

9 Focus on technology

“Technology” is often used as the generic term for all the technologies people develop and use. It involves the purposeful application of knowledge, experience and resources to create products and processes that meet human needs. Applications of technology include things as disparate as computer-assisted design and manufacturing, clothes hoists and automatic dryers, food production and processing, bicycles and jet aircraft, acupuncture and genetic engineering, as well as a range of management and organisational systems.

Technology programs in schools involve students in generating ideas and acting on them, as well as using and developing processes and products. Programs can be structured and presented as an integral part of other areas of learning or as discrete courses designed to develop specific technological capabilities and knowledge. In upper secondary school, many technology courses and syllabuses are directed towards work and further education.

Students’ tasks and activities in technology are directed toward developing their knowledge and skills in each of four strands of learning identified in the national statement on technology. They are:

- designing, making and appraising;
- information;
- materials; and
- systems.

All learning in technology involves the designing, making and appraising strand. The relative emphasis on the information, materials and systems strands varies according to student needs and the nature of the program and activities. In some programs, all three strands may receive equal treatment; in others one or more may be emphasised.

9.1 Participation in technology as a key learning area

Primary years

New South Wales, Victoria, South Australia, Tasmania and the Australian Capital Territory all reported that technology education was addressed in some way by all primary schools and that all students had access to technology-based subjects and resources.

Within the independent sector, the great majority of schools identified a range of technology subjects being taught as integral parts of the primary curriculum. Students in New South Wales were given access to the technology KLA through their science, computers, technology, information technology, art and textiles programs.

Student access was similar in Victoria, where all independent primary schools taught a range of technology subjects including science, computing, technology, art and textiles.

In South Australia, government and independent primary schools structured the use of technology within cross-curricula frameworks to ensure that teaching and learning remained the focus.

The technology KLA was integrated into the primary curriculum in independent schools in Western Australia through contexts in which it could be used effectively. For example, information technology as a research tool, science, languages other than English (LOTE) and the arts.

In Tasmanian Catholic schools, attention was given to integration of technology with other KLAs particularly science, mathematics, studies of society and the environment (SOSE), visual arts and craft. The emphasis was on the design, make and appraise strand with some computer-aided access to programs designed around specific subject areas and the utilisation of CD-ROMs.

Junior secondary years

States reported that students in government schools in these years had varied access to technology education. In New South Wales junior secondary schools, study of design and technology for approximately 200 hours was mandatory for all students. Many students undertook further optional study for the School Certificate, with technics, computing studies and food technology having the highest rates of participation for the Technological and Applied

Table 9A. School Certificate candidature, government schools, New South Wales, 1997

<i>Technology subjects</i>	<i>No. year 10 students in 100 and 200 hr courses</i>
Agriculture	5,772
Computing Studies	19,467
Design and Technology (additional)	1,492
Food Technology	12,775
Technical Drawing	5,550
Technics I and II	23,662
Textiles and Design	3,245
Total	71,963

Source: Board of Studies, New South Wales

Studies (TAS) KLA, in New South Wales government schools (Table 9A).

In Western Australia, students in years 8 to 10 undertake learning programs in the context of the areas of agriculture, business education, computer-related studies, design and technology, home economics and media and choose from a range of units offered in schools, while in many government schools in Tasmania, technology was compulsory in years 7 and 8 but optional in years 9 and 10.

In South Australian government schools, the technology KLA was addressed in subjects such as computing, agriculture, media studies, business education, design, information technology, construction technology, food and nutrition. Participation is 100 per cent but begins to decline in year 10.

Reporting from the independent sector showed that integration of technology was well established in the junior secondary years.

In New South Wales, most independent secondary schools reported that the technology KLA was integrated into a variety of technology-related subjects such as food technology, technical drawing, design and technology, textiles, home economics, art and information systems technology.

In Victoria, secondary schools from the independent sector reported the integration of technology into technology-related subjects such as drawing and design, ceramics, information technology, graphic design, textiles and material design studies; some of these subjects were compulsory in the early secondary years and optional thereafter.

The South Australian independent sector reported that at the secondary level, the technology KLA was being addressed through subjects such as computing, information technology, construction technology, materials and design, food and nutrition and home economics. Many of these subject areas were compulsory in years 8 and/or 9. At least one school was working extensively in the area of solar energy.

In independent lower secondary schools in Western Australia there were numerous courses to which a technology paradigm was applied, including those in the arts, home economics and manual arts.

In the Australian Capital Territory, all independent schools surveyed identified a range of technology subjects, including textiles and design, food studies, design technology, technical graphics, information technology, computer applications and wood construction. Such courses were generally compulsory in the years 7 and 8, or earlier in some cases, but were generally optional in years 9–12.

Table 9B. Participation in technology, by gender, Catholic schools, South Australia, 1997 (per cent)

<i>Year Level</i>	<i>Total students studying technology</i>	
	<i>Males</i>	<i>Females</i>
8	100.0	100.0
9	93.3	88.5
10	80.5	54.4

Source: Catholic Education Office, South Australia

In South Australian Catholic schools, participation in technology at junior secondary level started as 100 per cent but dropped considerably in year 10 once the selection of these subjects became optional (Table 9B).

In Tasmanian Catholic secondary schools, there was some technology component available to all year 7 and 8 students.

Senior secondary years

Reports received from the sectors regarding the areas of technology being addressed at the senior secondary level indicated that most States covered similar subject areas. These included:

- agricultural and horticultural studies;
- arts (interactive multimedia);
- automotive studies;
- business;
- cottage crafts;
- desktop publishing;
- electronics;
- engineering;
- food technology;
- hospitality;
- information technology;
- materials and technology;
- print;
- systems and technology; and
- technological design and development.

In the New South Wales government sector, computing studies represented over a third of the Higher School Certificate (HSC) Technological and Applied Studies (TAS) load in government and Catholic schools and almost half of the HSC TAS load in independent schools.

Table 9C HSC candidature, government schools, New South Wales, 1997

<i>Subjects</i>	<i>No. students year 12</i>
Agriculture	1,367
Computing Studies	8,495
Design and Technology	2,849
Engineering Science	1,082
Food Technology	2,384
Industrial Technology	668
Industry Studies	944
Textiles and Design	496
Total	18,285

Source: Board of Studies, New South Wales

The major areas of growth within the TAS KLA in New South Wales were vocational education courses, design and technology and computing studies. Growth in vocational education courses within TAS was particularly strong in government and Catholic schools, reaching 22.3 per cent and 17.5 per cent respectively of the HSC TAS load in 1997. Vocational education courses such as building and construction, electronics, furnishing, hospitality, metals and engineering and rural industries continued to increase in popularity in 1997.

For senior secondary students in the New South Wales government sector, the study of courses within the TAS KLA was optional, though students were required to take at least one unit from the KLAs of mathematics, science or TAS.

Study within the TAS KLA continued to increase, its share of the total enrolment load of HSC students, growing from 10.6 per cent in 1993 to 11.9 per cent in 1997. HSC students in New South Wales government schools took programs of study with a slightly higher average TAS load share (12.8 per cent in 1997) than was the case with students in Catholic (10.3 per cent) and independent schools (10.5 per cent).

In Victoria, the figures for Victorian Certificate of Education (VCE) students across all sectors indicated the choice of a wide range of technology options with the highest proportion of students participating in information technology (50 per cent), materials and technology (16 per cent) and technological design and development (12 per cent).

In Queensland, the percentage of year 12 students accessing technology-related subjects was slightly higher than for year 11 students for almost every technology area (Table 9D).

Table 9D. Proportion of students enrolled in at least one Board subject, Technology KLA, Queensland, all schools, 1997 (per cent)

<i>Technology area</i>	<i>Per cent enrolled</i>
<i>Information and Engineering</i>	
Year 11	22
Year 12	24
<i>Business</i>	
Year 11	23
Year 12	25
<i>Hospitality</i>	
Year 11	9
Year 12	11
<i>Technology KLA as a whole</i>	
Year 11	47
Year 12	51

Source: Education Queensland

Year 11 and 12 students in Western Australian government schools were not obliged to study any of the disciplines of this learning area. However, there was an increase in 1997 in student participation in contributing subjects. Post-compulsory schooling was being reviewed and the requirements for technology and enterprise will be determined in the context of this review. In 1997, post-compulsory subjects continued to be developed and trialled in self-selecting schools. These subjects were designed to provide increased flexibility for curriculum delivery, were outcomes-oriented and adopted a common assessment framework.

In relation to this initiative, support materials and a CD-ROM were distributed to all school sectors. The CD-ROM provided teachers with an insight into the implementation of new subjects through the approach taken by six teachers, representing each of the contributing disciplines.

Figures for participation in technology subjects at senior secondary level within the Catholic sector in South Australia indicated a significant decrease by year 12.

Table 9E. Participation in technology subjects, by year level, by gender, Catholic schools, South Australia, 1997 (per cent)

<i>Year Level</i>	<i>Males</i>	<i>Females</i>
8	100.0	100.0
9	93.3	88.5
10	80.5	54.4
11	47.7	48.7
12	28.0	16.3

Source: Catholic Education Office, South Australia

Technology education and gender

In the primary and middle school years, given the compulsory nature of the curriculum, schools from all three sectors identified no differential gender participation in technology education. However, information from the States and sectors gave varying accounts regarding gender participation in the senior secondary years or once participation became optional.

In New South Wales government schools, as one example, female students at the HSC took about two-thirds of the TAS load share that was taken by male students in government and Catholic schools. The proportion of TAS load share was about the same for both female and male students in independent schools.

In Victoria, the figures for VCE students for all sectors in 1997 indicated that participation by female students in technology remained within the traditional subject areas such as business and hospitality. Females represented less than one-third of the numbers of males studying subjects such as agriculture, automotive studies and electronics (Table 9G).

Figures from Queensland showed a similar subject variance between female and male students enrolled in Board subjects in specific technology KLA areas across the three education sectors. Females were under-represented in information and engineering, but were over-represented in the business and hospitality sub-groups. However, for technology education overall, gender representation was almost equal (Table 9H). The proportions were similar for each of the three education sectors.

Table 9F. HSC TAS enrolment load, by school sector, by gender, New South Wales, 1997 (per cent)

	<i>Per cent of total subject load</i>
<i>Government schools</i>	
Female	10.2
Male	15.8
Total	12.8
<i>Catholic schools</i>	
Female	8.0
Male	12.7
Total	10.3
<i>Independent schools</i>	
Female	11.1
Male	10.1
Total	10.5
<i>All schools</i>	
Female	9.7
Male	14.2
Total	11.9

Source: Board of Studies, New South Wales

Table 9G. Technology KLA enrolments (a) VCE, all schools, by gender, Victoria, 1997

<i>Subject</i>	<i>Males</i>	<i>Females</i>	<i>Total</i>	<i>Per cent Female</i>
Agricultural & horticultural studies	1,309	522	1,831	29
Agriculture	332	120	452	27
Arts (interactive multimedia)	33	4	37	11
Automotive studies	1,765	45	1,810	2
Desktop	175	88	263	33
Electronics	1,311	34	1,345	3
Engineering	1,235	57	1,292	4
Food technology	16	28	44	64
Horticulture	79	49	128	38
Hospitality	1,585	2,619	4,204	62
Information technology	20,541	16,711	37,252	45
Information technology - VET	2,984	2,732	5,716	48
Materials and technology	8,228	4,808	13,036	37
Print	26	4	30	13
Systems and technology	5,225	215	5,440	4
Technological design & development	5,570	4,496	10,066	45
Total Technology KLA	50,414	32,532	82,946	39

(a) Enrolments are for units 1 and 3 only, the first of a two semester sequence in each of years 11 and 12.

Source: Board of Studies, Victoria

Table 9H. Students enrolled in at least one Board subject in technology KLA, all schools, Queensland, 1997 (per cent)

<i>Information and Engineering</i>	<i>Male</i>	<i>Female</i>
Year 11	35	10
Year 12	39	10
<i>Business</i>		
Year 11	14	31
Year 12	16	34
<i>Hospitality</i>		
Year 11	3	16
Year 12	3	18
<i>Technology KLA as a whole</i>		
Year 11	46	48
Year 12	50	51

Source: Education Queensland

Gender participation in technology varied amongst independent schools. Schools in New South Wales and Western Australia generally reported that gender participation reflected the broader student population. However, there were some schools which identified a tendency for male students to dominate in some subjects such as woodwork and information technology, whilst female students were more dominant in subjects such as home economics, art and clothing fabrics.

In Queensland, independent schools surveyed indicated that male students tended to dominate some subjects, such as

information technology and graphics, while females were more dominant in home economics and art.

The South Australian independent sector, for the most part, reported no issues regarding gender balance in technology subjects, partly because a significant proportion of the sample was single-gender schools. One coeducational school did report that boys tended to dominate technical studies and girls home economics, although other coeducational schools made no such assessments.

The Australian Capital Territory, on the other hand, reported significant gender imbalances in independent schools, with female students identified as predominant in textiles and home economics, and male students in design technology, graphics and wood construction. A closer balance was apparent in food studies and information technology subjects.

Independent schools identified a range of measures being pursued to support gender-balanced participation within technology-related subjects. Measures taken included:

- programs targeting stereotyping and sexism;
- ensuring the provision of equitable access to resources;
- monopolising behaviours and gender role identification;
- the development of gender-inclusive curricula;
- the employment of both male and female technical studies teachers;
- re-naming and re-focusing courses; and
- encouraging students to consider all options available to them.

In Tasmanian Catholic secondary schools, males and females had equal access to technology. Uptake of technology-related subjects was fairly evenly divided, although slightly more females than males took business, food and textiles studies and slightly more males than females took computing science and wood and metal technology.

Students with disabilities

Reporting on the access of students with disabilities was very limited. However, an example of a program teaching a variety of living skills incorporating the use of technology was reported from an independent school in South Australia which catered for students with disabilities. It was noted, however, that the information technology skills expected of the students assumed a level of literacy which they did not necessarily possess.

In South Australian government schools, technology is integrated into teaching programs for students with disabilities wherever possible and where deemed appropriate for the individual student as part of access and participation in a broad and balanced curriculum.

Other equity groups

In New South Wales, HSC students at government schools which were part of the Disadvantaged Schools Program (DSP) and the Country Areas Program (CAP) on average took programs of study with a higher proportion of TAS load than was true for government school students as a whole. Thirteen per cent of HSC students in DSP schools and 16.6 per cent of those in CAP schools participated in this curriculum area, as did 12.7 per cent of Indigenous students. These totals compared with 12.8 per cent for all government schools.

Queensland data for 1997 indicated that a higher proportion of students at remote schools were enrolled in business and hospitality subjects, as well as in the technology KLA, than was true for Queensland students as a whole (Table 9I).

Technology facilities and programs in Tasmanian government schools were highly valued because they

Table 9I. Students enrolled in a range of technology subjects, government schools, Queensland, 1997 (per cent)

	<i>Enrolled per cent</i>
<i>Information and Engineering</i>	
Students at remote schools	22
Students at disadvantaged schools	21
Males	38
Females	9
<i>Business</i>	
Students at remote schools	27
Students at disadvantaged schools	21
Males	12
Females	34
<i>Hospitality</i>	
Students at remote schools	14
Students at disadvantaged schools	13
Males	3
Females	19
<i>Technology KLA as a whole</i>	
Students at remote schools	55
Students at disadvantaged schools	47
Males	48
Females	52

Source: Education Queensland

contributed to the provision of curriculum which is adaptive and responsive to student needs. A high participation rate and effective response to schooling by equity groups was reported within technology subjects such as foods, catering, textiles, design in metal, design in wood, design graphics, electronics and information technology in secondary technology courses.

9.2 Access to information and communication technologies

Reporting from the States and across the three education sectors indicated that generally, the use of information and communication technologies was well established within the primary school curriculum. Information technology (IT) or its equivalent was offered as a research tool or as a compulsory separate subject in the lower secondary years and then as an optional subject at the senior secondary level.

In Australian Capital Territory government schools, the ability to use information technology and information sources was required in the ACT curriculum frameworks in the eight key learning areas from preschool to year 12. All primary students had access to information technology as one of these essential areas of knowledge and experience. In 1997, there was a ratio of 13.73 students per computer.

At the senior secondary level information access was one of nine identified across-curriculum perspectives in Australian Capital Territory government schools. It encompassed two elements of the curriculum—information literacy and information technology.

Course frameworks developed at secondary college level required the development of information skills. Senior secondary student access to information technology was surveyed in October 1997 and found that for high schools the students to computer ratio was 10.43:1, while for college students it was 10.14:1.

Within the Catholic sector, technology planning in primary schools was regarded as essential and the rate at which Catholic schools were undertaking this process increased in 1997. In Western Australia, for example, schools employed IT to enhance the curriculum and as an information resource and communications tool. The Internet was used to improve curriculum outcomes and the rapid increase in Internet connections facilitated developments.

All Tasmanian primary students in Catholic schools had computer access in every classroom. One primary school

had a computer lab for whole-class access. All secondary schools had computer laboratories and additional access for students via computers in libraries. All secondary schools and half the primary schools had access to the Internet. Some schools had computerised libraries and more use was being made of CD-ROM materials. Three schools had satellite dishes and accessed LOTE programs broadcast from Victoria and New South Wales for professional development.

Northern Territory Catholic secondary schools reported that students had access to computers and the Internet, although the level of access varied according to whether students had chosen to study technology-based subjects or key learning areas that required computer use. It was also indicated that teachers who were 'change agents' afforded students greater access to and participation in information technology.

South Australian independent schools established Internet connections and provided support for teachers to use technology for the development of curriculum resources.

9.3 Student achievement in technology education

Reporting of outcomes data pertaining to technology was limited. Some States provided information regarding specific subjects such as information technology and others for the technology KLA as a whole.

Achievement by senior secondary students

In Queensland, the mean achievement level at year 12, across all sectors, in the technology KLA subjects was 3.2 on a scale of 1–5.

The Tasmanian government sector estimated that 40.7 per cent of the total student population achieved a year 12 award in a technology subject, of which 90 per cent were achieved at a pre-tertiary level. Most of these awards were in information technology subjects. However, this was likely to be an underestimate of the total number of students that studied any technology subject in years 11 and 12.

Achievement by gender

Queensland reported that on a scale of 1–5, the mean achievement level at year 12 across all sectors in the technology KLA subjects for females was 3.28 compared with 3.05 for males.

Table 9J. Student outcomes in the Technology KLA, Year 12 Certificate, all schools, by gender, Australian Capital Territory, 1997

<i>Total Student Courses</i>		<i>Student Grades (a)</i>				
		<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
<i>Government colleges</i>						
Female	728 (37%)	213	286	192	34	3
Male	1,248 (63%)	281	435	399	122	11
Total	1,976	494	721	591	156	14
<i>Non-government schools</i>						
Female	322 (39%)	114	121	74	11	2
Male	496 (61%)	119	192	156	29	0
Total	818	233	313	230	40	2

(a) Course grades are calculated from a grade point average of students' unit grades. These data are formulated from student course records. Total records may exceed number of students because many students do more than one course in a key learning area.

Source: Australian Capital Territory Department of Education and Training

Approximately one-third of enrolments in the technology KLA in both government and non-government colleges in the Australian Capital Territory were by females. However, there were ten per cent more female enrolments achieving the top two grades than males (Table 9J).

Victorian figures for technology KLA units 1–4 for all sectors showed that female students performed significantly better than males in 1997 although there were at least 20 per cent fewer enrolled (Table 9K).

Table 9K. Technology KLA results, units 1–4, all schools, by gender, Victoria, 1997

<i>Unit</i>	<i>Gender</i>	<i>Total Assessed</i>	<i>Number satisfactory</i>	<i>Per cent satisfactory</i>
1	Male	32,324	25,210	78
	Female	20,250	17,470	86
2	Male	22,721	18,355	81
	Female	14,678	12,774	87
3	Male	15,064	13,604	66
	Female	10,561	9,983	95
4	Male	21,853	20,110	92
	Female	10,087	9,640	96

Note: Includes all sectors and VET in Schools units

Source: Board of Studies, Victoria

Achievement by other equity groups

Reporting in this area was limited, although information from Queensland provided some insight. In Queensland, the mean achievement level at Year 12 in subjects linked to the technology KLA, across all sectors, showed that students from remote schools achieved lower scores than those from other schools (3.08 compared with 3.17, on a scale of 1 to 5). Students attending disadvantaged schools also achieved lower scores than those from other schools (2.86 compared with 3.19).

9.4 Initiatives and developments

Government sector initiatives

A number of significant developments were featured in State reporting. One of the key success stories in 1997 was the New South Wales government sector's Technology in Learning and Teaching (TILT) professional development program. This provided training and development opportunities for 6,826 teachers at a total cost of \$5.3m. Designed to introduce computer-based technologies to primary and secondary teachers not using computers in their classroom, TILT was widely reported as valuable because it gave teachers access to new technologies that could easily be incorporated into classroom practice.

The TILT program was one of a number of initiatives of the Government's Computers in Schools Policy. Other major aspects included the provision of curriculum support targeting each key learning area, and the allocation of extensive infrastructure support, including funding for 90,000 extra computers in schools, allowing the computer to student ratio to be brought down to below 1:8.

Developments in the technology KLA in Victorian government schools in 1997 included:

- development and distribution of course advice for early primary and secondary years;
- production of professional development kits and training of network leaders;
- information published on the Victorian SOFWeb website (www.sofweb.vic.edu.au) provided information for teachers; and
- interactive TV programs provided through satellite, Science and Technology Education in Primary Schools (STEPS) was broadcast via SOFNet to schools each

fortnight for students in Years Prep, 1–2, 3–4 and 5–6 and their teachers. The broadcasts were accompanied by classroom support materials to assist teachers in the planning of their science and technology curriculum.

Queensland reported that a competition initiated by the Australian Council for Education through Technology in conjunction with Education Queensland and with private sector sponsorship was very successful in securing participation from schools across the country, and particularly from within Queensland.

The South Australian government sector was successful in winning two Telstra LEARN-IT grants in 1997. The first was for a trial of the neT120 conference server and Farsite software for conferencing over the Internet, and the second for a trial of OnRamp technology. Three country schools were involved and they received access to high speed telecommunications in advance of the planned roll-out of broadband width data carriage facilities.

In 1997, work also commenced on a national website for Indigenous people in South Australian government schools. NATSIEW (National Aboriginal and Torres Strait Islander Education Website) was funded by the Commonwealth Department of Employment, Education, Training and Youth Affairs (DEETYA) and produced by the South Australian Department of Education, Training and Employment (www.natsiew.nexus.edu.au).

South Australian government schools were also able to apply for funding from the Schools Technology Education Program (STEP) to establish innovative technology programs in schools. In addition, all schools are able to utilise the Technology School of the Future to expand horizons and provide training and development of both students and staff.

Developments in Tasmania's government schools included Design Centre facilities centrally located in schools and servicing the whole technology area. Twenty-five high schools now have design facilities, including three where work was completed in 1997. The provision of these facilities was closely linked to the emergence of computer-aided drawing and design.

Significant achievements in technology education in the Northern Territory were the result of a number of projects funded through the Commonwealth's targeted programs. A considerable proportion of the funds were used to increase the application of technology in schools to address the needs of educationally disadvantaged students, particularly those disadvantaged by isolation. They also involved teachers in professional development and ongoing learning

in the area of technology education, particularly those teaching in remote locations. In 1997, 144 schools participated in a project designed to encourage schools to use the Internet and 35 remote schools established web-sites.

The Northern Territory also reported that professional development was provided for teachers from Transition to year 10 through activities such as, Programming for Technology. The *NT Technology Teachers Resource Materials Book* was developed by curriculum officers and widely distributed to all schools.

The Australian Capital Territory Government announced an information technology package to be implemented in government schools from 1998. It includes:

- a new computer for every permanent teacher;
- grants to schools to provide computers, training and infrastructure;
- a digital network for fast and reliable communications; and
- a new school administration system.

Independent sector initiatives

Growing involvement by independent schools in on-line technology and an increasing number of computers available to students were reported in 1997. Schools also reported on a range of initiatives including moves to extend the provision of Internet and e-mail access and several laptop programs for students in selected years.

Independent schools in Queensland reported:

- that the technology KLA was integrated into a variety of technology-related subjects, such as home economics, art, computer science, business studies, mathematics, graphics and economics;
- the removal of specific computing courses for years 9–10 in one school, with information technology now being delivered through mathematics, English and various other curriculum areas;
- improving integration of technology subjects into primary school; and
- introducing subjects more specific to technology in years 8–10.

Plans in the independent sector in South Australia included greater classroom access to computers, development of emerging collaborative learning programs, introduction of CAD, control technology and Web page development and vertical grouping of students by skills/ability.

Western Australia reported significant developments in technology in 1997, including:

- the use of personal laptops in the learning process or the provision of groups of computers in strategic areas;
- improved access (including remote access) to schools network and availability of hardware, software and development of intranet sites;
- removal or minimisation of computer electives as skills were gained through subject areas;
- application of computers across the curriculum in the classroom; and
- assistance for staff in purchasing equipment for their own personal literacy and for use in school-related activities.

Catholic sector initiatives

Within available resources, technology education continued to be a major priority of Catholic schools during 1997. Initiatives and developments in technology education were reported by two dioceses in New South Wales. In Parramatta, the Learning Technologies Initiative was established to enhance learning and teaching through the curriculum integration of various technologies. This initiative included network installation, curriculum development teacher support and system level technical support. The Wollongong Diocese implemented the TALENT project in a number of schools, establishing communication between all classrooms, the library and administration.

In Victoria, the Learning and Teaching Technologies in Catholic Education (LaTTiCE) initiative was further developed in 1997 to establish models of best practice in learning and teaching and develop the skills and confidence of teachers and parents to help students in the use of information and communication technologies.

National initiatives

Information Technology Skills Study

Australian primary and secondary school students can expect to work and live in environments requiring high levels of competence in computer use. Furthermore, they will need the ability to adapt their skills and understand change. Their skills in using information technology (IT) will be inseparable from their analytical abilities and their capacities for creativity, teamwork, problem solving and communication.

In late 1997, the Australian Key Centre for Cultural and Media Policy (Griffith University) was commissioned to

undertake a study on the IT skills of school students, for input to this report. The study was designed to report on Goal 6d of the Common and Agreed National Goals for Schooling in Australia, *to develop in students skills of information processing and computing*. Measurement of progress towards these goals was focused on the extent to which students were developing skills in using information and computer-based technologies; expressing ideas and communicating with others using computer-based technologies and discrimination in the use of these technologies and developing confidence to explore, adapt and shape technological understanding and skills to future challenges.

A key objective of the study was to establish national baseline information about primary and secondary school students' experience of, and skills in, using information technology. The quantitative research involved national surveys of principals, teachers and students. This was supplemented by qualitative research comprising interviews with senior officers in government and non-government school systems, the conduct of focus groups to investigate key issues and the commissioning of a series of research papers designed to feed into project design, the formulation of the questionnaires and the interpretation of findings.

There were 400 schools in the sample, comprising 200 schools covering the primary exit year of 6 or 7 and 200 schools covering year 10. In selecting schools, a stratified random sampling process was used, to ensure a representative mix of schools in each of the States and Territories, according to sector, region, type and size. Two hundred and twenty-two principals, 1,258 teachers and 6,213 students completed the questionnaires.

The *students' questionnaire* focussed on students' own experiences with information technology inside and outside school, their perceived skill level, confidence and enjoyment in using computers, and knowledge of and attitudes to ethical and legal issues that arise from the use of information technology. The study was also required to provide information on the development of skills of particular groups of students. It defined the 'skills of information processing and computing' as including:

- using information and computer-based technologies to locate, access, evaluate, manipulate, create, store and retrieve information;
- expressing ideas and communicating with others using computer-based technologies;
- developing an awareness of the range of applications of computer-based technologies in society;

- being discriminating in the choice and use of computer-based technologies; and
- developing the confidence to explore, adapt and shape technological understanding and skills to challenges now and in the future.

The *teachers' questionnaire* sought information on students' involvement in information technology-related activities across the curriculum and teachers' perceptions of students' levels of competence. It included questions on students' participation in various types of activities and on the impact of information technology on student learning across the curriculum, with distinctions made between the integrated use of skills and specialised information technology study. Teachers were also asked about their own skills and participation in various types of activities, including professional development.

The *principals' questionnaire* was designed to provide information on policy and planning for information technology in the school, the current stage of development in regard to the integration of information technology across the curriculum, and the level of human and other resources supporting information technology in the school. The instrument also provided general information on access to equipment, software and networks, indicating 'what schools have, in broad terms, for teaching and learning purposes'. It also investigated the frequency with which students obtained access to resources, including the Internet, current equipment, software and network access and trends in this area.

The following results are based on preliminary findings, with the final report to be released during 1999.

Students' skills

Students enjoy using computers at school and they express high levels of confidence in their own skills, especially in comparison with the confidence levels of teachers.

Nearly all the students surveyed have more than half of the skills core to the basic operation of computers and nearly 80 per cent have close to all of them (see Table 9L for more detail). The majority of students who have these basic skills developed them at home.

More than half the students surveyed had a sound range of advanced information technology skills, including knowing how to connect to the World Wide Web. A little more than a third are able to use email.

Students' basic skills in using information technology are equivalent to those of their teachers. In advanced skills, they leave teachers behind, especially in areas such as

multimedia creation, using video music and sound clips and creating Web sites or home pages.

Students are most experienced in information and creative uses of computers and they appear to be familiar with a variety of games and educational programs. Informational use appears to increase with students' age, as creative uses decline. Communication uses are lower than might have been expected in both primary and secondary schools, especially in lower-income areas.

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' gender, cultural background and ethnicity.

Indigenous students and those from small schools, especially in rural and isolated areas, are the most likely to lack basic skills. In the advanced skill range, students from independent schools and single-sex boys' schools report familiarity with the most complex uses of information technology, while those in primary schools, small schools and schools in rural, isolated and low-income areas are falling behind. Boys have more of the advanced skills than girls do, although their basic skills are on a par. They are also more confident about their ability to use computers. Indigenous students are less confident about their ability, while students from language backgrounds other than English are markedly more confident.

Students tend to acquire their advanced information technology skills at home rather than at school. The study also showed high levels of computer usage outside school (85 per cent of all students). Fifty per cent of students report that they use a computer outside school every day or almost every day. The earlier they begin using them, the more frequently they use them at a later age.

The higher the average family income of the area in which students go to school and the greater the population density, the more likely they are to have acquired information technology skills at home, to use them more frequently and to have started earlier than others.

Boys are also more likely to have learned basic skills at home than girls, whereas girls tend to acquire their skills at school.

Girls are falling behind boys in the advanced information technology skills, despite showing considerable interest and skill in other applications. Girls tend to be acquiring basic skills at school, but many of the advanced skills are not being taught at school. Where girls do not learn advanced computer skills at home, they tend not to acquire them at all.

Table 9L. Students' and teachers' basic and advanced computer skills (a)

<i>Basic skills</i>	<i>Have skill</i>		<i>Advanced skills</i>	<i>Have skill</i>	
	<i>Students %</i>	<i>Teachers %</i>		<i>Students %</i>	<i>Teachers %</i>
Use a mouse	98	99	Play computer games	94	80
Turn on a computer	98	99	Draw using the mouse	93	77
Use a keyboard	98	98	Creative writing, letters, etc.	92	85
Shut down and turn off	97	98	Use spreadsheets or databases	68	75
Exit/quit a program	97	97	Use the World Wide Web	65	76
Save a document	95	97	Search the Web using key words	58	71
Print a document	95	96	Create music or sound using computer	58	26
Start a program	95	96	Send an email message	53	65
Open a saved document	94	96	Copy games from CD-ROM or Web	53	41
Delete files	86	89	Create a program, eg. in logo, Pascal	52	45
Get data from a floppy disk or CD-ROM	85	93	Use virus detection software	50	52
Create a new document	84	90	Create multimedia presentation	48	37
Move files	78	82	Make a Web site/home page	38	24

(a) Preliminary findings based on self-report by students and teachers.

Source: Australian Key Centre for Cultural and Media Policy, Griffith University

Teachers' skills

Nearly all the teachers in this sample study possess the basic range of skills required to use computers. The majority has more than half the advanced skills specified. However, a considerable proportion of teachers (from 25 per cent to over 50 per cent) is lacking some skills necessary to use or teach a range of computer applications (see Table 9L for more detail).

Those who are most likely to lack basic skills in using information technology are over 50, female and primary school teachers. Those in Catholic schools and, to a lesser extent, government schools are falling behind in basic skills, while these are strong in independent school teachers.

Most teachers with information technology skills are self-taught, usually learning basic skills first at work. Many make extensive use of personal computers at home.

Information technology in the school

The majority of schools give a high budget priority to the provision of hardware and software for students and for teachers. However, principals and teachers report that funding presents one of the main barriers to developing students' skills in using information technology.

In relation to resources:

- 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.

In relation to budget priorities:

- schools that make information technology a high budget priority are most likely to have large populations, to be secondary rather than primary schools and to be schools in urban areas. Schools in country, rural and isolated areas are less likely to make spending on computer facilities a high priority.

In relation to school policy:

- most principals agreed that, at a school level, information technology is integrated across the Key Learning Areas. Secondary schools, large schools and independent schools are less likely to claim that they have achieved curriculum integration of information technology.

In relation to professional development:

- principals regard it as important for teachers to be technologically literate but there are consistent gaps between the availability of training (according to principals) and the extent to which teachers make use of it. Those teachers with access to training in the school

are most likely to undertake it. Asked where they would prefer to do training, most nominate school-based training, short courses and workshops rather than extended modes of study.

Key initiatives: EdNA

There were a number of national developments in the area of information and communication technology during 1997, most carried out under the auspices of Education Network Australia (EdNA). Initiated by the Commonwealth in 1995, EdNA is a national process for collaboration and cooperation between all sectors of the Australian education and training community, focussing on information technology. It aims to maximise the benefits of information technology for Australian education and training and to avoid duplication of cost and effort between the various sectors and systems.

The EdNA process has established a collaborative framework which involves Commonwealth and State governments, government and non-government schools, and the vocational education and training, higher education and adult and community education sectors. Advisory groups have been established to enable each sector to provide input into the development of EdNA and to enable the exchange of information and ideas about using information and communication technology in education. This has facilitated cooperation and collaboration across all States, and has ensured that the needs of all education sectors are addressed. It has also led to significant cost savings through the elimination of duplication and overlap.

The EdNA Reference Committee has been examining other issues relating to the use of information and communication technology in education and training. These include implications of the new Telecommunications Act for delivery of on-line education services, copyright reform issues and on-line content regulation.

One of the major outcomes of EdNA has been the development of the EdNA Directory Service, now known as EdNA Online (www.edna.edu.au). Launched nationally in November 1997, the service is a unique Internet site, which is technically state of the art and offers many high-quality features. These include a powerful search engine and a range of categories through which users can browse to find resources and access information about schools, universities, vocational education and training and adult and community education organisations.

The EdNA Directory Service provides free access to quality education resources on the Internet for all sectors of

Australian education. It vastly improves communication between peers for both students and teachers, especially those now working in isolation because of geographical or physical factors. It allows improved access to curriculum materials and facilitates joint exploration of topics between teachers and students around the world.

1997 OECD/CERI Dissemination Conference on Innovations in Science, Mathematics and Technology Education

In September 1997, the Commonwealth hosted the OECD/CERI Dissemination Conference on Innovations in Science, Mathematics and Technology Education (SMTE). The conference encouraged the national and international exchange of ideas and practices in science, maths and technology education and provided an opportunity to showcase recent developments in the use of technology in education.

The conference was by invitation to 120 educational leaders and policy makers, representatives of education systems and professional associations concerned with SMTE. Program development was managed by the Australian Science Teachers Association in conjunction with the Australian Association of Mathematics Teachers and the Technology Federation of Australia, along with representatives of DEETYA and OECD.

One of the major outcomes of the conference was the opportunity for dialogue between subject teaching associations and a mutual resolve to build on this cooperation for the benefit of students.

Training and development in technology education

Education Queensland, in conjunction with the Queensland Catholic Education Commission, professional associations and the Automotive Industry Training Council, published 500 introductory kits on technology entitled, *Teaching Technology*. This included a video on teaching strategies and a document outlining 55 case studies.

In South Australia, workshops supporting the publications *Technology for Early Learners* and the *R-10 Technology Classroom Guides* were devised to assist teachers in implementing technology KLA programs utilising Designing, Making and Appraising.

The Northern Territory Department of Education developed an interim on-line teacher support service utilising the Internet. A special project, Create and Communicate, was developed, focussing on using the Internet to support and enrich the teaching of English. The project focussed on research and publication of student writing and interactive

communication with other schools in the Northern Territory, interstate and overseas by improving teachers' knowledge, confidence and skills in the area.

Also in the Northern Territory, the Participative Professional Development project established a website which contained information, references and professional contacts for teachers. This is structured around the 32 competencies outlined in the National Competency Framework for Beginning Teaching.

Professional development modules were developed in Tasmanian government schools, and trainers accredited to provide teachers with a set of benchmark skills in information technology. Ongoing support will be provided to achieve best practice in the application of information technology in the teaching-learning process.

In the Northern Territory Catholic sector, there was an emphasis on information technology, with schools committing their own funds to the purchase of hardware and software. Likewise, there was a commitment to the professional development of staff in order to ensure a useful articulation between information technology and the core curriculum. Teacher education was mentioned as a significant factor for improving student access to information technology in all its forms.

In Western Australia, seminars were conducted by the Association of Independent Schools to assist independent schools in the effective use of the Internet and focussed on the practical aspects of connection and the potential of the Internet in advancing teaching and learning.

The Australian Capital Territory Plan for Information Technology in Learning and Teaching 1997-99 was implemented in government schools. Two major goals are the development and maintenance of teachers' information technology competence and the establishment of a learning environment appropriate to the information society. Initiatives included providing computers to teachers, improving student/computer ratios, establishing good practice exemplar sites for teachers and providing targeted professional development in all key learning areas, including across-curriculum perspectives.

9.5 Emerging issues in technology education Curriculum

According to a number of education authorities, the changing nature of technology-based syllabuses and support materials was an emerging issue in 1997. It was

noted by the New South Wales Board of Studies that in the future, curriculum materials will need to be sufficiently flexible to cater for the rate of change and evolution of technologies in industry and society. The nature and range of technology subjects, especially in secondary schools, was a matter for attention, as was the role of enterprise in developing technology curricula.

Although the integration of the technology KLA was well established in the majority of primary schools and in the early secondary years in most schools, improving integration and delivery through mathematics, English and other learning programs was an issue mentioned by most sectors and States, particularly in senior secondary years. For example:

- the New South Wales Government's Computers in Schools Policy provided nine support documents, detailing activities and strategies for the integration of computer-based technologies, specific to each KLA. Every secondary teacher in New South Wales government schools received a copy of the document relevant to their teaching areas. An integrated primary volume was distributed to all primary teachers in government schools; and
- government schools and the independent sector in South Australia reported that many schools in 1997 structured the use of technology within cross-curricula frameworks to ensure that teaching and learning remained the focus.

A key issue discussed in independent schools was that of whether to have technology teachers teaching technology skills or teachers incorporating technology into their classroom teaching. The trend in Western Australian independent schools was toward the latter, with a focus on technology being a tool for learning across the curriculum. This came together with the realisation that computer laboratories and computer teachers often segregated learning and skills and that this needed to change so that students learnt skills as they needed them.

Development and training

Education authorities reported consistently that training and ongoing development of teachers in technology was a priority issue. The following key issues were mentioned:

- the promotion of best practice;
- development of national networks;
- development of the understanding that students learn differently as they become technology proficient and so teachers need to adapt their styles of teaching;

- ensuring the provision of adequate, specialised pre-service training at all levels;
- the pre-service training of technology KLA teachers and the retention of trained professionals, with the potential shortage of secondary technology teachers mentioned by several sectors; and
- an awareness that the roles of teachers, school assistants and library personnel were changing.

Access and equity

The level of engagement of schools in information technology varied markedly, ranging from schools which were well-resourced throughout, to those focussing on special interest areas and those who have little or no IT capacity and who are in urgent need of assistance.

In common with many schools outside major population centres, Western Australian independent schools in remote locations reported difficulties in linking with the Internet because of outdated computers, expensive connections to Internet service providers and unreliable telephone lines.

Independent schools surveyed in the Australian Capital Territory identified a general tendency for educationally disadvantaged students to prefer technology subjects, and offered a range of programs to support such students.

To fully assist the learning process, technology must be available in an equitable manner. Several States reported

that equity of access to specialised facilities and participation was an issue for students living in remote areas, with authorities in South Australia, Queensland and Western Australia identifying the challenge of providing telecommunications for all schools, given the spread and isolation of sites. The provision of equitable access to technology for students in low SES areas and students from the Disadvantaged Schools Program was an important current issue, while ensuring gender equity in the access to technology in the event of technology-related subjects becoming optional was seen as a future issue.

Cost

The most beneficial and cost-effective way of providing professional development, technical support and equipment was an ongoing issue. Other specific cost difficulties which were identified included:

- the constant cost of updating technology with the associated growth in hardware complexity;
- the increasing need for technical support;
- the cost of providing on-line access;
- pressure from industry to keep up with the latest software applications, equipment, etc.; and
- the nature and quantity of physical resources for technology studies, e.g. access to electricity in classrooms, spaces suitable for using tools or a range of materials.