.[27]

[24] Results of a survey undertaken in 1994-95.
[25] DET Memorandum, June 1997.
[26] DET Memorandum, June 1997.
[27] DET Memorandum, June 1997

The Government's initial target of a computer to student ratio of 1:14 was exceeded through the provision of hardware as a component of the Computers in Schools Program. By the end of 1999, the ratio of students to Program provided computer units was better than 1:11 in all schools. The ratio in small schools and Schools for Specific Purposes was significantly better. The Department does not have information on the current ratio of computers to students (ie, computers from any source) State-wide or in individual schools.[28]

The Government is committed to reducing the ratio further during its second term,[29] and announced in the 1999-2000 budget that an additional 25,000 computer units will be provided to schools over three years.

Interstate

Targets for computer to student ratios			
NSW	1:7.5 by 2003	**Qld**	1:7.5 by 2001
Vic	1:5 by June 2000	**SA**	1:5 by 2001
WA	1:5 secondary and 1:10 primary by 2002		

Research

There was strong support amongst leading experts for a ratio of one computer per five students in publicly funded schools.[30]

This ratio was considered to offer adequate access to allow effective utilisation without being excessive and thereby compromising efficiency and economy. It was also considered a feasible target given the resource constraints of public education.

This view was by no means universal with a substantial body of experts calling for lower (ie more generous) ratios.

The schools visited by the Audit Office:

- indicated that they had far more computers as a result of the Program than they believed they would have had without it. Some principals and teachers described the change in number of computers as a result of the Program as a 'quantum leap'

[28] The Department has information on the number of 'computer units' provided to schools under the Computers in Schools Program. The Department also knows what equipment schools have obtained with their computer units. The Department does not, however, know the number of computers within schools which have been funded from other sources.

[29] DET's response to the Audit Office issues paper, provided January 2000.

[30] For example, President's Committee of Advisers on Science and Technology, Panel on Education Technology, *Report to the President on the Use of Technology to strengthen K-12 Education in the US*, March 1997.

- were strongly supportive of the Program's flexibility to combine computer units to obtain lap tops or file servers, although some principals indicated that if given total flexibility they would have sought to obtain a larger number of used computers.

The Department has been able to use its purchasing power to obtain good prices for new computers. Further, research suggests that used and/or donated computers can be a false economy.

Research

Whilst they are cheaper to obtain, maintenance costs of used computers will generally be higher and down-time greater. New software often requires greater computer functionality than available from older computers.[31]

The school communities visited:

- were generally satisfied with the specifications of the computers available under the Program, commenting that computers have been of sufficient functionality for most purposes and able to be networked
- supported the leasing of computers to maintain currency, although they were concerned at the workload associated with installing new computers each time computers are replaced
- strongly supported being given the choice of operating systems.

Audit observation

Multiple operating systems may, however, have contributed to:

- the need to train staff and provide support for multiple computer environments
- limitations on the ability of the system to transfer programs and materials between schools
- the need to retrain students who move between schools with different operating systems.[32]

Documents

The Department in 1983 recognised that "computer education presents particular problems, relatively unusual in kind in education, because of the need for programs and other materials to be transferable between schools. The department recognises the significant economies that can accrue through some degree of coordination within the system in the choice of both equipment and the associated computer programs".[33]

[31] For example, President's Committee of Advisers on Science and Technology, Panel on Education Technology, *Report to the President on the Use of Technology to strengthen K-12 Education in the US*, March 1997.

[32] Particularly where a secondary school has a different operating system to a feeder primary school.

[33] NSW Department of School Education, *Computers in Schools, A General Policy Statement*, 1983.

The impact of multiple operating systems may have, however, diminished over time as the two operating systems have become more alike.

Apples have until recently been more expensive than Intels, so savings in the cost of obtaining computers would have accrued by standardising on an Intel operating system. Further, under the 'computer unit' approach to distribution adopted by the Department, desktop Apples and Intels both equated to one computer unit despite differences in costs, so there was no incentive for schools to consider price differentials. Prices for Intels and Apples are now generally similar, with each having some products cheaper than the other.

The Department advises that a number of issues were considered prior to choosing the distribution model, including:

- the existing user base, where a 1995 survey showed that more than 50% of the computers in schools were Apple
- the significant investment by schools and their communities in the purchase of relevant educational software
- the training and development costs and hardware replacement expenses that would be incurred if a single platform were to be selected
- the importance of providing schools with a choice of equipment.[34]

Further, the Department considers that platform diversity has the advantage that students have the opportunity to develop their ability to transfer their learning and adapt their skills to a range of hardware and software.[35] As a result, the Department did not consider it necessary to conduct a cost:benefit analysis.

4.2 Peripheral and other equipment

Schools have to bear any additional costs of setting up and using computers, including peripheral equipment, primarily from their own resources.[36] Program funding is limited. The computer coordinator allowance and the once-off technology grant may be used for peripheral or other equipment, and the technology adviser may be consulted for advice.

[34] DET's response to the Audit Office issues paper, provided January 2000.

[35] The Audit Office, however, only sees this as relevant for students moving to a new school with a different platform or in schools with multiple platforms.

[36] That is, non-Program funding which includes the school global budget, non-compulsory contributions provided by parents/the community and special funding such as Disadvantaged School Program funding.

Research

> The uses to which computers can be put are expanded significantly by the availability of peripheral equipment.[37]

Additional costs that may need to be incurred by schools include network cabling, security, consumables (such as paper, ink cartridges etc), electrical wiring and power consumption, telecommunications costs (Internet access), refurbishment / retro-fitting of classrooms and ergonomic furniture.

4.3 Technical support

Schools have various requirements for technical support, including:

- network and computer set-up
- on-going network observation and modification
- general administration
- troubleshooting
- user support.

Research

> Technical support is critical to utilisation of computers for teaching and learning. Teachers are more likely to use computers if they have someone available to deal with the technical support issues.[38]

The Program provides:

- a computer coordinator allowance to all schools
- technology advisers located in each District Office (40) who receive support and professional development through a number of multi-day conferences each year[39]
- a central help desk to assist schools with technical support.

The computer coordinator allowance can be used for things other than technical support and technology advisers have a range of duties in addition to technical support. The main focus of the help desk is the Department's administration system.

[37] Education Victoria, *Learning Technologies Planning Guide for Schools*, March 1997.

[38] President's Committee of Advisers on Science and Technology, Panel on Education Technology, *Report to the President on the Use of Technology to strengthen K-12 Education in the US*, March 1997, p 25.

[39] These conferences have focussed on a wide range of issues including what advice needs to be provided to schools. Officers from various areas of the Department including Curriculum Support Directorate and Training and Development Directorate have provided workshops for technology advisers to ensure that they have the latest information.

The aggregate figures for the elements of the Program outlined in chapter two indicate that 65% of program expenditure to date has been on computers and the technology grant, with 35% on the technology advisers, training and development, curriculum support and the computer coordinator allowance.[40]

Research

Leading experts consider that as a minimum 45% of technology expenditure in schools should be on technical support and training and development (15% technical support, 30% professional development).[41]

All schools indicated that the Program did not provide sufficient technical support and that this presented an impediment to effective use of computers.

Schools in action

A common response from teachers was that they were reluctant to use computers without having adequate technical support at their disposal. Some schools provided additional technical support from their own funds.

A recent Australian study found there were equity issues in the provision of support services.

Research

The level of support services provided in the school varies according to sector, income area, location and the size of the school. Schools in middle to high-income areas have better resources of this sort, while schools in country, rural and isolated areas are under-resourced.[42]

Technical support has been increasing under the Program. The help desk is a recent initiative, unknown to the sample schools at the time of the site visits, although its primary focus is on administrative systems. The computer coordinator allowance has been increasing over time, but so has the number of computers to be supported. Nevertheless, at the end of phase 4 of the Program it stands at approximately $325 per computer per annum compared to $250 at the end of phase three of the Program.

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[40] The Department does not have figures for Program expenditure on technical support. The way the Program is resourced makes it difficult to estimate the amount of Program funds spent on technical support. Further, it is difficult to separate technical and teaching support, as each of the computer coordinator allowance and the technology advisers can also be used for teaching support.

[41] President's Committee of Advisers on Science and Technology, Panel on Education Technology, *Report to the President on the Use of Technology to strengthen K-12 Education in the US*, March 1997, p 24. Education Victoria, *Learning Technologies Planning Guide for Schools*, March 1997.

[42] Australian Key Centre for Cultural and Media Policy, *Real time – Computers, Change and Schooling*, October 1999, p xxviii.

Recent initiatives/announcements

- The formula for allocating technical support to schools is being reviewed,[43] with a single allowance (wrapping together the various current entitlements) being considered.
- The inclusion of installation in the contract for the next roll-out of computers is being considered.

Audit observation

Based on school visits and research, the level of technical support provided under the Program appears to be less than that necessary to make efficient and effective use of the computers provided by the Program for teaching and learning.

4.4 Networking and Internet access

The Department is providing schools with an ISDN line which provides high-speed access to the Department's wide area network and the Internet. Schools are also provided with a link between the ISDN connection (generally in the administration block) and the library.

This element of the Program has been centrally administered, and not devolved to schools. The Department considered that a per capita allocation to schools would have disadvantaged some schools because of their particular circumstances (eg distance between library and administration block, school layout and geography etc).

The Department provides guidance to schools about networks through the district technology adviser, technology grants, computer coordinator allowances and the technology component of school global funds.

Research

Computers used as stand alone devices are limited in resources. They are bound by the hard disk space and memory available. Networks enable a school to:

- link computers so that files and applications can be stored and shared
- connect different computers and allow them to communicate with one another, either within the school or over the Internet
- share hardware resources such as scanners, CD-ROM drives, printers etc.

Local area networking can be used to increase wide area network and Internet access points.[44]

[43] DET's response to the Audit Office issues paper, provided January 2000.

Beyond the basic backbone, local area networking has been a matter left largely to individual schools. The Program has not provided resources specifically for local area networking. The computer coordinator allowance and the once-off technology grant could be used for cabling, and the technology adviser may be consulted for advice.

The programs of several other States include Internet access, wide and local area networking of schools.

Interstate

Internet Access	
NSW	• all public schools through 64Kb ISDN (nearing completion)
Vic	• all public schools through 64Kb ISDN • corporate sponsorship to provide multiple Internet access points in schools (at no cost to the taxpayer)
Qld	• all public schools through 64Kb ISDN
WA	• centrally funded, but arranged by schools
SA	• all public schools through 64Kb ISDN (planned)

Wide Area Networking	
NSW	• schools being connected to Department network (nearing completion)
Vic	• schools being connected to the Government's network
Qld	• all schools connected to Department network
WA	• all schools connected to Department network
SA	• all schools to be connected to Department network by 2001

Local Area Networking	
NSW	• school responsibility - technology advisers provide guidance on developing a local area network
Vic	• school responsibility - guidelines and standards on developing a local area network are provided
Qld	• all schools provided with at least one local area network
WA	• school responsibility - guidelines on developing a local area network (in development) to be provided
SA	• all schools to be provided with local area networks by 2001 - guidelines on developing a local area network (in development) to be provided

[44] Education Victoria, *Learning Technologies Planning and Implementation Guides for Schools*, March 1997.

The Sydney Catholic Diocese has implemented a program to assist schools to establish effective local area networks.

Research

Features of the Sydney Catholic Diocese local area networking program include:

- minimum standards for networks have been established
- current school networking arrangements are reviewed
- improvements necessary to bring schools to the standards are identified
- current and desired networking arrangements are documented
- documents form the basis for competitive tendering.

Recent initiatives/announcements

The Department is currently developing resource materials to assist teachers and school communities make sound decisions regarding the management and use of networks and network resources.

The Government announced in the 1999-2000 NSW Budget the allocation of $10m over three years for cabling for local area networks. This equates to approximately $5,000 per school.

Schools in action

The cost of cabling in place in the sample schools ranged from approximately $10,000 to $60,000 (although two schools had no local area network).

A pilot project has recently been conducted to provide a broad estimate of what will be necessary to put local area networks in schools.

Audit observation

The additional funds earmarked by the Government do not appear sufficient to install effective local area networks in all schools. If the Department targets funding to schools without a local area network, this will disadvantage those schools that have made efforts to install a local area network from their own resources.

4.5 Software

Software is largely a matter for individual schools. The Program does not provide resources specifically for software. Computer tenders specifically excluded software.

The Department recently negotiated State-wide contracting arrangements with the major supplier of corporate software, Microsoft. The Department had previously negotiated State-wide arrangements for some Novell products, and some concessional rates for a limited amount of other software.

Interstate

Software	
NSW	• State-wide licensing agreements with major software providers • concessional rates on some software • review and list of software resources
Vic	• State-wide licensing agreements with major software providers • concessional rates on some software • State-wide Software Rolling Fund, aimed at reducing the cost to schools of other major software established • review and list of software resources
Qld	• schools receive a grant for the purchase of curriculum software • negotiation of State-wide licensing agreements and purchasing agreements is under way.
WA	• review and list of software resources
SA	• concessional rates for curriculum software products most popularly used in schools

Some further economies may be available from expanded State-wide licensing and preferential pricing arrangements for software. The Department is a considerable player in the market for software, particularly educational software. As monitoring and evaluation improves, the Department will be able to better understand school-level demand for particular software and target its efforts to obtaining either State-wide licensing or concessional rates on such software.

Schools in action

Larger schools are able to acquire site licences more cost-effectively than smaller schools due to economies of scale.

One school drew a particular software package to the attention of the Audit Office. The package was available to Victorian schools for less than $50 through State-wide licensing arrangements. There were no such arrangements in NSW. The cheapest price for NSW schools for this package was $150.

The Department is of the view that software diversity has advantages in that students develop the ability to transfer their learning and adapt their skills to a range of situations. The decision to not settle on a common or limited suite of software may, however, have contributed to:

- additional costs arising from the need to train staff and provide support for a wide range of software
- difficulties for students and teachers moving between schools
- substantially different approaches to the use of computers in teaching and learning and uncertainty at the school level about effective use of computers.

Audit observation

The Department has recently negotiated State-wide arrangements with Microsoft, which should result (over time) in savings for schools.

Central coordination and a degree of commonality of software can result in significant economies.

4.6 Audit conclusion

The centralised approach to the computer roll-out and connection of schools to the Internet and wide area network have been more economical than a decentralised approach would have likely been. Leasing allows computers to be kept up-to-date, and the decision to lease modern, multi-media computers means they have not become redundant before scheduled replacement.

The Program, however, leaves much responsibility for setting-up computers to schools, in terms of both funding and approach. The implications of this are discussed in the following chapter.

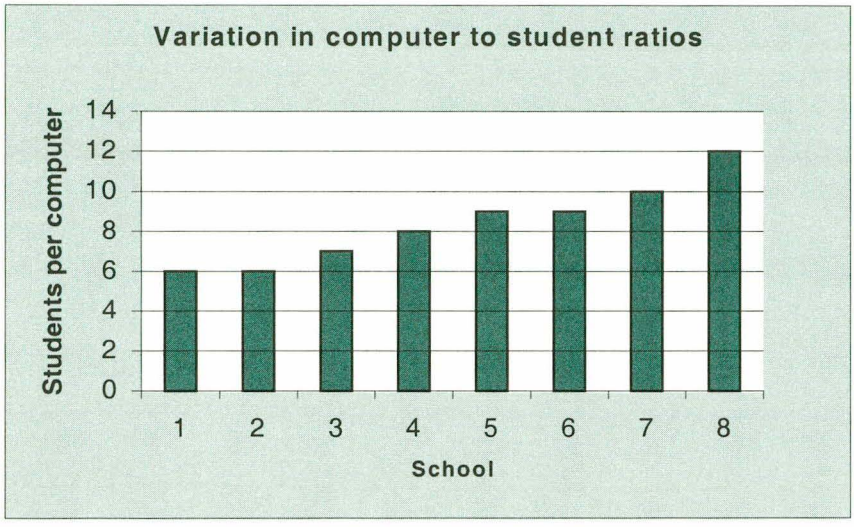
There may be areas where more commonality or central coordination could generate economies. There is a need to balance the benefits of diversity and choice with the potential costs to economy that a decentralised approach may bring in some circumstances.

5 Putting Computers in Schools – In Practice

5 Putting computers in schools – In practice

5.1 Computers

The Audit Office observed significant variation between the schools visited in the ratio of computers to students.



There were marked differences between the sample schools in where they located computers.

Location of computers in sample schools								
	Primary				Secondary			
	P1	P2	P3	P4	S1	S2	S3	S4
Library	✓	✓	✓	✓	✓	✓	✓	✓
Classroom	✓	✓	✓	✓			✓	
Laboratory			✓	✓	✓	✓	✓	✓
Mini lab					✓			
Demonstration Room				✓				
Mobile computers	✓				✓			✓

Secondary schools had a greater tendency to locate computers in laboratories while primary schools were more likely to locate computers in classrooms.

Research

A significant body of research favours location in the classroom. Many experts see this as a facilitator of a more student-centred approach to teaching and learning. Increasingly, however, experts are seeing benefits in having both a laboratory in which to learn about computers and how to use them, and computers in the classroom to integrate into key learning areas such as English, History, Mathematics etc. This caters for a range of teaching and learning styles.

Schools in action

Two primary schools accommodated computers in both laboratories and classrooms. The laboratory was where basic skills were learnt while the classroom was where the skills were applied to key learning areas.

One school also located computers in a 'technology room' set-up so that four to five students worked on each computer. The school expected to move to this model in the future.

One high school had several mini-labs (a mini lab is a group of about four computers) scattered throughout the faculty areas. The mini-lab approach was considered by the school to be a viable alternative to laboratories when it was not possible to provide sufficient computers in classrooms.

5.2 Other equipment and facilities

There was a wide array of peripheral equipment in the sample schools. Peripheral equipment observed in schools included printers, scanners, plotters, video/digital cameras, data projectors, CD-ROM stackers, CD writers, data loggers and file servers. The amount and type of peripheral equipment varied between the sample schools.

Schools in action

All of the schools had printers, and most of the schools had scanners and digital cameras. However, the number per computer varied markedly.

Schools with networks had file servers. Some of the sample schools had data projectors, CD-ROM stackers and/or CD writers. Some secondary schools had data loggers.

The expenditure on cabling, electrical outlets, electricity, consumables, telephone and data points, refurbishment etc varied between the schools.

Schools in action

One school located largely in a single building, on a relatively flat site with an underground access tunnel running the length of the school was fully networked for $10,000. A smaller school, with several geographically dispersed buildings on a steep site was partially networked for $28,000.

One school in a high crime area located its computers in laboratories on the top floor of its building primarily due to security considerations. It was cheaper to secure a small number of laboratories than a larger number of classrooms and stairways could be blocked for added security. Another school located in a low crime area had implemented few additional security measures for its computers, and was able to locate computers in classrooms as well as laboratories.

The cost of communications for isolated rural schools is a significant impost on schools and the Department. The Department subsidises these costs for such schools and there are restrictions placed on these schools regarding the amount of time they are able to access the Internet. Rapid growth in usage of the Internet is increasing costs. This is a problem common to other States and other countries such as the US.

Overseas

In the US, a common, low-cost telecommunication rate for schools has been negotiated (known as the E rate).

In Australia, methods of reducing this impost on isolated schools are being discussed at an inter-governmental level, given that communication is a Commonwealth responsibility and education a State responsibility.

5.3 Technical support

There were substantial differences between schools in their approaches to providing technical support.

Schools in action

Schools adopted various approaches to technical support including:

- outsourcing
- releasing a teacher or teachers to provide part-time technical support
- releasing a teacher full-time to provide technical support and skill training to staff and students.

Schools identified problems where the computer coordinator also had a teaching load and with outsourcing, ie:

- troubleshooting and user support often either took the computer coordinator/teacher from their class or alternatively had to be delayed until the computer coordinator/teacher had a period of release from class. Either way, one class would be disrupted
- a timely response can be costly where support is outsourced, and it was generally more cost-effective to delay a 'call out' until several problems had to be rectified. This caused disruption to classes while rectification of problems was awaited.

Several of the sample schools were exploring ways of obtaining free or cheap support.

Schools in action
One school was discussing with TAFE the option of using a technology student to provide technical support. Benefits for the school in terms of costs and student in terms of experience were expected. Another school was already using this approach.

There was also significant variation in the extent of technical support.

Schools in action
One primary school employed a full-time computer coordinator from parental contributions. She taught basic skills to staff and students, administered the network, liaised with network engineers and provided day-to-day technical support. In another primary school, the computer coordinator allowance was used to purchase the services of a technician who came to the school to sort out problems on Tuesdays. Teachers acknowledged that his technical expertise was essential to resolve many problems, but found the need to 'wait until Tuesday' annoying and disruptive.

The replacement of computers every three years also presents some problems for technical support.

Schools in action
Principals indicated that installing computers was a particular drain on technical support. Program computers were delivered to schools in boxes, with the school being responsible for installation. Most principals expressed concern that the regular roll-over of computers meant that each computer would have to be reinstalled once every three years. There was strong support for computers to be installed as part of the leasing arrangement.

5.4 Local area networking

Approaches to and the extent of local area networking varied between the sample schools.

Local area networking arrangements – sample schools								
	Primary				Secondary			
	P1	P2	P3	P4	S1	S2	S3	S4
Library	N	N	F	F	F	P	F	P
Classroom	N	N	F	F	-	-	F	-
Laboratory	-	-	F	F	P	F	F	F
Mini lab	-	-	-	-	P	-	-	-
Demonstration Room	-	-	-	-		-	-	-
Mobile computer	-	-	-	-	N	-	-	N
Professionally installed	-	-	F	F	N	F	F	F

Key: N=nil, P=partial, F=full - = not relevant

Research

In general, schools will be better placed to take full advantage of computers with the capabilities provided by a local area network.[45]

The design and installation of some of the local area networks in the sample schools were by professionals, but others were by volunteers.

[45] Education Victoria, *Learning Technologies Planning Guide for Schools*, March 1997.

5.5 Software

The amount and type of software available for student use varied between the sample schools.

Schools in action
Some schools had large libraries of educational and desktop software, whereas others had a very limited number of pieces of software. Novell (eg Claris Works) and Microsoft (eg Microsoft Office) were common to most schools. These usually had capabilities including: • word processing • spreadsheets • graphics • databases • paint and draw. Some schools had multi-media packages, particularly those schools espousing a student-centred approach. One school adopted a deliberate strategy of restricting the number of software packages used. Teachers were required to familiarise themselves with only one or two software packages. The software packages chosen were considered to facilitate a student-centred approach to learning. Students use the software to prepare multi-media presentations and it can be applied to each of the key learning areas.

5.6 Reasons for variation

5.6.1 Leadership

A school is likely to be more technologically advanced with leadership that:

- understands the potential for computers in teaching and learning
- articulates a clear vision for the use of computers in teaching and learning
- actively promotes the use of computers and models effective computer usage
- gives resourcing priority to computer technologies.

Such leadership often comes from the principal, but can also come from other teachers and from the wider school community.

5.6.2 Additional sources of funds

Some schools had significantly greater capacity to fund computers than others.

Schools in action

Variations between schools in discretionary funding can be seen in the following examples from the schools visited:

- the average (paid) annual fee per student of one primary school was more than $110, compared to some others (including secondary schools) of less than $25. The primary school used the fees to pay for the salary of the computer coordinator, allowing her to work on computing full-time
- one school raised an additional $30 per student in each of the last two years from fund raisers, compared to other schools that had raised little or no additional funds
- some schools had very active P&Cs that raised substantial funds while the P&Cs of other schools were largely inactive
- some schools had facilities which lent themselves to entrepreneurial activity while others did not
- canteen earnings varied significantly between schools, especially where canteens were staffed by volunteers as opposed to contractors
- the school with the most computers per student was a secondary school participating in the Disadvantaged Schools Program, while a secondary school with a similar socio-economic status profile but not qualifying for DSP funding had half as many computers for each student.

Based on the Audit Office's school visits and discussions with other experts, it is apparent that schools that receive high levels of voluntary parental/community contributions are well placed to advantage their students with more computers. Also, schools which receive special funding, such as Disadvantaged Schools Program funding, have some funds for this purpose. However, the large number of schools which fall into neither group rely mostly on computers from the Program. These schools generally have fewer computers available for their students and have less effective computer set-ups.

The practical implications can be illustrated through local area networking. As discussed earlier, there are clear benefits if a school has a local area network of good quality covering most of the school. In particular, a good local area network increases:

- access to the Internet and the Department's wide area network
- scope for communication
- capacity for storage and retrieval of work.

Schools in action
One primary school (about 800 students) had a professionally designed and installed local area network, with computers located in classrooms, a laboratory and a model classroom all with Internet access. Considerable financial contributions from parents were required, together with parental involvement in planning. In contrast, another primary school (about 400 students) had no network as it could not afford to install or maintain one. The computer coordinator allowance was used (together with other school funds) to obtain a technician one day per week. Parental contributions to this school were minimal. The principal indicated he would install a network when funds became available.

5.6.3 School specific factors

Factors such as school location, layout, design, geography, age, facilities etc, impact on the costs and complexities of computing initiatives for individual schools.[46] Some other factors may not be within the capacity of an individual school to address, such as classroom size.[47] At present, however, resourcing does not generally acknowledge these factors.[48]

Differences in technical support approaches and scope in the schools visited in part appeared to relate to school size. This is backed by recent research. This research also highlighted the gap between government and independent (non-Catholic) schools.

[46] For example, the costs of security, re-wiring, refurbishment and network cabling.

[47] For example, several classrooms in some sample schools appeared too small to house both students and more than one or two computers.

[48] The Department provides schools with global funds to meet costs associated with electricity, furniture and communications. Global funds do not, however, appear to have increased to fund the additional costs generated by computing. Additional funds are provided to schools which do not have local access to the Internet to meet increased STD charges, although restrictions are also placed on these schools which limit the amount of time they can use the Internet to contain costs.

Research

The majority of schools depend on a single teacher to coordinate information technology provision in the school. Large ones can call on a wider range of personnel, including network managers and technicians. There is a considerable gap in the level of these resources between Independent and Government schools, especially in the provision of full-time network managers and technicians.[49]

The relevance of school specific factors can be illustrated using the location of computers as an example.

Schools in action

Some schools indicated that they located computers in laboratories rather than classrooms by choice. Reasons included:

- appropriate for the stage of development of teaching staff
- allowed whole class instruction
- provided opportunities for individual rather than group activities
- facilitated the training of basic skills to students and staff
- maximised the time computers were in use.

Some schools, however, indicated that they located computers in laboratories rather than classrooms for pragmatic rather than educational considerations. Reasons included:

- classrooms too small to fit computers
- higher costs of networking multiple classrooms compared to one or two laboratories
- too few computers to provide more than one or two in each classroom
- technical and teaching support issues more easily and cost-effectively dealt with in laboratories
- physical security easier and cheaper in laboratories
- teachers unable to make effective use of computers in classrooms.

Recent initiatives/announcements

The Department advises that its new building codes for primary and secondary schools have been specifically designed to make generous provision for data outlets, classroom space and additional flexible areas suitable for a range of computer-based activities. A pilot initiative of Properties Directorate, assessing the adaptation of existing school facilities, is also under way.

[49] Australian Key Centre for Cultural and Media Policy, *Real time – Computers, Change and Schooling*, October 1999, p xxxi.

Audit observation

Some of the additional costs of setting-up and using computers vary between schools due to factors such as age, topography, location and geography of each school. Resourcing generally does not acknowledge these differences. Further, some schools are able to make decisions based largely on educational considerations, while others are required to compromise educational considerations due to logistical matters or resource considerations.

5.6.4 Knowledge of school communities

Written guidance available to schools is limited.[50] Whilst not the only source of advice, much reliance is placed on district technology advisers, but each technology adviser is required to support more than 55 schools on average.[51]

Schools in action

The schools visited reported that they needed more assistance than the technology adviser was able to provide.

Interstate

Victoria provides for schools a detailed learning technologies planning guide and learning technologies implementation guide. WA provides similar guidelines to its schools under a licensing arrangement with Victoria.

Recent initiatives/announcements

Resource materials to assist teachers and school communities make sound decisions regarding the use of new or refurbished facilities are being developed. These will specifically address issues in the management and use of networks and network resources.

Audit observation

Schools would appreciate if the Department provided guidelines which are sufficiently detailed to free technology advisers to concentrate on more strategic issues (eg planning) and more complex technical issues. Alternatively, there would seem to be a need to increase the number of technology advisers.

[50] For example, there is no written guidance on optimal equipment levels, how to best leverage computers for teaching and learning etc.

[51] District technology advisers may also have differing views and philosophical approaches.

5.6.5 Primary and secondary

Secondary schools tend to be larger. Size can be important for establishing aspects of infrastructure such as networking.

They are also, generally, more likely to have technical expertise among staff, given that most have specialist computer studies teachers.

The usual structure of secondary education, with subject-specific periods and students moving around the school may also encourage the establishment of laboratories, at least as a priority. Laboratories are also useful for teaching computer studies classes. Naturally, these specialist courses tend to have priority for computer access.

On the other hand, primary schools tend to have a class allocated to a teacher for the year for most activities. Movement around the school is generally far less than in secondary school. This may promote location in classrooms.

Research

Some experts argue that computers are most effective when used for cross curricula tasks.[52]

Audit observation

The class-oriented structure of primary education may be more sympathetic to cross-curricula learning than the subject-oriented structure of secondary education.

5.7 Audit conclusion

As found in the previous section, the Program leaves much to schools in terms of resourcing and approach to setting-up computers for teaching and learning.

The variation in computers, infrastructure and support identified in the school visits accords with the observations of the Ministerial Advisory Council on the Quality of Teaching in 1997:

> The overall picture is that the schools surveyed were offering students access to computers in varying degrees.[53]

[52] President's Committee of Advisers on Science and Technology, Panel on Education Technology, *Report to the President on the Use of Technology to strengthen K-12 Education in the US*, March 1997.
[53] NSW Department of Education and Training, *Computer Proficiency for Teachers,* Ministerial Advisory Council on the Quality of Teaching, June 1997, p 9.

The Ministerial Advisory Council on the Quality of Teaching went on to note that:

> Critical to the achievement (of social justice objectives) will be development of strategies to ensure that local differences in the cost of establishing infrastructure in schools and the cost of teacher access to that infrastructure are minimised so that neither geographic nor socio-economic barriers are a significant impediment to participation.[54]

It will be important to ensure that differences in computers, infrastructure and support do not exceed an acceptable range in order to prevent serious inequity. Recent Australian research supports this view.

Research

A challenge for school systems is to address the existing and emerging disparities in students' information technology skills. The existing research literature consistently shows that students' information technology skills are at least partly dependent on access to computers at school, to school resources and to the opportunities that students have to use computers by themselves. [55]

Where student-to-computer ratios are advantageous, students are more confident about their own basic and advanced skills, more satisfied with the resources provided and more likely to say that they enjoy using computers at school. The lower the student-to-computer ratio, the more time students spend on computers at school, both alone and in small groups, and the wider and more sophisticated the use of information technology across the curriculum. [56]

It will also be important to ensure that technical support is sufficient to allow schools to make effective use of computers. Insufficiency of technical support, in particular, will result in under utilisation of computers. There is a need to consider when infrastructure in schools may be sufficient and resources can be diverted to technical support.

[54] NSW Department of Education and Training, *Computer Proficiency for Teachers,* Ministerial Advisory Council on the Quality of Teaching, June 1997, p 13.
[55] Australian Key Centre for Cultural and Media Policy, *Real time – Computers, Change and Schooling,* October 1999, p xxv.
[56] Australian Key Centre for Cultural and Media Policy, *Real time – Computers, Change and Schooling,* October 1999, p xxxi.

6. Using Computers for Teaching and Learning – Program Implementation

6 Using computers for teaching and learning - Program implementation

6.1 Devolution to schools

The Department does not mandate particular approaches to using computers for teaching and learning. The Department advises that the practice of devolving decisions on the use of computers in teaching and learning and providing centralised training and curriculum is consistent with the Department's general approach to teaching and learning.

Research is inconclusive as to the best way to use computers to improve student learning outcomes in key learning areas. In part, this is because different teaching philosophies hold out different uses for computers in teaching and learning.[57] Research also recognises that different students can learn in different ways.

The Department considers that there is rarely a single best approach for any area of education, including the use of computer-based technologies. A range of strategies and approaches is needed to cater for differences in students and school contexts, and to provide a variety of experiences for all students. Models of good practice have been provided in the curriculum support documents and within the TILT program (which may be adapted to local needs). The Department's current Focus Schools Project will provide a model where good practice can be fostered, documented and then disseminated to others. The Department considers that the use of a 'common approach' across the State would prevent essential school-based decision making and planning from taking place.

6.2 Professional development

TILT:

- had few precedents to guide its development
- was developed in consultation with key stakeholders
- accords with principles of modern professional development in an educational setting
- evaluation results have been generally positive

[57] Appendix 1 compares teacher-centred and student-centred approaches to teaching and learning.

- balances the economy of central coordination with the diversity resulting from devolving implementation to district and school staff
- has won several awards
- has been licensed by several overseas education systems.

Schools in action

Most teachers who had undertaken TILT interviewed by the Audit Office indicated that TILT had raised their awareness of the possibilities for using computers in teaching and learning and their use of computers for administrative purposes.

Some teachers indicated that TILT had contributed to greater integration of technology into teaching and learning, while others indicated that TILT had not changed their teaching practices.

Teachers who reported to the Audit Office that they had changed their teaching and learning practices indicated that in-school support was necessary to supplement TILT before any substantial change to practices occurred.

The main criticisms of TILT from interviewees were that it:[58]

- covered too much ground in too little time
- did not have sufficient focus on teaching with computers
- mixed primary and secondary teachers, who have different needs.[59]

Nevertheless, there was strong support for TILT to be offered to all those that needed basic training, and for a more advanced training course for those who had completed TILT or whose skill levels equalled or exceeded TILT.

[58] The relief days that are part of TILT have presented problems for some schools, particularly in rural areas, where casual relief is hard to find. The Department is aware of the relief issue and has put in place remedial strategies. Further options for TILT delivery, eg on-line access, are also being developed.

[59] The Department advises that the TILT course was deliberately designed to bring primary and secondary schools together to facilitate exchange of ideas/practices. The Department's view was that secondary school structures make it more difficult to engage in student-centred learning including use of computers. This included the dominance of computer studies in computer use/decisions/access in many secondary schools. The TILT Program has been tailored to provide key learning area specific training in mathematics, science, computing studies, early childhood and special education.

Recent initiatives/announcements

- Training of a further 10,000 teachers in TILT.
- TILT has been redesigned as an interactive CD-ROM, including videos as well as workshop materials and resources.
- Training of an additional 15,000 teachers in advanced and specialised computer skills (TILTPlus).
- TILT graduates to be eligible for a TAFE Level II Certificate in Information Technology.
- Computer training in specific subject areas for secondary teachers.
- Computer training packages for early childhood and for special education teachers.
- Further research is to be undertaken to provide a greater understanding of effective use of computers, including better practice examples.

Research

Professional development should be ongoing recognising the presence of continued technological innovation.[60]

The Department is making extensive and innovative use of its infrastructure to support training and development. The recently published document *Accessing Training and Development Through Technology* (December 1999) highlights this initiative. The plans to deliver TILT through computer-based courses will take advantage of technology itself for professional development of teachers.

Research

Technological progress may itself contribute toward the solution of some of the problems of professional development by making educational software easier for teachers to use; by helping teachers in various ways to recover some of the time invested in the introduction of technology; and by supporting on-line professional development seminars and remote mentoring and consulting activities, which are likely to prove more cost-effective than conventional instruction under appropriate circumstances.[61]

[60] President's Committee of Advisers on Science and Technology, Panel on Education Technology. *Report to the President on the Use of Technology to strengthen K-12 Education in the US*, March 1997, p 25.

[61] President's Committee of Advisers on Science and Technology, Panel on Education Technology. *Report to the President on the Use of Technology to strengthen K-12 Education in the US*, March 1997, p 25.

Audit observation

TILT is an award-winning course, but no 30 hour training program can be expected to transform a beginning user into someone competent and confident enough to integrate computers into teaching and learning.

Observations in the schools visited and discussions with experts indicate that some teachers require further professional development and practical assistance before they will be able to effectively use computers for teaching and learning.

6.3 Curriculum support

Content is critical to effective use of computers, together with an understanding of how computers can be best utilised.

As indicated in chapter 2, the Department has implemented a number of initiatives in the area of curriculum support.

This curriculum support:

- has been complementary to the Department's TILT program
- had few precedents to guide its development
- was developed through a thorough process involving key stakeholders and client feedback
- has been generally evaluated positively
- has been reviewed and enhanced as the Program has proceeded
- has sought to use technology where appropriate, having regard to the 'technological literacy' of teachers
- has been developed economically.

Schools in action

Many of the teachers consulted displayed little or no knowledge of the Department's curriculum support documents. Those that recalled them, however, thought they were helpful. Nevertheless, few said they regularly used them either directly or to generate ideas.[62]

[62] There were some concerns about the assumptions made about the level and location of equipment in schools, and that in the less technologically rich schools some suggestions may not be not feasible.

Recent initiatives/announcements

- HSC On-line website to include more subjects and provide students with access to extra resources.
- Curriculum support documents to be updated.
- DET's website to be updated and improved to provide increased access to resources on the Internet.
- Upgrading of connect.edu to provide teachers with up-to-date practical ideas for integrating the Internet into teaching and learning and step-by-step advice on how to use the Internet.

The Department's Curriculum Support Directorate is currently undertaking research, in partnership with the University of Technology, Sydney, to identify factors and strategies that promote the integration of technology use in teaching and learning. The Department advises that this research is essential in order to provide a sound platform for the development of curriculum support for teachers and schools.

Audit observation

Curriculum support documents were developed in close consultation with stakeholders and they have been evaluated positively. Despite being provided to all teachers, recognition and use among teachers in the schools visited was limited. Similarly, knowledge among teachers of other curriculum support provided by the Department was also limited (with the exception of HSC On-line). Taken together with the limited and variable use of computers by some teachers in the schools visited identified in the following chapter, this suggests a need for:

- further curriculum support
- a need to develop additional strategies to promote awareness of the curriculum support available.

6.4 Technology advisers

The role of the district technology adviser includes:

- coordinating TILT at the district level and providing technical support to the TILT facilitator
- working in collaboration with district curriculum consultants in advising teachers on how they can use technology to enhance their teaching programs
- working with district training and development consultants in delivering technology training.

Schools in action

School communities indicated that technology advisers found it difficult to provide sufficient advice and assistance to their school. They considered that technology advisers had too many schools to service and had to concentrate on the 'laggers'.

School communities reported little input from district curriculum consultants to the integration of computers into the curriculum.

The computer coordinator allowance can be used also for teaching support.

Audit observation

Much reliance is placed on technology advisers for assisting schools with teaching (and technical) issues. Each technology adviser supports 55 schools on average, as well as undertaking activities for the District Office. This makes it difficult for technology advisers to provide sufficient support to schools, particularly during the current period of substantial change.

6.5 Wide area network and Internet

In addition to Departmental sources, teachers are able to access information from a variety of other sources. The wide area network and the Internet, in particular, offer teachers a vast array of information and the opportunity to communicate with fellow teachers and share experiences and knowledge.

Research

The University of Sydney, Faculty of Education offers a large amount of information relevant to teaching (http://alex.edfac.usyd.edu.au). This includes:

- a web page which includes information on using computers in teaching and learning, with links to other web sites with such information
- access to two 'virtual schools', which incorporate examples of school and system policies and procedures as information and models of good practice
- a listserv, which allows teachers and computer coordinators to exchange information and share their experiences. The listserv commonly sees computer coordinators seeking advice from their colleagues or others participating in the listserv.

Examples of other useful sites include:

- *The Technology Source*, the purpose of which is "to provide thoughtful, illuminating articles that will assist educators as they face the challenge of integrating information technology tools into teaching and into managing educational organisations." (http://horizon.unc.edu/TS/)
- *EdNA Online*, the website of Education Network Australia web. EdNA Online networks the bodies responsible for Australian education and points to an array of resources contributed by Australian educators (http://www.edna.edu.au)
- *International Society for Technology in Education*, whose mission is to help K–12 classroom teachers and administrators share effective methods for enhancing student learning through the use of new classroom technologies (http://www.iste.org/index.html).

Schools in action

Discussions with teachers suggested that there was not widespread knowledge of sources of information on, and suggestions about, how to use computers in teaching and learning.

Some teachers were, however, very knowledgeable and these tended to make much use of computers for teaching and learning.

Audit observation

There is a vast amount of information available on the wide area network and the Internet which would be useful to teachers. Many teachers in the schools visited, however, demonstrated little or no knowledge of the availability of such information. There seems to be a need to better communicate the existence of this extensive source of information to teachers, together with strategies for navigating the Internet to find suitable information.

6.6 Teacher competencies

The report of the Ministerial Advisory Council on the Quality of Teaching *Computer Proficiency for Teachers* (1997) recommended the establishment of a minimum proficiency for graduates of initial teacher education courses, and the introduction of graduate certificate courses for computer competencies.

Recent initiatives/announcements

From 2000, the Department will only employ graduates of NSW and ACT higher education institutions as teachers where they have a minimum proficiency in the educational use of computers. They will need to be able to:

- perform the basic functions eg retrieve information from a CD-ROM, understand and use a variety of software including spreadsheets, word processing and desktop publishing
- find information from the Internet and use e-mail
- organise and present relevant educational material
- evaluate the educational value of software and its appropriateness for the classroom curriculum
- use computers to create student-centred learning environments to promote creativity and integration.

Research

Colleges of education should adequately prepare teachers to use technology effectively in their professional activities.[63]

Discussions with universities providing pre-service teacher training indicate that some graduates entering the system may not be adequately versed in how to make effective use of computers for teaching and learning, including learning and classroom management techniques, and in particular how to use computers to create student-centred learning environments. The requirements also do not relate to incoming teachers who graduated from:

- NSW and ACT universities prior to 2000
- universities in other States or overseas.

[63] President's Committee of Advisers on Science and Technology, Panel on Education Technology, *Report to the President on the Use of Technology to strengthen K-12 Education in the US*, March 1997, p 27.

Audit observation

It is critical for the Department to ensure that incoming teachers have the ability to use computers effectively for teaching and learning. The Audit Office is concerned that not all incoming teachers will have the required skills. The cost implications for the Department are significant if it needs to train both existing teachers and new graduates in making effective use of computers.

No 'minimum competencies' for existing teachers in the use of computers for teaching and learning have been established in NSW. These exist in some other States.

Interstate

Queensland has established minimum standards for teachers in the use of computers in learning. In order to achieve the minimum standards, it is necessary for teachers to apply the skills and strategies to the classroom and school settings. Assessment and credentialling is undertaken at the school level and there is accreditation towards tertiary study. The four skill areas are:

- IT skills, which focuses on the operation and use of both hardware and software
- curriculum applications, including classroom planning and management, which addresses the use of learning technology in key learning areas
- school planning, which looks at the processes and procedures which promote continuity and coordination of learning technology activity at the whole school level
- student-centred learning, which deals with the application of effective learning and teaching processes to learning technology.

Minimum standards are also being developed and implemented overseas.

Overseas

The International Society for Technology in Education (ISTE) has developed general standards that provide a foundation in technology for all teachers in US schools. These have been adopted by the US National Council for Accreditation of Teacher Education (NCATE) and are currently being used in the process of accrediting teacher preparation programs in many American universities. ISTE is also developing *Standards for Using Technology in Learning and Teaching* which will describe how technology should be used throughout the curriculum for teaching, learning, and instructional management.[64]

[64] ISTE web site.

Research

A recent major report called on Australian education systems to, inter alia:

- establish a regime in which information technology skills are expected of teachers and rewarded
- set targets (for teacher use of computers in teaching and learning) at the level of the education authority and the individual school and incorporate these in information technology plans.[65]

Audit observation

Minimum teacher competencies in using computers for teaching and learning could:

- clarify expectations of teachers for using computers
- motivate teachers to obtain the competencies
- offer an intermediate outcome which can be measured.

Consideration should be given to methods of rewarding teachers who demonstrate proficiency in the use of computers for teaching and learning. Targets could also be set for use of computers by teachers.

There may also be scope for a larger role for TAFE in enhancing teacher technical skills in using computers, given that public school education and TAFE are now in the same Department.

6.7 Teacher access to computers

Increasing teacher access to computers should raise teacher competency. The Ministerial Advisory Council on the Quality of Teaching noted the need to:

> ...acknowledge research findings indicating that proficiency in computer use among teachers correlates directly with personal ownership of a computer.[66]

Research

Most teachers need to feel comfortable with using a computer before they will attempt to integrate them into teaching and learning. Comfort is gained by using a computer.

To use technologies well, teachers not only need access to them, but they also need opportunites to discover what the technologies can do, learn how to operate them, and experiment with ways to apply them.[67]

[65] Australian Key Centre for Cultural and Media Policy, *Real time – Computers, Change and Schooling*, October 1999, p xxxiv.
[66] NSW Department of Education and Training, *Computer Proficiency for Teachers*, Ministerial Advisory Council on the Quality of Teaching, June 1997, p 13.
[67] US Congress, Office of Technology Assessment, *Teachers and Technology: Making the Connection*, Washington DC, 1995, p 6.

The Department gives teachers the option of obtaining a lap-top computer by sacrificing part of their salary.

Schools in action
Most of the teachers spoken to during site visits did not avail themselves of current 'salary sacrifice' arrangements. They considered them to be an insufficient incentive to obtain a computer. There was strong support for a scheme that provided greater subsidisation.

Subsidisation of computers for teachers occurs in other States.

Interstate

Subsidisation of computers for teachers	
Qld	Four hundred teachers receive lap-tops for attending professional development in their own time
Vic	Education Victoria subsidises the leasing of 12,000 lap-tops for teachers (one per three teachers)
ACT	Every teacher is provided with a desktop computer

Research

A recent major report found that teachers' access to hardware and software varies considerably across sectors, income areas and according to location. The most marked disparities are in the patterns of students' and teachers' access in school time to more advanced communication uses of information technology, especially the Internet and the Web.[68]

Audit observation

Options for increasing teacher access to computers should be examined, in particular the linkage of subsidies to competency.

6.8 Time to integrate computers into teaching and learning

Integration of computers into the curriculum can mean a substantial change in approach for some teachers. A substantial change of this kind will be time consuming. Further, change in information technology is likely to continue apace, and teachers will have to keep abreast of these changes and the teaching implications.

[68] Australian Key Centre for Cultural and Media Policy, *Real time – Computers, Change and Schooling*, October 1999, p xxx.

Research

Teachers need to have sufficient time in their working week to effectively incorporate technology into the curriculum. There is a lack of time to attend training workshops, to experiment with machines and explore software, to talk to other teachers about what works and what doesn't, and to plan lessons using new materials or methods.[69]

The Ministerial Advisory Council on the Quality of Teaching reported that a common theme among the schools it surveyed was that:

> ...professional development needed to be ongoing and time had to be provided for teachers to practice and refine newly learned skills.[70]

Schools in action

Teachers and principals consistently commented on:

- the time necessary to educate themselves in the use of computers for teaching and learning
- the time constraints under present curriculum arrangements.

Primary teachers and principals were particularly concerned at the crowded curriculum, and the difficulty this presented for coming to grips with technology.

As discussed elsewhere in the report, the Department has provided additional hardware to schools and many types of assistance to teachers and schools to promote the integration of computers into teaching and learning, including:

- curriculum support documentation
- technology training in self-paced modules which can be completed by teachers at a time and place of their choosing
- allocation of relief days to the schools of TILT participants
- district technology advisers and curriculum consultants.

[69] President's Committee of Advisers on Science and Technology, Panel on Education Technology. *Report to the President on the Use of Technology to strengthen K-12 Education in the US*, March, 1997, pp 26 and 27.

[70] NSW Department of Education and Training, *Computer Proficiency for Teachers,* Ministerial Advisory Council on the Quality of Teaching, June 1997, p 9.

The Department is also of the opinion that:

- teachers have always had to change teaching practices to reflect the needs and aspirations of future work or study environments
- the increasing importance of technology in schools is a reflection of the change which is occurring in workplaces generally.

Audit observation

Options need to be considered which afford teachers the time to implement this change.

6.9 Curriculum requirements

The Government's commitment to incorporating technology into syllabuses and curricula is being advanced. The responsibility for this lies with Board of Studies. Aside from key learning areas with a specific technology component (eg Computing Studies, Design and Technology 7-10) for the most part computers are offered as a strategy for delivering a student learning outcome. In these cases, use of a computer is not necessary and the syllabus can be delivered without use of the computer.

This position is consistent with the notion of decision making at the local level. It is also necessary as under its charter the Board of Studies cannot create an educational requirement which has resourcing implications for schools. A requirement to use technology could have resourcing implications for some schools.

Nevertheless, there is a view among some experts that as a result of technology:

> ...there will need to be a fundamental rethink about the structure of the curriculum and how it will be assessed. This rethink will lead to greater emphasis on more generic competencies, particularly those involved with information handling and communication.[71]

[71] M Salier, CEO Tasmanian Secondary Assessment Board, *Electronic Technologies in Teaching and Learning*, 1997.

Audit observation

Revised syllabuses and curricula include references to how computers can be used to deliver outcomes. In the main, however, they do not require use of computers. Further, the Audit Office has not seen evidence of a fundamental review of the structure of the curriculum and how it will be assessed.

6.10 Audit conclusion

The Department has put in place a central training program and made available curriculum support of good quality.

As will be seen in the next chapter, however, the rate of take-up of computers for teaching and learning is generally at an early stage and variable. Some schools and some teachers have a long way to go to catch up with the more effective users.

While several initiatives are under way or have been announced, more needs to be done. The Department needs to consider when there will be enough school infrastructure in place to allow it to divert more resources to providing more teaching support to teachers and principals.

The Department needs to concentrate on enhancing:

- principal and teacher knowledge of how to make effective use of computers and how to obtain ideas for integrating computers into teaching and learning
- teacher access to computers
- systems for identifying usage that is below acceptable standards
- systems for encouraging efficient and effective use of computers, such as linking competency to promotion.

7. Using Computers for Teaching and Learning – In Practice

7 Using computers for teaching and learning – In practice

7.1 Variations between schools

There was substantial variation between the schools visited in their approach to using computers for teaching and learning. There were differences between primary schools and secondary schools. There were also differences among the secondary schools and among the primary schools.

Schools in action
Secondary schools: Computer studies generally had priority for computer use in secondary schools. In other subject areas, computers tended to be used to broaden sources of information, to improve presentation or to develop capabilities. Three of the schools appeared to use computers mainly to enhance traditional approaches to teaching and learning, although some teachers were also inclined to use computers to implement a student-centred approach. In these schools, on the whole the integration of technology into other curriculum areas was limited. In one school, however, computer use across all key learning areas was occurring. The principal and most teachers spoken to indicated that they were seeking to implement a more 'student-centred' approach. Computers were located around the school and 'owned' by different faculties. The school had enunciated both a clear policy and strategies for integrating computers into teaching and learning.
Primary schools: The primary schools tended to exhibit a more student-centred approach than secondary schools. Three of the four schools used multi-media software. In two of these schools, however, most use of the computers for such activities occurred outside the usual classroom in laboratories and model classrooms. This was accompanied by basic skills training in laboratory settings by a teacher specialising in Information Technology. In one school, there were no laboratories and more computers were available in classrooms. This school had a clear strategy of using multi-media packages as a tool for a student-centred approach to learning and teaching, and classrooms were set-up to encourage group work with computers.

The Department is undertaking a number of initiatives concerning the structure of secondary education and the use of information and communications technologies in any future structures. It is also participating in several on-line content development projects, including the national, collaborative on-line content strategy coordinated by the Curriculum Corporation. The observations of the Audit Office support the need for such initiatives.

7.2 Differences between teachers

The Audit Office observed significant variation between teachers in the way they and their students used computers and in their extent of computer use.

Schools in action

The average time computers were used by students appeared to vary between classes. Some teachers made substantial use of computers, while others hardly used them at all.

Some teachers adopted a student-centred approach, while others used computers to enhance traditional approaches. Those adopting a traditional approach tended to largely use computers for word processing or retrieving information from a CD-ROM or from the Internet. Typically, those espousing student-centred philosophies tended to use more of the potential of the computer. For example, the Internet was used for communication, not simply as a passive source of information, and content-free multi-media software was used to develop interactive presentations.

Discussions with principals and teachers indicate that some teachers are both more inclined and more able to integrate computers into teaching and learning than others, and that the differences can be stark. All principals indicated that some teachers made more effective use of computers in teaching and learning than others.

Three of the eight schools visited had instituted basic skills and software awareness training of students by a computer aware teacher. One reason was to compensate for the differences in knowledge of teachers and use in classrooms.

Research

A recent major report identified that between 25% and 50% of Australian teachers were lacking some skills necessary to use or teach a range of applications.[72]

[72] Australian Key Centre for Cultural and Media Policy, *Real time – Computers, Change and Schooling*, October 1999, p xxxiv.

7.3 Reasons for variation

7.3.1 Leadership

School culture and environment appear to play a critical role in whether teachers 'take-off' after centralised training or whether they do not. Strong leadership, including technological awareness and a clearly articulated vision for using computers in teaching and learning, is critical.

Some schools, exhibited a clearer 'vision' for using computers than others. This tended to be where the principal or another school leader had enunciated and reinforced such a vision and had put in place supporting strategies.

Schools in action

One primary school had undergone radical change in less than 18 months, coinciding with the appointment of a new principal. Teachers reported that they had previously been reluctant to use technology, as the former principal had stressed that they would be responsible if anything went wrong with the equipment.

The new principal was technology-aware, and encouraged staff to use computers as much as possible. He offered a clear vision for teachers and implemented achievable strategies, principally concentration on a limited amount of content-free multi-media software.

School based professional development has been refocussed on technology. The principal has also implemented some requirements for using computers as a management/administrative tool, to encourage teacher familiarity with information technology.

Recent initiatives/announcements

A package for principals has been distributed to all districts. The package should:

- give principals a better understanding of resource purchasing, software packages and the Internet
- assist principals to conduct technology skills audits and develop plans for technology across the school.

An on-line training program for principals is being trialed in ten districts. It is designed to assist educational leaders develop a critical and practical knowledge base in the use, management and future of technology in teaching, learning and administration.

Audit observation

Leadership in schools is critical for establishing an environment which encourages effective use of computers for teaching and learning. The Department is now incorporating technology training in leadership programs. The challenge is, however, significant given that there are more than 2,200 schools in the system.

7.3.2 Level of resourcing and other school specific factors

School specific factors which influence the use of computers for teaching and learning include the level of:

- technology
- in-school professional development
- technical and teaching support available.

Research

Teachers' use of information technology is directly linked to the level of resourcing and planning in the school, to their access to computers, to the availability of software and to the degree of support provided to in-service education, including time release and opportunity for professional recognition and promotion.[73] Teachers' access to hardware and software varies considerably across sectors, income areas and according to location. The most marked disparities are in the patterns of students' and teachers' access in school time to more advanced communication uses of information technology, especially the Internet and the Web.[74]

Schools in action

In-school training and development in computers varied between schools. All schools recognised the importance of in-school training and development for building on TILT and generating improved teaching and learning practices. Principals indicated that recent cuts to the training and development allocation meant that training had to be reduced or funded at the expense of other activities.

[73] Australian Key Centre for Cultural and Media Policy, *Real time – Computers, Change and Schooling*, October 1999, p xxxiii.

[74] Australian Key Centre for Cultural and Media Policy, *Real time – Computers, Change and Schooling*, October 1999, p xxx.

In-school training and development funding amounts to approximately $25 per teacher per year. This is for all training and development, not just technology training.[75]

Schools in action
Most schools supplemented their allocation from other sources, although the scope to do so varied between schools. The availability of expertise to deliver in-school professional development also varied between schools.

Recent Australian research highlights principal and teacher views of the adequacy of teacher professional development.

Principals regard it as important for teachers to be technologically literate, but only a third of principals agree that professional development in their schools is adequate. Teachers tend to share these perceptions.[76]

For many teachers, there will be a reluctance to use technology in the classroom due to a fear that they will encounter technical problems with either software or hardware.

Schools in action
There was widespread support in school communities for on-call technical support (preferably in the classroom/laboratory to set-up and to fix any technical problems that arose) to allow teachers to concentrate on teaching issues.

This is supported by recent Australian research.

Many teachers report that their ability to use new technologies with their classes is affected by lack of resources in the school, including maintenance and technical support. This report called on Australian education authorities to give teachers access to support staff who are not only technically competent but who realise the implications for classroom practice.[77]

[75] As part of the 1996 Teachers Salaries Agreement between the NSW Teachers Federation and the then Department of School Education, school training and development allocations were adjusted by $7.9 million per annum as an offset towards the cost of increased teachers salaries. At the same time, a major part of staff training and development activities were re-scheduled to occur on predetermined student free days during the school year to minimise the cost of relief required to cover teacher absences due to staff development activities. Schools have been encouraged to undertake system-wide staff development activities on these set student free days. Funding for the training and development component of the Computers in School Strategy (ie TILT) was not affected by the $7.9 million adjustment.

[76] Australian Key Centre for Cultural and Media Policy, *Real time – Computers, Change and Schooling*, October 1999, p xxxiii.

[77] Australian Key Centre for Cultural and Media Policy, *Real time – Computers, Change and Schooling*, October 1999, p xxxiii.

Research suggests there may also be a need for on-site teaching support.

Research

Most teachers cannot use computers effectively unless someone is available to help not only with the technical problems that are likely to arise from time to time, but also with the deeper teaching and learning challenges of choosing software, organising projects that make use of technology and learning how to guide students in the use of computer-based resources.[78]

Schools in action

One school used mentoring and team teaching to provide teaching assistance in the school environment. Several teachers and principals indicated that such an approach across the public school system would be highly beneficial in accelerating effective use of computers.

Audit observation

Research and school visits indicate that many teachers are reluctant to attempt to integrate computers into teaching and learning without on-site technical and teaching assistance. Teaching assistance may only need to be for a limited period until teachers gain confidence and competence, although the need for technical assistance is likely to be permanent.

Recent Australian research reiterates the findings in the previous chapter regarding the implications of differential discretional funding between schools.

Research

The level of support services provided in the school varies according to sector, income area, location and the size of the school. Schools in middle to high income areas have better resources of this sort, while schools in country, rural and isolated areas are under-resourced.[79]

Audit observation

As would be expected, school technology resources are a factor in teacher use of computers. As discussed in the previous chapter, these vary significantly between schools.

7.3.3 Principal and teacher knowledge

Differences in the use of computers will relate to knowledge and skills in using the technology.

Schools in action

Teachers, and to a lesser degree principals, in the schools visited displayed a range of understanding of computers and their application to teaching and learning.

[78] President's Committee of Advisers on Science and Technology, Panel on Education Technology, *Report to the President on the Use of Technology to strengthen K-12 Education in the US*, March 1997, p 25.

[79] Australian Key Centre for Cultural and Media Policy, *Real time – Computers, Change and Schooling*, October 1999, p xxxi.

Audit observation

Factors such as background, experience and external interests are influential. It is unlikely that all schools came from an 'equitable base' of principal and teacher knowledge and skills, so it is to be expected that progress will be variable.

7.3.4 Primary and secondary

The underlying reasons for the variation between primary schools and secondary schools in their approach to using computers were not completely clear to the Audit Office. Discussions with some experts suggest that the subject-oriented periods characteristic of secondary education may provide some explanation. It could also be that the existence of 'computer studies' in secondary schools encourages some teachers to assume that 'computer studies' will provide sufficient exposure to computers for students, relieving them of responsibility for using computers in teaching and learning.

Recent initiatives/announcements

The Department is:

- undertaking a number of significant initiatives concerning the structure of secondary education and the use of information and communications technologies in any future structures
- participating in several on-line content development projects.

7.4 Audit conclusion

Some of the schools visited articulated clearer strategies for the use of computers in teaching and learning than others. Teachers in these schools were generally more likely to use computers in teaching and learning than teachers in other schools.

There were also substantial differences in use by teachers within each school, ranging from regular and innovative to little and basic. Many teachers only made limited use of the potential of the computers, with use for little more than word processing or accessing information being common. There is nothing to require teachers to use computers if they do not want to.

Clearly, there is still a long way to go before some schools and some teachers are able to use computers as effectively and efficiently for teaching and learning as some of the better schools and teachers. The Department will need to ensure that usage in individual schools and classes does not fall below acceptable standards.

8. Appendices

Appendix 1

Comparison between traditional, teacher-centred and new, student-centred learning environments.	
Teacher-centred learning environment	Student-centred learning environment
• teacher centred instruction	• student-centred learning
• single sense stimulation	• multi sensory stimulation
• single path progression	• multi path progression
• single media	• multi media
• isolated work	• collaborative work
• information delivery	• information exchange
• passive learning	• active/exploratory/inquiry based learning
• factual, knowledge based	• critical thinking and informed decision making
• reactive response	• productive/planned action
• isolated, artificial context	• authentic, real-world context

Source: Gerry Smith, Founding Principal, River Oaks Public School, Ontario, Canada, Teaching, Learning, Technology and Effectiveness, (undated).

Appendix 2

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