



Australian Government

Department of Education, Science and Training

# Australia's Teachers: Australia's Future

Advancing Innovation, Science,  
Technology and Mathematics

MAIN REPORT

COMMITTEE FOR THE REVIEW OF TEACHING AND TEACHER EDUCATION OCTOBER 2003

Backing

Australia's

Ability

The Australian Government's  
Commitment to Innovation

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## List of acronyms

AAMT	Australian Association of Mathematics Teachers Inc.
ACDE	Australian Council of Deans of Education Inc.
ACE	Australian College of Educators
ACER	Australian Council for Educational Research
AEI-NOOSR	Australian Education International – National Office of Overseas Skills Recognition
AIEW	Aboriginal and Islander Education Worker
ANU	Australian National University
APAPDC	Australian Principals Associations Professional Development Council Inc.
AQF	Australian Qualifications Framework
ASCED	Australian Standard Classification of Education
ASMS	Australian Science and Mathematics School
ASTA	Australian Science Teachers Association
CGS	Commonwealth Grant Scheme
CQTP	Commonwealth Quality Teacher Program
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEWR	Department of Employment and Workplace Relations
GCCA	Graduate Careers Council of Australia Ltd
GDP	Gross Domestic Product
GDS	Graduate Destinations Survey
GERD	Gross Expenditure on Research and Development
HECS	Higher Education Contribution Scheme
IBPP	Innovation and Best Practice Project
ICT	Information and Communications Technology
IETA	Indigenous Education Training Alliance
KBC	Knowledge Building Community
KLA	Key Learning Area
LOTE	Languages Other Than English
LSAY	Longitudinal Surveys of Australian Youth

MAYOP	Move at Your Own Pace
MCEETYA	Ministerial Council on Education, Employment, Training and Youth Affairs
OECD	Organisation for Economic Cooperation and Development
NESB	non-English Speaking (Background)
PEEL	Project for Enhancing Effective Learning
PISA	Programme for International Student Assessment
PMRT	Performance Measurement and Reporting Taskforce
R&D	Research and Development
RATE	Register of Australian Tertiary Education
RATEP	Remote Area Teacher Education Program
RPL	Recognition of prior Learning
SBNA	School-Based New Apprenticeships
STAR	Science/Technology Awareness Raising programme
TIMSS	Third International Mathematics and Science Study
TQELT	Teacher Quality and Educational Leadership Taskforce
TRIP	Teacher Release to Industry Program
VET	Vocational Education and Training

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## Background

The Review of Teaching and Teacher Education is an initiative under the Australian Government's \$3 billion innovation statement *Backing Australia's Ability*, which was launched by the Prime Minister. The purpose of the Review was to identify strategies which will increase the numbers of talented people who are attracted to teaching as a career, especially in the fields of science, technology and mathematics education, and build a culture of continuous innovation at all levels of schooling in Australia. The Review's Terms of Reference are at Appendix 1.

An independent Committee, with representatives from school, university and industry sectors, was established by the Minister for Education, Science and Training, the Hon Dr Brendan Nelson MP, on 8 August 2002, to oversee the Review. A broad-based Reference Group—drawn from deans of education and science, teacher professional associations of science, technology and mathematics, business organisations, parents' groups, principals, teachers' unions, teacher education bodies, educational organisations and others—was established to assist the Review Committee. A Review Secretariat drawn from the Department of Education, Science and Training was established to manage the progress of the review. Details of the Review Committee, Reference Group and Review Secretariat, are at Appendices 2 and 3.

The Review Committee released two Discussion Papers, *Strategies to Attract and Retain Teachers of Science, Technology and Mathematics* on 5 September 2002, and *Young People, Schools and Innovation: towards an action plan for the school sector* on 21 March 2003, which were accompanied by national calls for submissions, and provided an opportunity for parents, teachers, educators and all those interested in teaching and schooling to contribute their ideas.

The response to the Discussion Papers was extremely encouraging, and the submissions provided a rich source of ideas and information for consideration by the Review Committee. Submissions came from a wide range of organisations, including government and non-government school education authorities; most universities; teacher professional associations; industry, peak parent, principal, teacher and union bodies; as well as a diverse group of individuals. A total of 241 submissions were received. These submissions are listed at Appendix 4.

In addition to its collective experience, the Committee consulted widely, held meetings and discussions across the country, visited schools already in the vanguard of innovation, reviewed Australian and international experience and research literature, and commissioned a number of papers to inform its work, which are available on the Review's website. A list of this work is at Appendix 5.

On 20 February 2003, the Review Committee released an Interim Report *Attracting and Retaining Teachers of Science, Technology and Mathematics*. The Committee's final report is presented in three volumes: an *Agenda for Action*, a *Main Report* and *Background Data and Analysis*. The *Agenda for Action* presents the Review Committee's main findings and conclusions and a range of actions the Committee believes need to be taken. The *Main Report* presents the reasoning and argument based on evidence from a wide variety of sources that underpin the *Agenda for Action*; and the *Background Data and Analysis* presents much of the data supporting the views formed during the course of the Review.

Further details are available at <[www.dest.gov.au/schools/teachingreview](http://www.dest.gov.au/schools/teachingreview)>.

## Foreword

Throughout our history, generations of Australian teachers have risen to the challenges of the times in educating the nation. Today, their success is demonstrated in a quality of student learning and achievement which generally compares well with the highest international standards.

Over time expectations rise, and educators set more demanding goals and seek new ways to achieve them. As knowledge becomes a staple of the economy and of our social and cultural life, everyone must become better informed and able to apply knowledge and skills in life and in work. A key issue now is Australia's capacity to foster innovation. For this we must mobilise human talent to foster scientific discovery, creativity, inventiveness and the ability to produce needed goods and services, be they material products, services, or practical ideas.

So a central theme of the Review is strengthening science, mathematics and technology education. We need talented people to teach these subjects. But equally, all teachers across all subjects, and all our students should become partners in a learning society that underpins innovation and a high standard of living.

Across Australia, successful schools are showing the way forward as outward-looking learning centres, forming partnerships within the community and drawing on the resources of technology to facilitate learning. But as not all schools have moved in this way, not all students fulfil their potential, and teachers now are called upon to meet ever higher demands and expectations.

Over the next decade Australia's teaching force will be replenished as thousands reach retirement. In this same time, high professional teaching standards are being set, and provision is being made for ongoing professional learning for all teachers. These changes provide opportunities for further significant improvements.

The Review benefited from the support and cooperation of large numbers of individuals and organisations who contributed submissions, and participated in interviews, meetings and visits. Teachers and other leaders in the schools we visited reinforced our sense of a positive future.

It is a pleasure to acknowledge the commitment of organisations represented on the twenty-five member Reference Group, especially but not only in their attending five national meetings.

The Review Committee itself showed dedication across a fourteen month period, meeting formally on ten occasions, as well as participating in school visits and other activities.

The Review Secretariat in the Department of Education, Science and Training provided essential support, coordination, and contributed greatly from their own expert professional knowledge. The leadership of the Secretariat Manager, Ms Di Weddell, was in every way exemplary.

A number of individuals were engaged to undertake commissioned papers. Our thanks go to them, and particularly to Dr John Ainley, Australian Council for Educational Research, for leading the development of the *Background Data and Analysis*. We are indebted also to Emeritus Professor Malcolm Skilbeck and Dr Helen Connell, who brought to the drafting of the *Main Report* a broad international perspective.

I also thank the Minister for Education, Science and Training, the Hon. Dr Brendan Nelson MP, for establishing the Review initiated under *Backing Australia's Ability*, and providing, with his office, ongoing encouragement, support and a quite personal commitment to our shared goals and hopes.

A handwritten signature in black ink, reading 'Kwong Lee Dow' in a cursive script.

Professor Kwong Lee Dow AM

Review Chair

9 October 2003



## Executive Summary

### Schooling and innovation

Sustained innovation is the key to future growth and prosperity in a competitive global economy. Building a culture of continuous innovation through education is an essential requirement, parallel to and supporting research and development.

Many areas of knowledge and skills are involved in creating a culture of innovation in addition to science-based research and development (R&D). Strategies are needed for the whole of schooling and all areas of the curriculum. But special emphasis is needed now on improving scientific and mathematical education and technological capability.

Innovation in the knowledge economy is not confined to a small group of specialists. It must be supported by a highly educated workforce and citizenry. Schools have a major role. So too do families, businesses and the wider community.

Teachers are the key to mobilising schools for innovation. System-wide support and leadership both for and within schools is vital. The Review in emphasising these requirements gave attention to ways of improving the attractiveness of teaching, and career-long development. A large turnover of teachers is anticipated during the next decade, due to retirements, so first rate national workforce planning is required to address all fields of teaching, at all levels of schooling.

Australia has a comprehensive and inclusive educational system which performs very well in international comparisons, meeting requirements for a well educated citizenry and workforce. Average standards are high and the best students and schools are among the best anywhere, but there is no cause for complacency.

The strength of democratic institutions and community life, and continuing economic growth, hinge on realising the potential of all children and young people. Increasingly, they will need to show initiative and solve problems and to generate new and better ways of doing things. This innovative capability is needed in a rapidly changing, knowledge-driven, globalising world.

## Prioritising science, technology and mathematics education

Australia's ability to prosper in this environment depends on high levels of R&D. These in turn require that more young people achieve scientific and technical qualifications with a strong base in the physical and biological sciences and mathematics. By itself, this will not be enough. Policies and strategies are required to ensure a broad base of scientific, mathematical and technological literacy for all students. This means that science, technology and mathematics education must be given high priority nationally, in all education systems and every school.

There is increasing demand in all occupations and in the community generally for well-educated, creative and enterprising people who communicate well, show initiative, work effectively together and demonstrate high levels of competence and responsibility. These and other attributes are identified in Australia's *Adelaide Declaration on National Goals for Schooling in the Twenty-first Century* (National Goals for Schooling). Much remains to be done to translate the goals into effective action and to ensure that *all* children are set firmly on pathways toward lifelong learning. The Review addresses these and related issues but it is clear that they will continue to require attention far beyond the scope of this inquiry.

The Review focuses on issues in science, technology and mathematics education, which are of national concern. They include:

- a declining proportion of students who complete Year 12 studies in physics, chemistry, biology and advanced mathematics;
- insufficient numbers of highly trained teachers in science, technology and mathematics;
- present uncertainty among primary school teachers about how best to teach science, accompanied by primary teachers' relatively low levels of interest and academic attainment in science and mathematics;
- teaching which does too little to stimulate curiosity, problem solving, depth of understanding and continued interest in learning among students, or to thus encourage them to undertake advanced study in science and mathematics at school and beyond; and
- some students who do not do well at school, including too many Indigenous students, and may leave at the minimum permitted age with low attainments and poor motivation for continuing learning.

For all primary teachers there is need to strengthen the content and pedagogical knowledge of science, technology and mathematics in initial teacher education and in professional development programs. For secondary teachers of science there is in addition a need to strengthen further pedagogical knowledge.

The currency of scientific and mathematical knowledge of a generation of teachers who will reach retirement age within the next decade and the nature of professional development opportunities likely to be of most value for these teachers are issues which will continue to require attention over the years ahead.

The Committee visited outstanding, innovative schools where teaching and students' learning was excellent, not only in science, technology and mathematics, but right across the curriculum. Evidence from many sources demonstrates that high quality teaching and successful learning are widespread. But since they are not universal; the Review has addressed ways to disseminate the best ideas, the most effective practice, as widely as possible across all schools.

The concepts of the knowledge society and economy, innovation and a culture of innovation have similar resonance in education as in industry, employment and social affairs in that:

- it is through continuing systematic inquiry, research and well analysed practice that knowledge for practical application is generated;
- it is increasingly through the systematic application of new knowledge and creative ideas that innovations of practical value are generated; and
- it is those 'new knowledge' innovations that will in future underpin employment, economic growth, social development and people's well-being.

## Australia's teaching profession

In Australia's nearly ten thousand schools, there are a quarter of a million teachers with responsibility for the learning of three and a quarter million students. Most are either primary or secondary teachers but some boundaries are becoming more permeable and more diverse patterns of schooling are emerging.

In just fifteen years, to 2001, the median age of the teaching population rose from 34 to 43 years, 44 per cent being older than 45 years. In light of this generational change, attracting, recruiting and retaining people to teach will have to become a top national priority.

Teaching now is virtually an all-graduate profession, with teacher education the responsibility of universities and a few other higher education institutions. Australian Government higher education policies and university-wide decision making are two crucial influences on how teachers are educated.

The supply of teachers has been broadly adequate to meet school needs nationally. But recruiting difficulties are apparent for certain secondary specialisations—including physics, chemistry, mathematics, technology studies and languages other than English (LOTE)—and in many rural and remote and some metropolitan locations. Targeted policy initiatives, including financial incentives, will be required to attract and retain teachers, especially of science, technology and mathematics. Prospective teachers from Indigenous and other groups at present poorly represented in teaching need to be recruited to achieve a better correspondence with the diversity of students.

A gender bias towards females is pronounced in the teaching profession, especially in the primary sector and in lower secondary schooling. The male teacher cohort is concentrated more heavily in the older age groups and it is mainly older males who teach upper secondary and advanced courses in science and mathematics.

Data limitations and inadequacies make analysis and forecasting supply and demand difficult. However, several priorities stand out:

- ensuring an adequate supply of highly talented, well-educated teachers to meet the need for a more extensive provision of science, technology and mathematics in primary as well as secondary schooling;
- understanding demand by region and specialisation and developing broader strategies to attract, recruit and retain quality teachers of all subjects and at all levels;
- ensuring that all schools regardless of location are well staffed with appropriately qualified teachers; and
- achieving a more diverse population of teachers more representative of the cultural, social and ethnic diversity of the Australian community.

Incentives are needed to attract more talented people to become teachers where shortages are identified. The Australian Government's identification of teaching as one of two national higher education priorities, to which it proposes to apply a lower rate of HECS, is a significant initiative.

However, those qualifying to teach through completion of a Bachelor of Science degree followed by a graduate teacher education award accrue a higher HECS debt than other teachers, but receive the same pay once employed as teachers. Similarly, those teachers who enrol in higher education units in science, technology and mathematics for the purpose of enhancing their professional expertise accrue a higher HECS debt than their colleagues enrolled in units in other disciplines.

The Committee concluded that secondary and primary teachers of science, technology and mathematics should not pay more HECS than their teaching colleagues.

A difficulty in national workforce planning is insufficient data. Moves now under way to strengthen data collection and analysis and research into conditions affecting teacher demand and supply will need to become more intensive to provide a basis for policy development.

## Revitalising the teaching profession

High quality teachers make a significant and lasting contribution to young people's lives. The quality of their initial education and training should be further improved by a greater concentration on the quality of the school experience components. Difficulties surrounding this issue should be resolved by teacher employers, schools, universities and governments in partnership.

Teacher retention in a highly competitive labour market is a serious challenge with many dimensions. Strategies to retain high quality teachers include sustained improvements to the working conditions of teachers, effective induction programs and mentoring support for beginning teachers, curriculum and pedagogy which engages students, articulated professional standards, flexible workplaces and enhanced career pathways, ongoing opportunities for professional learning, strong school based leadership and team practices.

Professional standards will provide a basis of competence for all teachers. When nationally consistent they will also assist in mutual recognition by different jurisdictions and systems of teacher qualifications and capabilities. They will also improve the public profile and standing of the teaching profession.

Recognising and rewarding teaching excellence and providing opportunities for teachers to further develop their expertise and leadership within the profession will aid quality improvement. The profession itself should play a leading role in steps to achieve these outcomes.

The Review Committee welcomes the Australian Government's establishment in 2004 of a National Institute of Quality Teaching and School Leadership. To be run by and for the profession, the Institute will complement arrangements to support and strengthen teaching and school leadership already in place in various State and Territory school systems and in the non-government sector. The Institute is likely to address professional teaching standards, professional learning for teachers and school leaders, quality assurance, research into teaching and learning, induction, mentoring and succession planning for school leaders, and other ways to improve quality and recognise achievement.

Several factors underpin teacher satisfaction and retention. Among them are: improved remuneration; physical conditions within schools; availability and quality of curriculum resources; teaching loads; class sizes; access to and use of technology; appropriate in-service training and the opportunity for study leave and professional development. These need to be kept under constant review and wherever possible improvements should be made.

Consideration should be given to rethinking career progression according to teaching performance. Recognising and refining strategies to support quality teaching and educational leadership will be important. Teacher salary advancement should be based on teaching performance and career structures, with better recognition points for proficient teachers and highly accomplished teachers. Diverse roles teachers perform to complement class teaching, including mentoring, community leadership, cluster support and other leadership roles within the school, need to be recognised.

Progressively, teaching career and salary advancement should come to be based on merit and teaching performance rather than length of service, with accomplished teachers rewarded at higher rates. While starting rates for teachers' salaries are comparable with other professions, ceilings reached eight to eleven years after entering the profession and lack of rewards for outstanding quality of teaching disadvantage teachers.

The Committee noted among submissions and in its visits and meetings a concern over the standing of teaching and the general community regard for education. More has to be done to make teaching once more a career of choice and not, as it has been for too many, a fallback option.

## Preparing to teach

Teaching has become a graduate profession based on not less than four years of higher education. The many different pathways into teaching fall mainly into either four year education degrees, four year double degrees, or degrees in other subjects followed by one to two years of professional training. Mature-age students are being attracted to teaching, often bringing rich experience from other careers and adult life. They require flexible pathways and recognition of what may be heavy personal and family responsibilities. While selection for admission to teacher education courses must be stringent and high entry standards maintained at all times, there is scope for recognising the wide variety of prior learning and competencies that many prospective students bring.

Universities and other higher education institutions can do much to equip prospective teachers with the skills and knowledge needed to develop an innovative capacity in students. They can value, encourage, and model creativity, initiative, enterprise and diverse ways of applying and using knowledge. There are many innovative programs and approaches in teacher education, notably those with close links to schools, including organisation of students' practical experience of schools and classrooms. Linkages can be further strengthened between initial teacher education, induction, mentoring and continued professional learning. Additional funding the Australian Government has proposed for the practicum under the *Backing Australia's Future* package should be used to improve the workplace learning component of initial teacher education.

Teacher employers, education faculties and professional bodies representing teachers will need to collaborate so that all beginning teachers receive well structured induction programs, mentoring and time to reflect on their practice.

Academic staff involved in the planning and delivery of teacher education courses are often directly involved in schools in various roles. More academic staff need such experience to maintain the currency of their practical knowledge and to build up greater collegiality between schools and universities. Experienced, practising teachers have much to offer teacher education programs. There is scope for conjoint appointments and close working partnerships between school and universities in the design and delivery of teacher education. Overcoming impediments to moving further in this direction will require greater collaboration among universities, schools and employing authorities.

## The professional learning continuum

The overall professional preparation of teachers should be strengthened through seeing initial teacher education, practical experience, internships, induction and ongoing professional learning as a continuum.

More extended professional learning is essential for the vitality of the profession. Teachers will be better placed to foster students' innovative capabilities, or respond adequately to students' diverse learning needs if they continue their own professional learning. Professional learning needs to become a central feature of career development—planned, systematic, regular and relevant.

Access by all teachers, regardless of location and specialisation, to high quality, professional learning has several purposes: to facilitate and enable career advancement; to motivate, rejuvenate and retain good teachers; and to provide the knowledge and competence schools need in pursuing their goals and priorities.

Initial and professional development programs are needed to prepare primary science specialists with sufficient knowledge, confidence and experience to support and advise other teachers when and where needed.

It is necessary to take a wide, career-focused approach to professional learning. Teachers change schools, they move into different areas of specialisation, they may move in and out of the education profession. In addition to professional learning focused on the requirements of the individual teacher's current school, approaches are needed which recognise the changing nature of the teaching career and the directions being taken by education authorities as they develop new priorities and re-position themselves in response to wider jurisdictional and national needs.

Upgrading disciplinary and pedagogical knowledge will be at the core of professional learning, especially in the sciences and technology where there are rapid changes in knowledge and techniques. It is a feature of all subject areas that research, scholarship and practical experience are constantly reshaping both the surface features of the domain and its structure and foundations. The message for teacher professional learning is that it be current and vital and that it connect with both teachers' present responsibilities and their evolving career profiles.

Responsibility for professional learning should be shared among teachers, schools, education authorities and the various providing bodies. Increasingly, the value for professional learning of structured experience in industry and both public and voluntary services is being recognised, but it is yet to develop to the point where it is a common experience for practising teachers (or those preparing to teach).

Two requirements to meet for a fully functioning system of professional learning for Australia's teachers are:

- recognition and reward for teachers who demonstrate advanced competencies and continued professional development; and
- greatly improved teacher access to and use of new knowledge and the communication and information technologies pertinent to teaching and learning.

Educational research is vital, but its diffusion and use in solving practical problems in education are constrained when, in both content and form, quality data, evidence, critical evaluation and other products of research and inquiry are not accessible. Teachers require timely and ready access to new knowledge. New technologies have immense potential as vehicles for providing this access and for developing the networks through which professional practice thrives.

## Future schooling

Among the key factors in bringing about school improvement are:

- outstanding leadership, from formally designated staff, notably the school principal, and from the teaching staff and students;
- a clear vision and sense of purpose together with the capability to manage and orchestrate institutional change;
- a commitment by the whole school community, including parents, to this vision and to sustain it in all facets of school life;
- highly competent teachers dedicated to achieving excellent learning outcomes for all students and to maintaining the highest standards of professionalism and professional learning; and
- strong system and employer-led strategic planning, resourcing and support.

These need to be complemented by greater school autonomy in combination with system-wide strategic steering and resourcing, targeted professional learning and flexible career pathways.

Science and mathematics education coordinators should be appointed for clusters of secondary schools and their feeder primary schools to stimulate science teaching and learning in primary schools and ensure that the teaching and learning of science and mathematics are well articulated between the two sectors. Primary school science specialists will boost science in primary schools.

Teachers need a rich understanding of the changing world of children's experience, of youth culture and the lives of students, irrespective of the subjects they teach. Effective teaching requires that teachers are sensitive to and connect with this culture and build upon it. Learning is strongest and most meaningful when it engages students actively, connects with their own knowledge and understanding and relates to their interests and experience. To meet these challenges teachers need a great deal of support in the often difficult conditions of the contemporary school.

Greater consistency is needed in educational outcomes. When schools have been provided with the necessary resources and fully supported, they should be held to account for avoidable weaknesses and shortcomings in student learning. This is a demanding criterion which reflects the fundamental importance of high quality learning for all students.



## Energising schools for innovation

Schools are not working individually and in isolation; teams, external partnerships, clusters and networks are connecting teachers and schools with one another and with the wider community. These can be extended and teaching made a more collaborative enterprise. The potential role of communication and information technology in this respect is yet to be fully realised but many schools are well down the track. More flexible working spaces in schools, to enable a wider array of teaching and learning approaches to be used, are being provided through adaptations of older buildings and the design of new ones. But too many schools lack high quality spaces and resources for learning that are needed.

Flexible teaching–learning spaces and communication and information technology provide the means for more creative teaching and better learning outcomes. These are particularly needed to overcome such problems as student disengagement in the middle years of schooling and to motivate and support those students whose learning outcomes have been weak or poor. As shown in the international comparisons of student performance in reading, scientific and mathematical literacy, while Australian students perform very well on average and the best students attain high scores, too many do not do well, so there is room for considerable improvement. The foundations have to be laid in high quality early childhood education and care.

New vocational pathways in secondary education are being developed, and should assist in improving retention rates and in developing pathways into post-secondary vocational training and skilled employment. Learning pathways and forms of assessment, especially at senior secondary level, will require further attention: to test their consistency with the objective of successful schooling for all; and to meet changing knowledge and skill requirements in both the tertiary sector and the labour market.

In order to energise schooling for innovation, a very high quality of educational leadership is required. Competent leaders who have a strong, clear vision, are determined and have a capacity to inspire and move things forward will be in great demand. They need freedom and authority to steer, manage and orchestrate what are very often large, complex organisations.

The exemplary teaching and learning practices that daily occur in Australia's schools are too often submerged beneath highly publicised problems. An investment in the dissemination of good practice and more systematic recognition of outstanding achievement would benefit all schools and give the community a better understanding of how schools are changing.

Schooling in Australia is on the verge of transformation to drive forward policies and strategies to reach new national standards of educational quality and relevance.



## Part 1 Learning needs for the knowledge economy

The key to the nation's future prosperity is its success in generating new ideas, knowledge and high levels of education and skill across the whole Australian community. This is the message of *Backing Australia's Ability*.<sup>1</sup> It provides a foundation for this Review and a direction for the future development of teaching and learning in the nation's schools.

Australia is expanding the base of its knowledge economy and enhancing its innovation capability through strong information and communications technology (ICT) infrastructure, well-developed human resources and an economic framework geared to productivity and international competitiveness. Like many nations seeking to position its citizens to participate in the emerging global economy, Australia is increasingly having to base its future on emerging science and industry fields, such as bioinformatics, biotechnology, genomics, laser science, nanotechnology and microelectronics. At the same time, competitive advantage in the agricultural, manufacturing, mining and service sectors must be sustained through enhanced knowledge and skills. Knowledge-based industries now account for approximately half of Australia's Gross Domestic Product (GDP) and this upward trend is set to continue.

Australia needs to be at the forefront of these developments, to create and extend innovation capability, and to bring the education system to the centre of the knowledge revolution. The knowledge economy depends on continuous innovation, to develop new products and processes and to adapt to established ways of doing things. This imposes quite diverse demands, from extending the frontiers of science to educating for the many different kinds and levels of skill and capability needed by the nation's workforce. Innovation and a capacity for innovation call for many varied talents. As the Australian Council of Deans of Education says, these are for personal growth and citizenship as well as employment.<sup>2</sup>

Scientific and mathematical knowledge, and technological capability, are essential for the knowledge economy and to achieve high levels of innovation. But so too are other kinds of knowledge and understanding—in the social sciences, the humanities and the arts and in the broadly defined cultural and ethical domains. The riches of the knowledge society have to be developed in partnership with the knowledge economy if growth is to be sustainable and its benefits shared by all and in all spheres of life.

A well-educated and skilled workforce that embraces lifelong learning is essential for generating employment and achieving growth, thus bringing benefits to all Australians, a point made by the Australian Primary Principals' Association: 'A sound education base is central to the future of the nation's most valued resource, the youth of Australia'.<sup>3</sup> All students need access to high quality education in primary and secondary schools, as a basis for lifelong learning.

Teachers are the nation's most important resources for educating students. There must be a sufficient number of well-qualified teachers to ensure that all schools are adequately staffed to deliver the curriculum in ways that foster and support successful learning by all students. A well-educated force of teachers of science, technology and mathematics is fundamental, and new approaches may be needed both to attract and retain people of the highest calibre and to ensure the adequacy of their initial training and continual learning. Nothing less should be the target.

Chapter 1 examines the demands of the knowledge economy, the requirements of a nationwide culture of innovation and why innovation has become so important to national well-being. The challenge for education is to find ways of relating teaching and learning and the education of teachers to these requirements and demands. At the same time, Australia must affirm educational goals and values to meet personal and social needs of all people.

The knowledge economy requires citizens who have breadth as well as depth of knowledge—a broad general education together with specialised expertise and capability. All domains of learning are important in providing a sound educational base for a strong nation. Highly trained expertise in science, technology and mathematics is particularly important for maintaining living standards and international competitiveness.

Chapter 2 deals with the teaching and learning of science, technology and mathematics in schools and ways of developing a greater capacity to use scientific and technological knowledge and information and communications technology (ICT). The current situation in Australian schools is considered.

# 1. Schooling and innovation

As societies become more complex, so do the challenges they face. Australia's success in meeting these challenges hinges on its capacity to develop innovative solutions in many spheres of life—economic, social, cultural and personal. The need is not just to solve problems, but to solve them in ways which build something new and beneficial, enhancing the quality of life for all. This is the principle the Committee believes underlies the innovative culture Australia is seeking to develop.

Solutions need to be relevant to social and cultural purposes, not just technological and industrial ones. For students, the aim is to develop knowledge and sensitivity and a capacity to innovate, create and take control of their lives. For teachers and schools, this will entail the exploration of new possibilities for educational improvement and the creation of cultures of innovation in the schools themselves, in which all students are valued and enabled to succeed.

The goals of democratic, inclusive and high quality education for all Australians have been adopted through the National Goals for Schooling.<sup>4</sup> Their realisation in practice depends upon a readiness to be bold and creative, to define new pathways, to remain motivated when faced with difficult circumstances, to find new ways to work together and to develop in students those same capacities.

## 1.1 Schools and teachers are central to an innovative knowledge society

Change in the contemporary world is everywhere. It is multidirectional and uncoordinated, with effects for individuals and society that can be beneficial or harmful. The term 'innovation' is used in many different ways. For the purposes of this report, it is construed as deliberate action to steer change and use it for beneficial results. In the terms of the Review, to achieve and sustain a 'culture of innovation' is to strive in and through teaching and teacher education for improvements in the way of life for all Australians.

As discussed below, there are compelling reasons to approach a 'culture of innovation' from the perspective of the knowledge economy, that is, to see innovation as a driving force for economic growth and to focus on the kinds of knowledge needed for economic growth. 'Innovation' is, however, a value in all areas of education, not only those serving the economy. Educational innovation is purposive directed change aimed at improving learning, teaching and the conditions that affect them.

Schools and schooling, teachers and teaching, students and their learning have to be prepared for changes of a different order and scale from those experienced in the past. Schools are the baseline. They need to be ready to respond to the challenges that Australia continues to experience in its expanding regional and global roles, to create, to invent and to innovate. Many schools and teachers understand this and are producing outstanding results. A key task is to find ways to spread the best ideas and most successful practice to all schools and to involve all teachers.

Clear policies, appropriate resources and a high level of leadership both within schools and in all parts of our educational systems are necessary if Australia is to perform to the best international standards. More teamwork and partnerships between schools, universities, TAFE, industry, business and community groups are needed. They will pay rich dividends both in student learning and in better appreciation by the community of the value of education.

The whole community has a responsibility to create and support schools to achieve a culture of lifelong learning and innovation among Australia's students and teachers. Community leadership in support of education is vital. Improvements of many different kinds in teaching and learning are needed, for a more proficient citizenry. To carry conviction and be effective, these improvements should be grounded in best practice and research. They need to be systematically evaluated and to take advantage of the experience of other systems and countries.

A wide array of programs, projects and policies in Australian education today are aimed, either directly or indirectly, at improving learning and enabling teachers to do a better job overall, and in science, technology and mathematics education in particular. There is a gathering tide which can carry all areas of learning forward: a closer integration of different elements of the curriculum, more coordinated and collaborative teaching and a concentration on fostering those conditions most likely to advance learning in all schools and by all students. It is now widely agreed that teaching must give more attention to diverse learning strategies and be ready to provide stronger encouragement and support when students encounter difficulties.

A fine example of schooling which sets success for all students as an attainable goal and which is diversifying curricula, teaching and the organisation of learning to achieve this goal is Salisbury High School in South Australia (Box 1.1).

### **Box 1.1: Pathways to success for every student in a South Australian high school**

**Salisbury High School** which opened in 1959 had, up until eight years ago, declining enrolment numbers, falling retention rates, high absenteeism, low teacher morale, and numerous behavioural problems including low self-esteem in students. However, through strong school leadership, close parental, local, community and business involvement, and strong support from the South Australian Department of Education and Children's Services, the school has had remarkable success in reversing these trends. Salisbury High has now achieved a national reputation for meeting the needs of its students and the community. Other achievements include increased enrolments in science and mathematics in the senior years, an increase in numbers of students taking the university pathway and the delivery of quality learning through an enterprise teaching programme which deploys a wide variety of strategies under the emblems of 'can do' and 'success for all students'. Salisbury High School has recently embarked on the International Baccalaureate Middle Years programme which will further develop its focus on providing a relevant engaging and rigorous curriculum for its students and staff.

Source: Secretariat report on Review visit (April 2003).

One of the clearest messages is that a society-wide culture of innovation cannot rest exclusively on a minority of highly educated specialists. It will depend also on the varied innovative capacities and predispositions of many different people, well-nurtured in schools. This goal cannot be achieved by sporadic and piecemeal efforts.

## **1.2 Twin engines of education and research**

There are two principal engines or drivers of the innovative culture which lies at the heart of the knowledge economy, namely, scientific research and education. Research of many different kinds yields new knowledge. Applied research, also of many different kinds, puts this knowledge to use in the economy and society through a continuing cycle of innovation.<sup>5</sup> Education provides the flow of knowledge workers—for basic research, applied research and—no less important—for all the numerous and varied spheres of economic and social life in which knowledge is put to active use. Without high quality formal education in schools, TAFE and universities and high quality non-formal education in the workplace and everyday life, the knowledge economy cannot survive. While often treated separately, these two 'engines', of research and education, are intimately related. Neither alone is sufficient; both must work together in generating innovation and creating a nationwide culture of innovation.

Equipping students and teachers to understand and to thrive in the emerging knowledge economy and knowledge society means adopting innovative approaches—in schools, but equally in the initial and continuing education of teachers—and developing in students a capacity to be innovative. To achieve successful and enjoyable learning by all students requires new initiatives or, as some commentators suggest, transformations. This does not mean starting with a blank slate but with the living reality of schools and the students and teachers who are already there. As Cropley and Gribov said, ‘Innovation involves the insertion of beneficial novelty into a functioning system’.<sup>6</sup>

To indicate in practical ways how best to go about the necessary transitions from past practice and beliefs about what schools are for is challenging. But, as discussed in later chapters, there are very significant initiatives under way in the States and Territories and many programs with Australian Government support and leadership. It scarcely needs to be stated that it is a formidable, long-term enterprise to transform schooling; it needs to be underlined that it must be a collaborative effort in which teachers and students themselves play central roles.

There are complex interrelationships between, on the one hand, basic educational values and strategies for educational change and, on the other, the patterns and structures that go variously by the name of innovative cultures, knowledge economy and the knowledge or network society. But knowledge, with capacity to share and use knowledge, is always the central concern.

Submissions to the Review pointed to disjunctions in the processes of innovation and the need to consider who benefits and which—and whose—values are at stake. The South Australian Department of Education and Children’s Services is of the view that there needs to be ‘a national dialogue about innovation, its definition and how it might lead us forward’.<sup>7</sup> The Association of Independent Schools of South Australia said that the development of a culture of innovation within schools ‘must also address social policy issues’.<sup>8</sup> This Review and its follow-up should be part of a continuing dialogue within the education profession and in the wider community.



### **Box 1.2: Philosophy and leadership transform a Queensland primary school**

**Buranda State School** is a Queensland government primary school situated on the fringe of the central business district of Brisbane, with students from a wide range of family structures and cultural, religious and socioeconomic backgrounds.

The shared vision for the school is that it should be a place where learning is creative, fun, joyful, exciting, surprising and challenging.

The adoption of philosophy as a core subject that underpins all curriculum activities, has transformed the school's teaching and learning methods. By listening to each other, building on each other's ideas and accepting that there is no single right answer, children learn to be fair and open-minded, intellectually cooperative and mutually respectful. They become thoughtful and reasonable citizens.

Technology and real life learning also play an important role at Buranda School as part of a futures-oriented curriculum.

The changes at Buranda over the last six years have been far-reaching and extraordinary. Most importantly, they include demonstrable, improved student outcomes. There has also been a significant increase in enrolments, improved work practices and the development of a professional teacher learning community. The school enjoys strong support from the parent and wider communities.

Source: Secretariat report on Review visit (May 2003).

The Committee's invitation to show how and in which ways Australia's educational systems can take bold initiatives to strengthen the quality of teaching and learning was warmly responded to with many striking examples of fresh thinking and imaginative practice and of a readiness to rethink values and to use research and reflective inquiry in shaping educational policy and practice. Two of these are offered as illustrations.

### **Box 1.3: A Victorian college renews itself: building a school culture of innovation**

**Eltham College of Education** is a coeducational independent school which set forth on a path of renewal in 2000, aiming to build a culture of innovation in a school that, at its inception, had been notably innovative but, over the years, 'had become more settled into a traditional Melbourne independent school culture'. In order to achieve this, the College Board and College Executive worked together to prepare a business plan which set directions for the following five years. Features of the plan included: establishing clear expectations in all curriculum areas for students to become self-directed learners; upgrading the status of the student body and bringing it into partnership with the principal, senior staff and College Board; developing self-managing teaching teams with team budgets and ownership over time; and increasing funding for professional development and to support individual and team innovation.

The introduction of teams in place of faculties and departments resulted in the distribution of tasks according to interest and ability and, together with the appointment of a multimedia specialist to plan and manage a new integrated learning intranet, led to significant changes in the way the school operated. Other initiatives included the development of a powerful ICT network, which resulted in greatly increased and more effective use of the school's library and other resources including the Web, and the creation of a digital student learning management model, which enhanced students' computer literacy and research skills. The College has developed highly innovative programs for Year 9 students, involving intensive study of the urban life of central Melbourne and environmental education in a semi-rural setting.<sup>9</sup>

Source: Submission 170, Eltham College of Education.

Innovation is inherently risky since no clearly set path lies ahead. In order to innovate, schools must be prepared to take a step into the unknown. Schools therefore need freedom, confidence and capability of a high order. Building on the diverse values held by families and communities, and sharing responsibilities with them, schools can equip all young Australians to take advantage of the opportunities and themselves to become effective catalysts of change.

Many schools, but by no means all, are moving in these directions. The national challenge can be summed up as pursuing new avenues to achieve quality and inclusiveness. It is to ensure that all schools understand the key messages of an innovative national culture and are able to translate them into effective teaching and learning for all students. The quality of teaching and its outcomes in student learning will mean the difference between outstanding success and mediocre performance in this regard.

No-one should underestimate the educational challenge posed by what has been called 'the wealth of knowledge' or the 'network society'.<sup>10</sup> Not just new skills are needed, but broad competencies and sensibilities across all fields of endeavour, together with new kinds of understanding and patterns of relationship. As indicated in several submissions, school curricula are undergoing quite profound changes to engage learners more effectively and to develop understanding and skills that will equip them to be active and productive global citizens.

The educational challenge of innovation attracted a great variety of responses in submissions to the Review. It is evident that there is widespread interest in exploring just what is meant by an 'innovative culture', and the role of schools and education systems in developing it. There is, in the submissions, a general convergence of views that both a positive disposition among educators and structural changes in schooling are needed: 'Innovation does not occur in a vacuum. It requires time, exposure to new ideas and a willingness to go beyond the familiar and comfortable to forge new directions and new learning. Even where this willingness is apparent, the demands of timetables, workloads and accountabilities often work against innovation in schools.'<sup>11</sup>

Innovation in and through schooling is not a matter of prescription or blueprints to follow, but of developing consciousness and capabilities. It is more likely to emerge from generative processes rather than prescriptive steps and packages of possible solutions'.<sup>12</sup>

The concepts of innovation and of the knowledge economy and the knowledge society are in many ways quite familiar to forward-looking educators.

Knowledge, in this context, can be thought of as ways of knowing in many different domains and through a very wide range of cognitive capacities and processes. These include depth of knowledge and understanding, critical thinking, evaluation, judgment and, especially, the capacity to find new ways of solving problems and attaining goals creatively.

Cuttance and Stokes, in their study of school innovation in Australia, point out that: 'Schools ... have always been one of society's primary users of current knowledge. They are the creators of new knowledge in the learning of the students. Schooling is the engine of the future knowledge society.'<sup>13</sup>

In order to be generators of knowledge in their students and within themselves and to stay abreast of developments relevant to their teaching, teachers must be active learners at all stages of their career. Rapid changes in all subject domains, and in the educational research and analysis that inform teaching and learning in schools, require the continual reconstruction by teachers of their own knowledge and understanding. This cannot occur unless, nationally, more comprehensive and systematic arrangements are made for career-long professional development.

If research and education are twin drivers of innovation and if they are interdependent, how does this affect schools and the work of teachers? The creation and application of research-based knowledge clearly requires both highly educated researchers and people good at applying and using research findings in the productive and service sectors. Since much of this research and its application depends on scientific and mathematical knowledge and technological capability, it is essential to have an appropriate supply of well-educated people in these fields. But a 'culture of innovation', one where scientific knowledge is constantly being developed and applied, also requires a broad understanding across the community of science, technology and mathematics, what is now termed scientific, technological and mathematical literacy. Since society-wide innovation depends on many different kinds of knowledge and capability, all learning areas of the school curriculum are affected, not only science, technology and mathematics.

The knowledge economy and the knowledge society will thrive when the whole of schooling is mobilised and all teachers see themselves as contributors.

It has been argued that Australia can do much better in turning knowledge and ideas into marketable goods. Indeed, Cervantes has shown that, compared with other member countries of the Organisation for Economic Cooperation and Development (OECD), Australia has a low intensity of research and development, as measured by gross expenditure on research and development (GERD) as a percentage of gross domestic product (GDP).<sup>14</sup>

It is important that education does better in maintaining a flow of high-level scientific and technological expertise and ensuring for all Australians a sound basic knowledge of science and mathematics together with technological capability. It is from schooling and tertiary education that the country expects a flow of future scientists, technologists, innovators, knowledge workers and highly skilled citizens. While the level of university graduates in science, engineering and health in Australia fell slightly between 1998 and 2000, it stands around the middle of the field of OECD countries. It is, however, well below countries like Sweden and Finland where comprehensive policies for the knowledge economy and society are well established and increases have been achieved.<sup>15</sup>

If innovation is to take off, two engines must be fired up: those of science, broadly defined, and of education, even more broadly defined, at all stages from early childhood, through primary and secondary schooling, to tertiary education, and throughout adulthood. Research-based knowledge and education are two sides of the same coin and their integration within a single policy framework is necessary to achieve the national culture of innovation which will energise and sustain the knowledge economy.

A number of countries with highly developed economies are already making substantial funding commitments to foster innovation in schools, with the aim of boosting their economy's longer term performance. The interest on Hong Kong's five-year-old HK\$5 billion *Quality Education Fund* has supported more than 4600 projects, often with public and private sector partners, and effectively cultivated a climate of innovation in its schools.<sup>16</sup> Through its *Specialist Schools Trust*, with funding of some £7.7 million in 2003, the United Kingdom has promoted specialist, innovative approaches in its secondary schools.<sup>17</sup> As at September 2003, the UK had 1448 specialist schools (representing 46 per cent of maintained secondary schools), including 497 technology,

14 engineering, 77 mathematics and computing, and 121 science specialist colleges. Singapore's *Thinking Schools, Learning Nation* program commenced in 1997, with the objectives of developing all students into active learners with critical thinking skills and forming a creative and critical thinking culture within schools.<sup>18</sup>

#### **Box 1.4: Finland's LUMA program**

In a major national action program undertaken between 1996 and 2002 (the LUMA program), the Finnish Ministry of Education set both quantitative and qualitative targets for improving mathematics and science education to meet the needs of the knowledge society. The targets were directed at: increased enrolments in science and technology in higher education; in upper secondary science and mathematics; in basic education (primary and lower secondary); and in vocational education. Targets were also set for citizenship (adult) education and gender balance.

Ten national projects were set up to reach these targets, including a network of pilot schools and institutions, in-service education and teacher education. These projects incorporated partnerships with business and industry, networks of institutions and special measures to support the most talented students and slow achievers.

Among the outcomes were increased higher education enrolments in science and technology, including teacher education programs in mathematics and science subjects, an increase in numbers of secondary students enrolled in advanced courses in science and mathematics, and greater media participation and awareness. Despite significant gains, LUMA reported that needs were not being fully met and that further, follow-up work was required to spread good practice and engage more parts of the education system.

Among the conclusions was that science education should start in kindergarten and that teaching methods should emphasise observational and experimental aspects of science, and conceptual understanding and application of basic concepts and theories.

Source: Arajarvi 2003.

Finland has experienced remarkable success in exploiting its knowledge resources and skills to develop new products. It has high school retention rates and has reached the very highest levels in international comparisons of student performance. The Finnish Ministry of Education points out that, in the information society, knowledge gained through education and research is the key resource, and that 'advances in technology which facilitate production and improve communication have an essential effect on the structure, contents and methods of education and research'.<sup>19</sup>

### 1.3 Innovative and creative people and organisations

Innovation refers to a collective and individual capability to turn research-based knowledge into products and services of economic, social and cultural value. As indicated above, different kinds of knowledge and skills are required, with a particular specific demand for scientific and mathematical knowledge and technological capability. The processes of innovation call for a wide variety of attributes in people and conditions in society. Many submissions identified what they regard as essential features of innovative people and organisations.

The Chair of the CSIRO (Commonwealth Scientific and Industrial Research Organisation) Board noted that: 'People are at the heart of innovation. The innovation system is replete with interdependencies and causal loops, but the key to its success is the linkage between the nodes and these linkages are forged by people, not by institutions. We do need institutions to provide the framework, but people are the enablers of innovation. They have the working relationships, the curiosity, the passions and the ideas. For innovation to occur, those people must be allowed to take risks and make mistakes—even to fail.'<sup>20</sup>

In its submission, the Australian Council of Deans of Education identified knowledge, skills and attributes that individuals require as knowledge workers, 'situated in a climate of constant change', and as democratic citizens. To achieve this, schools would have to focus more on dispositions and orientations of learners, assisting students to become 'self-directed ... able to navigate change and diversity, learn-as-they-go, solve problems, collaborate and be flexible and creative'.<sup>21</sup> The Australian Education Union sees independent thinking and a readiness to challenge the status quo as requirements for an innovative workforce.<sup>22</sup> For the Australian Society for Educational Technology, innovative organisations are open and dynamic, have a commitment to staff development and research, value their members, and encourage teamwork, interdisciplinary approaches to problem solving, global thinking and holistic approaches.<sup>23</sup>

Innovation is not, therefore, a function of individuals with a narrow set of skills or circumscribed knowledge. The capacity to innovate is social as much as it is individual and it calls into play a very wide repertoire of skills and knowledge, both 'know-that' and 'know-how', and other personal and social attributes. Education for innovation is therefore broad and general as well as deep and technical. It is important that educational policies for innovation are broad in scope and inclusive.

Educational policies designed to foster and encourage innovation are in place in many schools. Significant changes are occurring through many recent curriculum and pedagogical and assessment framework documents and programs, such as the *New Basics* in Queensland, *Essential Learnings* in Tasmania and the South Australian *Curriculum Standards and Accountability Framework*.

These programs are exploring new ways of structuring the curriculum and encouraging new styles of learning by teachers as well as students. These innovative, system-wide curriculum frameworks are aimed at promoting innovative schools and developing innovative capacity in teachers as well as students.

In their *New Learning, A Charter for Australian Education*, the Australian Council of Deans of Education envisages that students educated through 'new' rather than 'old' basics, 'will be able to navigate change and diversity, learn-as-they-go, solve problems, collaborate, and be flexible and creative', and that the 'new learning will be increasingly interdisciplinary, requiring deeper engagement with all its complexity and ambiguity'.<sup>24</sup>

How teachers teach is as important for student learning as what they teach. School organisation is also crucial. Education Queensland regards it as critical to the learner that collaboration and participative decision making are modelled through organisational structures and processes, and that the school perceives itself as a host of interdependent teams working across levels. In South Australia, the Department of Education and Children's Services has supported the development of a culture of innovation by involving teachers, students and the community in co-constructing a new curriculum framework covering the first year of life to the end of compulsory schooling and beyond. Thinking, creativity, communicating and working with others are central to the new framework.<sup>25</sup>

Many submissions identified features of innovative schools, both as they exist now and as they may become in future. The School of Education at Edith Cowan University believes that the best way to learn how to be innovative and enterprising is to work in an environment where these norms are nurtured. Inspiring innovation within teaching institutions requires building new norms around questioning, trialling, investigating, observing and evaluating.<sup>26</sup> Innovation is encouraged in schools, according to the Australian Council of State School Organisations, by: a broad and shared vision of the purposes of education; equal valuing of the sciences, humanities and creative arts; and leadership teams committed to the school's vision.<sup>27</sup> According to the Association of Independent Schools of Victoria, an innovative contemporary school:

- is a learning community;
- recognises individuals as unique and treats them as such;
- works with students so that they learn how to learn;
- views teaching as facilitating learning, often in group settings;
- has open boundaries for learning;
- encourages risk taking among staff and students as part of the learning process;
- enables students and teachers to pose problems, identify learning contexts and negotiate outcomes;
- values both convergent and divergent problem solving;
- emphasises a cooperative and collaborative learning environment that maximises success for all; and
- recognises that parents and partnerships are integral to learning.<sup>28</sup>

Public awareness of the building of innovation capacity in schools is crucial to their success. According to the Australian Parents Council, parents and communities do not accept imposed innovations affecting children and their schooling but wish to be partners in their introduction and development.<sup>29</sup> Community engagement with innovation strategies is essential if they are to take hold. This often requires careful negotiation at both the school and the system level. There appears to be a need for more attention to these requirements at a time when education policy initiatives are being taken to strengthen Australia's innovative capacity.

Australian Government schemes under the National Innovation Awareness Strategy, including the Prime Minister's Prize for Science, the Eureka awards for science, technology and engineering, and National Science Week are all part of public familiarisation with the reasons for innovation—in industry, education, community affairs and government itself. Together with recognition and award schemes by industry and the media, these are part of a pattern of public awareness, recognition of achievement and incentives.

Teachers do not stand aside from these national efforts to raise awareness but are indispensable for their success. Teachers, schools and education authorities need to be more than innovative themselves. They should be among the leaders in establishing a more comprehensive and effective innovative culture in Australia.

The Committee believes that teachers will need to be willing and prepared to:

- search for the ideas and knowledge to enable them to become active players in the knowledge economy, through networking, links to databases, regular accessing of research findings and evaluation reports, and collegial sharing of information and experience;
- adopt more creative, experimental attitudes and approaches to teaching and school organisation; take more calculated risks; and use evidence-based approaches in evaluating the impact of their teaching on student learning outcomes;
- engage with the intentions and directions of social and economic policy and education frameworks, devising programs and curricula that achieve society's goals in local settings;
- reach out to more diverse partners in the community and develop collaborative strategies for the better mobilisation of community-wide resources for student learning;
- focus more of their teaching on students' creativity, inventiveness, potential and capability, and on fostering a love of learning; and
- become more entrepreneurial and show leadership in exploring and promoting multimedia and multi-site learning.

To meet these requirements, changes will be needed in initial and continuing teacher education, in education systems and in schools. These are discussed in later chapters.



## 1.4 When do innovations take hold?

As a result of several decades of research and numerous evaluation studies, educators now have a very good basis for understanding conditions in schools and educational systems—and in the wider society—that either support or hinder innovations in schooling.<sup>30</sup>

In the past, successful innovation in education which is effective, timely, on a large scale and faithful to initial purposes and goals has been relatively rare, leading some commentators to the conclusion that schooling is a stabilising, conservative and essentially reproductive force in society, not an instrument or a system for promoting or supporting social and cultural change. On this view, individual schools may change themselves but only within fairly narrow limits due to system requirements and to structural features of society. Educational innovations, it is suggested, may have an impact in single schools or parts of systems, but they are seldom pervasive and do not obviously affect the wider society. That is, so the argument runs, there has been relatively modest success in developing system-wide innovative cultures in and through schooling. It has also been argued that innovations that do succeed tend to be those that are most readily assimilated to pre-existing conditions. That is to say, the more ambitious and forward-looking aspirations of innovators are acceptable only insofar as they correspond closely to the established or institutional values and processes and existing structures.<sup>31</sup>

If these observations were all there was to say on the matter, would there be any point in looking to schools and schooling to be leaders in innovation or to generate the knowledge and competence in students that would equip them as future innovators, or even prepare them to be active members of an innovative culture?

The Committee accepts that bringing about substantial changes in and through schooling is not at all straightforward and that past efforts have not always been successful. But there are lessons to learn from innovation research that will help shape future policy.

A culture of innovation is more likely to take hold if it is a culture of conviction and engagement. Carefully prepared changes which are negotiated and satisfy the diverse interests of those involved have better prospects than those that are imposed. Collaborative design and management of innovations is better than concentration of power in a single source. Susceptibility of goals and targets to modification and adjustment in the light of shared experience is indicative of a healthy flexibility and readiness to evaluate process as well as outcomes. This applies as much to single schools as whole systems.

Key points about innovation are made in several submissions:

- Policies to foster innovation and a ‘culture of innovation’ in education need to be grounded in the realities of schools which include a perceived need for stability in the face of constant change and tensions between organisational practices and individual preferences; schools need to develop collective ways of resolving such tensions.
- The stakeholders include teachers and students whose needs as members of the school community must be met in constructive and democratic ways.
- Innovation requires good management and systemic planning.<sup>32</sup>

Where innovative programs are judged to be significant, successful and capable of further development and diffusion to other schools, they should be maintained and deployed in a strategic way to capitalise on gains already made. The Committee believes that more systematic and inclusive approaches to school innovation are needed, whereby individual schools and projects are linked through networks of innovation.

## 1.5 The role of knowledge and understanding

The changing nature of work requires broadly knowledgeable, flexible, and self-directed people who can communicate well and work collaboratively together. All students should have the opportunity to learn about and develop these attributes in practical ways—not only in formal classroom or school settings. Above all they need the understanding that ‘knowledge’ is not a fixed body or topic on the timetable but a process of inquiry, discovery, testing, verification—a construction in which they are active partners.

The key role of applied knowledge in society, as a driver of economic growth and social progress, has been captured in the so-called ‘new growth’ theories.<sup>33</sup> Although many different kinds of knowledge are implicated, research-based knowledge in the basic or enabling sciences of physics, chemistry and biology, in mathematics and in the applied sciences is a key. Such knowledge is a dynamic source of economic growth when linked through technology and technical, productive processes to the market.

Other fields and kinds of knowledge are equally important, for economic purposes and to sustain social and cultural life. Systematic social science knowledge, the tacit knowledge or ‘know-how’ of the experienced worker, the perspectives and insights of the humanities and the creativity of the arts all play a part in defining and determining both the goals and the processes of a culture of innovation to serve human needs.

In the emergence of the new knowledge economy, society-wide innovation processes have been expressed in a three-stage model: a (historical) transition from a factor-driven economy, to an investment-driven economy, and then to an innovation-driven economy. The mobilisation of large numbers of relatively unskilled workers and low technology inputs in the first, factor, stage has been progressively displaced by ever higher levels of technology and a highly educated workforce in combination with progressively advancing scientific knowledge.<sup>34</sup>

Activity at each of these three stages continues, and therefore employment does also, but in all advanced economies a shift is occurring toward innovation driven by science and technology, with a consequent requirement for rapid and continuing increases in the skill level of the workforce. This is expressed as an increasing demand for higher levels of human capital, that is, ‘the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being’.<sup>35</sup>

Human capital is one side of the coin; the other is social capital, or social norms (such as trust and civic engagement), networks and interpersonal interactions that provide social ‘glue’ or cohesion. Whereas human capital may be thought of as the knowledge and competencies possessed by individuals, social capital is relational, shared by a group. It has been defined as ‘networks together with shared norms, values and understandings that facilitate co-operation within or among groups’. The political philosopher Michael Oakeshott, in defining community as ‘shared understandings

arising from common forms of experience',<sup>36</sup> put his finger on two fundamental points. First, that the concepts of human and social capital are linked, that knowledge and understanding are both individual and communal; and second, that it is breadth of knowledge and understanding, not only skills and specified expertise, that should be cultivated in schools, colleges and universities, both within science, technology and mathematics education and across the curriculum.

### **Box 1.5: High levels of human capital and social capital matter for innovation**

#### ***Human capital***

The economists' term 'human capital' includes what educators recognise as acquired knowledge, capability and learning—know-that and know-how. Measuring human capital entails assessing learning outcomes, standards achieved by students, years of formal schooling and the social and economic value of different kinds of informal and experiential learning. The skills and attributes of communication, numeracy, intra- and inter-personal skills and tacit knowledge, and the learning of the home and the workplace, are as important for the formation and use of human capital as formal school learning and advanced cognitive skills. Although there are only proxy measures for several of these items, the formation and use of human capital is assuming pre-eminence as a factor of production in all sectors of the economy and for all kinds of occupations.

'Although the information economy is accompanied by an increasing codification of knowledge, much knowledge remains tacit, embodied in people's skills, experience and education. Human capital is therefore crucial to the innovation process, and innovations surveys point to a lack of skilled personnel as one of the greatest barriers to innovation. This is particularly true in the service sector, where innovation is not always related to technology, and where people and the skills they embody help drive innovation.'<sup>37</sup>

#### ***Social capital***

The OECD has defined social capital as 'networks, together with shared norms, values and understandings that facilitate co-operation within or among groups'.<sup>38</sup>

The building of trust, shared values, common understandings and networks has profound social, economic and personal benefits.

- The dislocation and neglect of communities are sources of impoverishment, ill-health, school failure and dropout, and potential or actual criminal activity, and of high costs to individuals and society as a whole.
- A sense of a common life, community and shared values contributes to people's understanding of severe social inequities and will to do something about them.
- There are risks to the social fabric, to social cohesiveness and to economic activity if large numbers of people are, or feel, disconnected and alienated.
- Social capital is a way of counterbalancing the strong formal bureaucratic and depersonalising tendencies in modern society.

### Box 1.5: High levels of human capital and social capital matter for innovation continued...

- People's participation in active citizenship groups, voluntary bodies and local community organisations can strengthen their capacity to cope with rapid change and crises.
- Social capital drives human capital and together they drive innovation.

Social capital is as important for the knowledge economy and society as human capital. Developing a culture of innovation in and through schooling requires as much attention to the norms and values, relationships and common experiences of students—and teachers—as to the formal curriculum.

A widely accepted indicator for human capital comprises levels of educational attainment expressed in years of formal education, adult skills and the value of human capital in the labour market. In practice, level of educational attainment is commonly used as a proxy for human capital although other measures more focused on student learning and adult literacy continue to be developed for international comparisons and are being reported accordingly, for example, in the OECD international education indicators. Australia has a relatively low school retention rate but relatively high tertiary participation rate in OECD statistics.

It has become necessary for countries to find ways to increase the quantity and improve the quality of both human and social capital relevant to *all* fields of activity and *all* occupations—to create and use advanced knowledge, high-level skills and advanced technology in a highly competitive world where international flows of goods, investment, people and ideas have vastly increased.

Increasing the quantity and improving the quality of human and social capital are crucial for continuing personal as well as national well-being. No one should be missing out on the benefits of a sound education throughout the whole of schooling and beyond. Hence the strong policy emphasis on raising present levels of human capital, as measured by the proportion of students now and in past decades who have completed Year 12, or education and training of equivalent value.

Some 15 per cent of Australian students are leaving school or some other educational regime before completing studies leading to a qualification that is recognised at the tertiary level or in the labour market. Australia cannot afford to have such numbers of inadequately educated citizens. A disproportionate number of those leaving school early and not attaining qualifications or skills valued by the labour market come from lower socioeconomic groups and, as a result of their lower educational attainments, have, on average, poorer labour market and career prospects. This is an important equity issue with implications for social cohesiveness and economic performance.

Schooling is now offering more education and training pathways, for example, through vocational programs which are very important avenues for young people. Progress is being made to ensure as far as possible that all Australians have the opportunity to achieve their potential through education and training.

## 1.6 Making connections

The creation of a culture of innovation will depend upon effectiveness not only in filling gaps in formal educational attainments of young people, but also in developing partnerships and forging new alliances. To expand scientific and technological capability, closer linkages between education, industry and research are needed. Beyond that, an inclusive national culture of innovation requires well-functioning communities, a high standard of health, a lowering of rates of social dysfunction including crime and environmental factors that support productive capacity and personal and community well-being. The importance of these factors and their interrelationship is now being widely and authoritatively acknowledged, for example, in the construction of indicators of social progress by the Australian Bureau of Statistics.

Education contributes to the broad well-being of the community. This is to see education in context and to acknowledge the need for more cross-sectoral and cohesive policy making. It is also to underline the point that fostering, supporting and developing an innovation capacity through schooling will involve many community links and partnerships.

Innovation in the knowledge economy and knowledge society draws together different and complementary perspectives. It is not simply a unitary, linear process of (scientific) knowledge application, utilisation and dissemination with different categories of trained personnel, tied to different points on the line. Workforce flexibility and adaptability, breadth of understanding and the ability to use various kinds of knowledge and understanding in different settings are required, rather than narrow specialisations. Innovation is much more than a well-formulated set of activities with different highly skilled players in well-demarcated roles; it is a habit of mind, a way of thinking, perceiving and acting in any domain.

The technologies upon which innovation in the economy and society depends, and which it feeds, cover a very wide spectrum of knowledge, attributes and skills. They include those of applied science—for example, engineering and health sciences, craft and design and the use of tools and instruments. ICT is a large family of transforming technologies fundamental to economic activity but also to social and personal well-being.

People's diverse interests and capabilities have to be mobilised and connected if the concept of a culture of innovation is to make sense. For example, innovation occurs through and in association with the arts and humanities. Like the sciences, they too have discernible outcomes and products of considerable economic value. There are parallels and connections with science-based knowledge and capability that education systems have not always adequately explored, especially in the subject-divided curricula in secondary schools and tertiary institutions. The history of the arts can be read as a succession of technical, conceptual and material innovations grounded in quite diverse bodies of knowledge and experience. The same is true of philosophy and all the human and social sciences, which are rich in innovative ideas, processes and products, many with significant market value.

Linkages between core learning areas across the curriculum are difficult to take beyond a superficial level and require both imaginative teachers able to work well in teams and intensive curriculum development. These difficulties notwithstanding, students need a capacity to interrelate different areas of knowledge and to make insightful links and connections in perceiving relationships, solving problems and applying their knowledge to real-life situations.

An ‘innovative culture’, if it is to be inclusive and socially well-grounded, will reverberate throughout the whole of society. Thus the school subjects of science, technology and mathematics, which are a focus in this Review, cannot be treated in isolation from the contexts of application and use, somehow disconnected from other fields of human experience. Indeed, in the separation of these as subjects in traditional curriculum organisation and teaching arrangements and in their separation from their sociocultural contexts, schools and teachers could be missing rich opportunities for motivating students and deepening their understanding.

Two issues arising from the growth of scientific and technical knowledge that are of increasing social and economic concern are environmental sustainability and the ethical implications of innovation.

The issue of sustainability has become more prominent through increasing knowledge and understanding of the social, economic, environmental and personal impact of industrial processes, land use, urbanisation and transport. For example, it is estimated that Australia’s environmental capital has diminished, as a result of land clearance, land degradation, use of water, air pollution and greenhouse gas emission.<sup>39</sup> While the knowledge exists to halt or reverse these processes, it may not be widely distributed beyond pockets of expertise. Expert scientific and technical knowledge in such instances is a necessary but not a sufficient condition for solving problems.

Ethical considerations have become prominent, for example, as a result of rapid advances in biological and medical sciences and resulting dilemmas for the community. There are also ethical issues arising from unequal sharing of the benefits of technology and innovation, both within and between countries. Problem identification, problem solving and other inquiry strategies deployed by teachers of science, technology and mathematics can capture student interest by connecting learning to issues arising in application—the use and misuse of scientific knowledge. To analyse such issues, specialist teachers of particular subjects need to work with others: being innovative and at the same time socially and ethically responsible requires breadth as well as depth of knowledge and understanding.

The educational underpinnings of a culture of innovation grounded in science, technology and mathematics embrace also those fields of knowledge and inquiry concerned with the social and personal dimension of change. Australia’s four national research priorities are:

- an environmentally sustainable Australia;
- promoting and maintaining good health;
- frontier technologies for building and transforming Australian industries; and
- safeguarding Australia.<sup>40</sup>

Building Australia's creative and innovative capacity will need to be a key feature of the national research effort. For all research priorities, a high quality education system, sensitively and appropriately attuned to all national research priorities, is necessary. It is significant that the national research priorities open up broad avenues of inquiry—for the social sciences and humanities as well as the physical sciences, technology and mathematics.

The knowledge and competence of all teachers, not only those in science, technology and mathematics, should combine a broad understanding of the knowledge society, technology, innovation and the sociocultural context with depth in the fields of their specialisation.

## 1.7 Entrepreneurship and creativity

*Entrepreneurship* is quintessentially a domain of multidisciplinary and applied knowledge. In the past, entrepreneurs, including prominent Australian business leaders, have often succeeded through drive, initiative and natural intelligence, unsupported by high levels of formal education. While it is likely that there will always be opportunity for such people, success now relies upon a greater emphasis on trained intelligence and technical and organisational skills. Enterprise education is fundamental to enabling students to develop entrepreneurial behaviours. Including enterprise education in the school curriculum supports students to develop personal characteristics such as creativity and self-reliance, an investigative mind and the knowledge and understanding to identify and take advantage of opportunities. These are essential skills and values for life. They also enable learners to maximise their employment opportunities, including self-employment.

Young Australians have confidence in their entrepreneurial talents and potential.<sup>41</sup> How is this potential to be realised? Education is only part of the story, but it is a crucial part. Schools across the country are responding to the enterprise education priority area of the National Goals for Schooling, and the MCEETYA framework for vocational education in schools.<sup>42</sup> A wide variety of programs designed to foster learning for real-life situations has been introduced in schools. The focus is on active learning of a practical nature, to develop 'those skills, competencies, understandings and attributes which equip [students] to be innovative, and to identify, create, initiate, and successfully manage personal, community, business, and work opportunities, including working for themselves'.<sup>43</sup> Through research on schools where enterprise education goals are being pursued, qualities and characteristics of a typical 'enterprising learner' have been identified (Box 1.6).

### Box 1.6: Qualities and characteristics of an enterprising learner<sup>44</sup>

<b>Key Qualities</b>	<b>Enterprising Characteristics</b>
<b>The enterprising learner is:</b>	<b>The enterprising learner:</b>
Connected	takes action that links learning to the real world communicates effectively participates in the community
Engaged	makes a head and heart contribution is task-oriented and outcomes-focused applies understanding to move forward manages resources and time effectively
Resilient	takes advantage of opportunities actively monitors and responds to feedback maximises capability and responds appropriately to setbacks
Self Efficacious	takes responsibility for own actions has a sense of self worth and belonging
Ethical	contributes to the development of community values acts in accordance with agreed values

*Creativity* is frequently linked with innovation and with the dynamics of the knowledge society and economy. The relationship of creativity to innovation is sometimes disputed but they have much in common. Not all innovations require creativity in the highest degree. They may be clever adaptations to a new setting of something familiar and well-established in another, or may take the form of a well-tried system into which an idea or product is planted. Nevertheless, each of these has an element of novelty, of difference from what came before. The framing of future possibilities, conjecturing, and fresh or novel ideas are valuable attributes of innovative people and innovative cultures. So, in its different forms and manifestations, creativity is certainly important.

Creativity has been defined as 'the application of knowledge and skills in new ways to achieve a valued goal'.<sup>45</sup> Visualising or seeing possibilities, imagination, playfulness with ideas, problem solving and lateral or divergent thinking are attributes of creative people and of innovative organisations or cultures. Creative learners ask questions and raise issues that take them on a voyage of discovery and innovation. Creativity, like innovation, is not always comfortable, since creative people frequently challenge accepted beliefs, habits and processes; they have a critical edge, and teachers, parents and the community at large have to be ready to accept the challenge of the new and the different—including the student perspective.



The attributes of creativity, in the context of innovation, include strong motivation, curiosity, commitment, self-confidence, willingness to take risks, the capacity to arrive at alternative views of reality and the courage to be different. A mixture of cognitive, affective and sensorimotor attributes is widely sought in modern knowledge-based industry. The Australian Council of Deans of Science argued for a combination of content knowledge, technical skills, planning, teamwork, problem solving and creativity as the ingredients of innovation. It is the application of creative ideas that is important for innovation.<sup>46</sup>

All students and teachers have creative potential. On the basis of submissions and other evidence before it, the Committee believes that schools and teacher education programs could be doing more to encourage students to be creative and should be adopting procedures to reward creative efforts.

## 1.8 Research foundations for a national culture of innovation

The value of fundamental research, inquiry and creative scientific ideas for innovation is not in dispute. How important for innovation is *educational research* and the systematic use of evidence, evaluation and data on all aspects of schooling? The answer might seem obvious, yet support for these processes in education falls well short of the need.

Research, reflective inquiry and the quest for verifiable knowledge are becoming accepted as generators of the fundamental understanding needed to improve teaching effectiveness and student learning outcomes. The increasing scale and scope of educational research on the one hand, and closer focusing of educational research on issues of policy and practice on the other, will assist in overcoming reliance in teaching on customary practice and habitual routines. The quest for evidence about the effects of different approaches to teaching and the conditions that enhance student learning is gathering momentum. The need for better national data is becoming more urgent, for example in workforce planning.

Many teachers and policy makers have become active researchers through taking advanced degrees or joining action research projects. There is now a conducive climate for research as a way of knowing in education, which parallels the role accorded to research-based knowledge in generating economic growth and supporting social development. This is part of a wider movement in education, to ground policies and practices on evidence—to have a well-attested knowledge base for action.

Although most educational research and inquiry are not fundamental in the way that scientific research is, and although sources and forms of evidence in education need further strengthening, there are common goals—to understand, to predict, to discover what was previously not known and to ground action in robust hypotheses. Education is also increasingly dependent on research in such fundamental areas as brain science and body chemistry. Since it is deeply influenced by practical concerns and the need to solve problems, educational knowledge is akin to the applied sciences that connect fundamental inquiry to products and other practical outcomes.

What is produced or intended to be produced through most educational research projects and action programs, drawing on research and on the evaluated experience of practitioners and policy makers? The answer, broadly, is ideas, strategies, procedures and materials to enhance understanding and to improve practice. Such products, even if intangible, are comparable in key respects to those in industry. The products are for use in the practice of education and in developing future policies and strategies. The users, mainly the policy makers and the teachers, should, as highly educated professionals, have a major part to play in deciding on their suitability and in what ways they can best be used.

From both investment in economic activity and the commercial processes of innovation, society expects not only a product, but a social outcome—a higher standard of living, a better quality of life, not just for the immediate beneficiaries. For education, the expected ultimate outcome is much the same—for individuals and society as a whole, a better quality of life. The monitoring and evaluation of innovation in education, as in industry, should provide information that will facilitate judgments about its contribution to this key outcome.

Despite progress in educational research and its increased influence on policy and practice, it has not achieved the same regard as research in the fields of health and engineering. This was pointed out in submissions by the Australian College of Educators and the University of Technology, Sydney. Citing an OECD report stating that both of these sectors produce and use knowledge more effectively than the education sector, they claimed that the regular improvement of products and processes through R&D still eludes education. Limited expenditures were cited as one explanation; others included the view that education remains essentially craft-based, that the over-prescription of the curriculum inhibits innovation and that a strategic focus is lacking.<sup>47</sup>

The Committee has uncovered a very strong interest, in numerous submissions, in educational research and inquiry, in judgments based on evidence and in carefully evaluated experience. Educational R&D in Australia needs higher levels of investment. This will be increasingly recognised as the role of education in sustaining the knowledge economy is better appreciated. At present, there are many gaps in the systematic knowledge base for decision making, especially in two areas highly relevant to this Review: workforce planning and conditions that enhance or inhibit student learning. Future research should fill in these gaps.

Use of research findings by practitioners is also a problem. Accessibility of data is being improved, but this is not the whole issue. Teachers need more encouragement to locate relevant sources, to use information in practical ways and to evaluate their own experience against that of fellow professionals. Research as a driver of educational innovation has still to match the industry-based science system, or the research culture which underpins the health sciences.

## 1.9 Strengthening educational outcomes for the knowledge economy

The educational purpose and focus of school innovation is to enable all children and young people to develop an innovative capability, to experience success in learning, to learn effectively and to achieve learning outcomes of discernible value to themselves and the community. At the national level, these outcomes have been delineated in the National Goals for Schooling and in more detail by education authorities and schools.

In order to become innovative, students need:

- systematic encouragement and guidance in their learning by highly qualified and flexible teachers;
- freedom and opportunity to experiment and follow divergent pathways;
- direct experience of activities which call forth inventiveness and creativity;
- realistic expectations of using and adapting technology throughout schooling;
- manageable challenges to show initiative and display entrepreneurship; and
- a solid foundation in well-structured programs of study.

These features should pervade the whole curriculum. Consistent and systematic effort will be required to ensure that the continuing development of scientific, technological and mathematical *literacy* is an integral part of the curriculum of all students throughout the compulsory years of schooling (Box 1.7).

### Box 1.7: Scientific, technological and mathematical literacies

*The term 'literacy' has come to refer to fundamental learning in the different domains of the school curriculum. While science, technology and mathematics literacy are the ones discussed here, all literacies are important foundations of innovation in the knowledge economy.*

The term 'literacy' has various meanings. Just how the literacies are translated into curriculum, teaching and learning tasks and outcomes varies greatly by jurisdiction. All three literacies signify continuing learning and different levels of comprehension and mastery: they signal directions, not end points.

**Scientific literacy** is defined by the OECD as 'the capacity to use scientific knowledge, to identify questions, and to draw evidence based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity'.<sup>48</sup>

**Mathematical literacy** is defined by the OECD as 'the capacity to identify, understand and engage in mathematics, and to make well founded judgments about the role that mathematics plays in an individual's current and future private life, occupational life, social life ... and life as a constructive, concerned and reflective citizen'.<sup>49</sup>

**Technological literacy** has been defined by the Australian Academy of Technological Sciences and Engineering as: 'the synthesis of knowledge, ideas and skills in the solution of identified problems and the development of innovative capabilities. In its focus on synthesis, design and invention, it embraces creativity across the full spectrum of a student's learning. In a real sense, this synthesis places technology education as a significant integrating force within schooling. It is learning through practice. It is often practised through group or team activities and with the objective of finding solutions that are culturally and environmentally informed. It is about "design, build and appraise"...about matching materials to purpose ... about studying, disassembling the working elements of equipment and systems ... it is about "making and doing"'.<sup>50</sup> Technology includes ICT, but ICT is not dominant. Technology in education has a very wide array of meanings, from primary school cross-curricular inquiry and action to specialist studies of engineering, health and other applied sciences in university.

Enterprising and creative schools need freedom, resources and support, to develop ideas and strategies, to mobilise resources and to take the kinds of decisions they judge to be in the best interests of students, the community and their staff. All schools must align their work to the broad framework of national and system-wide goals, priorities, strategies and resource allocation models, and with a shared vision of the purposes of education. Enterprising schools and school leaders are seeking to broaden the scope of their decision making and to achieve greater influence over resources and their application.

The Committee, supporting these aspirations, believes that the professionalism of teachers and the capability and responsibility of school leadership should be fully acknowledged and fostered. New kinds of system-wide steering and accountability procedures can be combined with increased autonomy for schools in meeting public policy objectives and procedures.

There is no question that a highly positive and productive learning climate exists in many of Australia's schools but it needs to exist in *all* Australia's schools. Such a climate provides a platform on which to build a culture of innovation in all schools. What is broadly important is that:

- schools take explicit action to prepare *all* students for a society dependent on using knowledge for its prosperity;
- broad principles are developed to guide schools and school systems; and
- schools' capabilities are strengthened and supported, and resources are applied to achieve these ends.

The immediate implications of this are that schools need to develop new capabilities that are both strategic and organisational.<sup>51</sup> In developing strategic capabilities, schools might be expected to:

- take a long-term view of their core business;
- develop their ability to identify and anticipate broad trends in society; and
- develop a capacity to look outwards and respond to the community and to change.

In building on their current organisational capabilities, schools might be expected to:

- adopt a whole-school approach that builds on good practice and embraces new ways of doing things; and
- develop greater internal and external cooperation with colleagues, other professionals, higher education institutions, parents, students, business, industry and the wider community.

Innovativeness and creativity are goals and conditions for learning and teaching. They call for a wide repertoire of teaching and management skills, methods and resources.

## ■ Key Conclusions

In summary, the key messages for relating schooling to the innovative, knowledge-based society that Australia is in the process of becoming are:

- teachers and all involved in education are active partners in and contributors to the knowledge economy and the knowledge society;
- developing an innovative capability in students requires action in all areas of the curriculum and all aspects of school life;
- student engagement with, and joy of, learning is fundamental to their success at school and their continued learning;
- all parts of the community have a responsibility to support schools and teachers; teachers are the key resource, and they must have the qualities needed in their capacity as 'knowledge workers' and the ability to develop them in students;
- greater commitment is required to the teaching and learning of science, technology and mathematics and to developing innovative capacity in all students throughout the years of schooling;
- concerted action is required by all parts of the education and training system to address projected shortages of productive workers, at all levels, for the knowledge economy; and
- the research foundations of a systematic knowledge base for educational policy and practice will have to become stronger in order to fully integrate education with the knowledge economy and society.

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<sup>2</sup> Australian Council of Deans of Education, *New learning. A charter for Australian education*, ACDE, Canberra 2001.

<sup>3</sup> Australian Primary Principals' Association, submission no.142.

<sup>4</sup> Ministerial Council on Education, Employment, Training and Youth Affairs, *The Adelaide Declaration on National Goals for Schooling in the Twenty-first Century*, MCEETYA, Melbourne, 1999.

<sup>5</sup> Organisation for Economic Cooperation and Development, *Globalisation of Industrial Activities*, OECD, Paris, 1992; Organisation for Economic Cooperation and Development, *Technology and the Economy. The Key Relationships*, OECD, Paris, 1992.

<sup>6</sup> Arthur Cropley and Lourii Gribov, submission no.191.

<sup>7</sup> South Australian Department of Education and Children's Services, submission no. 233.

<sup>8</sup> Association of Independent Schools of South Australia, submission no. 210.

<sup>9</sup> Eltham College of Education, submission no. 170.

- <sup>10</sup> TA Stewart, *The Wealth of Knowledge: Intellectual Capital and the Twenty-First Century Organization*, Nicholas Brealey, London, 2001; M Castells, *The Rise of the Network Society*, Blackwell, Cambridge, 1997.
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- <sup>13</sup> P Cuthance and S Stokes, *Lessons for practice*, in P Cuthance and the Innovation and Best Practice Consortium (eds), *School Innovation: pathway to the knowledge society*, Department of Education, Training and Youth Affairs, Canberra, 2001.
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- <sup>16</sup> <<http://www.info.gov.hk/qef/index1.htm>>.
- <sup>17</sup> <<http://www.specialistschoolstrust.org.uk/>>.
- <sup>18</sup> <[http://www.mti.gov.sg/public/ECD/frm\\_ECD\\_default.asp?sid=25&cid=94](http://www.mti.gov.sg/public/ECD/frm_ECD_default.asp?sid=25&cid=94)>.
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- <sup>23</sup> Australian Society for Educational Technology, submission no. 208.
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## 2. Prioritising science, technology and mathematics education

Chapter 1 drew attention to relationships between innovation and science, technology and mathematics and economic activity, in order to show that more scientifically trained people are needed to achieve high levels of growth in the knowledge economy. At the same time, a broad view was taken of the kinds of knowledge and skills needed, in many different fields. A national culture of innovation must be supported by numerous firm pillars, not only those of science, technology and mathematics.

All of schooling, all teachers and all learners are implicated. The messages of innovation and the knowledge economy are relevant not only to industrial processes, products in the marketplace and highly specialised fields of scientific inquiry. But changes in these areas depend on meeting the challenges facing scientific and mathematical education. Economic development, social progress and Australia's ability to compete effectively internationally will be affected unless several worrying and now long-established trends and tendencies in science and mathematics education are reversed.

### 2.1 Raising scientific, technological and mathematical literacy

In positioning Australian schooling now and for the future, it has been right to put emphasis on literacy and numeracy as foundations of knowledge and skills. Agreement at the national level to the goal that every child will achieve a minimum acceptable literacy and numeracy standard and the consequential agreement to measuring the literacy and numeracy achievement of all students at Years 3, 5 and 7 has necessarily focused schools' attention on these two essential areas. Australian schooling has come a long way with literacy and numeracy, which have received a great deal of national attention in recent years. It has been shown that there is a strong relationship between a student's literacy and numeracy skills and their ability to complete school and make a successful transition to further education and future employment.

Literacy and numeracy must continue to be of fundamental importance, for example as strategies for enhancing language learning across the curriculum and in laying foundations for mathematical literacy. Now, however, it is time to give a national focus to scientific and technological literacy as well. The excellent work being done by schools and education authorities must be built on, to ensure higher levels of literacy—in science, technology and mathematics—for all Australians.

The view of the Australian Academy of Technological Sciences and Engineering is that: ‘... 21<sup>st</sup> century democracy demands scientific and technological literacy and understanding throughout the population. Ordinary people will increasingly be asked to make judgements about matters underpinned by science knowledge or technological capability. Those without a basic understanding of these matters will, in the future, be either disempowered or misled in exercising their democratic rights and powers within a technologically dependent society.’<sup>1</sup> In a complementary submission, the Australian Council of Deans of Science ‘firmly believes that Australia’s future prosperity and independence requires a community which has a significantly higher level of scientific literacy than at present. Teachers who know “what” as well as know “how” to teach are the key.’<sup>2</sup>

The significance of the ‘literacies’ in question is that they refer to young people’s ability to *apply* their scientific and mathematic knowledge and skills and to *use* their technological understanding and capability, in a context of real-life problems and situations. Analysing, reasoning, communicating ideas, arguments and conclusions are abilities and tools that everyone needs. Equally necessary is depth of knowledge and understanding in using these abilities and tools in a world increasingly shaped by scientific knowledge and technology. According to the Bright Minds Group at the University of Queensland: ‘Schools will promote an innovative learning culture by giving students the chance to understand and use the science that underpins current developments in technology and many of the current issues and debates in society.’<sup>3</sup>

Literacy, in the sense of common, shared, basic knowledge, skills and capability, as defined in Chapter 1, is a necessary first step. It would be a very considerable achievement if all Australians could be characterised as scientifically and mathematically informed and able to use their knowledge to solve practical problems, to communicate effectively, to gather and use information systematically and to be at ease with the rapid rate of technological change in contemporary society. Every child should be scientifically, technologically and mathematically literate, to be able to put scientific, technological and mathematical knowledge and skills to functional use.

However, scientific, technological and mathematical literacy for all—that the general level of scientific literacy in the population needs to be raised—important as it is, is only one side of the coin if Australia is to remain competitive in a global economy. Of critical importance is the position of the enabling sciences which means, in schools, high levels of knowledge and capability in physics, chemistry, biology and mathematics. We need to prepare more students who choose to study high-level school science, technology and mathematics and continue into tertiary education in the science, technology and mathematics fields. In summary, there are increasing demands on Australia's education system to:

- improve the scientific, technological and mathematical literacy of all Australians and create a well-educated and skilled workforce that embraces lifelong learning;
- enhance Australia's capacity to train, inspire and retain outstanding teachers of science, technology and mathematics who can in turn inspire their students' learning in these areas; and
- equip Australia with more world-class scientists and innovators in a range of disciplines able to take ideas through to successful application and commercialisation.

## 2.2 Science, technology and mathematics education

In primary schools, science is often either not taught or not taught systematically. At the secondary level, too many students lose interest and, even when showing considerable potential, turn away from more demanding courses in science and mathematics. The evidence of decline (over the last decade) and only modest growth of school student interest in the study of physics, chemistry, biology and advanced mathematics subjects (over the last 25 years) at the Year 12 level is inconsistent with the knowledge needs of an advanced technological and democratic society, and needs to be addressed nationally.

### 2.2.1 Primary schooling

In 1999 the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) endorsed science, technology and mathematics as three of the eight key learning areas within compulsory education in Australian schools.<sup>4</sup> While numeracy has been a staple of primary schooling, science and technology have not. In their 2002 report on science and technology in primary schools, the Australian Academy of Technological Sciences and Engineering found that 'progress in States and regions is uneven and that there is still a long way to go before the nation's schools can deliver on the 1999 Ministerial commitments to science and technology for primary schools'.<sup>5</sup>

At the MCEETYA meeting of 10–11 July 2003, State and Territory Ministers agreed to the development of statements of learning for each of four curriculum domains, including science and mathematics. The objective is to define common curriculum outcomes—the knowledge, skills and capacities to be developed by the end of particular years—in order to achieve greater national consistency.

The importance of ‘developing an interest from an early age in science, technology and mathematics’, noted by the National Council of Independent Schools Associations, cannot be overstated, and that interest is first developed in primary schools.<sup>6</sup> However, the regularity and quality of science teaching in primary school is highly variable. According to Goodrum, in some primary schools, science is taught both as a specific subject and integrated into other curriculum areas, but in many other primary schools, science is either not taught or poorly taught. However, when it is taught well and on a regular basis, there is a high level of student satisfaction.<sup>7</sup>

There is an important clue here to reasons for the low levels of interest in studying science and mathematics that have been reported for subsequent years of secondary education: high quality teaching in primary schools can stimulate interest and motivation which, if carried through in systematic teaching for well-structured learning, can be sustained and further developed to much higher levels in later years of schooling.

The trend at the primary level in recent years has been toward integrated teaching—interrelating many domains of learning within a series of broadly defined topics and themes designed to connect with the interests and concerns of younger children. Indeed, new curriculum frameworks in several states (as discussed in Chapter 7) generally do not specifically identify science, mathematics or technology as organising centres but rather develop significant concepts from these learning domains through rich transdisciplinary experiences. There is an unresolved debate within parts of the science and mathematics professional community over how science and mathematics can best be handled by primary level teachers, including the kind of specialist support that is needed.

The degree to which the whole school community embraces science, technology and mathematics, grounding those areas within the whole academic and cultural ethos of the school, matters a great deal. It is necessary to have, in addition to highly competent teachers and adequate resources for learning, recognition of performance and active encouragement and support by the school principal. School principals and others in authority need to give very positive messages, show knowledge and understanding of the value of science and mathematics, and ensure a supportive school climate.

Learning in these areas thrives when supported by clear minded and firm leadership.<sup>8</sup> According to the South Australian Department of Education and Children’s Services: ‘School leaders, particularly in primary education, require a good understanding of qualitative components of the curriculum (i.e. science, technology and mathematics) and the implications for curriculum planning and resourcing’.<sup>9</sup> Without such understanding and recognition of their vital role in the life of the nation and for the growth of understanding in children, it is difficult to see how school leaders could be effective in engaging students in science, technology and mathematics and gaining the active support of their families.

There are schools which the Committee visited that are succeeding in developing a strong base of scientific and mathematics education—Redeemer Baptist School in New South Wales, for example (Box 2.1).

## **Box 2.1 An independent school in New South Wales achieves outstanding results in science and technology**

### *Redeemer Baptist School*

Redeemer Baptist School has an enviable reputation in the teaching of science, technology, mathematics and design, its students and teachers having won numerous national and international awards over the last few years.

But prestige in the world of science and technology awards has not come about solely through the specialist education of a few bright students, or the employment of a few enthusiastic teachers. It has come about through a 'whole-school' focus on science, mathematics and technology, from primary level upwards, by pedagogy that keeps both students and teachers interested, motivated and satisfied.

Redeemer Baptist School consciously aims to be innovative in its approach to science and is always looking for new and exciting ways to introduce and consolidate scientific concepts to its students. Other key factors in the school's success are: focused support for science and technology from the principal and school board; employment of mid-career teachers with direct industry experience and strong supportive mentoring program; problem solving, cross-disciplinary, multi-age team pedagogical approaches; strong community support for placement of graduating students in science-related employment; and strong support for teachers in attaining higher education degrees and professional development.

Many of the teachers at Redeemer Baptist have science qualifications, enriched by having come to teaching later in life after earlier and successful careers in industry. Using established networks with scientific research institutions and industry, these teachers are able to access real-life learning through innovative science-based excursions.

Established in 1981, Redeemer Baptist School caters for a diversity of skills, abilities and backgrounds from Kindergarten to Year 12, with the school years grouped in an unconventional system comprising Preparatory School (K1 to Year 4), Middle School (Years 5 to 8) and Senior School (Years 9 to 12). In addition, Years 1 to 10 are deliberately arranged in modules of non-streamed classes with mixed ages.

The School seeks to create a learning environment that is thoughtful, free, sharing and respectful, rather than competitive, self-serving and fearful. The learning style is highly collaborative with large groups working on the one major project, though divided, as in a corporation, into different divisions that take responsibility for different aspects of the project. Individual attention is also paid to students, or small groups of two or three students, who take on high-level science or technology projects. Equipment needed for science projects is frequently financed through local fundraising activities that are organised by the students themselves.

### **Box 2.1 An independent school in New South Wales achieves outstanding results in science and technology continued ...**

Science and technology is also supported by a much higher ratio of ancillary staff, who are members of the Redeemer Baptist Church Ministry Order with qualifications and background skills in computer applications, science, mathematics, engineering, design and technology, and who assist in many ways at the ‘interface between education and industry’. To assist vocationally oriented students, the School is a Registered Training Organisation and offers a number of TAFE courses and, through an apprenticeship system, young school graduates are able to become fully qualified in a trade.

Source: Secretariat report on Review visit (May 2003).

A multi-faceted approach is required for primary schools, characterised by:

- system-wide policies and support;
- many more teachers expert in science, technology and mathematics—through both initial training and professional development programs;
- strong, supportive school leadership;
- appropriate curriculum resources;
- parental understanding, support and encouragement; and
- a strong research and evaluative base to better determine conditions for effective learning.

## **2.2.2 Junior secondary and ‘middle years’ schooling**

The transition from primary school to secondary school is a critical juncture. Most students find themselves in a new milieu, a differently structured school day and a new teaching and learning environment, with specific teachers for each subject. For some students this transition is staged through a new focus on structures and organisation for the middle years of schooling bridging upper primary and junior secondary.

Evidence from the United Kingdom shows that the effectiveness of learning outcomes in primary school endures through secondary school; hence the importance of quality teaching in science, technology and mathematics at primary level.<sup>10</sup> But this learning must be reinforced and developed. While Goodrum et al. report that post-primary students in Australia are generally enthusiastic when they initially enter junior secondary school, this enthusiasm is frequently not sustained beyond the second year.<sup>11</sup> Other studies have shown that expectations of an interesting and challenging science curriculum in secondary school are not fulfilled and, instead, students are faced with ‘chalk and talk’ style teaching rather than hands-on practical lessons.<sup>12</sup>

It is at this stage that too many students begin to feel that science and mathematics are too hard or are irrelevant to their everyday lives.<sup>13</sup> It is clear that early school experiences are highly influential in terms of both the development of proficiency and emerging interest for later years of schooling. According to Monash University, '... were school mathematics and science designed to enthuse, inspire and equip students in and for their present lives, more would elect to continue their involvement'.<sup>14</sup> But other evidence suggests that many students are doing well although there are important, specific issues to address in the teaching of science and mathematics at the primary and lower secondary stages.

By international comparison, schooling outcomes among Australian 15-year-olds in science and mathematics are very good, as evidenced through the Programme for International Student Assessment (PISA) reports on student performance.<sup>15</sup> What PISA says about Australian student performance is generally very positive and favourable. Australia is being outperformed only by Japan and Hong Kong/China in terms of mathematical literacy, and by Japan and Korea in terms of scientific literacy.<sup>16</sup> Indeed, the Australian Council for Educational Research (ACER) concluded that the Australian student performance was outstanding: 'Considering only the highest-performing five per cent of students in each country, Australia's record was even better, in that no country performed at a statistically higher level'.<sup>17</sup> It is important to note that there was no significant difference between the scores of male and female Australian students in either mathematical or scientific literacy.

The strong performance in PISA is supported by outcomes of the Third International Mathematics and Science Study (TIMSS). Reporting on the learning of students at ages nine, thirteen and at the final year of secondary school, these show that in both mathematics and science, Australian students generally performed above the international average and often at levels not far below the world leaders.<sup>18</sup>

These international studies are highly relevant because the range of competencies they measure are important to lifelong learning in a technologically advanced society. PISA and TIMSS provide information that relate to technological literacy even though that is not directly assessed. The problem-solving and applications of knowledge called for in PISA point in the direction of the kinds of practical intelligence required for people who can use tools and techniques, solve problems, make and do. The conceptual learning that is assessed by PISA is highly relevant to these and other processing skills.

Australian results from TIMSS revealed that Australian students' attitudes towards science deteriorate markedly between primary and secondary education. When responding to the item 'I enjoy learning science', the frequency of 'disagree' and 'strongly disagree' responses increased from 22 per cent male and 19 per cent female middle primary students, to 32 per cent male and 37 per cent female lower secondary students. Almost 40 per cent of secondary students surveyed in this study reported that they never got excited about what they do in science. This suggests that the junior secondary school level is strongly in need of attention in terms of science, technology and mathematics pedagogy and curriculum.<sup>19</sup>

Australia's results in PISA and TIMSS are very encouraging in many respects. But they are not a cause for complacency. Within the overall performances there are matters of real concern. While PISA and TIMSS results testify to generally high standards of student performance, the broad national profile of performance masks considerable unevenness. Several areas require action to ensure that appropriate high-level outcomes are secured for all students:

- a small number of students do particularly well;
- most (but not all) Indigenous students have relatively low scores in mathematical and scientific literacy;
- student performance differences within schools count for more than differences between schools; and
- there is a fairly wide dispersion of results between students from higher and lower socioeconomic backgrounds (noting that socioeconomic background alone does not determine outcomes, and that there are many students from lower socioeconomic backgrounds who achieve very high scores).<sup>20</sup>

Several further issues require attention. First, overall there is evidence that the problems through which students learn mathematics in Australian junior secondary classrooms lack depth and challenge compared to those in other high performing countries.<sup>21</sup> Second, participation in mathematics, science and technology at school and university may not be matching emerging employment opportunities that depend on conceptual understanding. Third, it is questionable whether future short and medium term availability of teachers with expertise in mathematics, science and technology are sufficient to support and nurture continued relatively high performance by Australian students.<sup>22</sup>

Several conclusions can be drawn:

- Australian research has shown that there are serious problems especially in science teaching in the middle years of secondary schooling;
- while Australian students perform well in international comparisons overall, action is needed on specific issues, in both science and mathematics, by education authorities, schools and teachers; and
- too many teachers are not meeting the specific challenges of science in the middle years of schooling.



### 2.2.3 Senior secondary schooling

The transition from compulsory to post-compulsory schooling is a most important juncture for students making choices for Year 11 and 12 subjects preceding tertiary studies or entering the workforce. For most students this is the first time they make choices about whether and in what form to continue studies of science, technology and mathematics which up to that point—at least in theory and in some form—have been essential components of the core learnings of all students.

Enrolments in science, technology and mathematics in the final years of secondary school lead to subsequent tertiary education options and career opportunities for students. The Non-Ministerial members of the Victorian Council for Knowledge, Innovation, Science and Engineering have argued that while there is a core group who are passionate about science and another group who are meeting pre-requisite requirements or keeping options open, there are others who do not enrol due to poor experience in earlier years, perceptions that it is ‘too hard’, peer and/or family pressures (or lack thereof), and lack of opportunity due to timetable blockages.<sup>23</sup>

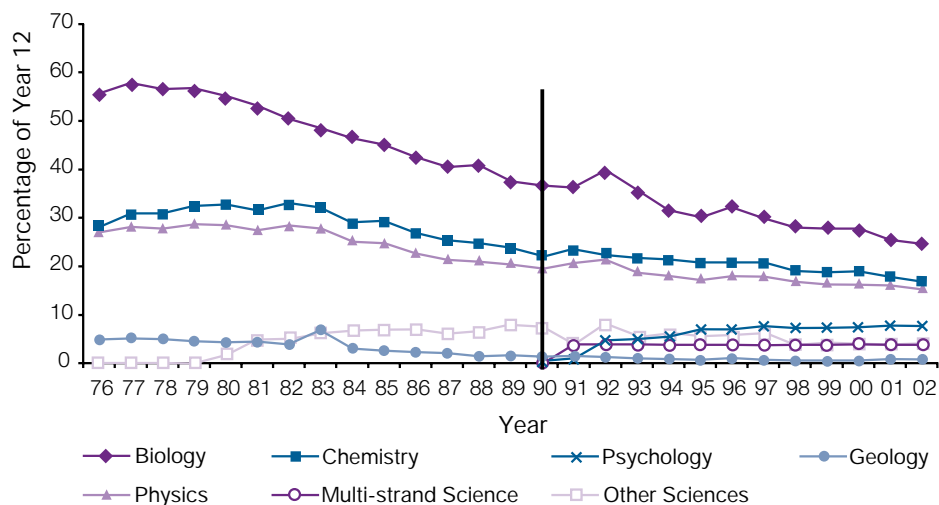
From different quarters and for several years, there have been waves of concern that insufficient numbers of well-qualified, well-motivated students are being attracted to enter tertiary courses in science and mathematics and that this reflects problems, especially in secondary school teaching. There are also concerns that even when students do perform well in the sciences and mathematics in Year 12, they are not attracted to careers in science and mathematics, for reasons which may include family or peer group influences, the relative attractiveness of other career paths, and changing student perceptions of career and other lifestyle values.

As noted in the Committee’s Interim Report, there has been declining school student interest in science since the early 1990s. Between 1992 and 2001, enrolments in Year 12 biology decreased by 30 per cent, enrolments in Year 12 chemistry decreased by 23 per cent, and enrolments in Year 12 physics decreased by 22 per cent. This decline was sharper in the first half of the 1990s and enrolments plateaued midway through the decade. For mathematics, overall Year 12 enrolments have changed little over the past decade. Between 1992 and 2001, enrolments in Year 12 mathematics decreased by 3 per cent; the decline was slightly lower midway through the decade and rose from that point.<sup>24</sup>

In a substantial analysis undertaken for the Review (and published as Volume 3 of the Committee’s final report), Ainley and Underwood have identified trends from 1976 to 2002 in enrolments in science, technology and mathematics subjects at Years 11 and 12. From this analysis a picture can be drawn of a situation marked by a decline in the proportion of Year 12 students studying science and mathematics. Ainley and Underwood point to some difficulties in interpretation, and the data are drawn from different sources for different periods of time. These considerations do not, however, affect the trend.

A steady decline in the percentage of Year 12 students participating in biology, chemistry and physics from 1976 to 2002 is shown in Figure 2.1.

**Figure 2.1: National participation rates among Year 12 students in science subjects, 1976–2002**



Source: J Ainley and C Underwood, *Australia's Teachers: Australia's Future*, Volume 3, 'Background data analysis', Review of Teaching and Teacher Education, DEST, Canberra, 2003.

From 1998 to 2001, as Table 2.1 shows, there was a decline in the percentages of students studying various combinations of science subjects. One combination of particular interest, because of its tradition as a foundation for further science-based studies, is that involving two physical sciences (chemistry and physics). Just under 10 per cent of the 2001 Year 12 cohort undertook a course of study that included both chemistry and physics. This compared with just over 11 per cent in 1998, and estimates of 13 per cent in 1993 and 15 per cent in 1990. While percentages have declined, there has been a growth in cohorts. Also, school curriculum changes and the diversification of programs in higher education have opened up many options to students not available 20 years ago, and universities have changed pre-requisites for many areas of study. While these considerations do not affect the trend data, they must be borne in mind in interpreting the figures.

**Table 2.1: Percentages of Year 12 students undertaking combinations of science subjects in 1998 and 2001**

Combination	Percentage of Year 12	
	1998	2001
Chemistry, physics and biology	1.4	1.9
Chemistry and physics (including top row)	11.4	9.7
Chemistry and biology (including top row)	6.7	6.3
Physics and biology (including top row)	2.4	2.8
Chemistry total <sup>a</sup>	20.3	17.9
Physics total <sup>a</sup>	20.1	16.6
Biology total <sup>a</sup>	25.1	25.4

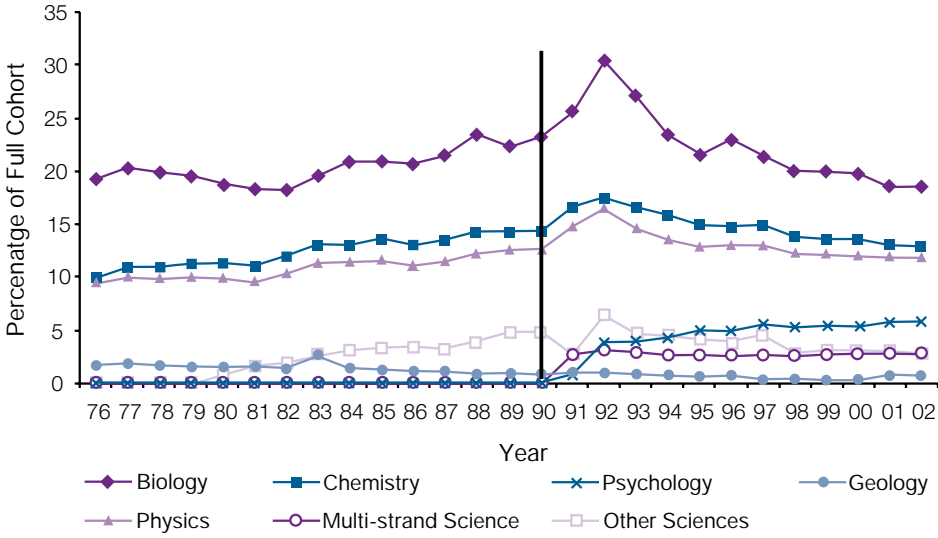
Notes: Source is the Longitudinal Surveys of Australian Youth (Fullarton et al. 2003).

Sample sizes are 5,009 for 1998 and 6,910 for 2001.

<sup>a</sup> Percentages recorded are based on nationally representative samples but the totals may differ slightly from those derived from enrolment data because of sampling error.

The figures need to be seen, however, in the context of many more students now continuing to Year 12. When we look at what proportion of a cohort of students starting secondary school go on to study physics and chemistry in Year 12, we find that this has grown modestly over the past 25 years (Figure 2.2). As total Year 12 enrolments grew during the 1980s, with a dramatic increase in school retention rates to Year 12 from 35 per cent in 1982 to 77 per cent in 1992, participation in biology, chemistry and physics considered in relation to the full cohort rose during the 1980s, but fell during the 1990s, albeit not dramatically. Thus, more of today's 16 and 17 year olds are studying physics and chemistry at Year 12 level than was the case 25 years ago, despite the fact that physics and chemistry enrolments represent a declining proportion of overall Year 12 enrolment choices.<sup>25</sup>

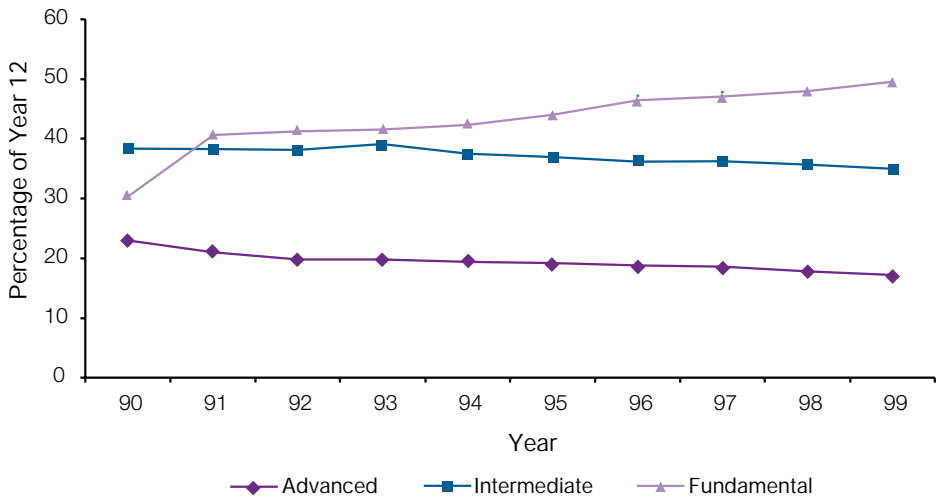
**Figure 2.2: National participation rates among full cohorts of secondary students in Year 12 science subjects, 1976–2002**



Source: Ainley and Underwood, op. cit.

Participation rates in mathematics at Year 12 are very high—almost 84 per cent of Year 12 students studied one mathematics subject or more in 2001. Establishing trends in mathematics participation is not easy because of changes in course structures and nomenclature for defining and labelling mathematics subjects. Based on categorisation of the level of difficulty of different Year 12 mathematics courses offered across the country, Dekkers and Malone found substantial increases in mathematics participation rates during the 1990s, largely in ‘fundamental’ mathematics whereas there was a modest decline in participation in advanced mathematics (Figure 2.3). They noted that advanced mathematics is no longer a pre-requisite for certain university courses.

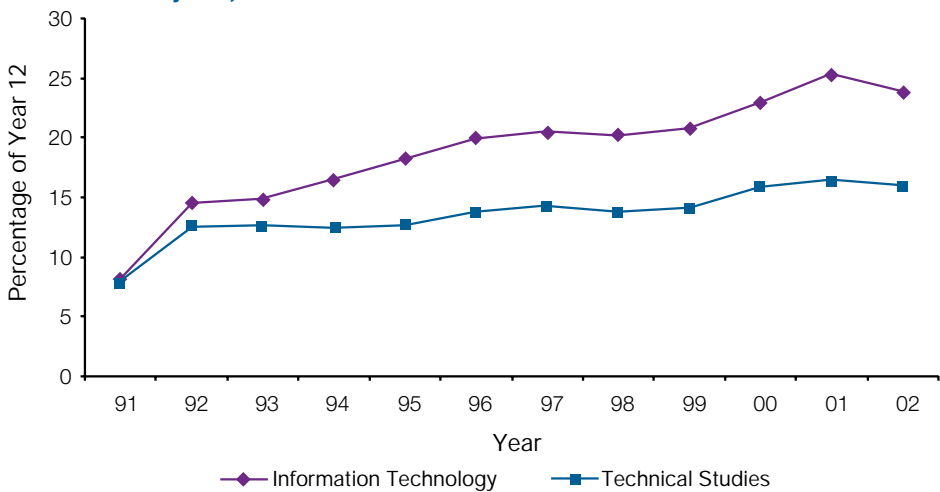
**Figure 2.3: National participation rates among Year 12 students in mathematics subjects, 1990–1999**



Source: Ainley and Underwood, *op. cit.*, citing Dekkers and Malone.

Increases in participation rates have occurred over the past decade in technical subjects and in information technology (Figure 2.4). Almost one-quarter of Year 12 students in 2001 studied an information technology course, and one-sixth a technical subject.<sup>26</sup> Ainley and Underwood note that the increases in these subject areas were greater than the declines in physics and chemistry.

**Figure 2.4: National participation rates among Year 12 students in technology subjects, 1990–2002**



Source: Ainley and Underwood, *op. cit.*

The Longitudinal Surveys of Australian Youth for 1998 and 2001 (Fullarton et al. 2003) provide data on the enrolment share of each key learning area at Year 12 in 1993, 1998 and 2001. As shown in Table 2.2, those data indicate different percentages of enrolments in each key learning area;<sup>27</sup> being 17 per cent in mathematics and 14 per cent in each of science and technology in 2001. The data in Table 2.2 also illustrate increased participation in technology subjects and decreased participation in the sciences over the past decade.

**Table 2.2: Average percentage of enrolments in Year 12 in each key learning area in Australian schools, 1993, 1998 and 2001**

Learning area	Enrolment share (percentage)		
	1993	1998	2001
English	18.3	18.9	19.5
Mathematics	18.0	17.9	17.4
Studies of society and environment	23.0	20.3	20.0
Science	17.3	15.4	14.1
Arts	6.9	6.7	7.8
Languages other than English	1.8	1.9	1.9
Technology	10.7	13.7	14.2
Health and physical education	3.9	5.2	4.9

Source: Subject Choice Survey for 1993 (Ainley et al. 1994).

Longitudinal Surveys of Australian Youth for 1998 and 2001 (Fullarton et al. 2003).

Many stakeholders are concerned over levels of science enrolment in senior secondary years because this is the key pool from which those who will work in specialist science areas are drawn. In contrast with some other fields of study at the tertiary level, senior school study of science is, in practice, a prerequisite for studying in post-school science-related fields.

Specialising in science in the final year of secondary school and commencing science-related fields of education at university appear to be fairly strongly connected. Of those students studying two physical science subjects in school in 1998, 86 per cent continued to university, as did 77 per cent of those students who studied any two science subjects. Both groups were much more likely to continue to university study than those who did not study two science subjects (Table 2.3). But which courses at university do these students enter? The Committee received anecdotal evidence indicating that numbers of top science and mathematics students in Year 12 are rejecting the idea of a science career. Data, however, were not available to permit investigation of this point.

**Table 2.3: Percentage of Year 12 students from 1998 in various educational destinations by extent of science studies in Year 12**

	Two physical science subjects in Year 12		Two science subjects in Year 12		All Year 12 students
	Yes	No	Yes	No	
University	86	44	77	40	48
TAFE	3	24	9	25	22
Apprenticeship/traineeship	5	14	7	15	13
No education or training	6	18	7	20	17
Total	100	100	100	100	100
(n)	(526)	(4,939)	(1,109)	(4,356)	(5,465)

Source: Longitudinal Surveys of Australian Youth (analyses by Julie McMillan).

Levels of participation in science subjects in Year 12 are of major importance for teaching and teacher education. They are the most significant pool of potential science students in university and of potential candidates for science-based teacher education programs. This is a numerical relationship and it is affected not only by the size of the Year 12 pool and the performance of students but by environmental influences such as personal, intellectual and career motivations of school (and university) students, which are having a negative impact on the numbers proceeding from school science to university science.

An analysis, by the Australian Council of Deans of Science, of Victorian Tertiary Admissions Centre data on university entrants for 1998 shows the relationships between the various combinations of science and mathematics subjects studied by Year 12 students in Victoria in 1997 and entry to the science or engineering broad fields of study at university in 1998 (Table 2.4). While chemistry and physics were the most common combination of Year 12 science subjects for those entering engineering, all combinations of Year 12 sciences were found with almost equal frequency among students entering science degrees in 1998.

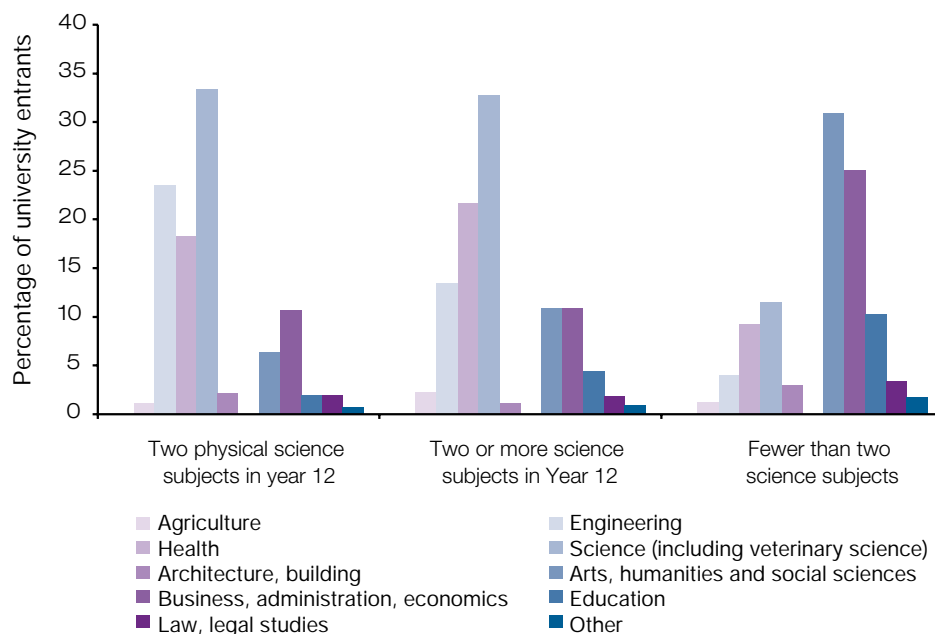
**Table 2.4: Percentage distributions of entrants to university fields of study 1998 for various science specialisations by Year 12 students in 1997 (Victoria)**

Year 12 science combination	Science	Engineering	Other	Total
Chemistry and physics	36	20	44	100
Any two science subjects	33	15	52	100
Any two science subjects (not counting psychology)	35	18	47	100
Two science subjects (not chemistry and physics)	32	6	62	100

Source: ACDS 1999.

Data from the Longitudinal Surveys of Australian Youth (LSAY) show that, overall, more than 70 per cent of science specialists and 79 per cent of physical science specialists from Year 12 entering university, study in a science-related field (Figure 2.5). For an explanation of the trends and of reasons why Year 12 science and mathematics students choose to continue their studies in these fields in higher education, further research is needed.

**Figure 2.5: Percentage distribution across fields of study at university by science background in Year 12 (LSAY data)**



Source: Ainley and Underwood, op cit., citing LSAY.



Research by Teese and Polesel,<sup>28</sup> the TIMSS and PISA studies and the Ainley and Underwood analysis indicate that there are potential sources of tertiary science students that are not being tapped and it may be possible, through strategic interventions, to increase the supply of highly qualified scientific personnel, including teachers of science. Research by Teese et al. shows that there are considerable differences between schools in their ability to retain students beyond the minimum school leaving age, to enrol them in higher level science and mathematics courses, and to achieve high scores in Year 12 examinations.<sup>29</sup>

Research is needed to cut through broad socioeconomic explanations and focus more closely on curriculum and pedagogical practices that make for successful schooling, improved retention rates and increased interest in study of science. Since, according to the PISA findings, differences within schools may be more important than differences between schools, it is important to look closely at relationships among teacher attributes, teaching styles, and other factors in teaching that are or may be related to student attitudes and their preference for different subjects.

The relationship brought out in the Ainley and Underwood analysis between gender and preferences for specific areas of science and mathematics, may be less important than the growing imbalance between males and females, with secondary school completion rates, attainment levels and undergraduate enrolments now higher among females. This trend has been one reason for the identification of the middle years as a crucial stage, not only for choice of subjects for upper secondary study, but retention beyond the minimum leaving age.

As Ainley and Underwood point out, there is a 'strong association between participation in chemistry and physics and earlier proficiency in mathematics'.<sup>30</sup> Ainley and Underwood also note longitudinal studies of progress through secondary schools which indicate that the development of mathematical proficiency and an interest in scientific investigation in the early secondary years are powerful influences on the uptake of physical science studies in the upper secondary years.

No single solution will solve the problem of declining participation in science and mathematics, what is needed is a repertoire of strategic interventions at different stages of schooling. Establishment of the Australian Science and Mathematics School on the campus of Flinders University in South Australia is an example of the kind of strategic initiatives that are needed to focus on these disciplines and support their further development through innovative schooling (Box 2.2).

### **Box 2.2 World class leadership through a purpose-built science and mathematics school in South Australia**

Seeing an emerging need for more emphasis to be placed on excellence in science and mathematics at high school, the Flinders University began to investigate the concept of a specialist secondary school some six years ago. Now a reality, with doors opening in February 2003, the Australian Science and Mathematics School (ASMS) is a specialist government school that aims to provide a strong emphasis on the disciplines of science and mathematics through innovative teaching and learning methodologies in order to halt the decline in student numbers in these disciplines. It also aims to decrease the gap between teaching methodologies and subjects at secondary school level and at tertiary level.

Situated in a purpose-built, \$14 million, ICT-rich, world-class building which incorporates environmentally sustainable features and nine learning 'commons', the complex aims to promote flexible groupings and facilitate learning 'anytime and anyplace'.

With 180 students in Years 10 and 11, and a projected full enrolment of 450 students over Years 7–12 in 2005, ASMS is not catchment-based, but draws students from the entire Adelaide metropolitan area, from regional and rural areas outside Adelaide and from overseas. Students are selected through an application and interview process in which they must demonstrate their interest in and aptitude for science and mathematics.

Being situated within a university campus, the school has strong links with various departments and academics, and shares a number of university resources, including the library and sporting facilities. Learning is often located in the workplace alongside university teachers and researchers, industry scientists and technologists, as well as visiting teachers and mentors and experts from all over the world.

The school maintains an interdisciplinary approach to curriculum design and teaching and provides a very different knowledge and experiential environment for students. Rather than working in silo-style learning systems, students take part in project-based, interdisciplinary activities. They are encouraged to develop higher-order thinking skills through metacognitive processes.

The school uses learning methodologies which prepare young people to be creative, thoughtful and self-motivated contributors to an increasingly diverse and complex society and which instill in them the confidence and capabilities to succeed at a high level. The school expects that its students will become nationally and internationally acclaimed thinkers and leaders in their chosen field.

Learning activities are supported by a technology-rich environment and a strongly collegiate approach to learning. Together, the school and students develop individual learning plans, which have multiple entry points and pathways, and they are able to demonstrate understanding and skills in multiple ways.

### **Box 2.2 World class leadership through a purpose-built science and mathematics school in South Australia continued ...**

The school also has a very strong emphasis on professional development which is targeted at both improved teacher performance and improved school performance. Staff at both the school and the university are jointly researching and providing leadership in science and mathematics teaching and learning.

As a teaching school, ASMS is set to become one of the most advanced learning centres of its kind, providing Australian educators with state-of-the-art professional development opportunities, particularly in the fields of science, technology and mathematics. Programs will be based on the latest research into highly successful professional development which has a focus on: improved teacher and student performance; school/team based; observation, critique and reflection of actual practice; continuous and extended programs; and theoretical underpinnings and understandings.

*Source: Secretariat report on Review visit (April 2003).*

School participation rates and student performance in science, technology and mathematics have a broad and far-reaching impact. They indicate how well prepared Australia is to meet existing and future needs of the knowledge economy and society in terms of community-wide scientific literacy and preparation of scientists and innovators for economic and industry needs. Moreover, they are a key contributor to the number of undergraduates electing to study science, technology and mathematics, as well as the number of undergraduates who graduate as teachers in these areas.

Despite the caution Ainley and Underwood express over interpretation of some of the data—for example in accounting adequately for changes in curriculum structures that make the consistent plotting of some trends difficult—the conclusion is that Year 12 participation rates in biology, physics and chemistry have shown a steady although modest decline over the past decade.

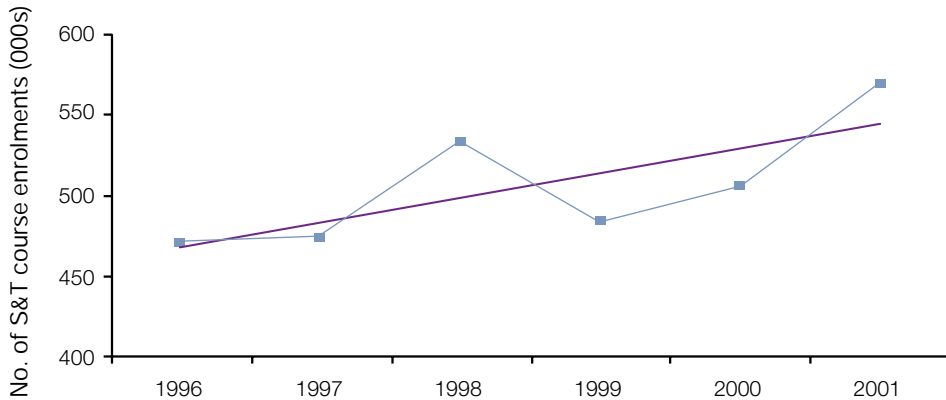
What is remarkable is not just that there has been a decline in the proportion of Year 12 students studying physics, chemistry and advanced mathematics, but that there has not been a more substantial increase in participation in these areas. In 1976, these participation rates may well have been appropriate for an economy dominated then by the primary and tertiary sectors and an emerging service industry. However, when Australia is seeking to increase its international competitiveness, build up its innovative capacity, strong information and communications technology infrastructure and well-developed human resources for a knowledge-intensive economy, considerably higher rates of participation in upper secondary sciences are needed.

Important questions are raised about why these trends have become established, and what would cause them to change. The Committee was not able to gain firm data on these questions. The reasons are likely to be complex and include reference to the calibre of science teaching which students received, their perceptions of the degree of difficulty of the field of study against its utility for them, perceptions of a career in science (status, remuneration, stability, intrinsic interest), and youth attitudes to science as opposed to technology, particularly information technology. Further exploration of these issues as indicated above will be needed if any enduring change to these trends is to be achieved.

### 2.2.4 Vocational education and training

The vocational education and training (VET) sector is a major provider for developing skills in science and technology and building a culture of science and innovation throughout Australian society. The VET sector offers a range of qualifications in science and technology, advanced and associate diplomas, and certificates, I through IV.<sup>31</sup>

**Figure 2.6: Total number of course enrolments in science and technology in VET, 1996 to 2001**



Source: Australian Vocational Education and Training statistics 2001: In detail and equivalent publications for 1996 through to 2000.

In 2002 there were almost 2 million course enrolments in VET.<sup>32</sup> Of the 1.4 million course enrolments leading to a credential awarded under the Australian Qualifications Framework (AQF) or equivalent,<sup>33</sup> approximately a third were in science and technology courses—natural and physical sciences; information technology; engineering and related technologies; agriculture, environmental and related studies; and health.

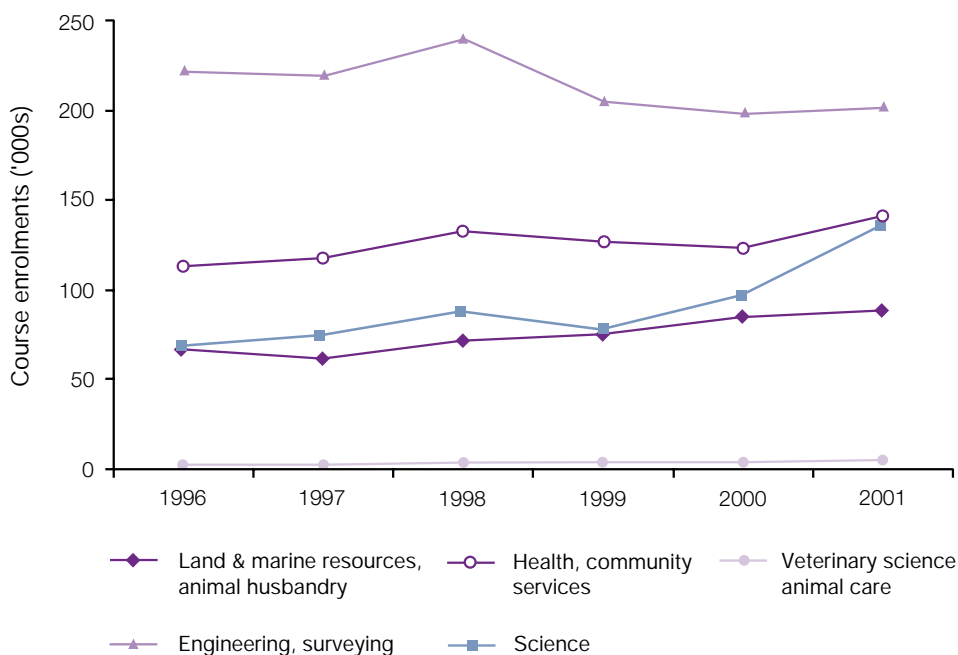
**Table 2.5: Science and technology course enrolments in VET as percentage of all enrolments, 1996 to 2001**

	1996	1997	1998	1999	2000	2001
S&T Course enrolments as % of all enrolments	36.01	36.24	36.63	35.87	36.03	37.44

Source: Australian Vocational Education and Training statistics 2001: In detail and equivalent publications for 1996 through to 2000.

Although course enrolments in science and technology are increasing, they may not be increasing at the same rate as the total course enrolments in VET. In 2000, the number of course enrolments in science and technology had increased by 21 per cent since 1996 (Figure 2.6). However, as a proportion of all course enrolments, the 2001 science and technology course enrolments increased by 1.4 percentage points over the same period (Table 2.5).

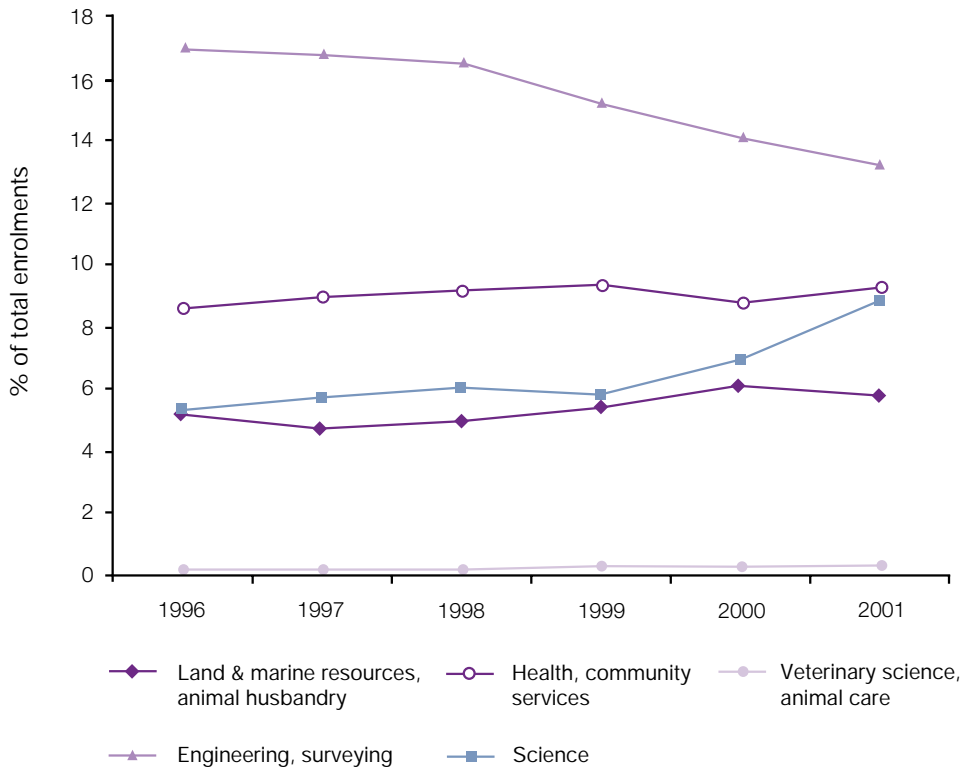
**Figure 2.7: Number of course enrolments in science and technology in VET by field of study, 1996–2001**



Source: Australian Vocational Education and Training statistics 2001: In detail and equivalent publications for 1996 through to 2000.

With respect to course enrolments in specific enabling science and technology courses, although enrolments may have increased or remained stable, their share relative to all courses may have fallen or not increased at the same rate. Engineering and surveying is the most striking example. Enrolments in these courses remained fairly stable from 1999 to 2001, but the proportion of course enrolments relative to all courses fell substantially over the same period (Figures 2.7 and 2.8). On the other hand, it is encouraging that course enrolments in science increased from 1999 through to 2000, and their share relative to all enrolments also increased.

**Figure 2.8: Course enrolments in science and technology in VET as percentage of all course enrolments, by field of study, 1996–2001**

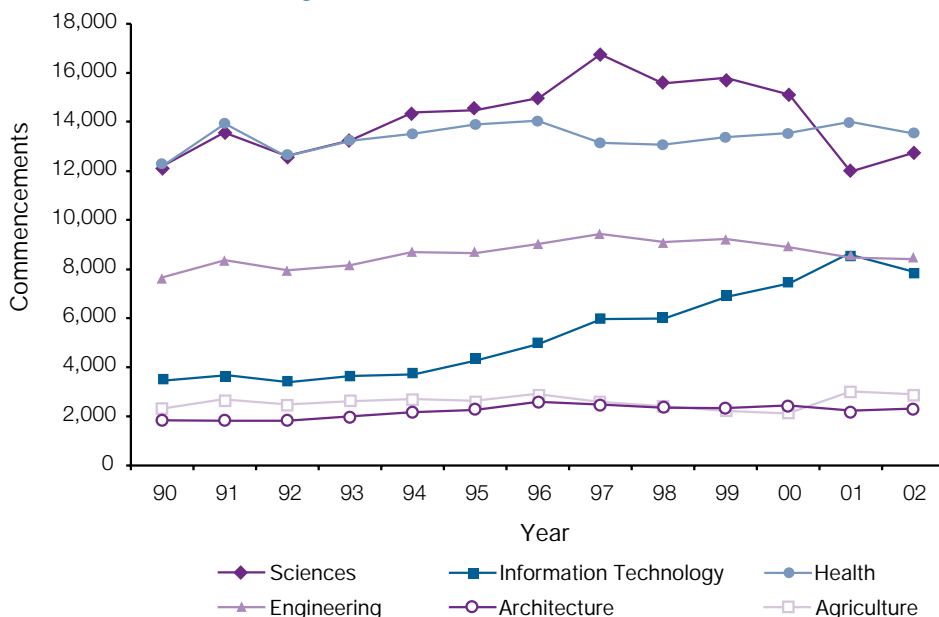


Source: Australian Vocational Education and Training statistics 2001: In detail and equivalent publications for 1996 through to 2000.

## 2.2.5 Higher education trends

Commencing enrolments in undergraduate courses in science-related fields fluctuated over the period from 1990 to 2002 (Figure 2.9). The overall pattern shows a post-1997 decline in commencements in the physical and natural sciences, and to a smaller extent in engineering, accompanied by a rise in information technology.

**Figure 2.9: Trends in commencing domestic enrolments new to higher education in bachelor degree courses 1990 to 2002**



Source: Ainley and Underwood, *op cit*.

Trends in commencing enrolments in undergraduate courses in science-related fields are clearly important for teaching, particularly for upper secondary teachers whose preparation is most commonly through a science degree followed by a graduate diploma. The Committee explored the question of the relationship between enrolment and completion of higher education courses. Data from two studies indicate that those students least likely to finish their courses were enrolled in science, engineering, arts, humanities and social sciences (only 58–59 per cent had completed their courses within seven years of commencement) (Table 2.6).<sup>34</sup> By comparison, there were higher completion rates for veterinary science (90 per cent), health (79 per cent), law (72 per cent) and education (71 per cent).

**Table 2.6: Completion rates for university undergraduate courses by broad field of study**

Field of study	Status of the 1992 entry cohort in 1997			Predicted probabilities of completion	
	Completed	Not completed		1992 entry cohort	1993 entry cohort
		Not studying	Still studying		
Agriculture	54.5	41.1	4.4	61.7	62.4
Architecture	61.6	29.4	9.0	65.6	64.7
Arts, humanities & social sciences	55.0	39.2	5.9	59.4	58.4
Business admin & economics	56.4	36.2	7.4	63.0	62.5
Education	69.9	27.6	2.5	74.8	71.4
Engineering	55.8	34.2	10.1	59.4	58.8
Health	75.4	18.1	6.5	79.2	78.5
Health (nursing)	73.1	25.6	1.3	76.9	75.2
Law, legal studies	63.4	28.3	8.3	70.9	72.0
Science	56.2	37.5	6.3	57.9	58.3
Vet science	90.2	6.9	2.4	89.8	89.8
All	60.4	33.8	5.8	65.3	64.3

Source: Urban et al. (1999); Martin et al. (2001).

Completions from undergraduate courses (bachelor honours, bachelor pass and diploma) from science-related fields of study over the years from 1997 to 2001, together with total completions over the same period, are shown in Table 2.7. Graduates in science-related fields made up approximately 40 per cent of all graduates, yielding just over 40 000 graduates in 2001. The science field of study (which included information technology in 2001) accounted for almost half of these graduates.



**Table 2.7: Completions from science-related undergraduate courses rates by non-overseas students, 1997–2001**

Year	Field						Total completions
	Natural & physical sciences	Information technology	Engineering & related technologies	Health	Agriculture, environmental & related studies	Architecture & building	
2001 Number	10,904	5,418	6,276	13,054	2,802	2,018	97,632
% of total	11.2	5.5	6.4	13.4	2.9	2.1	
2000 Number	16,165		5,325	11,551	1,831	1,926	91,626
% of total	17.6		5.8	12.6	2.0	2.1	
1999 Number	15,975		5,408	11,765	1,691	1,992	92,934
% of total	17.2		5.8	12.7	1.8	2.1	
1998 Number	15,464		5,616	12,614	2,044	1,910	108,119
% of total	14.3		5.2	11.7	1.9	1.8	
1997 Number	15,182		5,579	13,006	1,748	1,953	91,392
% of total	16.6		6.1	14.2	1.9	2.1	

Source: Computed from the DEST Higher Education Statistics Collection.

Note: Change of classification between 2000 and 2001.

Although there are fluctuations in these completions data there does not appear to be a noticeable decline in the percentage of graduations in science-related fields of study. Comparing the distribution of commencements for 2002 (see Figure 2.9) with completions for 2001 (as shown in Table 2.8) there appears to be a small increase in engineering and information technology and a decline in health.

**Table 2.8: Percentage distributions of 2002 commencements and 2001 completions across science-related fields of education**

	2001 Completions	2002 Commencements
Natural and physical sciences	11.2	11.2
Information technology	5.5	7.1
Engineering and related technologies	6.4	7.3
Architecture and building	2.1	2.0
Agriculture, environmental & related studies	2.9	2.5
Health	13.4	11.9
Total	41.5	42.0

Source: Ainley and Underwood, op. cit.

The study of science in school and university is an indication of Australia's strategic scientific research capability. The science system, as pointed out in Chapter 1, can only function with a continuing supply of highly qualified science personnel, as researchers, academic scientists and technologists. For a culture of innovation, Australia needs both a broad base of scientific, mathematical and technological literacy and an increasing participation in high level courses in these fields in upper secondary schooling and higher education. While there can be different conclusions drawn from the trend data, and further research is certainly needed, it is evident, on balance, that national requirements for a scientifically, mathematically and technologically literate community and high level expertise must be better met.

Without an increasing number of scientifically well-educated teachers it will not be possible to extend scientific education further into primary schools, to meet the demand over the next decade for replacement of the existing stock of secondary teachers, or to raise the motivation of students in the middle years to continue their scientific and mathematical studies to higher levels at the upper secondary stage.

## 2.3 Teaching of science, technology and mathematics

Quality teaching will encourage young people in their early years to understand and value science, technology and mathematics as an integral part of their lives and encourage more of them to continue their studies and participate in science, technology and mathematics in post-compulsory schooling.

### 2.3.1 Primary and middle years teaching

Where primary science is taught, as discussed earlier, it is generally taught well, and it is taught by a teacher with a strong liking for science and good pedagogical content knowledge.<sup>35</sup> However, in their initial training, primary teachers mostly do not specialise in science and mathematics. As a result, many primary teachers who teach mathematics and science lack the necessary expertise and confidence, and may even actively dislike mathematics and science.<sup>36</sup> Fritz observes: 'The great majority of teachers who select a career in early childhood or primary school education have a personal preference for the humanities as opposed to the sciences. They often confess to feeling ill at ease with teaching science and technology.'<sup>37</sup>

The importance of foundations in science, notably in early childhood years, is being increasingly recognised. As outlined earlier, science teaching in primary schools is uneven (and often effectively absent) across the country. The Science Teachers Association of Queensland, for example, comments on the lack of universities offering quality science programs specifically targeted at primary school teaching.<sup>38</sup> Developing an interest in and enthusiasm for science among primary teachers, either as specialist science teachers per se or teachers who have developed particular expertise in these fields and may act as leaders within the school teaching team, will require very considerable effort extending over many years.

The picture of science education at the junior secondary stage of schooling is better in many respects than at the primary stage. Year 8 science classes were mostly taught by teachers with a major study in biology; majors in physics were less common. Those teachers who are not trained in science and are of fairly modest mathematical attainments need assistance and support within the classroom and encouragement to extend their scientific and mathematical capability. This is a clear target for professional development programs.

While there are adequate numbers of primary teachers in Australian schools, there needs to be a much higher priority attached to science, technology and mathematics in primary schools. Extending and strengthening the teaching of science, technology and mathematics at primary schools will require more exposure of primary teachers to science and assistance to build their confidence in teaching science.

There are several ways in which to improve the teaching of science, technology and mathematics in primary and middle years of schooling. These include the employment of specialist science teachers in these years of schooling and the employment of science coordinators across and between schools.

### 2.3.2 Secondary teaching

Ensuring a sufficient flow of well-qualified science, technology and mathematics teachers into secondary schools is a critical issue. Broadly speaking, there are sufficient numbers of secondary teachers overall in Australia, but current shortages have been identified of specialist teachers of science (physics and chemistry), technology and mathematics. These shortages are primarily in some outer metropolitan and regional areas.<sup>39</sup> Also, a disproportionate number of vacancies are anticipated over the next five years. The science, technology and mathematics workforce has an older age profile than the overall secondary workforce, with significant numbers coming into the retirement age bracket over the next decade.

The most recent assessment by Department of Employment and Workplace Relations (DEWR) of the teacher labour market is dated February 2003, and is based on information obtained from teacher employers in the second half of 2002. DEWR's assessment is that national shortages existed at the end of 2002 in the areas of secondary manual arts/technology studies, mathematics, physics/chemistry, and general science teaching. Information technology is listed as a shortage in Victoria and Queensland. DEWR does not quantify the extent of identified shortages.

Numerous submissions to the Review have drawn attention to both present and anticipated staffing difficulties in the fields of science, technology and mathematics; of particular concern for the New South Wales Department of Education were geographically isolated and other hard to staff schools.<sup>40</sup> The inability of schools to '...offer higher level maths and science courses if they do not have access to teachers with appropriate qualifications and experience'<sup>41</sup> was a key concern for the Association of Heads of Independent Schools of Australia.

The teacher supply issue is more than just a quantitative one of having sufficient numbers of teachers. It is also a qualitative issue. All teachers, regardless of specialisation, should be well-trained, have appropriate qualifications and experience, and be able to create an enthusiastic and inspiring learning environment. While not providing statistical evidence, a number of institutions and organisations directly involved in science, technology and mathematics teaching and teacher education expressed concern over 'lack of qualifications', 'hidden shortfalls' and 'out of field' teaching.<sup>42</sup>

Particular staffing challenges for the technology area, identified by the Technology Education Association of Victoria, were: 'a general shortage of technology education teachers; finding quality teachers who have a comprehensive understanding of the technology learning area, the knowledge and skills involved, the design process that is central to it, as well as having practical hands on expertise'.<sup>43</sup>

While in no way underestimating the very real concerns outlined above, the Committee noted evidence that Australia's teachers of science and mathematics are formally better qualified than ever before. As reported in TIMSS 1998, 72 per cent of Year 8 teachers of mathematics were qualified either in mathematics or mathematics education. In a study of Year 12 teachers, 80 per cent of teachers of general science, biological science and physical/earth sciences had at least third-year tertiary level study, an honours degree or higher qualification in those areas. Of Year 12 mathematics teachers, 70 per cent had undertaken mathematics studies to third-year tertiary level, or held an honours, masters or doctoral degree. A further 10 per cent of teachers of these science and mathematics subject areas had two-year qualifications in their specialist subject discipline.<sup>44</sup> By contrast, fewer than half of Year 12 information and communication technology (ICT) teachers held third-year university or higher qualifications in that field; for teachers of technical subjects the figure was approximately 40 per cent. Ainley and Underwood note that Year 12 teachers of ICT and technical subjects have a range of other qualifications, but the percentage with a TAFE qualification is not as high as would be expected were the field attracting people with industry experience.

How Australia will fare in the future is very much dependent on securing a sufficient number of very well prepared teachers within the next decade. The overall outlook for continued maintenance and expansion of the science, technology and mathematics teaching force is extremely challenging. Table 2.9 shows completions of secondary level initial teacher education courses by secondary specialisations for 2001. Of particular note are the low proportion of mathematics specialists (7.1 per cent), given that mathematics courses attract 17.4 per cent of average course enrolments at Year 12 level, and the low figure for ICT (4.0 per cent), given the marked enrolment growth at Year 12 level over the past decade. Interpreting the figures of 3.6 per cent and 5.5 per cent, respectively, for physics and chemistry is difficult in the absence of data for the other science specialisations.

**Table 2.9: Course completions by secondary specialists by selected specialisations, 2001**

	Physics	Chemistry	Maths	English	ICT	LOTE	Other	Total
ACT	3	6	12	35	2	13	71	88
NSW	106	140	139	325	49	152	911	2102
NT	1	2	2	8	3	3	19	25
QLD	19	42	71	201	30	76	439	1091
SA	8	12	18	38	2	35	113	235
TAS	0	2	8	25	1	7	43	56
VIC	40	97	114	402	110	134	897	1548
WA	30	17	44	89	37	32	249	641
TOTAL	207	318	408	1123	234	452	2742	5786
% of Total	3.6%	5.5%	7.1%	19.4%	4.0%	7.8%	47.4%	100.0%

Source: R Ballantyne, JD Bain and B Preston, 'Teacher education courses and completions. Initial teacher education courses and 1999, 2000 and 2001 completions', Department of Education, Science and Training, 2003.

Those qualifying to teach mathematics and the physical sciences have a greater propensity to do so via an undergraduate degree plus a graduate teacher education pathway than is the case for those qualifying to teach other secondary specialisations. As Ainley and Underwood note, more than 80 per cent, and probably around 90 per cent, of chemistry and physics specialists, and approximately 75 per cent of senior mathematics specialists, came from graduate programs. This is a significant fact that has implications for attracting teachers of these specialisations.

Drawing on the DEST Higher Education Statistics Collection for 2000, which showed 16 225 completions by domestic students from the science broad field of study, Ainley and Underwood estimate the immediate yields from the graduates of 2000 for teaching in different specialisations. They conclude that there is at present only a small number of graduates from science-related fields entering teaching or teacher education immediately after completing a bachelor degree. This conclusion is supported by an audit of the teacher labour market in Victoria, which concluded that technology, physics, mathematics and computer studies have the lowest numbers of expected graduate teachers.<sup>45</sup>

Based on initial teacher education course enrolment data for 2001 from Lawrance and Palmer, Ainley and Underwood estimated that 217 new mathematics teachers and 464 new science teachers would begin teaching in schools in 2002. Since then, higher enrolments in science and mathematics, especially by career change entrants, have been noted by two institutions.<sup>46</sup> At the University of Melbourne, for example, teacher education enrolments in secondary science, technology and mathematics methods increased by over 30 per cent from 2001 to 2002.

Data from the Graduate Destinations Survey (GDS), conducted annually by the Graduate Careers Council of Australia (GCCA), show that overall around 6 per cent of mathematics graduates, 6 per cent of life sciences graduates and less than 3 per cent of physical science graduates entered teacher education or schools directly. These very low figures suggest a need for universities and employers to be much more active in connecting science and mathematics tertiary students with teaching careers.

It is clear that the number of students who have recently been coming through initial teacher education programs with specialisations in secondary science, technology and mathematics is not high. Policy initiatives must target science, technology and mathematics graduates and encourage them to continue to develop their discipline knowledge and skills, qualify to teach (for example, through Graduate Diploma in Education programs) and share their expertise with young people.

## 2.4 Moving ahead

Australia's human capital, at least in science and mathematics, and branches of technology, appears to be eroding. The situation now is one where:

- there has been a fall in the percentage of Year 12 students undertaking physics, chemistry and advanced mathematics;
- there is a present and predicted future shortage of well-qualified teachers of science, technology and mathematics; and
- there is insufficient well-researched knowledge about students' attitudes and motivations concerning the study and teaching of science, technology and mathematics to guide policy.

Stimulating programs of secondary school science, technology and mathematics should be part of broader strategies for teacher recruitment and teacher education considered in later chapters. The careers of specialists in science, technology and mathematics need to become more attractive than many teachers now find them. These are necessary developments when Australia is endeavouring to build its knowledge resources and innovative capability, and when competition for high level expertise can only increase. The task is urgent, and its execution requires concerted, nationwide action.

Action by governments, education authorities, higher education institutions and schools will not by itself suffice. This is also a responsibility for business, industry, the wider community, parents and students to show interest and leadership. The present situation cannot continue unchanged if Australia is to develop and prosper, and to build the knowledge capital now required for domestic growth and international competitiveness. In the global knowledge economy and the knowledge society, education matters; science, technology and mathematics matter—and teacher quality, attraction and retention are core issues.

The fundamental principles—of novelty, inquiry, speculation, experimentation, criticism and the quest for useful ways to solve problems—which find expression in science, technology and mathematics are integral parts of the way of life of all advanced nations, even though the silos of specialised knowledge into which they have been elevated may be poorly understood and are often undervalued in the community at large. Given the fundamental role of science, technology and mathematics in providing foundations for the knowledge economy, their importance for all Australians is indisputable. What is debated is not the necessity but how best to improve the quality of teaching and learning in subjects that appear to resist mass appeal and do not grip the imagination of students. Through more motivating, more engaging, and more relevant study experiences many more students can develop their scientific and mathematical knowledge. They can also deepen their understanding of their practical capability—and come to a better appreciation of the value of their knowledge to themselves and the community.

## Key conclusions

### *Australia needs:*

- to ensure that through its educational systems there are in place personnel, procedures and resources for all Australians to become scientifically, mathematically and technologically literate;
- to take more direct measures to equip itself with world-class scientists and innovators;
- to enhance national capacity to recruit, train, reward and retain world-class teachers of science, technology and mathematics;
- to use incentives, publicity and recruiting drives to attract very good students into teaching and to provide them with effective and high quality teacher education, particularly in science, technology and mathematics;
- to ensure a much higher priority for science at the primary level and that primary teachers are effectively prepared and supported to improve student learning of science;
- to make postings to 'difficult-to-staff' locations more attractive through a variety of inducements such as financial incentives, additional classroom support, accommodation and professional learning opportunities; and
- both through initial teacher education and career change strategies for teachers in post, to increase the flow of trained teachers of science, technology and mathematics to meet the teaching and learning needs of the knowledge economy and society and to make this a top priority for national workforce planning.

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- <sup>1</sup> Australian Academy of Technological Sciences and Engineering, submission no. 139, p. 4.
  - <sup>2</sup> Australian Council of Deans of Science, submission no. 45, p. 1.
  - <sup>3</sup> Bright Minds Group, University of Queensland; Submission no. 214, p. 2.
  - <sup>4</sup> *The Adelaide Declaration*, Ministerial Council for Education, Employment, Training and Youth Affairs, 1999.
  - <sup>5</sup> Australian Academy of Technological Sciences and Engineering, *The teaching of science and technology in Australian primary schools. A cause for concern*, AATSE, Canberra, 2002.
  - <sup>6</sup> National Council of Independent Schools' Associations, submission no. 76.
  - <sup>7</sup> D Goodrum, M Hackling and L Rennie, *The status and quality of teaching and learning of science in Australian schools—a research report*, DETYA, Canberra, 2001, p. 8.
  - <sup>8</sup> Technology Education Association of Victoria, submission no. 47, p. 8; Australian Science Teachers Association, submission no. 55, p. 10.
  - <sup>9</sup> Department of Education and Children's Services, South Australia, submission no. 143, p. 6.
  - <sup>10</sup> P Sammons, P Cuttance, D Nuttall and S Thomas, 'Continuity of school effects: a longitudinal analysis of primary and secondary school effects on GCSE performance', *Journal of School Effectiveness and School Improvement*, 6, 1995, pp. 285–307.
  - <sup>11</sup> Goodrum, Hackling & Rennie, op. cit., p. 8.
  - <sup>12</sup> JR Baird, RF Gunstone, C Penna, PJ Fensham and RT White, 'Researching balance between cognition and affect in science teaching and learning', *Research in Science Education*, 20, 1990, pp. 11–20; W Speering and L Rennie, 'Students' perceptions about science: the impact of transition from primary to secondary school', *Research in Science Education*, 26, 1996, pp. 283–298.
  - <sup>13</sup> Goodrum, Hackling & Rennie, op. cit., p. 8.
  - <sup>14</sup> Monash University, submission no. 91, p. 2.
  - <sup>15</sup> Students were aged between 15 years 3 months and 16 years 2 months at the time of assessment.
  - <sup>16</sup> OECD and UNESCO Institute for Statistics, *Literacy Skills for the World of Tomorrow: Further Results from PISA 2000*, 2003; and J Lokan, L Greenwood and J Cresswell, *15-Up and counting, reading, writing, reasoning ... how literate are Australia's students? The PISA 2000 Survey of students' reading, mathematical and scientific literacy skills*, Organisation for Economic Cooperation and Development Programme for International Student Assessment, Australian Council for Educational Research, Melbourne, 2001.
  - <sup>17</sup> *ibid.*, p. 203.
  - <sup>18</sup> J Lokan, P Ford, and L Greenwood, *Maths and science on the line: Australian middle primary students' performance in the Third International Mathematics and Science Study*, TIMSS Monograph No 2, Australian Council for Educational Research, Melbourne, 1997; J Lokan, P Ford, and L Greenwood, *Maths and science on the line: Australian junior secondary students' performance. Third International Mathematics and Science Study*, TIMSS Monograph No.1, Australian Council for Educational Research, Melbourne, 1996.
  - <sup>19</sup> Lokan, Ford & Greenwood, *Middle Primary*; Lokan, Ford & Greenwood, *Junior Secondary*.
  - <sup>20</sup> Lokan, Greenwood & Cresswell, *ibid.*
  - <sup>21</sup> H Hollingsworth, J Lokan and B McCrae, *Teaching mathematics in Australia: results from the TIMSS 1999 video study*, Australian Council for Educational Research, Melbourne, 2003.
  - <sup>22</sup> Ministerial Council on Education, Employment, Training and Youth Affairs, *Demand and supply of primary and secondary school teachers in Australia*, MCEETYA, 2003, <[www.curriculum.edu.au/mctyapdf/demand](http://www.curriculum.edu.au/mctyapdf/demand)>.



- <sup>23</sup> Non-Ministerial members of the Victorian Council for Knowledge, Innovation, Science and Engineering, Victoria, submission no. 112, p. 3.
- <sup>24</sup> DEST, unpublished data.
- <sup>25</sup> J Ainley and C Underwood, 'Background data analysis' *Australia's Teachers: Australia's Future*, Volume 3, Review of Teaching and Teacher Education, DEST, Canberra, 2003, Figure 3.
- <sup>26</sup> Within information technology, Ainley and Underwood have included subjects such as computing applications, software design and development, information technology, information systems, information processing and management; and within technical studies subjects such as materials and technology, design and technology, technology studies, textiles and design, technology design and development and graphics, have been included.
- <sup>27</sup> The values shown are enrolment indices for Key Learning Areas (KLAs). These are the enrolments in an area expressed as a weighted percentage of all enrolments (in full-time equivalent subjects). Values of enrolment index are additive across areas and sum to 100 for any student or group of students. Another way of thinking about enrolment indices is to consider them as curriculum share; a concept that can be envisioned as applying to the program of an individual student or across a group of students.
- <sup>28</sup> R Teese and J Polesel, *Undemocratic schooling: equity and quality in mass secondary education in Australia*, Melbourne University Press, Carlton, Victoria, 2003.
- <sup>29</sup> *ibid.*
- <sup>30</sup> Ainley and Underwood, *op. cit.*
- <sup>31</sup> Different systems are used to classify the levels and standards across the different sectors of education and training. The OECD in its publication, *Education at a Glance OECD Indicators 2002* uses the International Standard Classification of Education (ISCED). The Australian Bureau of Statistics, in its publication *Education and Work*, May 2002 (cat 6227.0) uses the Australian Standard Classification of Education (ASCED). There is broad agreement across these two systems, but they differ in some of the detail. Equating qualifications across the different credentialling systems used in VET, schools and higher education is difficult. However, as an indicative guide, VET certificates I and II are usually regarded as being synonymous with the end of compulsory schooling and may be undertaken during senior secondary schooling. Certificate III and certificate IV are regarded as above Year 12 (certificate III is the exit point for most trade qualifications).
- <sup>32</sup> *Australian Vocational Education Training Students and Courses 2002: In detail*, NCVER, 2003, Table 18, p. 29.
- <sup>33</sup> The analyses are undertaken with courses recognised nationally through the Australian Qualifications Framework (AQF) or the Register of Australian Tertiary Qualifications (RATE). Non-award, miscellaneous and other recognised courses have been excluded.
- <sup>34</sup> M Urban, E Jones, G Smith, C Evans, M MacLaclan and T Karmel, *Completions – Undergraduate academic outcomes for 1992 commencing students*, occasional paper series Higher Education Division, Department of Education, Training and Youth Affairs (DETYA), Canberra, 1999; and Y Martin, M MacLaclan and T Karmel, *Undergraduate Completion Rates: An Update*, occasional paper 01/F, Department of Education, Science and Training (DEST), Canberra, 2001.
- <sup>35</sup> Goodrum, Hackling and Rennie, *op. cit.*
- <sup>36</sup> S Yates and D Goodrum, 'How confident are primary school teachers in teaching science?', *Research in Science Education*, 20, 1990, pp. 300–305; D Goodrum, J Cousins and A Kinnear, 'The reluctant primary school teacher', *Research in Science Education*, 22, 1992, pp. 163–169; K Appleton, 'Discipline knowledge and confidence to teach science: self perceptions of primary teacher education students', *Research in Science Education*, 22, 1992, pp. 11–19; J Osborne and S Simon, 'Primary science: past and future directions', *Studies in Science Education*, 27, 1996, pp. 99–147; P Galbraith, 'Maths teaching: does it add up?', *Campus Review*, 21, June 2002, pp. 19–25.
- <sup>37</sup> A Fritz, 'Schooling in science and technology: is it a case of neglect?', Australian Academy of Technological Sciences and Engineering, Fellows seminar, November 1998.

- <sup>38</sup> Science Teachers Association of Queensland, submission no. 193.
- <sup>39</sup> MCEETYA *Demand and supply*, op.cit.
- <sup>40</sup> New South Wales Department of Education and Training, submission no. 141, p. 6.
- <sup>41</sup> Association of Heads of Independent Schools, submission no. 58, p. 13.
- <sup>42</sup> Murdoch University, submission no. 82, p. 2; Australian Mathematical Society Incorporated, submission no. 79, p. 1.
- <sup>43</sup> Technology Education Association of Victoria, submission no. 47, pp. 1, 3.
- <sup>44</sup> Australian College of Educators, 'Qualifications of Year 12 teachers: maths, science and technology: 1999 national survey of teachers in Australian schools', unpublished paper, 2002.
- <sup>45</sup> Auditor-General, *Teacher workforce planning*, Auditor-General of Victoria, Melbourne, 2001.
- <sup>46</sup> University of Melbourne and Queensland University of Technology, correspondence with the Review Committee.

## Part 2 Attracting, preparing and retaining quality teachers

In Part 1, a wide array of challenges was identified as teachers prepare students to be responsible citizens and capable, energetic participants in the knowledge economy. For all teachers and schools there is both need and opportunity to show initiative and creativity in enabling all students to become effective learners. A great deal of work is underway in all jurisdictions and systems to project future demand for teachers, to improve supply and to map the qualities needed in the future teaching workforce. It is teachers who have the carriage of developing the creative and innovative capacities of the next generation of young Australians.

The Australian teaching profession is generally very well educated, and has succeeded in producing high levels of education. It is imperative that teaching attracts people of the highest calibre who value learning, understand children and young people and have the skills, knowledge, values and attitudes needed to enable them to meet the challenges of the 21<sup>st</sup> century.

There have been some difficulties in ensuring that there are sufficient numbers of appropriately qualified specialist teachers in all the regions and locations of the country where there are schools to staff. Workforce planning can be improved and more progress made. It will not be enough to maintain a supply—essential as that is with the coming age-related tide of retirements. An equally crucial factor in workforce planning for the future will be to retain and support as many quality teachers currently employed as possible, particularly those in the earlier years of their careers. Induction and mentoring programs, sustained improvements to the working conditions of teachers; articulated professional standards, flexible workplaces and enhanced career pathways, opportunities for professional learning, strong school based leadership and team practices are all important features of the solution to better retain teachers in Australian schools. Initial teacher preparation and the schools where teachers start their careers are closely related elements that influence teachers about their careers and are of demonstrable significance for retention. Many of these measures are the subject of discussion throughout the remaining Parts of this report.

It is important to build a comprehensive framework to ensure quality and high qualifications and professional standards for all teachers. Current moves to develop a national framework for professional standards of teaching and to harmonise initial entry requirements across the country are important steps in this direction.

In higher education, many changes occurred in the 1990's following the introduction of the unified national system of higher education. Now there are robust structures of initial teacher education whereby all teachers will have a minimum of four years of higher education. The Australian Government's reform package *Our Universities: Backing Australia's Future* identifies teacher education as a national priority, proposing incentives for people to enrol in teacher education programs. This initiative demonstrates the readiness of government to use financial incentives and other strategic measures to address the internal difficulties over allocation of teacher education places and to attract people to careers in teaching.

The education faculties in higher education institutions have shown great determination in reshaping teacher education programs to ensure that they provide the necessary foundations for graduates to enter a teaching career. More can be done to build partnerships between schools, employers and higher education institutions. There is considerable potential through such collaboration to strengthen the relations between academic programs, students' practical experience of schools and classrooms, and the experience of the first years of teaching. Considerable effort will be required to attract and retain teachers of science, mathematics and technology, to upgrade qualifications of people now teaching these subjects, and to develop expertise in science, technology and mathematics among primary teachers.

What Australia is reaching towards and must attain is a coherent and effective system to attract, prepare, deploy and retain highly talented teachers. To ensure their development and the advancement of the profession, teachers need to continue their own learning. Strategies are needed to bring about a full articulation of initial teacher education through induction and mentoring to continuing professional learning.

## 3. Australia's teaching profession

How Australia will fare in the future depends very much on how well it secures quality teachers in the next decade. The overall outlook for continued maintenance and expansion of the science, technology and mathematics teaching force is not without its challenges. Australia's profession of teachers is ageing and faces competition from other sectors of the knowledge economy for a relatively modest number of graduates with science, technology and mathematics expertise.

Establishing and maintaining an adequate supply of quality teachers generally, and of good science, mathematics and technology teachers in particular is a top priority. Better cooperative workforce planning to assure the necessary supply of good teachers will be fundamental to achieving this. To underpin that planning, better and more comprehensive data, including that at the national, state and local level, are needed to identify the likely patterns of future supply of and demand for teachers, and to inform education policies and programs. Teacher preparation, recruitment and retention for the future are high priorities for the present.

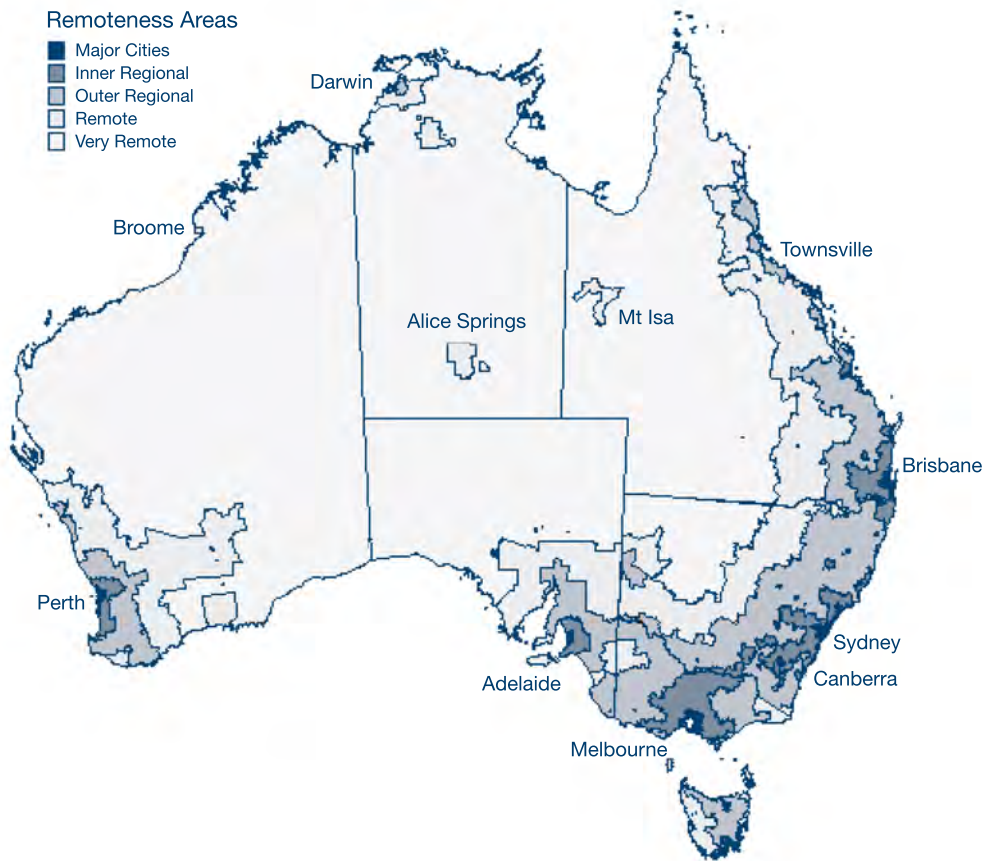
### 3.1 Our teachers—a professional profile

Teaching is a very large and diverse profession in Australia. In 2002, there were around a quarter of a million teachers working in nearly ten thousand government and non-government schools.

#### 3.1.1 Geographic distribution

Teachers work in thousands of communities spread throughout the country. The distribution of teachers closely reflects the geographic distribution and density of the population. A high proportion of Australians live in large urban centres; 64 per cent lived in State/Territory capital cities in 2001. The bulk of the population has come to live near the coast, notably the eastern, south-eastern and south-western seaboard, and this trend is strengthening. But teachers are also required in regional centres and for very small and isolated communities in thinly populated areas.

**Figure 3.1: Degrees of remoteness, Australia**



Source: Reproduced with permission from the Australian Bureau of Statistics, *Australian social trends 2003*, Catalogue Number 4102.0, ABS, Canberra, 2003.

Metropolitan cities continue to dominate as preferred places to live, and it is these settings that increasingly shape the experience of teachers. Just one in ten teachers has taught in an isolated area, mostly for less than five years, and commonly for two or three.<sup>1</sup> With many teachers having existing links in urban areas, including opportunities for professional advancement, there is difficulty in drawing teachers to rural and remote areas and retaining them there. There is also a need to recruit and train more Indigenous teachers.

Schools in some locations tend to be harder to staff—they tend to be both in rural and remote areas and in some metropolitan areas. Staffing rural and remote schools is not a new problem in Australia. Australia has very large areas which are classified as ‘remote’ or ‘very remote’ (Figure 3.1). Adapting to the social, cultural and lifestyle challenges of living in rural and isolated communities, particularly at a time when they may also be new to teaching, can be very demanding for the predominantly young teachers who usually staff these schools. Turnover tends generally to be high, with teachers often not staying longer than a few years, or beyond an initial contract. The submission from the Australian Education Union draws attention to the ‘tendency for [these schools] to have both inexperienced and transitory teachers’.<sup>2</sup> This said, for systems in which staffing decisions are taken centrally, a period of country service has long been regarded as a normal part of the teaching career, leading to subsequent career benefits. With the increasing move within systems toward greater involvement of the school in appointments, including full responsibility by Victorian government schools for their own staffing, attention can be focused on personal attributes which might make certain teachers more likely to fit well into remote and rural settings, and to focus on what incentives might be effective in recruiting them to these settings.

Another category of difficult-to-staff schools is in some locations within metropolitan areas, generally either inner-city or outer metropolitan fringe. In these areas there are students from low socioeconomic groups and non-English-speaking backgrounds. While teachers may not need physically to uproot themselves from their home and community to teach in such schools, the conditions of teaching can be often regarded as particularly difficult and unappealing, and teachers frequently seek to move when the opportunities arise. Thus, these schools suffer from high teacher turnover; they also tend to have poorer facilities than other metropolitan schools as the parent body is less able to command supplementary resources for the school budget. Student behavioural difficulties and lack of parental support for teachers are often cited as further disincentives for teachers to remain at difficult-to-staff metropolitan schools. As with the rural and remote areas, however, some teachers have the necessary qualities and motivation to work in these schools.

Special measures, including financial incentives, have been introduced by education authorities, and some communities have incentive schemes to attract and retain teachers in difficult-to-staff schools. For example, the New South Wales Government, through Beyond the (Great Dividing) Line, promotes rural teaching opportunities to pre-service teacher education students.<sup>3</sup> The Western Australian Department of Education and Training provides \$10 000 scholarships to final-year teacher education students to teach in areas of need, including science, technology and mathematics, in return for being contracted to the Department for two years in a rural school.<sup>4</sup> The South Australian Department of Education and Children’s Services has introduced a Country Scholarships Scheme.<sup>5</sup> In addition, most education authorities provide allowances that subsidise or offset costs for teachers in remote locations, including rental subsidies, relocation assistance and annual retention benefits in difficult-to-staff schools. Individual schools have also introduced incentives as a means of attracting teachers to regional locations.<sup>6</sup>

Other policy instruments are also available including the strategic location of teacher education campuses and the focusing of their programs on regional and rural life. Data provided by Charles Sturt University in New South Wales show that students educated in regional institutions are inclined to stay and take up professions such as teaching in regional areas.<sup>7</sup>

As the principles of choice and increased school autonomy are more widely adopted and as the profession develops an increasingly national character, no groups of students should be disadvantaged by the inability of individual schools to attract and retain appropriately qualified teachers.

### 3.1.2 Size and school sector

The teaching profession in Australia is very large. In 2002, 249 629 full- or part-time teaching staff (225 353 full-time equivalent, FTE) worked in 9632 schools throughout the nation.<sup>8</sup> While the most common form of school organisation and therefore of distribution of teachers by level of schooling remains the separate primary and secondary school, Pre-school/Kindergarten to Year 12 (P/K-12) schools are becoming more common (11.3 per cent of all schools in 2002, a growth of 29.6 per cent during the previous decade). Two jurisdictions, the Australian Capital Territory and Tasmania, have a separate senior secondary college structure in the government sector. Approximately similar numbers of teachers work at the primary level as at the secondary.

Sixty-eight per cent of teachers are employed in the government sector, and 32 per cent in the non- government sector. Between 1997 and 2002, the number of full-time equivalent teaching staff grew by 5.1 per cent in government schools and by 17.6 per cent in non-government schools. The non-government sector is proportionately larger at the secondary than the primary level, and notably in the senior secondary years. Within the non-government sector, Catholic schools continue to enrol some 20 per cent of students, while the independent schools, now enrolling 12 per cent of students, have shown continuing steady growth of student enrolment for many years.<sup>9</sup>

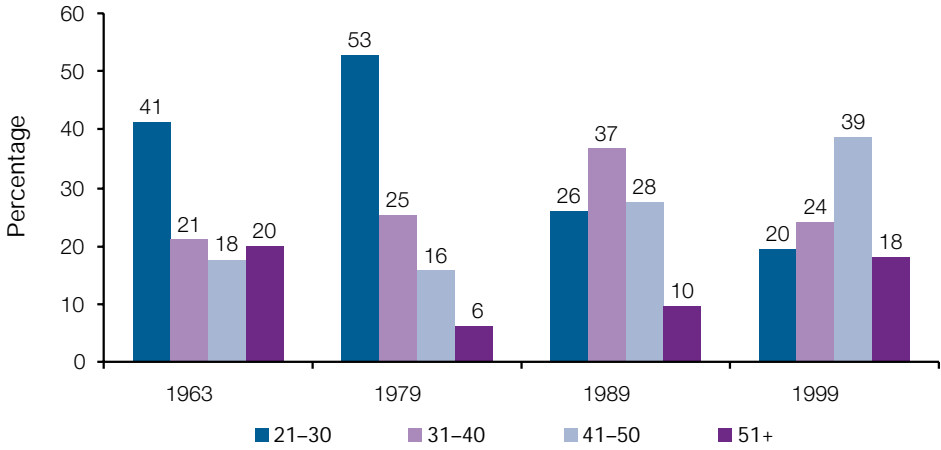
### 3.1.3 Age and generational change

Teaching is an ageing profession and, on average, teachers are now considerably older than at any time in the past 40 years. This is strikingly illustrated in Figure 3.2. Fifty-seven per cent of teachers were over the age of 40 in 1999, with a much smaller proportion under the age of thirty than in previous years. The median age of the teaching force rose from 34 to 43 years over the 15 years to 2001, during which time the proportion of teachers older than 45 years rose from 17 to 43 per cent.<sup>10</sup> The proportion of teachers under the age of 34 years is less than 29 per cent (Figure 3.2).

The age distribution for male teachers is more skewed to older ages (48 per cent were 45 years or older with 12 per cent being 55 years or older) than that for females (41 per cent and 9 per cent, respectively).

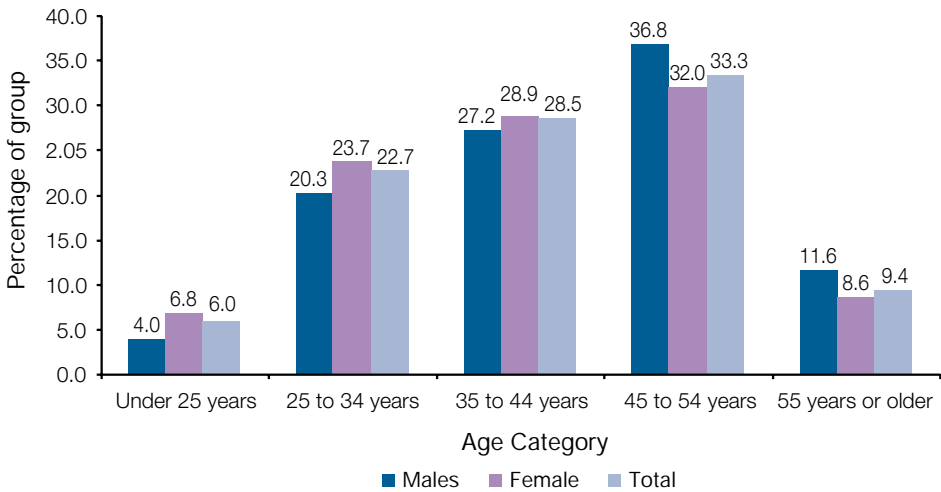


**Figure 3.2: Percentage age distribution of teachers, 1963, 1979, 1989 and 1999**



Source: Ainley and Underwood, 2003.

**Figure 3.3: Percentage of teachers employed by age and gender for 2001**



Source: Australian Bureau of Statistics, Census of housing and population, ABS, Canberra, 2001.

The age structure of the teacher workforce varies between the primary and secondary sectors and varies significantly across States and Territories, with:

- the proportion of primary teachers aged 45 and over ranging from 40 per cent in Queensland to 53 per cent in South Australia; and
- the proportion of secondary teachers aged 45 and over ranging from 42 per cent in Queensland to 69 per cent in the Australian Capital Territory.<sup>11</sup>

Given the tendency of many teachers to depart the workforce around age 55, many may retire in the next decade.<sup>12</sup> With a disproportionate number of teachers coming into the retirement age bracket over the coming decade, replenishing the teaching force will be a high policy priority for State and Territory education authorities.

### 3.1.4 Gender

The profile of the teaching workforce is skewed towards females, a trend which has been steadily growing over the past 40 years. Females made up 52 per cent of the total workforce in 1963 but, by 1999, this had increased to 65 per cent (Table 3.1).

**Table 3.1: Percentage distributions showing gender of teachers, 1963, 1979, 1989 and 1999**

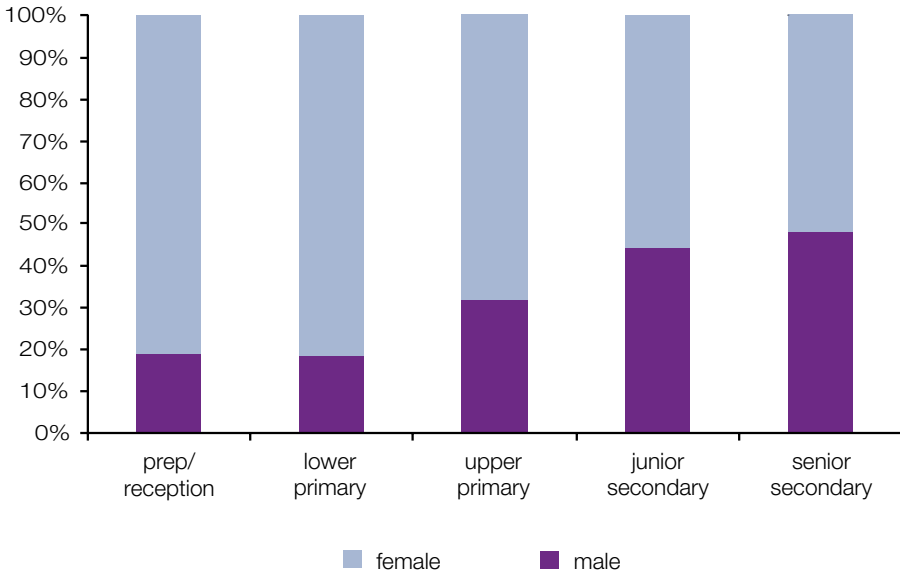
Year	1963	1979	1989	1999
Male	48	43	39	35
Female	52	56	61	65

Source: Australian College of Educators surveys: N Dempster, C Sim, D Beere and L Logan, *Teachers in Australian schools. A report from the 1999 National Survey. Executive summary*, Department of Education, Training and Youth Affairs, Canberra, 2000; Logan et al. 1990; Bassett 1980.

Recent trends suggest that the female proportion of the teaching workforce will increase. The past decade has seen the number of FTE female teachers in Australian schools rise significantly (from 125 362 in 1992 to 151 647 in 2002), alongside a slight decline in the number of FTE male teachers (from 76 704 in 1992 to 73 706 in 2002)<sup>13</sup> This trend is present at both primary and secondary levels. The ratio of female to male teachers in primary schools in 1982 was 2.4:1, and rose to 3.8:1 in 2002. Among secondary teachers, the ratio increased from 0.8:1 in 1982 to 1.2:1 in 2002.<sup>14</sup>

There is also an important gender differential by levels at which teachers work. Data from the 1999 Australian College of Educators' teacher survey illustrate a clear gradation of the gender profile from largely female at the pre-primary and lower primary levels to close to gender parity at the senior secondary level (Figure 3.4).

**Figure 3.4: Gender profile of teachers by level, 1999**



Source: Data from Dempster et al., op. cit.

Despite their numerical dominance, however, women hold significantly fewer formal and informal leadership positions in schools than men, as illustrated by data from the Australian College of Educators’ 1999 teacher survey (Table 3.2).

**Table 3.2: Category of official position within schools by gender, 1999**

Category of official position	% Male	% Female
Executive/ managerial	45.9	24.3
Class teacher	45.5	59.7
Support	8.6	16.0
Total	100.0	100.0

Source: Based on data from Dempster et al., op. cit.

There is an important age–gender relationship, as female teachers comprise about 80 per cent of teachers younger than 30 years of age, while the largest concentration of male teachers is in the older age groups. Moreover, enrolment figures in teacher education programs indicate a decreasing representation of males. From 1983 to 2002, the proportion of males in education studies at Australian higher education institutions decreased from 34.1 per cent to 23.4 per cent. Nine thousand, six hundred fewer males were enrolled in these programs in 2002 than in 1983. (Total enrolments in education studies at Australian higher education institutions in 1983 and 2002 were 74 314 and 67 283, respectively.)<sup>15</sup>

There are two important messages about diversity here. First, it is desirable that the numbers of quality male teachers increase in coming years, particularly in primary schools. Second, it is desirable that more females aspire to, and obtain, leadership positions within the profession. This would allow our children to see both men and women valuing learning and taking leadership in supporting the learning of others, and thus send strong messages about teaching as an occupation to male and female students.

### 3.1.5 Diversity

The profile of the present teaching force differs in significant ways from the profile of the broader Australian population. It is important that the teaching force both relates successfully to, and itself is representative of, all communities and groups within society. Australia is one of the most ethnically and culturally diverse countries in the world, but this diversity is only partially reflected in the composition of the teaching force. Since schooling to the age of 15 or 16 is universal and a high proportion of students complete a full secondary education, it is reasonable to expect that teachers have the full range of backgrounds needed to relate to a diverse student population. For instance, many education stakeholders—including the Australian Council of Deans of Education and Australian Education Union—called for close involvement of the Indigenous community in the education of Indigenous students.

There is great value in recruiting to the teaching profession more people from the diverse ethnic and cultural backgrounds of the Australian population. All aspects of schooling, and none more so than the composition of the teaching workforce, should better reflect the cultural and ethnic diversity of society. Increasing the cultural and ethnic diversity of the teaching profession will require special measures, including liaison at the system level with community groups, school links with parents and career guidance to encourage more young people from different cultural and ethnic backgrounds to enter teaching.

### 3.1.6 Qualifications

The teaching profession, as judged by the highest qualification in the field of education held by Year 12 teachers, has become better qualified professionally since 1979, as indicated in surveys conducted by the Australian College of Educators (Table 3.3).

**Table 3.3: Percentages showing highest qualification in education held by Year 12 teachers, 1979 and 1999**

Highest Qualification	1979 %	1999 %
Higher Degree (Doctoral or Masters)	2	8
Post Graduate Diploma or Certificate	21	21
Bachelor degree	19	44
Diploma or Teachers Collge Certificate	32	21
Associate/Certificate (not Teachers College)	6	4
Other	5	1
No qualification	16	0

Source: Dempster et al. (2000); Bassett (1980)

Overall, the teaching profession is highly qualified for all levels of schooling (Table 3.4). In almost all States and Territories, a minimum of four years of academic study, including at least one year of pre-service teacher education, is now the minimum requirement for entry of new teachers and re-entry of previously experienced teachers into permanent positions in the Australian teaching force. In the relatively near future, teaching in Australia will be a practically all-graduate profession.

**Table 3.4: Percentage distributions showing initial qualifications of teachers, 1999**

	Early childhood	Primary	Secondary	Special education	Other
Certificate	7.4	20.5	9.2	2.9	79.1
Diploma or three-year degree	52.7	52.2	21.6	11.0	10.1
Degree (four year)	6.8	13.9	22.5	24.8	4.7
Degree and diploma	21.7	11.8	43.7	53.6	5.4
Double degree	11.4	1.6	2.9	7.8	0.8
Total	100	100	100	100	100
Number of respondents	193	179	191	197	121

Source: Dempster et al., op. cit. (n = 5222).

### 3.1.7 Recognition and remuneration

Most teachers are recruited and employed by education authorities, either State/Territory government authorities or Catholic diocesan authorities. In independent schools and in Order-owned Catholic schools, teachers are usually employed directly by the schools at which they teach. Victoria is the only State where individual government schools (in the form of principals or selection panels) may make offers of employment to individuals, although in other jurisdictions individual schools and their principals are involved in appointments to differing degrees.

States and Territories are generally moving in the direction of according schools greater self-management responsibilities, a trend which the Committee welcomes as an indicator of the increasing professionalisation of the whole education service.

As in many other professions, maintaining career advancement opportunities and rewards is a challenge for employing authorities. It is well understood that one of the more attractive features of teaching is that beginning teacher salaries compare favourably with most other professions. However, teaching is less financially attractive the longer a teacher remains in the profession. 'Unless teachers opt to seek administrative appointments, the salaries of classroom teachers do not rise after eight years in the profession.'<sup>16</sup> In 1998, the Senate Employment, Education and Training References Committee Inquiry into the Status of the Teaching Profession noted the impact of this compressed salary scale: 'In this respect the teaching profession compares unfavourably with many other professions which have both extended salary scales and more opportunities for promotion at the "coal face".'<sup>17</sup>

Starting salaries for teachers compare favourably with average graduate starting salaries, and Australian teachers' salaries are above the mean of OECD countries, both at commencement and after 15 years of experience.<sup>18</sup> Salaries in government schools commence at around \$40 000 and, at the top end of the classroom teacher scale, salaries range from \$55 000 to \$60 000.

In terms of average weekly earnings, data from the 2001 Census of Population and Housing conducted by the Australian Bureau of Statistics indicate that teachers earn around \$100 more per week (the average for all school teachers was \$897) than the average for the workforce (\$799). Within the teaching profession, secondary school teachers earn more than primary school teachers who earn more than pre-primary school teachers. Each of these groups of teachers earned less than university lecturers and tutors. For each group of teachers, males earned more than females (Table 3.5).

**Table 3.5: Estimated full-time average weekly ordinary time earnings (AWOTE) \$ for educational professionals.**

	Males	Females	Persons
Primary school teachers	969	805	841
Secondary school teachers	1,038	878	956
Special education teachers	971	816	850
University lecturers and tutors	1,179	717	1,059
Vocational education teachers	924	657	798

Source: Australian Bureau of Statistics, 'Census of Housing and Population' 2001.

According to the commentary on social trends by the Australian Bureau of Statistics over the 15-year period to 2000, the average weekly ordinary full-time earnings for secondary teachers rose by 76 per cent and those for primary teachers rose by 75 per cent.<sup>19</sup> One comparison suggested is with full-time adult non-managerial professionals for whom the rise over the corresponding period was 86 per cent. The difference is very significant taking into account cumulative earnings.

Submissions highlighted the importance to retaining teachers of recognising teachers' work more broadly and of linking remuneration and rewards to appropriate recognition. A number of elements were raised:

- while commencing salaries of teachers compare well to some other professions, salaries plateau quickly and there is little opportunity for increased remuneration through career progression, especially at the mid-level;
- opportunities for increased levels of remuneration are in management positions, and to some degree this removes skilled teachers from the classroom;
- remuneration rewards longevity of service and experience rather than being linked to higher or further qualifications, or to performance;
- salaries do not recognise the diverse range of skills and expertise gained by teachers, especially in non-curriculum but increasingly essential areas such as behaviour management;
- salaries for mature-age recruits typically do not recognise prior work and non-teaching experience;
- little provision is made for permanent part-time employment, more flexible hours of work and job sharing;
- portability of entitlements should allow teachers to move around Australia but retain salary position and status;
- salary structures should be reviewed to ensure that there is a clear and attractive path to encourage people to remain in teaching.<sup>20</sup>

Another related aspect to retention of teachers is the conditions under which a teacher is employed. Despite recent trends in the economy leading to an increase in casualisation of many occupational areas and the growth of employment contracts (including short-term), for most teachers the career can be permanent, whether full- or part-time. In 1999, close to 80 per cent of teachers were full-time permanent employees, 10 per cent permanent part-time, and 11 per cent on a fixed term contract.<sup>21</sup> Teachers aged 21–30 were the most likely to be employed on a contractual basis, with contracting more common in the non-government sector. While the growth of contract employment can provide education authorities and schools greater staffing flexibility, very short contracts have been cited as a cause of beginning teacher attrition.<sup>22</sup>

The Victorian Department of Education and Training found that cessation rates in the 25–29 year age group have fallen since ongoing tenure became the standard mode of employment.<sup>23</sup> This suggests that permanency or ongoing tenure can positively influence beginning teacher retention. Don Zoellner of Centralian College argued:

Teachers must be offered permanent positions early in their career. One reason so many leave early is that they are on medium to short term contracts with little job security.<sup>24</sup>

The majority of teachers have been in the profession for some time and have already reached the highest salary increment. Other than for those seeking promotion out of the classroom into management positions, there is a dearth of financial incentives operating to keep these experienced teachers in the profession.

Limited information from the Graduate Careers Council of Australia (GCCA) about salaries five years after graduation shows that, on average for all graduates, salaries are 100 per cent greater than starting salaries. But the growth is not uniform in all professions. For education graduates, salaries rose by only 55 per cent over the first five years. This places them at a significant financial disadvantage over that period and indicates relatively disadvantageous salary prospects further into their careers.

Internationally, teachers' salaries appear not to have kept pace with other professions. It is significant that the difficulties being encountered in Australia in attracting and retaining teachers in fields such as science, mathematics and technology are common in other English-speaking countries.

How significant is the salary structure for the recruitment and retention of teachers? Salary plateau is a source of great frustration among experienced teachers and is a reason many feel undervalued and look to other occupations. A submission from the University of Sydney states that the pulling power of higher salaries available elsewhere becomes especially strong for teachers of science, mathematics and technology at the point of the salary plateau, typically in those teachers' early thirties.<sup>25</sup> The Committee believes that this is a matter for concern in Australia's push to become a more innovative, globally competitive nation.

'Promotions classification' positions within schools—deputy principal and principal positions—are dependent on teachers undertaking additional responsibilities within the school. Beyond existing increments there is currently little salary recognition for those teachers demonstrating advanced classroom skills, and who choose to remain class teachers. Only two States appear to have an extended pay scale which reaches beyond \$62 972 per annum for teachers with advanced skills. While remuneration does not appear to be a major point of dissatisfaction among those teachers surveyed by MCEETYA in 2002, higher salary levels were widely agreed by this same sample as a key inducement for retaining teachers.<sup>26</sup>

Salaries and levels of responsibility and performance related to remuneration are key signals of the value placed by the community on the teaching profession and its relative significance in the country's priorities. The Committee believes there needs to be greater sensitivity to the specific issue of the remuneration of the teacher who chooses to stay in the classroom and attend directly to the learning of students. Salary differentials related to high quality and accomplished teaching are important. The Committee considers that there is a very strong case for them.



Caldwell and Roskam argue for the need for more flexibility in government schools to allow devolution of responsibility for appointment of teachers to schools, greater reward for high quality teachers and removal of structural limitations built into salary scales by industrial awards. In return, teachers would be expected to meet standards of accreditation and re-accreditation that would match the best in other leading professions.<sup>27</sup>

State and Territory employing authorities have worked to improve career structures, for example by creating mechanisms for career progression and flexible employment conditions. For instance, the Western Australian Department of Education and Training has created a career pathway for teachers wishing to remain in the classroom using a financial incentive of approximately \$7 000 per annum additional salary.<sup>28</sup> Employers are also packaging the range of incentives they provide in different ways in order to attract and retain teachers in rural and remote locations. Attractive packages for teachers can include incentives such as additional training and development, reimbursement for certain dental and medical treatment, vacation travel expense and rental subsidies. Teaching can no longer be seen only as a localised state-based profession, but one where professional teachers will seek an employment package that best suits their individual needs.

There are some realities that need to be taken into account that will not see radical changes taking place in the short to medium term. The teaching workforce is one of the largest of all workforces in Australia. In 2002, there were 249 629 teaching staff employed in all schools.<sup>29</sup> Budgetary realities for government and other employers mean that addressing some of the issues surrounding remuneration are considerable. This is not specific to Australia—it is a worldwide phenomenon. Any change to remuneration would need to be sustainable within this context.

For the teaching profession this could mean systematically aligning recognition and performance structures with remuneration. This could produce significant financial gains for highly accomplished teachers and stronger encouragement for beginning and developing teachers. An overarching objective would be to maximise the impact of the investment in teaching on student learning outcomes. This may be achieved through making a stronger connection to professional standards.

Submissions strongly suggest that poor remuneration can lead to job dissatisfaction and that improved remuneration would encourage teachers to stay in the profession. However, remuneration itself is not necessarily the only or most important point of dissatisfaction. As discussed elsewhere in this report, there is a range of factors that impact on teacher satisfaction. Therefore attitudes to remuneration need to be considered along with other factors important to attracting and retaining teachers.

Retention of teachers, however, goes beyond questions of remuneration. Many younger people are now making career decisions on the basis of quality of life and family responsibilities, rather than merely financial rewards and status. Moreover, new visions of careers are developing, whereby a job is no longer seen as a lifetime commitment, particularly now that there are more career opportunities for people with high demand skills such as in the sciences, technology and mathematics.

### 3.1.8 Teachers of science, technology and mathematics

Broadly, the supply of teachers has been sufficient to meet school needs across the country. However, in the secondary specialisations of physics, chemistry, mathematics, technology studies and languages other than English (LOTE), significant recruiting difficulties exist in some rural and remote locations and in some locations within metropolitan areas.

The 2003 National and State Skill Shortage Lists produced by the Department of Employment and Workplace Relations (DEWR) indicate that there were national shortages in the second half of 2002 in the following secondary subject areas: manual arts, maths, physics/chemistry and general science. While DEWR does not quantify the extent of identified shortages, they are very similar to those areas identified by MCEETYA.<sup>30</sup>

**Table 3.6: Secondary teacher shortages, 2002**

Specialisation	AUST	NSW	VIC	QLD	SA	WA	TAS	NT
Manual arts/tech studies*	N	S	S*	S	S			
Maths	N	S	S	S	S		R	S
Physics/chemistry	N	S		S	S		R	S
General science	N	S	S	S			R	
Music			S					
LOTE*			S*	S	S			
Home economics					S			
Information technology			S	S				
Senior English							R	
Special needs					S			
Agricultural science				S				
Physical Education			S					

1. Not all occupations assessed in all States.

\* = Shortages are for specialist skills, see comments below.

N = National shortage S = State-wide shortage.

M = Shortage in metropolitan areas R = Shortage in regional areas.

RD = Recruitment difficulties in regional areas D = Recruitment difficulties.

MD = Recruitment difficulties in metropolitan areas.

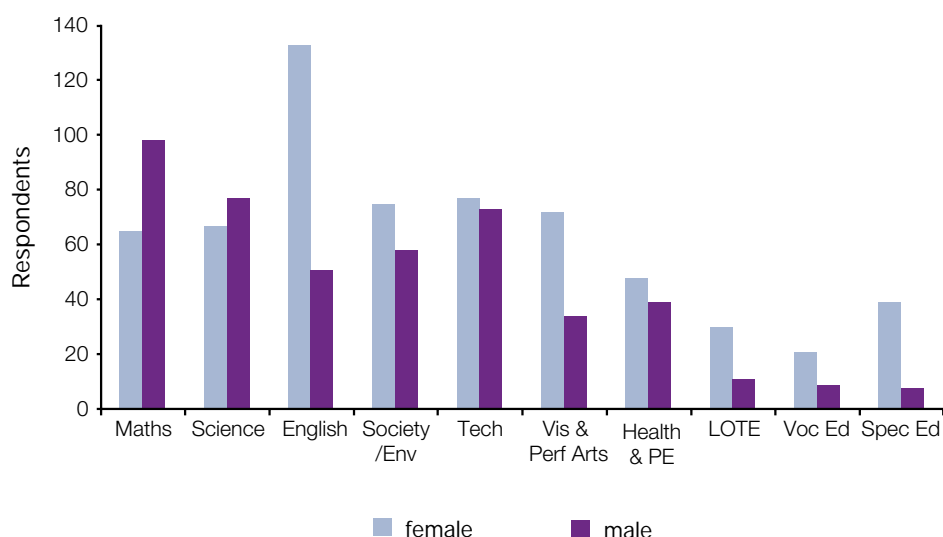
According to Elliot: ‘... many schools in hard-to-staff areas cannot get [mathematics], science, technology or ICT teachers. Some manage to obtain teachers who would not be acceptable in more affluent areas because of their poor training, poor spoken English skills, and poor classroom management skills. Many of these teachers are teaching in schools where students are from non-English speaking backgrounds, further compounding learning problems for students.’<sup>31</sup> Smaller class size and multi-level classes in many regional and remote areas can also work against the employment of specialist mathematics, science and technology teachers in those areas.<sup>32</sup>

Science, mathematics and technology courses at the secondary school level have a higher proportion of male teachers than is the case in other subjects. Data from the 1999 Australian College of Educators' survey indicate that 65 per cent of both Year 12 mathematics and Year 12 science teachers were male. The percentage of mathematics teachers who were male has remained constant since 1989, whereas the percentage of science teachers who were male increased from 59 per cent in 1989 to 65 per cent.<sup>33</sup>

A disproportionate number of male science, mathematics and technology teachers are aged 45 or over, and their potential retirement from the middle of this decade will require effective means to attract increased numbers of teachers of these specialisations. Significantly higher numbers of males than females currently working in education hold science degrees.<sup>34</sup> Increased numbers of female teachers should be recruited into science, mathematics and technology.<sup>35</sup>

Teachers in mathematics and technology tend to be older than the norm, hence the replacement issue will arrive relatively soon, as indicated above. MCEETYA found that mathematics and science were the only specialisations in which male teachers outnumbered female (Figure 3.5).

**Figure 3.5: Specialisation (first main subject) for female and male teachers**



Source: MCEETYA, *Demand and supply of primary and secondary school teachers in Australia*, 2003.

As could be expected, teachers of Year 12 mathematics and science subjects are generally well qualified in their subjects (Table 3.7).

**Table 3.7: Percentages showing highest qualification held by Year 12 mathematics, science and technology teachers by gender, 1999**

Highest Qualification	Males				Females			
	Maths %	Science %	Info Tech %	Tech %	Maths %	Science %	Info Tech %	Tech %
≥ 3 <sup>rd</sup> Year university	69	83	48	37	73	77	46	40
≥ 2 <sup>nd</sup> Year university	81	90	52	43	83	88	53	47
Other post-school	16	9	25	39	12	9	34	39
School or none	4	1	23	18	5	2	14	14
Number	406	597	92	90	219	310	80	57

Source: J Ainley and C Underwood, *op. cit.*

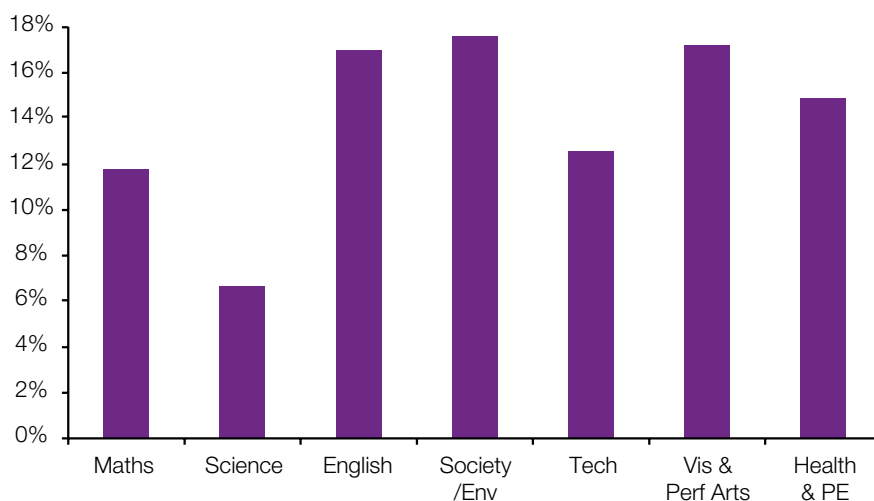
There are suggestions that numbers of teachers without adequate specialist backgrounds in science, technology and mathematics are teaching in these areas—that is, there are numbers of teachers teaching ‘out of field’. What constitutes ‘out of field’ teaching, and how widespread its occurrence is, are difficult matters to determine. At the heart of the ‘out of field’ issue is the use of such terms as ‘qualified teacher’, ‘adequately qualified teacher’ and ‘well qualified teacher’. Different interpretations and approaches to this issue also make analysis complex. While State and Territory education authorities have procedures for recognising specialist training for teaching at secondary schools, no national standard currently exists.

There is a very strong and consistent case advanced by professional associations of science, technology and mathematics educators for prescribing levels of subject specialist knowledge among secondary teachers of these subjects, but they have divergent views on what would constitute a desirable standard. The Australian Science Teachers’ Association has affirmed the desirability of secondary science teachers having at least a second-year tertiary qualification in the subject being taught.<sup>36</sup> Similarly, the Science Teachers Association of Western Australia defines a ‘qualified’ senior secondary science teacher as one who has successfully completed second-year university units in the subjects they teach.<sup>37</sup> The Federation of Australian Scientific and Technological Societies argues that senior secondary teachers should typically have a university major or higher degree in the relevant discipline.<sup>38</sup> The Mathematics Education Research Group of Australasia states that a ‘well qualified teacher’ should have ‘a strong theoretical and practical knowledge of school mathematics, including statistics, certified by formal qualifications’.<sup>39</sup>

One very significant issue to address is the way schools are organised and operated, and how teachers are assigned to teaching duties. It is a feature of secondary schooling that some teachers are not teaching either the first or second subjects in which they qualified as trainees. There are a variety of reasons for this: teachers need to fit into the requirements of the school in which they find themselves; changing curriculum patterns over the years; changing patterns of student subject choice; and changing teacher interests and expertise. Some subject areas in some secondary schools are inevitably taught by teachers who may not have the desirable specialist background. In this situation, teachers must be supported with targeted professional learning opportunities.

According to a national survey of teachers, on average, only 62.5 per cent of secondary teachers who had specialised in a subject taught it as their first main subject, and a substantial percentage were not teaching as either their first or second main subject the subject in which they held the highest qualifications.<sup>40</sup> Figure 3.6 indicates that a number of teachers of all subjects teach ‘out of field’, although this is less so for science, mathematics and technology specialists. This is clearly an area where professional learning has an important part to play.

**Figure 3.6: Proportion of all teachers who are not teaching as first or second main subject the subject for which they are best qualified**



Note: Teachers whose first main qualification was a language other than English, vocational education or special education were not included in this chart, as the numbers involved were too small to draw meaningful conclusions.

Source: MCEETYA, *Demand and supply of primary and secondary school teachers in Australia*, 2003.

Teaching 'out of field' or teaching grounded in qualifications that may be inadequate for the subjects taught has been frequently noted in recent commentaries on teaching in the fields of science, mathematics and technology. The issue is not, however, straightforward. Reported figures suggest that while there are significant levels of teaching 'out of field', most teaching appears to be 'within field'. The issue does require attention, since not only is there significant concern over the trends, it is not possible to adequately analyse the figures and their implications without more precise data and further research.

The implications and consequences of teaching 'out of field' will remain contested until more precise and disaggregated data can be procured and more rigorous analysis of research findings becomes possible. Greater emphasis needs to be placed on:

- deploying teachers according to their specialist expertise;
- treating disciplinary fields and pedagogical content knowledge as essential requirements for teachers; and
- targeting professional learning opportunities to strengthen teachers' pedagogical and discipline content knowledge.

## 3.2 Current trends

The MCEETYA report on teacher supply and demand found the teaching labour market 'broadly in balance' at the national level in 2002. Nevertheless, recruitment difficulties were reported in both government and non-government sectors in some geographic locations (for secondary teachers in rural and remote areas, and some locations in metropolitan areas) and in a number of teaching specialisations at secondary level.

As noted previously, all States and Territories experienced recruitment difficulties in mathematics, science (especially physics and chemistry) and aspects of technology (for example, industrial arts). Most, but not all, States and Territories experienced recruitment difficulties for languages other than English (LOTE). Table 3.8 characterises the level of difficulty of the teacher shortages which government schools faced in 2001.

**Table 3.8: Overall assessment of the government secondary school teacher labour market by subject area, 2001**

Key Learning Area	State/Territory								Counts of 'acute' and 'moderate' assessments
	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	
Health/physical education	None	Minor	None	Minor	None	Minor	Minor	Minor	0
LOTE <sup>1</sup>	Minor	Minor	Minor	Mod	Mod	Minor	Minor	Mod	3
Mathematics	Acute	Minor	Acute	Acute	Mod	Minor	Mod	Acute	6
English	Minor	Minor	None	Mod	Minor	Minor	Minor	Minor	1
Science	Mod	Minor	Mod	Acute	Minor	Minor	Mod	Minor	4
SOSE <sup>2</sup>	Minor	Minor	None	Mod	None	Minor	Minor	None	1
VPA <sup>3</sup>	None	Minor	Minor	Minor	None	Minor	None	None	0
Technology <sup>4</sup>	Mod	Minor	Minor	Acute	Mod	Minor	Minor	Mod	4
VET <sup>5</sup>	–	None	Mod	None	Minor	None	Mod	Minor	2
Special education	Mod	Minor	Minor	None	Minor	None	Mod	Minor	2
Other	None	Minor	None	Minor	Minor	None	Minor	Minor	0
Counts of 'acute' and 'moderate' assessments	4	0	3	6	3	0	4	3	

Source: *School Staffing Survey, Government Secondary Education, DEST 2002–reported in MCEETYA, 2003.*

Notes:

<sup>1</sup> Languages other than English.

<sup>2</sup> Studies of society and the environment

<sup>3</sup> Visual and Performing Arts

<sup>4</sup> Technology includes technical/industrial arts, home economics, information technology

<sup>5</sup> Vocational Education and Training

**Difficulty Level:**

**Acute:** Broad recruitment deficit (widespread shortfalls)

**Moderate:** ("Mod") - Unable to satisfactorily meet demand in some locations (some shortfalls)

**Minor:** Just able to satisfy the demand for teachers (significant shortfalls avoided)

**None:** Abundant teacher supplies (easily able to satisfy demand).

Mathematics recruitment difficulties were more serious in the government sector, while recruitment difficulties for technology and LOTE were more serious in the non-government sector.

Little growth in the overall number of school students in Australia to 2007 is anticipated by MCEETYA although, within the school population, the proportion of students of secondary age will grow. A decline in the number of school-age children is expected following 2007, according to the Australian Bureau of Statistics, along with a growth in the proportion of secondary age students.<sup>41</sup> If current staff–student ratios continue, it is unlikely there will be a growth in the overall size of the teaching force over the next 10 years as a result of demographic trends. The size of student cohorts could grow, however, thereby increasing demand, were targets for higher participation rates to be achieved in upper secondary schools, or were current levels of immigration to increase. A cautious estimate, taking all these considerations into account, is that there will be limited or no growth in overall demand for additional positions for teachers over the next decade.

The major anticipated demand, however, will be for teachers to *replace* those who may either retire or resign over that period. Replacement demand seems likely to rise, reflecting the ageing of the teaching workforce, as discussed earlier in this chapter.

Much attention has been given in recent years to anticipating the number of retirements from teaching over the next ten years when the ‘bulge’ reaches retirement age. Some 42 per cent of Australia’s teachers are aged 45 years and over, and the teaching workforce is older relative to the rest of the workforce. Given the tendency of many teachers to depart the workforce at around age 55, many may retire in the next decade.<sup>42</sup> Submissions stated that the ageing of the teacher workforce is a significant issue. Some State and Territory education authorities were of the view that they were unlikely to experience shortages in the short term but that there was likely to be greater demand in the medium to long term.

The Western Australian Department of Education and Training was confident of maintaining the supply of teachers ‘in balance’ with demand, but that there would be challenges with the retirement of the ‘baby boomer’ cohort over the next 10 to 12 years.<sup>43</sup> The Tasmanian Department of Education predicts that meeting overall demand in the secondary sector may become more difficult in 2006 and 2007 as a significant section of the teaching workforce begins to retire—as of June 2002, the average age of the Tasmanian teacher workforce was 43 years. A consequence of this will be high separation rates.<sup>44</sup>

The Victorian Auditor-General found that 45 per cent of the Victorian government teaching workforce is likely to retire over the next ten years, and that a substantial increase in the numbers of new entrants to the profession would be necessary to offset these losses.<sup>44</sup> The South Australian Department of Education and Children’s Services acknowledged that ageing and retirement may lead to shortages of teachers of science and technology in the next five to seven years.<sup>45</sup>

With a large proportion of its workforce aged between 45 and 55, a potentially high proportion of Australia’s government sector teachers may be eligible and decide to retire within the next ten years. The extent to which retirements occur will depend on the success of any incentives offered to older teachers to remain in teaching. A significant factor is the nature of superannuation arrangements which, while they vary between States and Territories, generally encourage departure at the age of 55–60 years, although a number of these teachers may return on a casual basis. The picture is not so clear in the non-government sector, where superannuation and potential age retirements have different patterns from those in the government sector.



How far it will be possible to stagger resignation dates in jurisdictions where age band resignations are currently encouraged by superannuation arrangements is yet to be seen. According to Clare: 'A number of superannuation schemes covering teachers have provisions favourable to early retirement. In the main, these are public sector defined benefit schemes that have been closed to new members for a decade or more. However, given that teachers in their 50s generally have been in employment for a considerable period of time, often continuously in one public school system, there are likely to be substantial numbers of teachers considering early retirement who can benefit from such provisions.'<sup>46</sup>

Clare explores a number of options which, in his view, would not entail major expense for employing authorities and which would provide incentives for teachers to continue in the workforce without loss of superannuation benefits. These might include: a guarantee that those eligible for an advantageous resignation benefit (typically at age 54 and 11 months) will receive a benefit on retirement after age 55 that at least equals the resignation benefit; continue to base final average salary for superannuation purposes on a teacher's previous salary should they opt from teaching full time to teaching part time or move to a lower level position with fewer responsibilities later in their career; or provide a bonus payment at, say, age 60 to any teacher still in employment who has achieved their maximum retirement benefit at age 55.

However, most teachers (those in non-government schools and the more recently employed, frequently younger, teachers in government schools) are members of accumulation-based superannuation schemes which do not have provisions favouring early retirement at specific ages. Thus this particular concern relates to a defined group of teachers over the next few years, and Clare estimates that the '54/11' effect may have already peaked.

Besides retirement, separations from teaching due to resignation are significant. In both government and non-government sectors, more teachers resigned than retired from service during 2001, with a notably higher rate of resignation in secondary than in primary schools within the government sector.<sup>47</sup> These rates need to be treated with caution, however, as resignation from an employer does not necessarily indicate a loss to teaching; it could mean that a teacher changes employer (whether systemic or individual school in parts of the non-government sector).

An important issue arising from the MCEETYA study was the number of teachers leaving the profession after less than five years working as a teacher. Some State and Territory education authorities have anecdotally reported high attrition rates early in teachers' careers.<sup>48</sup> This is possibly as high as 25 per cent within the first five years of teaching. Much better retention strategies must be implemented by education authorities, and it is generally agreed that greater emphasis on development and retention would help modify the impact of potential shortages.<sup>49</sup>

The MCEETYA supply and demand study notes that resignations out of teaching are affected significantly by the state of the economy—they tend to rise when general labour market conditions favour job seekers.<sup>50</sup> A number of submissions have referred also to the relative ease with which teachers of certain specialisations, notably science, mathematics and technology, can gain employment in other sectors, where salaries are more competitive at the mid-career stage.

A disproportionate number of males teach in science, mathematics and technology and are also concentrated in the older age groups. Thus a higher level of replacement demand for science, mathematics and technology teachers can be expected in coming years. This circumstance presents a definite opportunity to bring into teaching in these areas highly educated teachers with fresh ideas and a readiness to overcome what have become big challenges—in student motivation in the middle years and student interest in the most demanding upper secondary courses.

### 3.3. A career of choice

Sufficient numbers of people need to be attracted to teaching and undertake a course of teacher education—whether they be immediate school leavers, graduates in specialist areas, or people considering a mid-career switch to another profession. This is important because the most significant source of supply of teachers is recent graduates of initial teacher education programs in tertiary institutions, and these form some 4 to 5 per cent of the teaching workforce in any one year. Around 11 000 to 12 000 completions annually to 2005 are projected by MCEETYA, of whom 70 to 75 per cent are assumed available for teaching. A trough in initial teacher education commencements in the early to mid-1990s has been passed and the level of commencements is currently on a sustained upward trajectory.

Of the various sources of supply, most detailed attention has been given to graduates of initial training courses but, even here, a range of uncertainties remains about supply. The image of the 'teacher supply chain' has been invoked to bridge the very large gap in numbers between those who apply for and are accepted into an undergraduate teaching program, and those eventually employed to teach. Allen estimates that, in Victoria, based on 1999–2001 figures, 'for every 100 applicants, 56 received an offer, 41 enrolled, 31 would be expected to graduate, 23 would be available for full-time employment, and 15 would be employed as teachers in schools'.<sup>51</sup> Different reasons account for the attrition which characterises successive decision points, each of which is—to a lesser or greater extent—susceptible to different types of policy intervention. If these figures are more widely confirmed, they provide a very precise set of intervention points to work on. While this kind of wastage is highly inefficient, it could also reflect Generation 'X' and 'Y' ease with and desire for change.

Forecasting difficulties are compounded by data issues. Without improved data, closer interrogation of the data and well informed and far-sighted action, it is unlikely that earlier cycles of under- and over-supply will be or can be readily avoided in the future. The ability of universities to provide the right mix of places, even if student demand remains at its recent buoyant levels, is an issue. While supply to initial teacher education has traditionally been school leavers planning a lifetime career in teaching, in recent years a new stream of entrants to initial training courses has come from mature-age adults moving into teaching as a second career. This is a varied group, about which more knowledge is needed through labour market research.

Education authorities have policies and programs to attract people to teaching, primarily through public promotional/information campaigns and through career guidance for school (and university) students. The recent New South Wales recruitment campaign promoted teaching as a rewarding career where an individual teacher can make a difference. Strongly promoted in the media, the campaign was supported by a shopfront, website and outreach program where recruitment officers provided advice about teaching as a career.<sup>52</sup> Similarly, the Victorian Department of Education and Training recently ran a high profile public information campaign with the theme: 'Become a teacher because ... teaching is one of the most stimulating and satisfying careers available today and one which has the ability to influence or make a lasting difference to so many lives'.<sup>53</sup>

Attached to such recruitment campaigns is a range of supporting mechanisms and incentives to assist prospective teachers through their teacher training and preparation. For example, the Victorian Teaching Scholarship Scheme supports students to become qualified and teach in government schools through the provision of cash payments of \$3 500 and guarantees of ongoing employment in Victorian government schools.<sup>54</sup> The New South Wales Department of Education and Training offers pre-service scholarships to support students to become teachers of science, technology and mathematics, including covering Higher Education Contribution Scheme (HECS) liabilities, the provision of a training allowance and guaranteed appointment for a minimum three years to a school in a specific geographic area.<sup>55</sup> Similarly, the South Australian Department of Education and Children's Services Early Targeted Graduate Scheme targets graduates of science, technology and mathematics.<sup>56</sup>

School leavers are also a potential teaching source for rural and remote communities, because some individuals who are already members of a community are likely to return and remain there after they become teachers. Indeed, the Isolated Children's Parents' Association of Australia encourages students from rural and remote areas to pursue a career in primary teaching.<sup>57</sup>

The Victorian Department of Education and Training has identified a strong trend in increased numbers undertaking postgraduate teacher education courses and has noted the opportunities for attracting graduates seeking to change career direction through targeted recruitment campaigns.<sup>58</sup> This is premised on the likelihood that new teacher graduates are more likely to begin teacher preparation at the postgraduate level and come from an undergraduate degree in a non-education field. Indeed, The University of Melbourne indicates a recent and substantial increase in enrolments in its Graduate Diploma of Education.<sup>59</sup>

The pool of immediate science and mathematics graduates could extend to a range of other graduates, for instance of agricultural science or engineering. In this regard, the current accreditation and recognition restrictions in some States and Territories for engineering graduates, whereby they are not considered to have sufficient science, mathematics or technology to be eligible to enter one-year postgraduate teacher education courses, should be addressed.<sup>60</sup>

Some State and Territory education authorities have developed recruitment strategies which specifically target mid-career professionals and offer a range of appropriate incentives to support a mid-career switch to teaching. Such strategies facilitate entry of mid-career professionals into teacher training by taking into account: prior skills and knowledge; costs of re-training and loss of income; the use of different types of teacher preparation programs; greater levels of demand on mature-age students such as family commitments; and different expectations around salaries and remuneration. Education Queensland acknowledges the importance of 'creating new pathways and avenues for mid-career transition to teaching' and the 'use of differential starting salaries that recognises prior service in a related industry or service [and] facilitates ease of transition from existing career to teaching'.<sup>61</sup>

The Western Australian Department of Education and Training has found that training wages and payment of course fees coupled with guaranteed placement in a school at a salary above beginning teacher level are very effective means for attracting mid-career professionals. The Department targets mid-career professionals from technology-related fields and offers assistance with teacher training and through financial support.<sup>62</sup> In New South Wales, the Accelerated Teacher Training Program provides opportunities for professionals to retrain as teachers of science (physics), technology and mathematics, and covers costs associated with university tuition and administration.<sup>63</sup>

As education authorities' policies and programs to attract people to teaching become more sophisticated and more widespread, the interactions between financial incentives, income support and taxation will need further refining to ensure recipients gain maximum benefit.

### 3.4 Workforce planning to recruit and retain quality teachers

Teacher workforce planning needs to be undertaken in close association with analysis of overall labour market trends since the knowledge and skills teachers have are often in high demand in other sectors of the economy. Several varied sources of supply were considered by the 2003 MCEETYA supply and demand study:

- recent graduates represented about 70 per cent of new teachers appointed to schools in 2002;
- teachers returning from leave represent about 6 per cent of the teaching workforce;
- teachers in the pool of relief and casual teachers total some 30 000–40 000 Australia-wide, and teachers on State employment lists for ongoing teaching positions total around 31 000 in the States of New South Wales, Queensland and Western Australia alone (although an unknown degree of overlap exists between these categories); and
- overseas migration flows accounted for about 0.2 per cent of the teaching workforce in net terms on average in the late 1990s (although numbers have declined in recent years).<sup>64</sup>

A key policy interest in recent years has been those with teaching qualifications working or otherwise occupied outside the education sector. The *Transition from Education to Work 2001* survey data indicate that, in May 2000, 31.8 per cent of qualified teachers in the workforce (some 117 000 individuals) were employed in other industries, most commonly: health and community services; property and business services; retail; personal and other services; and government administration and defence.<sup>65</sup> Teacher education is a good preparation for a wide range of occupations. Research by the Ramsey review of teacher education in New South Wales found a general consensus among qualified teachers working outside teaching that their background as teachers strengthened their employability through enhancing communication skills and ability to deal with people, while a career outside teaching brought opportunities for greater flexibility and the prospect of higher salaries over time.<sup>66</sup> An additional potential source of supply of teachers exists in those with teaching qualifications who are not active in the workforce, some of whom might be available for teaching, depending on personal and family circumstances.

A further factor is the level of response by Australian teachers to specific targeting by overseas recruitment campaigns. The present broad balance between the numbers of teachers leaving and arriving in the country could change. Some submissions expressed concern about potential losses of teachers to overseas education systems. A number of countries, including the United Kingdom, Hong Kong, China, Canada and the United States recruit Australian teachers with offers of higher salaries and a range of incentives (including airfare, housing and rental assistance, training bursaries, bonus schemes, teachers' tax credit and exemption from repayment of student loans). There were views that this mobility appears to be particularly high in the areas of science, mathematics and technology education.

The international labour market for English-speaking teachers of science, mathematics and technology has expanded, greatly assisted by lowering of restrictions on mobility of labour. International competition can be expected to increase, both for these categories of school teachers and for teacher educators. Australia's teacher policies need to be further developed in the context of international as well as national mobility of highly skilled personnel. A longer-term view of teaching expertise and experience is also required. International experience provides excellent opportunities for Australian educators to bring back new knowledge and skills.

State and Territory education authorities have in place policies and programs to attract people back into teaching, primarily through the aforementioned public promotional campaigns which are, for the most part, recruitment drives to attract trained teachers to fill immediate vacancies in schools. Other programs include the NSW Graduate Recruitment Program, which aims to attract outstanding graduates to New South Wales government schools.<sup>67</sup> In the case of independent schools, a range of similar incentives are used to attract teachers where 'school authorities make decisions at the local level on advertising and recruiting'.<sup>68</sup>

While these generic campaigns and support activities attract sufficient numbers of teachers overall, it appears that different and targeted recruitment strategies may be required to retain existing teachers or to attract teachers back to teaching, particularly if their previous experience has been less than positive, or they are in higher paid employment elsewhere. According to teachers themselves, the main factors important in retaining teachers are:

- improved remuneration (25%);
- increased resources/reduced workload (23%);
- improved employment conditions other than remuneration (19%);
- improved professional standing in the community (13%);
- reduced class sizes (9%); and
- improved student behaviour (6%).<sup>69</sup>

A number of submissions to the Committee, and other evidence, have highlighted the pressures on teachers and the very wide array of duties they must perform in addition to direct teaching. Research by Dinham and Scott with some 3 000 teachers across five countries (including Australia) draws attention to this issue.<sup>70</sup> Society expects much of teachers and that teachers exercise responsibility for children's welfare as well as their formal learning.

Positive work environments in which teachers feel valued and are able to fully engage students are crucial to student learning outcomes. Teachers gain satisfaction from their teaching role and their part in school community life. Teacher dissatisfaction appears to derive from factors which are largely external to the school and over which they believe they have little control or influence. These include: the status and image of teachers; perceived poor opinion in the community of teachers' 'easy' working conditions; negative image of teachers in the media; problems with imposed educational change; coping with added responsibilities; perceived lack of support to implement change; lack of support services; and problematic promotion opportunities and procedures. Teachers commonly speak of the difficulties they encounter in behaviour management and the lack of interest shown by some students in learning and being at school.<sup>71</sup> According to a national survey of teachers, the key issues creating job dissatisfaction for teachers include:

- lack of resources or time (37%);
- student welfare issues (20%);
- attitude problems of parents and the community (17%);
- employment conditions other than remuneration (10%); and
- lack of autonomy or creativity (7%).<sup>72</sup>

These findings draw attention to the impact on teaching of changes in the environment or culture which affect community perceptions and expectations of education. Teachers, like the overall population, are subject to the drive for increased international competitiveness, higher levels of human competence and labour market capability, and a growing community preoccupation with results, outcomes and quality of performance. Teachers and teaching are judged against these expectations and operate in an environment where change has become the norm. Because schools have become generally more open to parents, the community and the media than in the past, teaching is more visible. Greater transparency is required by the elevation of education in the scale of public priorities. Accountability requirements must be met in teaching as in all other professions.

The challenge that wider society changes pose to the teaching profession are increasing and, as a consequence, the context of teachers' work has become more demanding. Many of these circumstances are unlikely to change in the short term, although several can be ameliorated. For example:

- the status and public image of the profession can be positively influenced by the present nationwide move toward higher professional standards;
- changes in work organisation and the use of resources at the school level can have a very significant impact on teacher time management and morale;
- workforce planning together with professional development can be an instrument for further developing the structures of the teaching career to give greater recognition to quality teaching and professional attainments.

Effective strategies need to be used to retain teachers, including satisfying the needs of teachers in a career expected to have multiple entry and exit points, using effective financial incentives and providing and recognising relevant professional learning.

### **3.5 Future challenges and national workforce planning**

As noted earlier, the MCEETYA report on teacher supply and demand found the teaching labour market 'broadly in balance' at the national level in 2002, with recruitment difficulties reported in both government and non-government sectors in some geographic locations (for secondary teachers in rural and remote areas, and some locations in metropolitan areas) and in a number of teaching specialisations at secondary level.

MCEETYA estimates indicate that Australia could face overall shortages of teachers in the future and the extent of any shortfall will depend on the policy initiatives to attract and retain teachers. Estimates of overall shortages of up to 20 000 –30 000 teachers later this decade could eventuate depending on the success of attraction and retention initiatives, including lowering the relatively high rates of both teacher resignations and retirements over the period.<sup>73</sup> MCEETYA has, in a broad sense, described the composition of any shortfall, as:

- likely to be in secondary teaching, due to an expected shift in student enrolments away from primary education towards secondary education;
- likely to vary between States and Territories, due to differential population growth and projected student enrolment trends;
- likely to be in secondary teaching specialisations (notably mathematics, science and technology); and
- likely to be in some geographic areas, particularly rural and remote.<sup>74</sup>

Much will depend on the success of policy initiatives to recruit teachers to schools and to retain existing teachers, by curbing potential teacher retirements and resignations.

In recent years there has been very considerable progress through MCEETYA in building up national profiles of the teaching workforce and in analysing likely supply and demand issues. However, there are real limitations to existing data and little firm evidence about what is happening in relation to supply (for instance, secondary specialisations of teacher education students) and demand issues (for instance, why a high percentage of teachers resign in the first 5 years and the intentions of teachers approaching retirement age). From a review of available demand and supply projections, Ainley and Underwood conclude:

Although there are a number of uncertainties involved in projections of both supply and demand for teachers there appears to be some general conclusions that emerge from data concerned with the availability of teachers over the years to 2010. The deficit in supply is much more an issue for secondary than primary schools, it is likely to be greatest in the mid to the latter part of the decade and may be greater in mathematics, science and technology. However, it needs to be noted that projections are based on data at aggregate levels and these overall generalisations can mask areas of particular need in some jurisdictions. There is a need for better and more disaggregated data to support labour force projections in school education.<sup>75</sup>

Due to existing data and other constraints, the Committee is unable to disaggregate existing information to a more detailed level to indicate, for instance, how many teachers of a certain specialisation may be required in a particular State or Territory in any given year. Teacher supply and demand data that is disaggregated to the State and Territory, as well as the regional level, would inform policy makers about specific demand for teachers in specific geographic areas, and in specific fields of specialisation like chemistry, physics and mathematics.



Substantially new and improved data collection and qualitative research is required. In preparation for the 2004 Report on Supply and Demand, MCEETYA is reviewing data-gathering instruments and processes. The Committee's conclusion is that more comprehensive statistics relating to teachers, teacher workforce trends generally and specific fields of teaching and teacher education need to be consistently, reliably and regularly collected on a national and collaborative basis.

Ideally, education authorities should be able to produce an accurate and detailed profile of current workforce needs—not just broad workforce demographics but specific skills, capabilities and intentions. A qualitative profile, coupled with knowledge of quantitative supply and demand, can be used to identify new and emerging trends. And if collected on an ongoing basis through regular monitoring mechanisms it will establish a sound basis for planning both shorter-term initiatives for more immediate solutions as well as longer-term initiatives. In this way, teacher employers will be able to know what teacher skills and attributes currently exist in schools and which of them need to be retained for the future; what skills and attributes need to be acquired through recruitment; and what skills and attributes can be developed through succession planning and professional learning and development.

Principles for coherent workforce planning include: successful recruitment and retention of high quality teachers with the required skills and expertise; understanding and analysing existing teacher motivations and intentions; ensuring rapid and strategic intervention and responses to changing needs; identifying and retaining the best; reducing costs associated with teacher attrition, replacement and retraining; and monitoring and evaluation. Through effective planning and managing of a high quality teacher workforce, school employers can ensure the efficient and effective delivery of their education services.

The Committee believes that anticipatory action is needed to address potential shortages through more definitive workforce planning that informs policies and programs that education authorities use to recruit and retain teachers.

Workforce planning is a complex and difficult task. Nonetheless, existing arrangements for workforce planning are varied and often uncoordinated across the country. While all education authorities have developed some form of planning measures, better and more collaborative planning among all the key stakeholders needs to be negotiated and implemented. For instance, in some States and Territories and for some systems, the projected teaching workforce needs of school systems do not formally influence the enrolment targets and shape of teacher education programs run by universities and other higher education institutions.

In this regard, the Committee welcomes the decision of State and Territory Ministers to work with the Australian Government in developing the proposed Commonwealth Grant Scheme (CGS), under which universities will be required to enter into a funding agreement with the Australian Government specifying both the number of places and the discipline mix, in part based on labour market needs. This is sound policy.

The focus of workforce planning for the present will be on recruitment, deployment and retention, as well as professional learning and development needs. Education authorities will need to capitalise on existing teacher capabilities; develop flexibility and adopt planning processes that respond to school needs, and changing demands, both internal and external. Success lies in supporting, shaping and reshaping the teacher workforce to anticipate current and future directions and needs.

More than ever, coordinated national planning, collaboration and action by the Australian Government, State and Territory governments, government and non-government teacher employers, higher education institutions and the profession itself will be required to ensure that high quality teachers lead and facilitate the best possible learning for all children. Establishing and maintaining an adequate supply and especially retaining existing quality specialist secondary teachers of science, technology and mathematics is a complex matter, requiring actions by a range of key players.

## Key conclusions

### Several conclusions follow.

- Although there are a number of uncertainties involved in projections of both supply and demand for teachers, there appear to be some general conclusions that emerge from data concerned with the availability of teachers over the years to 2010. Estimates of a projected deficit in supply is much more an issue for secondary than primary schools, it is likely to be greatest in the middle to the latter part of the decade and may be greater in mathematics, science and technology.
- Substantially new and improved data collection and qualitative research is required. More comprehensive statistics relating to teachers, teacher workforce trends generally and specific fields of teaching and teacher education need to be consistently, reliably and regularly collected on a national and collaborative basis.
- More information and research is urgently required into building the longer-term capacity of the teacher profession—more needs to be known about existing and future education and skills needs for the teacher workforce, and more needs to be known about the intentions and motivations of those likely to leave, and those likely to enter, the profession. Such data needs to find their way more systematically to teachers, educational leaders, teacher educators and policy makers alike.
- Teacher education places should be allocated by number and discipline mix in order to meet future workforce needs. Specifically, the allocation of places will need to take account of the shift in demand from primary to secondary, for specialist fields, particularly physics, chemistry, technology, mathematics and LOTE, and for specific geographic regions.

- There is more to workforce planning than simply ensuring that numbers of prospective teachers are being prepared to teach in Australia's schools. The focus of workforce planning for the present will be on recruitment, deployment and retention, as well as professional learning and development needs.
- State and Territory education authorities will be shaping and reshaping their teacher workforce in anticipation of current and future directions and needs. Through flexible and responsive planning processes, they must capitalise on existing teacher capabilities through better understanding of teacher motivations and intentions. Recruiting and retaining high quality teachers with requisite skills will require high levels of workforce planning expertise with a capability to intervene rapidly and strategically in response to changing needs.
- The range of incentives offered by education authorities to attract, recruit, deploy and retain teachers must be strengthened, become more widespread, and be targeted at areas of greatest need.
- Policy directions need to become more sophisticated to take account of mobility, but also of changing career expectations, competition for talented people from other sectors and changes occurring in schooling.
- Coming soon is not just a national market for teachers but a strong global market, at least among English-speaking countries—and wherever English-speaking teachers are in demand. This is true also of teacher educators, whose expertise is in demand internationally. Policies and practical procedures for attracting and retaining teachers need to be fully competitive in this growing international market.
- Further steps are now needed: for greater national collaboration to achieve more coherent and fine-tuned workforce planning across Australia.

<sup>1</sup> N Dempster, C Sim, D Beere and L Logan, *Teachers in Australian schools. A report from the 1999 National Survey. Executive summary*, Department of Education, Training and Youth Affairs, Canberra, 2000.

<sup>2</sup> Australian Education Union, Submission no. 178.

<sup>3</sup> New South Wales Department of Education, submission no. 141, p. 25.

<sup>4</sup> Department of Education, Western Australia, submission no. 102, pp. 1–2.

<sup>5</sup> South Australian Department of Education and Children's Services, submission no. 143, p. 7.

<sup>6</sup> Association of Independent Schools, South Australia, Submission no. 24, p. 8.

<sup>7</sup> Alumni Location Data from Charles Sturt University records, provided by Professor J. Pratley, Dean of Science and Agriculture, 4 March 2003.

<sup>8</sup> Australian Bureau of Statistics, *Schools Australia 2002*, Catalogue No. 4221.0, ABS, Canberra, 2003. In 2002, Australia had 249 629 school teaching staff; 225 353 full time equivalent, representing an increase of 1.4% over 2001. Teaching staff are defined as those staff who spend the majority of their time in contact with students. Australia had 9632 schools in 2002.

<sup>9</sup> At the primary level, the government sector accounts for almost three-quarters of the teaching staff, 72.7%, while at the secondary level, for 62.9 per cent (Australian Bureau of Statistics, *Education and training in Australia, 2002*, Catalogue No. 4224.0, ABS, Canberra, 2002).

- <sup>10</sup> Australian Bureau of Statistics, 2003, op cit., pp. 102–103 (see J Ainley and C Underwood, *Australia's Teachers: Australia's Future*, Vol. 3, Background data and analysis, Review of Teaching and Teacher Education, DEST, Canberra, 2003)
- <sup>11</sup> Centre of Policy Studies, *The economic outlook for the labour market*, briefing, Centre of Policy Studies—Impact project, Monash University, Melbourne, 27 November 2002.
- <sup>12</sup> B Birrell, IR Dobson, V Rapson and TF Smith, *Skilled Labour: Gains and Losses*, Centre for Population and Urban Research, Monash University, 2001.
- <sup>13</sup> Australian Bureau of Statistics, 2003, op cit.
- <sup>14</sup> Australian Bureau of Statistics, 2003, op cit. (See Ainley and Underwood, op. cit., section 5).
- <sup>15</sup> Higher Education Statistics, unpublished data, DEST, 1983 data reported in Ministerial Council on Education, Employment, Training and Youth Affairs, *Demand and supply of primary and secondary school teachers in Australia*, MCEETYA, 2003, <[www.curriculum.edu.au/mctyapdf/demand](http://www.curriculum.edu.au/mctyapdf/demand)>.
- <sup>16</sup> Department of Education, Western Australia, submission no. 102, p. 2.
- <sup>17</sup> Senate Employment Education and Training References Committee, *A class act: inquiry into the status of the teaching profession*, SEETRC, Canberra, 1998, p. 112.
- <sup>18</sup> In 2000, statutory teaching commencing salaries for primary teachers in Australia were US\$26 887—around US\$5000 greater than the OECD mean.
- <sup>19</sup> ABS, *Schools Australia*, p.104.
- <sup>20</sup> Malcolm Solomano, submission no. 5; Chad Gallaher, submission no. 9; Peter Best, submission no. 11; Sr Barbara Bochat, submission no. 13; AG Shannon, submission no. 14; Iona Presentation College, submission no. 17; p. 9. Nola Shoring, submission no. 19, p.3; Neville Hatton & Alan Watson, submission no. 20, p. 19; Association of Independent Schools, South Australia, submission no. 24, p.10; Don Zoellner, Centralian College, submission no. 25, p. 5; Curtin University of Technology, submission no. 41, pp. 2–3; Women in IT Tasmania, submission no. 43; Australian Council of Deans of Science, submission no. 45, p. 4; Australian Education Union, Submission no. 49, pp. 9–10; Board of Teacher Registration, Submission no. 50, pp. 4–7; Australian Science Teachers Association, submission no. 55, p. 4; School of Education, University of Queensland, Submission no. 57, pp. 10–12; Australian Association of Mathematics Teachers, Submission no. 60, p. 8; submission no. 61, p. 5; Queensland Deans of Education Forum, submission no. 65, p. 10; School of Mathematics, University of New South Wales, submission no. 68, pp. 2–3. University of Sydney, submission no. 71, p. 6; School of Teacher Education, University of Canberra, submission no. 72, p. 5; Edith Cowan University, submission no. 73, p. 5; Australian Mathematical Society Incorporated, submission no. 79, p. 2; Faculty of Education, Health and Professional Studies, University of New England, submission 87, p. 7; University of Western Sydney, Submission no. 89, p. 14; Australian Parents Council Incorporated, submission no. 93, p. 2; Professor Alison Elliott, submission no. 96, pp. 5–7; National Catholic Education Commission, submission no. 107, p. 7; Australian Council of Deans of Education Incorporated, submission no. 128, p. 4.
- <sup>21</sup> Ministerial Council on Education, Employment, Training and Youth Affairs, *Demand and supply of primary and secondary school teachers in Australia*, MCEETYA, Melbourne, 2001.
- <sup>22</sup> N Dempster, C Sim, D Beere and L Logan, *Teachers in Australian schools. A report from the 1999 National Survey. Executive summary*, Department of Education, Training and Youth Affairs, Canberra, 2000.
- <sup>23</sup> Department of Education and Training, Victoria, submission no. 124, p. 10.
- <sup>24</sup> Don Zoellner, Centralian College, submission no. 25.
- <sup>25</sup> University of Sydney, submission no. 71.

- <sup>26</sup> Responding to the single most important issue that bothered them in their work as teachers, only 2.3 per cent nominated remuneration. While it was slightly more important for male than female teachers, and for secondary rather than primary teachers, and in the non-government sector, and in the 25–34 age group, in no case did it rate for more than five per cent of a category of teachers. MCEETYA, *Demand and supply*, op. cit.
- <sup>27</sup> BJ Caldwell and EMA Carter, (eds), *The return of the mentor: strategies for work-place learning*, Falmer Press, London and Washington, 1993, p. 5.
- <sup>28</sup> Department of Education, Western Australia, submission no. 102, p. 2.
- <sup>29</sup> Australian Bureau of Statistics, *Schools Australia* op. cit.
- <sup>30</sup> Department of Employment and Workplace Relations; National Skill Shortage List—Australia 2003.
- <sup>31</sup> Professor Alison Elliott, University of Canberra, submission no. 96.
- <sup>32</sup> Isolated Children's Parents' Association of Australia (Inc), submission no. 48.
- <sup>33</sup> Ainley and Underwood, op. cit., p. 48.
- <sup>34</sup> *ibid.*
- <sup>35</sup> Department of Education, Tasmania, submission no. 116.
- <sup>36</sup> Australian Science Teachers Association, submission no. 55.
- <sup>37</sup> Science Teachers' Association of Western Australia, submission no. 133.
- <sup>38</sup> Federation of Australian Scientific and Technological Societies, *Australian science: an investment for the 21st century*, FASTS, Deakin West, Australian Capital Territory, 2000.
- <sup>39</sup> Mathematics Education Research Group of Australasia Incorporated, submission no. 30.
- <sup>40</sup> MCEETYA, *Demand and Supply*, op. cit.
- <sup>41</sup> *ibid.*
- <sup>42</sup> Department of Education, Western Australia, submission no. 102, p. 3.
- <sup>43</sup> Department of Education, Tasmania, submission no. 116.
- <sup>44</sup> Auditor-General, *Teacher workforce planning*, Auditor-General of Victoria, Melbourne, 2001.
- <sup>45</sup> Department of Education and Children's Services, South Australia, submission no. 143, p. 5.
- <sup>46</sup> R Clare, 'Superannuation arrangements for Australian teachers and their impact on retirement decisions', paper commissioned for Review of Teaching and Teacher Education from the Association of Superannuation Funds of Australia Research Centre, 2003, p. 4.
- <sup>47</sup> The greater number of individual employers in the non-government sector may help explain the higher overall resignation rates, which appear similar for both primary and secondary levels.
- <sup>48</sup> New South Wales Department of Education, submission no. 141, p. 15. In the United States, research has found that 29 per cent of all beginning teachers leave teaching after three years, increasing to 39 per cent after five years. Richard Ingersoll; *Turnover Among Mathematics and Science Teachers in the US*, National Commission on Mathematics and Science Teaching for the 21st Century, Washington, 2000, p. 6. See also Eric Hirsch, Julie Koppich & Michael Knapp; *Revisiting what States are doing to Improve the Quality of Teaching: An Update on Patterns and Trends*, Center for the Study of Teaching and Policy, Washington 2001, p. 19.
- <sup>49</sup> MCEETYA; Information statement 15th MCEETYA Meeting, Perth 10 - 11 July 2003. <<http://www.curriculum.edu.au/mceetya/meetings/meet15.htm>>.
- <sup>50</sup> G Burke, 'Teachers: employment in the 1980s and 1990s', in *The workplace in education—Australian perspectives. First yearbook of the Australian Council of Educational Administration*, Edward Arnold, 1994.
- <sup>51</sup> I Allen, 'The supply of new teachers from Victorian universities', unpublished report for the Victorian Institute of Teachers, 2002, p. 4.
- <sup>52</sup> NSW Department of Education and Training, submission no. 141, p. 24.
- <sup>53</sup> Department of Education and Training, Victoria, submission no. 124, p. 7.
- <sup>54</sup> <[www.teaching.vic.gov.au](http://www.teaching.vic.gov.au)>.
- <sup>55</sup> NSW Department of Education and Training, submission no. 141, p. 26.

- <sup>56</sup> Department of Education and Children's Services, South Australia, submission no. 143, p. 7.
- <sup>57</sup> Isolated Children's Parents' Association of Australia (Inc), submission no. 48, p. 11.
- <sup>58</sup> Department of Education and Training, Victoria, submission no. 124, p. 5.
- <sup>59</sup> University of Melbourne, submission no. 85, p. 6.
- <sup>60</sup> The Institution of Engineers, Australia, submission no. 123; Betty Jacobs, submission no.15, pp. 3-4.
- <sup>61</sup> Education Queensland, submission no. 53, p. 4.
- <sup>62</sup> Department of Education, Western Australia, submission no. 102, p. 3.
- <sup>63</sup> NSW Department of Education and Training, submission no. 141, pp. 28–29.
- <sup>64</sup> MCEETYA, *Demand and Supply*, op. cit.
- <sup>65</sup> Australian Bureau of Statistics, *Transition from School to Work*, 2001.
- <sup>66</sup> G Ramsey, *Quality matters. Revitalising teaching: critical times, critical choices*, report of the Review of Teacher Education, New South Wales, Department of Education and Training, Sydney, 2000, p. 39.
- <sup>67</sup> New South Wales Department of Education and Training, submission no. 141, p. 27.
- <sup>68</sup> Australian Association of Christian Schools Incorporated, submission no. 90, p. 8; Association of Independent Schools of South Australia, submission no. 24, p. 5.
- <sup>69</sup> MCEETYA, *Demand and Supply*, op. cit.
- <sup>70</sup> S Dinham and C Scott (eds), *Teaching in context*, Australian Council for Educational Research, Camberwell, Victoria, 2000.
- <sup>71</sup> Dinham 2002; Dinham and Scott 2000.
- <sup>72</sup> MCEETYA, *Demand and Supply*, op. cit.
- <sup>73</sup> *ibid.*
- <sup>74</sup> MCEETYA, *Demand and Supply*, op. cit.
- <sup>75</sup> J Ainley and C Underwood, 'Background data analysis for the Review of Teaching and Teacher Education', paper commissioned for Review of Teaching and Teacher Education, 2003.

## 4. Revitalising the teaching profession

Teaching has long been a preferred career for many people. People choose to be teachers for all sorts of reasons: they enjoy communicating and exploring ideas; they get satisfaction from helping students learn and develop; they have an enthusiasm for learning or for a particular subject and want to pass this on to others; and they want to work with young people, have an impact on future generations and make a contribution to the community.

National moves to reach agreed professional teaching standards, to achieve a better coordination of teacher accreditation and registration procedures and to develop a more mobile and national profession are part of a wider movement in education to improve quality of teaching and learning and to develop a national perspective on issues of common concern.

### 4.1 The attractiveness of teaching

In a recent survey of teachers by the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA), the two most frequently cited motivations for becoming a teacher were 'enjoy working with children' (30.7 per cent) and 'desire to teach' (22.0 per cent).<sup>1</sup>

**Table 4.1: Motivations for becoming a teacher—female, male and all teachers (per cent)**

	Female	Male	Total
Enjoy working with children	32.8	25.9	30.7
Desire to teach	24.0	17.4	22.0
Recruitment campaign or positive impact of role model	11.0	12.5	11.5
Employment conditions	6.5	13.4	8.6
To make a difference	6.8	11.8	8.3
Enjoy subject	5.7	7.2	6.2
Fallback option	6.6	4.9	6.1
Scholarship	5.9	5.9	5.9
Remuneration	0.7	1.0	0.8

Note: Some of the motivations recorded have been grouped for ease of analysis:

- 'Desire to teach' is a combination of 'desire to teach' and 'share skills/knowledge with students';
- 'Employment conditions' is a combination of 'job security', 'working hours/holiday provisions', and 'mobility of position allow for travel'; and
- 'Fallback option' is a combination of 'only option available', 'dislike previous career', 'injury sustained from previous career' and 'needed a job/fell into teaching'.

The attractiveness of teaching is an important feature of the profession. How the community, parents and teachers view the profession now and in the future is critical. There is a need to focus on community attitudes and to find ways to develop greater public understanding of, and confidence in, what schools and teachers do. Teachers and teaching are crucial to the knowledge economy and more value needs to be placed on the profession and its standing in the wider community.

Education authorities in Australia recognise the need for positive approaches to attract talented people to teaching and to bring teachers who have left the profession back into the classroom. Particularly in fields of scarcity, they are taking action both to draw people in and to encourage existing teachers to retrain to meet demand, for example in science teaching. As discussed in previous chapters, mathematics, physics, chemistry and technology teachers are in great demand, not only in Australia—people are not making teaching in these disciplines a career of choice.

There is much that can be done to interest school and university students in teaching. Career advice is one way. Teaching should be understood as a complex, sophisticated task requiring a high level of skill and training. Schools are dynamic changing institutions and the work that teachers do is also changing to include new roles in collaborative teaching, tailoring curriculum to local school needs, using information and communications technology to teach and taking on a variety of administrative, management, planning and leadership roles within schools. In addition to pedagogical skills, other abilities are important: to shape a changing school environment; to work as part of a team, communicating with parents, school administrators and the local community; and to develop and maintain partnerships and linkages with industry. In its advice about careers in teaching, the Graduate Careers Council of Australia explains: 'Teaching offers a stimulating career with scope for creativity and innovation, and provides a chance to influence students as well as parents and other teachers. Many teachers like the way they can be, to some extent, professionally autonomous. As long as the curriculum is covered and any other guidelines followed, the way they deliver the "product" is up to them. They can put their own stamp on their own work and gain a great deal of satisfaction when they see positive results from their own creativity and innovation in the classroom and wider school community.'<sup>2</sup>

In those parts of the universities where science, and especially mathematics and technology, are taught, there are too few students with an interest in teaching. More students might be attracted to these faculties and to careers in teaching if different approaches were adopted. One such initiative, now being considered for wider application, is the STAR program in Western Australia, which involves graduate students in work experience in schools acting as mentors for secondary students. Undergraduate students with talent could also be a potential source of future teachers.<sup>3</sup>



#### **Box 4.1 The Science/Technology Awareness Raising (STAR) program**

Developed at Murdoch University, the STAR program involves graduate students in work experience in schools, mentoring secondary students and assisting teachers in a number of ways. The scheme is assisted by industry and is effectively a university–school–industry partnership: teachers and university students form learning partnerships with groups of school students in a range of science and science-related subjects. STAR is being considered by other universities as a means of encouraging more school students to continue science and technology studies—and as a way to interest some of the talented tertiary students in a career in teaching.<sup>4</sup>

It is important to achieve the best possible match between the interests, qualities and capabilities of those preparing to teach and the changing landscape of schooling. This means much improved information about the realities of schooling for people who may be considering a teaching career. Equally, it means more specific knowledge on the part of education authorities about the kinds of people who do or might choose teaching and the factors affecting them. At issue is how best to develop informed interest on the part of schools, education authorities, students and their families, to ensure a better appreciation of the value of schooling and the opportunities teaching provides for a worthwhile career.

For people who may be interested in a career in teaching, or who have potential as teachers but have not considered the possibility of becoming a teacher, very good information is needed, especially on the positive challenges and opportunities teaching in the future is likely to present. This means better community understanding of how schools operate and of the changes that are occurring. Among these changes is the nature of the career itself, career mobility and opportunities for career advancement.

Choice is not, and should not be, restricted to decisions made by young people when still in school or undergraduate programs, and during or towards the end of their initial teaching studies. While these are the main stages where decisions are made, more adults are choosing teaching as a career after other occupational experience, and schools report the value of bringing people with other professional experience into teaching.

Informed choice is not confined to entry to the profession: with increasing mobility in the labour force generally, teaching is not always seen as a lifelong career for all teachers, but part of a broad and diverse career profile. This profile also includes multiple roles within teaching—such as mentoring, coordinating school activities and taking on leadership roles. Choosing to move out of teaching, possibly for a period of career change and refreshment, can be advantageous to the individual teacher and—if that person returns to teaching—to students. To facilitate this kind of mobility, conditions of employment need to be flexible.

Choice should not be confined to a single level of schooling, sector or system. It is increasingly accepted by education authorities that inflexibilities that stand in the way of national mobility should be removed. Teacher registration requirements are being reviewed in almost all State and Territory systems, and the work under way by the MCEETYA Teacher Quality and Educational Leadership Taskforce (TQELT) is expected to widen opportunities for teachers to become more mobile, within a national profession of teaching.<sup>5</sup>

The establishment of institutes and boards of registration in Tasmania, New South Wales, Victoria, Western Australia and Northern Territory in addition to the long established boards in Queensland and South Australia should lead to greater collaboration nationally to facilitate future mobility, and thereby embed teaching as a fully mobile and national profession. A 'career of choice' decision hinges upon many factors and high among them is an enhanced notion of the profession as a whole—the concept of a national profession, and the descriptor of an 'Australian teacher'.

Some teacher employers are finding difficulty in attracting teachers to particular schools and in specific subjects: for example, their choice may be limited by preferences people have for living in large cities near the coast. Teacher mobility within jurisdictions, nationally and internationally will be an increasing factor in staffing all schools appropriately.

In a study drawing on international literature, Ingvarson suggested several factors which relate both to general supply issues and to specific shortages of science and mathematics teachers:

- in the late 1980s and early 1990s, graduates moved into other fields when there were few vacancies in teaching science and mathematics;
- less than optimal presentation of the subjects at school and university is a disincentive to students to study these subjects;
- science is a relatively unattractive profession and the number of students studying it at university is too low; and
- mathematics, physics and chemistry are perceived by some students as excessively difficult.<sup>6</sup>

Research by Ingvarson and others indicates positive steps that can be taken to increase the intake of highly talented people into teaching in the fields of science, mathematics and technology. As well as incentives, better information and promotion and the quality of the school environment are crucial. Talented, energetic and creative people look for challenging and fulfilling careers.

Signals in the community that teaching is a highly progressive profession with fundamental roles to play in the knowledge economy and society are needed—from government, education authorities, other professions, industry, community organisations, parent groups and other stakeholders. The teaching profession itself has major responsibilities. Within the teaching profession there needs to be greater recognition of quality teaching, and a sense that high professional standards matter in raising the public esteem of teaching. All these considerations bear directly on the attractiveness of teaching as a career and its public and professional image.

## 4.2 Generational change

Different dimensions of the teaching career are being reshaped by the values and expectations of the new generation of entrants to teaching. For many entrants to the profession, teaching is no longer perceived as a lifetime career and continued without interruption until retirement. Many existing assumptions, including models of teaching as one career for life through to retirement, need to be reconsidered in workforce planning.

### 4.2.1 Teaching within a lifetime career

For a new generation, teaching is coming to be seen as one element in a lifetime career. Schooling policies directed toward retaining this group of teachers have to come to terms with the reality that career change is increasingly common within the labour force as a whole. It would be surprising if teaching were immune. Several surveys indicate that a small but significant number of teachers (of all ages) intend to leave teaching within a few years of starting to teach.<sup>7</sup>

The new generation's attitudes toward work and expectations of career participation are part of the changing pattern of aspirations and behaviour in the workforce. An emerging theme is that the generation born after 1970, now around the late twenties in age, is actively shaping flexible careers. Such people can bring a rich body of experience to schools and play valuable roles in teamwork, extending partnerships and importing the insights of other occupations into school life.

Training, retraining, multi-skilling and workforce flexibility are becoming commonplace within the broader workforce. While these features have not been as common in teaching as in some other professions, that is changing. Teachers are able to, and do, transfer to other areas within education and other professions. Greater fluidity within the whole arena of teaching and learning means, on the one hand, a need for more flexibility in career structure within education and, on the other, recognition that new career opportunities across the broad spectrum of education beyond schooling will increasingly emerge.

Careers in teaching can be seen as careers in education and, as such, open considerable opportunities in Australia and internationally for teachers in a knowledge economy, where expertise in knowledge management will increasingly become a highly portable skill. Some teachers incorporate travel into their careers and Australia has the opportunity to benefit from the experience both of those returning from overseas and of those born overseas, whether they migrate or come on temporary visas, who bring a wealth of cultural variety and social perspective to enliven our classrooms.

Balancing the movement of teachers out of the classroom and into different careers, there is a counter-trend emerging, namely, teaching as a second career. There has been an increase in mature-age entrants and entrants with a previous career. The Faculty of Education at the University of Melbourne reported a long-term trend away from entry to teacher education immediately following a degree and towards entry into teacher education as a second career. In a mathematics methods class of 74 students, for example, the average age of students was 31 and the median age 25. One-third of the students had more than one qualification (degree or diploma) and three-quarters had previous full-time professional employment, many in engineering.<sup>8</sup>

Schools need to welcome teachers with substantial career experience and use their talents well. Teacher education institutions, education authorities and schools must provide adequate recognition of the skills brought by, and opportunities provided by, mature-age entrants.

Emerging demographic trends and shifting social attitudes are affecting the way that new entrants and existing teachers participate in the education profession, and therefore the way that they need to be supported and retained. A study of current teacher education students concluded that the 'next generation of teachers will not replicate the past. They want flexible careers and are seeking personal fulfilment, commitment to themselves and advancement'.<sup>9</sup> New teachers have very different attitudes about work, career and life from the former generation: 'Given that a significant number of careers today appear to have a relatively short life, 3–5 years, could it be that teaching is seen as committing people for too long?'<sup>10</sup> Clearly this has implications for the way in which teachers will be developed and deployed within schools as they progress professionally.

Highly qualified individuals already in, or about to join, the teaching profession have career aspirations which need to be understood and respected. For many teachers, the type of opportunities for career advancement and flexibility are key motivations for entering and staying in the teaching profession. As a result, it is recognised that teachers develop over their careers and seek career pathways that provide personal and professional satisfaction. They also require recognition because 'teaching is a profession about which the public has high expectations.'<sup>11</sup> Practices that encourage and reward excellence in classroom practice, and encourage expert teachers in classrooms, can address retention and attraction issues, as well as raise the status of the profession. Here, flexible career and employment structures that recognise and reward advanced teaching skills are very important.

These changes point to the need for teaching to stand the test set by increasingly discriminating and mobile professionals. For education authorities, higher education institutions and schools, the Committee envisages several consequences:

- policies for attracting and retaining high quality teachers will concurrently address training and retention strategies for career-long teachers and those seeking career mobility;
- for areas in high demand, such as science, mathematics and technology, the net will be cast wide, both drawing in mature-age entrants from diverse fields of employment and accepting that 'retention' may be for relatively limited periods and possibly episodic;
- dynamic schools and communities will assess their own attractiveness to career-mobile teacher professionals in fields of high demand;
- teacher education institutions will provide maximum flexibility in their requirements for entry and for study, including combinations of work and study; and
- teacher education institutions, teacher employers, registration bodies and agencies responsible for professional standards will pursue more flexible but nonetheless stringent ways of setting requirements, assessing performance and defining career progression.<sup>12</sup>

#### 4.2.2 Leadership succession

Substantial numbers of people in leadership positions, particularly principals, are likely to leave the profession within the next few years, based on the age profile of the teaching force. Thus, a considerable renewal among people in leadership positions can be anticipated over the coming decade. Recent analyses by MCEETYA drew attention to a smaller than might be expected mid-career cohort of teachers (resulting from unusually low recruitment of teachers at an earlier period).<sup>13</sup> In 2003, the majority of principals surveyed, some 82.2 per cent, were aged 45 and over, with 30.3 per cent aged between 50 and 54 years. The age distribution of principals reflects the fact that principals were generally experienced teachers before becoming principals.<sup>14</sup> This suggests that either a larger proportion of current mid-career teachers need to be recruited to leadership positions, or leadership positions are likely to be filled in the coming years from much younger than usual cohorts of teachers. Significant generational change can be expected, then, in school leadership over the coming decade.

There is an important challenge in this, however, with the emergence of different attitudes towards assuming positional leadership roles. Bolster and Stevens noted a declining interest in the post of principal throughout the country. Among the factors contributing to this declining interest are:

- concern about dealing with dimensions of the role such as litigation, child abuse and hostile parents;
- concern that the organisational management role of the principal is being expanded at the expense of the educational leadership role; and
- the perception of potential school leaders that the principal does not derive job satisfaction from the role.<sup>15</sup>

Strong educational leadership, and leaders at all levels, are vital to the quality and effectiveness of schooling. It is a matter of great concern that many very able people perceive that the demands of the position of principal are such that it may be losing its attraction. If this is shown to have a significant impact on recruitment of school principals, it will be necessary to find more effective ways to recruit principals from the existing teaching workforce and the broader community and industry. It may also be necessary to find more effective ways to retain existing school leaders.

### 4.3 Towards a national teaching profession

Professions as diverse as education, accountancy, architecture, law, medicine and health services have several features in common which demand both high levels of knowledge and the trained ability to use that knowledge:

- dependence upon and systematic use of advanced knowledge;
- commitment to setting and attaining rigorous standards and to an ethics of practice;
- accountability to their clients and to society; and
- a highly structured, skilled practical element.

The practice of the profession entails both high levels of knowledge and the trained ability to use that knowledge in meeting human needs and solving problems.

Although these and other characteristics are common to these professions, they are not exclusive to them. Occupational difference in respect of such characteristics are frequently a matter of degree. Thus most occupations are in some measure knowledge-based and require practical capabilities which to a greater or lesser extent have to be acquired through formal training.

The sharpness of the status distinctions drawn between different professions are less marked now than in the past, partly because social hierarchies have levelled, but also because there is a tendency for more occupations to claim professional status as their use of systematic, theory-based knowledge has increased. Teaching, especially the teaching of young children, is an example, as it has progressed from a craft for which preparation in the 19th century required only an incomplete secondary education and no formal training, to a profession today where four or five years of university education following completion of a full secondary education is the normal requirement.

What happens in professional formation is very largely an intellectual process: forming and understanding concepts; developing skills of synthesis and analysis; mastering bodies of content; learning how to design and apply knowledge; and so on. Professions pride themselves on both their theory-based knowledge and their ability to apply it in a practical sense. Teaching is already a profession, in that a prolonged period of formal preparation through systematic study is required and it is expected that practice will be informed by this knowledge. What, then, is new or different about the recent moves to enhance teacher professionalism and revitalise the teaching profession?

Crucial to revitalising the profession is recognition by teachers themselves that the activity of teaching is an integral part of the knowledge revolution and the new global networks, as discussed in Chapter 1. This means that teachers and education authorities will in future make greater use of research and of systematic evidence in deciding what and how to teach, and in assessing the effects of teaching and of schooling on students' learning. They will draw more widely on data sources, make greater use of ICT, and use face-to-face collaboration and sharing of information and ideas. There will be a wider acceptance that very high standards for teaching will be set by and for the profession and that there will be a more open dialogue about what these standards are, the conditions needed to meet them and the way in which high quality performance will be recognised.

As Caldwell noted: 'The successful transformation of schools calls for a "new professionalism" in which teachers' work is increasingly research-based, outcomes-oriented, data-driven, and team-focused at the same time as it is globalised, localised and individualised, with lifelong professional learning the norm for teachers as it is for medical specialists.'<sup>16</sup>

There are important expectations of changes to consider. The growth of knowledge relevant to teaching is very rapid—in the areas of teaching, in how students learn and in the social, cultural and economic spheres. This demands a readiness to keep abreast of developments in these and other areas of knowledge that relate to teaching, schools and students. A profession is thoroughly informed by knowledge about learning and dedicated to the advancement of learning.

For education to be a powerful agency of social and economic development, as is now expected and needed, there has to be continuing appraisal of just what is required of teachers—what they need to know and how they can best use their knowledge. As in other fields, higher, more demanding, standards are being set—for entry into the profession of teaching, employment and performance within it. These standards may be those of a registration body or a whole system or even a single school or association of schools. As discussed below, there are moves to make them system-wide and to associate with them specific kinds of initial training and continuing professional development.

Increasing regulation and accountability of the profession of teaching—through entry requirements, registration, accreditation, performance targets, accountability procedures and greater transparency (for example, public reporting of outcomes) is taking place concurrently with various moves to devolve greater responsibility to schools and to involve teachers more in strategic planning and decision making. Thus autonomy as a feature of professionalism has a distinctive meaning in teaching, and should not be seen simply as more independence and freedom of judgment by teachers.

New professionalism is a blend of different kinds of up-to-date knowledge and understanding; of enhanced practical capabilities in teaching; of the ability to work effectively in organisations and systems where there are both firm structures and procedures and scope for leadership; and of opportunities for teachers to exercise judgment and take initiative. New professionalism must incorporate strong forms of public accountability and ethical standards of conduct that are relevant to community needs and expectations.

#### 4.4 Professional standards for teaching

A major step has been taken toward enhancing teacher professionalism in Australia by development work on defining explicit standards for teaching during the last decade. It is part of a broader international interest which has strengthened over the past decade, effectively replacing the teacher competencies movement of the 1980s and early 1990s. Teacher professional standards are highly likely to be a priority for all education systems and subject to continuing discussion within the profession for many years to come.

In parallel with systemic initiatives, the teaching profession, through a number of its national professional associations, has greatly increased the momentum for a national standards agenda by developing subject-specific standards through several of its national associations. The Technology Education Federation of Australia notes that the Australian Council for Computers in Education is conducting a project to define the relevant standards for senior secondary teachers of information technology.<sup>17</sup>

The Australian Association of Mathematics Teachers (AAMT) has developed *Standards for Excellence in the Teaching of Mathematics in Australian Schools* and is working towards establishing a mechanism for credentialling teachers against these standards as a means of acknowledging and rewarding highly skilled teachers. AAMT suggests that these standards be used to establish and implement a standards-driven professional development system for professional learning in mathematics.<sup>18</sup>

Similarly, the Australian Science Teachers Association (ASTA) has developed standards which capture what highly accomplished teachers of science know and do. ASTA argues that these standards are a means for recognising and acknowledging the skills, expertise and experience that are linked to performance reviews and salaries and that 'the furthering and implementation of professional standards for teachers is [also] seen as crucial to create career pathways that reward and recognise teaching excellence'.<sup>19</sup> ASTA also sees benefit in using standards for mentoring, teacher education and professional development.<sup>20</sup>



Some initial work has also been undertaken on a proposal to develop a national framework for describing teacher ICT competency standards to inform the work of teacher education faculties and education authorities. This work acknowledges the key role of professional associations in the development, implementation and assessment of standards, and emphasises the need for a national framework for standards development in Australia.<sup>21</sup>

That parts of the profession have initiated statements of standards is a particularly welcome development, because a key success factor will be the extent to which teachers embrace these developments. Projecting self-determination and balancing self-regulation with accountability and effectiveness are some of the challenges faced in any profession, and many submissions stressed the need for teaching standards to be developed and 'owned' by teachers. The Australian Association of Research in Education stressed:

The status of teaching cannot be resolved only by a professional standards movement that is imposed onto the profession. Professional standards must be developed, owned and mobilised by the profession. All professional standards should be grounded in a body of professional knowledge that has been developed by teachers.<sup>22</sup>

The Australian Principals Associations Professional Development Council (APAPDC) has also undertaken work to identify the knowledge, skills and attributes required of a successful school leader. This research builds upon previous work undertaken by APAPDC, to describe a competency profile for Australian school principals. The professional standards movement has brought together organisations of the teaching profession, government, education authorities, teacher educators and others in a broad coalition for professional advancement.

In addition, a wide range of organisations within the teaching profession have worked together to develop a *National Statement from the Teaching Profession on Teaching Standards, Quality and Professionalism*. Released in May 2003, this statement has the support of some fifteen leading national professional associations and unions and one State teacher registration board.

For the Australian College of Educators:

... teaching is not a standards-free endeavour and most teachers have always understood the essential elements of high quality professional practice, (although) much of this knowledge has remained at an intuitive level. Standards do help to make the knowledge and capabilities explicit—not only to professional colleagues, but also to students, parents and wider community. They also provide a means through which good teaching can be identified, celebrated and rewarded.<sup>23</sup>

The national statement considers how standards will be used: ‘standards are tools for action—tools with which the profession can exercise greater responsibility for the quality of teaching and learning in schools. Use of standards must be primarily about professional learning. It would be contrary to the spirit of professionalism if they were to be used for punitive or non-developmental purposes’.<sup>24</sup> It advocates non-quota-based recognition, through professional certification and reward, for teachers who demonstrate these standards. Incentives such as increased remuneration or professional leave are being argued for, to acknowledge high-level accomplishment in tangible ways.

## 4.5 A national approach to professional teaching standards

For the broader community, professional standards can provide a window into the profession, building confidence and sometimes correcting perceptions. For potential new entrants to a profession, standards provide information about, and give rise to, more realistic understandings of collegial expectations. Professional standards help define teaching roles, and can be refined over time. Standards provide direction for promoting and sharing good practice. For the profession as a whole, standards signpost, showcase and make transparent the extent and scope of members’ core competencies and responsibilities. From the perspective of society’s needs and expectations, standards indicate targets, quality and achievement.

In the case of teaching, professional standards would present critical information about, and effectively articulate, the fact that teachers have specialised practical skills and techniques, underpinned by a body of theoretical knowledge, that achieves objectives highly valued by the community. According to Ingvanson: ‘Without standards, a professional body is defenceless. A demonstrated ability to articulate standards for high quality practice is an essential credential if a professional body wishes to be taken seriously by the public and policy makers. When placed on the table in forums with policy makers about reform and accountability, established professional standards are hard to ignore’.<sup>25</sup>

The move towards enhanced teacher professionalism has emerged to meet these greater expectations. The Australian Council of Deans of Education argued that teaching needs to be seen ‘in similar terms to professions such as medicine and that policy must aim to raise respect for, and the perceived importance of, teaching in the wider community’.<sup>26</sup> Commitment by the profession itself to quality preparation for entry into the profession and individual development throughout a career, professional collaboration and collective development are all seen as important. Such commitment reflects attitudes and approaches which are essential to enhancing the attractiveness of the teaching profession to people of talent. Assisting potential new entrants to see teaching as a career of choice and setting high professional standards have become two important policy priorities. They can powerfully reinforce each other.

Teaching is a profession in transition. As a highly knowledge-based profession, teaching plays a leading role in the knowledge economy and society. It has acquired many of the attributes of other recognised professions, but has yet to become self-regulating. Teaching is also a salaried profession. The status of teaching as a profession is well up on the national agenda; although there is widespread agreement about the need to boost it, as yet no clear agreement has been reached on how this should be done, multiple initiatives notwithstanding.

Different systems have developed standards with different emphases. The thorough approach to professional standards of Education Queensland, the government school teacher employer, in *Professional Standards for Teachers*, can be seen as generic and applicable to all teachers at all levels and with different kinds of experience. Twelve standards were trialled in a pilot in 2002 and evaluated, prior to anticipated widespread use within the system.<sup>27</sup> The Ramsey report in NSW also supports this approach to standards.<sup>28</sup> The development of professional standards and the responsibility for the accreditation of courses of teacher education within Victoria is the responsibility of the Victorian Institute of Teachers, while Queensland, South Australia and Tasmania each have a teachers registration board to monitor teacher accreditation. The legislation in South Australia is currently being changed to enable the registration board to engage in a wider range of activities. Western Australia is working to establish a College of Teaching and the Northern Territory is considering the establishment of a teacher registration board.

Following consultations, the *National Framework for Professional Standards for Teaching* was endorsed by MCEETYA at its meeting of 10–11 July 2003.<sup>29</sup> The *National Framework* is intended to provide a mechanism through which detailed work of jurisdictions and professional associations on standards can have national application. The *National Framework* does not develop standards as such, but defines parameters with which they can be developed. It expresses core dimensions and attributes of standards that allow the development of generic, specialist and subject-specific standards.

The *National Framework* describes four career dimensions for teachers:

- graduation;
- competence;
- accomplishment; and
- leadership.

Each of these is defined through specific aspects of teachers' work, comprising four professional elements:

- professional knowledge;
- professional practice;
- professional values; and
- professional relationships.

MCEETYA agreed that, where work on professional teaching standards is undertaken within State and Territory jurisdictions, the *National Framework* be used as a guide to ensure national consistency.

There is a commonality of direction in the varied and impressive endeavours currently being undertaken. It is important to maintain the momentum of the individual and collective initiatives by MCEETYA and the profession, which have done so much to lay out frameworks and deal with key issues.

## 4.6 The Australian teacher

Teaching is a profession in which historically there has been low mobility between States and Territories. The 2002 Labour Mobility Survey showed that teachers had a mobility (defined as a person working in one State/Territory in 2001 and another State/Territory in 2002) of 1.7 per cent, by comparison with the average mobility for other occupations over the same period of 2.4 per cent.<sup>30</sup> The extent to which teaching is a mobile profession within States, however, is unknown, as national level data on intra-State mobility (and also on inter- and intra-sectoral mobility) are lacking.

As the advantages of teaching as a national profession are more fully understood, barriers to inter-State mobility should be progressively eliminated or substantially reduced. There are many obstacles to overcome. Two of them are that different jurisdictions provide different entitlements that are not necessarily transferable, and that jurisdictions have different arrangements for registering and accrediting teachers.

Portability is a fundamental feature of most professions. There is a need to make teaching qualifications and experience more portable to allow teachers to be mobile without losing salary, employment conditions dependent on length of service, career advancement status, superannuation or any other entitlements. Indeed, there was strong support in submissions for national agreement about the portability of professional status and recognition to allow teachers who are mobile to continue within the profession.<sup>31</sup> For instance, the Australian Council of State School Organisations supports a national system because 'an important outcome of this process will be that new teachers will have a nationally portable qualification'.<sup>32</sup>

Superannuation is an important area where conditions of service differ. Clare has pointed to a considerable number of different superannuation schemes to which teachers belong.<sup>33</sup> Generally State-based, they fall into two major categories: defined benefit and accumulation schemes. As outlined in the previous chapter, membership of defined benefit schemes is largely restricted to longer serving (and therefore older) teachers in government schools. The majority of teachers are members of accumulation schemes, notably non-government school teachers and younger teachers in government schools. Because the defined benefit schemes are unfunded, they are not portable, and as this type of fund also provides relatively generous benefits, it could be seen as an incentive not to move. The accumulation schemes, by contrast, are amenable to portability arrangements, within the education profession or beyond. Superannuation should therefore cease to be a major hindrance to inter-State mobility for an increasing number of teachers, and generally for more recently employed teachers. That is a factor of considerable significance for the concept of a national profession.

People move for a variety of reasons including positive career-related motives and to gain advancement. Teachers would benefit from a national labour market in which they could broaden their experience and strengthen their careers. The Committee believes that teaching is likely to become a more attractive career to talented, energetic people if the market is clearly a national one. Professional standards will facilitate this, as will nationally consistent policies for registration. Enhanced mobility is one of several policy levers that can be used to improve the status of teaching as a well-regarded career.

The Australian Council of State School Organisations argued that portability between States through national teacher registration must be seen as a key element to keeping good teachers teaching nationally, rather than being tied to particular jurisdictions.<sup>34</sup> The Australian Education Union contends that both younger and experienced teachers might also be encouraged to remain in the profession 'if greater portability of entitlements existed which allowed teachers to move around Australia but remain as a teacher maintaining salary position and status'.<sup>35</sup>

One of the attractive features of contemporary teaching, particularly among those choosing to undertake teacher education, is that it is perceived as highly mobile. One study found that 'for younger [teacher education] students a chance to move around and travel overseas with a transportable qualification' is significant.<sup>36</sup> The potential of this factor to attract new entrants to teaching is reduced when the reality of working as a teacher in Australia means that portability is hindered by diverse recruitment practices and employment requirements.

Notwithstanding the recognition issues associated with teacher qualifications and experience outlined below, the principle of portability should be pursued for its capacity to influence positively the character and overall standing of the teaching profession. National collaboration in this regard would send an important signal to students, teachers and parents that the profession is developing and extending as a national profession.

Another important area where a national professional approach is required is the capacity of teachers to be able to practise throughout Australia and specifically to take their professional qualifications and experience across jurisdictions. As noted by the Faculty of Education, Health and Professional Studies, University of New England, current registration and accreditation processes for teachers are 'different for each State and often each system within a State'.<sup>37</sup>

A number of established professions have well developed self-regulation or accreditation for membership, but the teaching profession does not. As discussed above, this matter is under consideration by a range of bodies developing statements of national standards for the teaching profession and work is being done on a national standards framework. Differing requirements for teacher registration and accreditation in each State and Territory need to be addressed collectively by the different jurisdictions. TQELT will give this issue some priority for the next 12 months.

The past few years have seen significant changes in both structures and procedures for registration of teachers and accreditation of teacher education courses. In Victoria and New South Wales, there is a movement to extend the development of standards for initial registration to standards for different stages of the profession over a teaching career. Among the issues being dealt with is the place of initial teacher education and continuing professional development and their links to registration.

Renewing and extending the profession through development of national portability and consistent registration and accreditation arrangements will serve to improve perceptions of the profession both internally and in the community as a whole.

Moves to reach agreed professional standards and to achieve a better coordination of registration procedures are part of a wider movement in education: to improve quality of teaching and learning; to improve transparency and communication; and to develop a national perspective on issues of common concern. For some observers, a central component in the move toward raising the professional standing of teaching within the community is the development of a more mobile national profession.

There will be many benefits from a national profession of teaching. For the teacher, freedom to work according to their interests in different parts of the country will be a benefit. Systems will gain from the opportunity to attract and recruit teachers freely, without the barriers and impediments that at present tend to discourage or complicate mobility. Parents and students will be assured that there are teachers of nationally consistent high quality in all classrooms in Australia, regardless of their location. As curricula, assessment and pedagogy gain in consistency across the country, the mobility of teachers will seem a natural circumstance rather than the exceptional phenomenon it is now. Teacher mobility and the concept of a national profession appear to the Committee to be entirely consonant with the social, cultural and economic forces which are leading to a greater sense of common national purpose and overall coherence of structures and policies in education. Further progress toward greater national consistency on the several matters addressed in this chapter will be to the advantage of teachers and systems.

The Review Committee is pleased that its work has helped inform the Australian Government's decision to establish in 2004 a National Institute for Quality Teaching and School Leadership. The National Institute is a tangible measure of recognition that teaching is a national profession, and will complement the arrangements to support teaching and school leadership which are in place in the various State and Territory school systems. It should play a central role in developing a coordinated and collaborative national framework for the advancement of the teaching profession. Its role should embrace professional teaching standards, teacher and school leader professional learning, quality assurance and research into teaching and learning. The Institute should focus on building cultures of innovation underpinning the teaching profession.

On the face of it, the image of a national profession, qualified through four or more years of university study, adhering to high professional standards and perceived to be a key part of the dynamics of the knowledge economy, would seem to have great force in attracting talented people. The reality of schooling and the roles teachers perform would have to live up to such an image and there are other factors, not least the relative attractiveness of other professions. To guarantee the attractiveness of teaching, it must be seen as a profession and a career of choice in the eyes of the community and in the eyes of those who form the profession.

## ■ Key Conclusions

Attracting and retaining teachers in Australia over the next decade will be for different contexts and will require different policies and policy levers from those widely used in the past.

- Generational change will provide opportunities to attract a new generation of talented young teachers and to bring into teaching large numbers of able people with experience in other careers.
- Policies will need to adapt to expectations of many teachers for geographic and career change mobility as part of a flexible career profile, while others will expect stability and a lifelong career of teaching and professional advancement.
- For areas of shortage, such as science, mathematics and technology, the net will be cast wide, both drawing in mature-age entrants from diverse fields of employment and accepting that 'retention' may be for relatively limited periods and possibly episodic.
- Growing national and international competition for highly skilled personnel will favour those occupations which can present themselves as highly attractive and rewarding to talented, hard-working professionals.
- Filling 'new generation' leadership positions will prove extremely difficult unless there is more scope for able people to exercise professional judgement and authority and to be rewarded for outstanding performance.
- The setting of national professional standards, whether collaboratively across systems or by national agreement, is a way to raise the quality and performance of teachers and to make the profession more attractive to very able people.
- Education authorities will need to take full advantage of a wide array of incentives to attract and retain high calibre teachers of science, mathematics and technology and to staff other shortage areas.
- Australia needs more uniformity in teacher registration and accreditation processes and portability of entitlements.

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<sup>1</sup> MCEETYA (2003) Demand and Supply of Primary and Secondary School Teachers in Australia. [www.curriculum.edu.au/mceetya/public/pub32.6.htm](http://www.curriculum.edu.au/mceetya/public/pub32.6.htm)

<sup>2</sup> Graduate Careers Council of Australia; *Careers in Teaching*, Melbourne 2003.

<sup>3</sup> Nola Shoring, submission no. 19, p. 2.

<sup>4</sup> STAR, *Annual report of the STAR peer tutoring and mentoring programme*, Murdoch University, 2002, viewed 9 September 2003, <<http://about.murdoch.edu.au/star>>.

<sup>5</sup> MCEETYA 2003, op cit.

<sup>6</sup> M Lonsdale and L Ingvarson, *Initiatives to address teacher shortage. Final report*, Australian Council for Educational Research, Melbourne, 2003.

- <sup>7</sup> N Dempster, C Sim, D Beere and L Logan, *Teachers in Australian schools. A report from the 1999 National Survey. Executive summary*, Department of Education, Training and Youth Affairs, Canberra, 2000; MCEETYA 2003.
- <sup>8</sup> University of Melbourne, submission no. 85.
- <sup>9</sup> D Tyler and H Stokes, Teacher education: students' views about their intentions to teach, Review of Teaching and Teacher Education, DEST, Canberra, 2002.
- <sup>10</sup> Education Queensland, submission no. 53, p. 3.
- <sup>11</sup> The Non-Ministerial members of the Victorian Council for Knowledge, Innovation, Science and Engineering, submission no. 112, p. 3.
- <sup>12</sup> Australian Council of Deans of Education, submission no. 102.
- <sup>13</sup> MCEETYA 2003, op cit.
- <sup>14</sup> MCEETYA 2003, op cit.
- <sup>15</sup> D Bolster and I Stevens, *Effective initiatives to support school leaders and ensure the supply of appropriately prepared principals in Australian schools*, Stakeholder Consultation Draft Report for Teacher Quality and Educational Leadership Taskforce, March 2003.
- <sup>16</sup> University of Melbourne, submission no. 195, p. 12.
- <sup>17</sup> Technology Education Federation of Australia, submission no. 106, p. 4.
- <sup>18</sup> Australian Association of Mathematics Teachers, submission no. 60.
- <sup>19</sup> Australian Science Teachers Association, submission no. 55, p. 2.
- <sup>20</sup> Australian Science Teachers Association, submission no. 55, p. 4.
- <sup>21</sup> Education Network Australia Schools Advisory Group, Learning in an online world: school education action plan for the information economy, Commonwealth of Australia, 2000.
- <sup>22</sup> Australian Association of Research in Education, submission no. 83, p. 2.
- <sup>23</sup> Australian College of Educators, *National statement from the teaching profession on teacher standards, quality and professionalism: towards a common approach*, ACE, Canberra, 2003.
- <sup>24</sup> *ibid.*, pp. 2–3
- <sup>25</sup> L Ingvarson, *Professional credentials: a discussion paper*, Australian Science Teachers' Association, 1995, p. 107.
- <sup>26</sup> Australian Council of Deans of Education, submission no. 128, p. 4.
- <sup>27</sup> Education Queensland, *Professional standards for teachers. Guidelines for professional practice. Pilot 2001–02*, Education Queensland, Brisbane, 2001.
- <sup>28</sup> G Ramsey *Quality matters. Revitalising teaching: critical times, critical choices*, report of the Review of Teacher Education, New South Wales, NSW Department of Education and Training, Sydney, 2000.
- <sup>29</sup> MCEETYA, Teacher Quality and Educational Leadership Taskforce, A National Framework for Professional Standards for Teaching, July 2003.
- <sup>30</sup> Cited in J Ainley and C Underwood, Australia's Teachers: Australia's Future, Vol. 3, Background data analysis, Review of Teaching and Teacher Education, DEST, Canberra, 2003.
- <sup>31</sup> Australian Education Union, submission no. 49, p. 2.
- <sup>32</sup> Australian Council of State School Organisations, submission no. 113, p. 6.
- <sup>33</sup> R Clare 'Superannuation arrangements for Australian teachers and their impact on retirement decisions', paper commissioned by Review of Teaching and Teacher Education from the Association of Superannuation Funds of Australia Research Centre, 2003.
- <sup>34</sup> Australian Council of State School Organisations, submission no. 113, p. 6.
- <sup>35</sup> Australian Education Union, submission no. 49, p. 9.
- <sup>36</sup> Tyler and Stokes, op. cit., p. 8.
- <sup>37</sup> Faculty of Education, Health and Professional Studies, University of New England, submission no. 87, p. 3.



## 5. Preparing to teach

Teachers are under pressure to meet growing community expectations of schooling. These include high standards of knowledge and competence, and wider responsibilities for the outcomes and effects of their teaching. For the multiple and diverse roles they must perform, and the breadth and depth of knowledge they require, new kinds of initial teacher education are being established. Innovative programs in higher education institutions are based on the premise that future teaching and the future school will differ in many ways from current practices and arrangements: in scope, methods, ways of functioning and relations with the wider society.

Intending Australian school teachers undertake a teacher preparation program through a university or other higher education institution. High standards in teacher education courses are required to ensure that every teacher is well prepared to enter the school environment. Perceived attitudes about the rigour and extent of professional preparation provided by education and other faculties can do much to influence prospective candidates in their choice of teaching as a career. Increased interest over the last two years in a teaching career follow a long period when, for a variety of reasons, teaching has not been high among the preferences of many talented students.

Careers in teaching can be seen as careers in education more broadly. Teachers, with their expertise in knowledge management, will increasingly have opportunities to work in the broader education profession that supports the knowledge economy. Initial teacher education is in reality serving several purposes, not all of them tied to the notion of a prolonged, unbroken career in the classroom.

Teacher education courses need to demonstrate overall quality and effectiveness in preparing highly competent teachers. To meet diverse student requirements, they need to be flexible and responsive. High entry standards are important. Above all, training has to be very clearly relevant to the needs of schools as well as of potential beginning teachers. Different pathways through teacher education are required to attune to the needs of a broad variety of prospective candidates. Initial teacher education should be seen as the beginning of a continuum which leads through well-structured programs of foundational knowledge and practical experience to induction into the school and continuing professional learning. These challenges, needs and requirements are being vigorously addressed in the wide range of teacher preparation courses offered by Australia's higher education institutions.

## 5.1 Teacher education pathways

Major changes have occurred in the initial education of teachers over the past two decades. Generally speaking, until the late 1980s, teachers' colleges, colleges of advanced education and institutes of technology provided two-year and then three-year programs, mainly to students preparing to teach in primary schools. Universities in general provided a three-year or four-year degree in discipline fields, followed by a one-year postgraduate diploma, mainly to students preparing to teach in secondary schools.

Two major policy shifts occurred in the early 1990s. First, teacher education (with some exceptions) became a university responsibility as a consequence of the introduction of a unified national system of higher education. Second, initial teacher education programs were progressively lengthened and strengthened. Teaching at all levels has now, for purposes of permanent employment, become a four-year, all graduate profession, on a par with other kinds of university-based professional education. The full implications of this have yet to be felt and much is being done within the universities in better aligning the different components of education degrees, strengthening links between different faculties and departments and building further on links with schools. Australia has a sound foundation of university-based teacher education to build on for the future.

Today, teacher education is provided through more than 400 courses in almost all of Australia's universities and some other higher education institutions. In 2001, these courses produced over 11 000 new, qualified primary and secondary teachers. Generally, these teachers are prepared through one of three broad pathways.

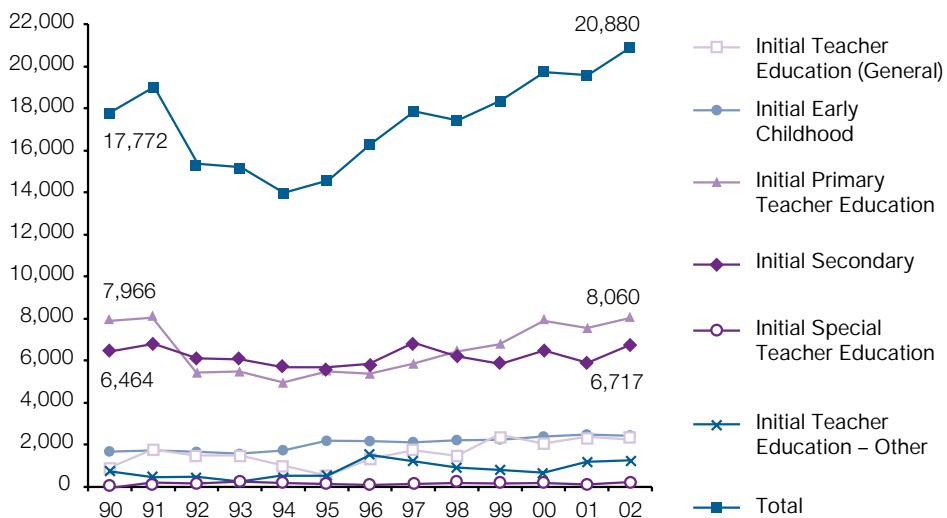
- 3–4 year undergraduate bachelor programs during which students concurrently study educational theory and related disciplines; pedagogy; disciplinary knowledge or teaching subject content in other faculties or departments. Extended practical experience in schools is usually distributed over several years of the degree program.
- 4–5 year double degree bachelor programs during which students study concurrently for an undergraduate education degree and an undergraduate degree in another discipline.
- 1–2 year 'end-on' graduate programs during which students undertake a program of teacher education following completion of an undergraduate degree in another discipline.

For primary teachers, the most common pathways are a single four-year undergraduate degree, most commonly a Bachelor of Education or Bachelor of Teaching; or a double undergraduate degree, such as a Bachelor of Education plus a Bachelor of Arts or Bachelor of Science. For secondary teachers, the most common pathways are: an undergraduate degree in discipline subjects (arts and science are the most common) followed by a graduate degree in education, such as a Graduate Diploma in Education or Master of Teaching; or a double undergraduate degree program.

Across the country, study by distance education is available to teacher education students through a number of universities. This facilitates access for students in rural and remote areas, although distance programs are also valued by students closer to an institution, notably mature-age students, for whom flexibility is needed.

The number of domestic students commencing teacher education courses dropped during the early 1990s, but has grown strongly since the middle of the decade. As Figure 5.1 shows, commencements in initial secondary courses have shown less tendency to fluctuate than in initial primary courses over the past decade; 2002 showed slightly higher enrolments in courses at the primary than at the secondary level.

**Figure 5.1: Commencing domestic students in various initial teacher education courses, 1990–2002**



Source: DEST Higher Education Statistics Collection, cited in J Ainley and C Underwood, *Australia's Teachers: Australia's Future, Vol. 3, Background data analysis, Review of Teaching and Teacher Education*, DEST, Canberra, 2003, p. 27.

In 2001, 48 per cent of completions from initial teacher education were from undergraduate education programs, 40 per cent from graduate education programs and 12 per cent from double degrees. Table 5.1 shows relationships among course completions (in the five horizontal rows) and the type of degree (in the vertical columns). The figures reflect what has been a longstanding pattern of primary training through an undergraduate degree/diploma (66 per cent) and secondary through end-on graduate study (63 per cent). Of students completing secondary education programs, 21 per cent undertook an undergraduate degree and 16 per cent a double degree. Almost 25 per cent of primary completions followed the graduate route, and a further 10 per cent a double degree. Only 5 per cent completed qualifications which straddled both primary/secondary or middle levels.

**Table 5.1: Characteristics of initial teacher education courses and completions, 2001**

Courses	Undergraduate			Graduate			Double degree			Total	
	N	Row %	Total %	N	Row %	Total %	N	Row %	Total %	N	%
Early childhood	1365	83%	10%	180	11%	1%	99	6%	1%	1644	12%
Primary	3526	66%	25%	1240	23%	9%	601	11%	4%	5367	38%
Prim/Sec or middle	266	42%	2%	320	50%	2%	49	8%	0%	635	5%
Secondary	1188	21%	8%	3674	63%	26%	924	16%	7%	5786	41%
Adult	457	71%	3%	184	29%	1%	0	0%	0%	641	5%
Total	6802		48%	5598		40%	1673		12%	14073	

Source: R Ballantyne, JD Bain and B Preston, 'Teacher education courses and completions. Initial teacher education courses and 1999, 2000 and 2001 completions', unpublished mimeo, Higher Education Group, Department of Education, Science and Training, 2002.

Initial teacher preparation is characterised by a very large number of programs, by their diversity, and by the volume of higher education providers. Although there is considerable variation in content, all programs include an interrelationship of educational theory, pedagogy, disciplinary/content learning, and practical classroom experience. The structure of programs is extremely varied, as is the number of completions among different institutions and programs. Of the total of 410 teacher education courses offered in 2001, only 263 were active in the sense of having completions, and in only 44 courses did 100 or more students complete. Of all 2001 completions, 43 per cent were in eight major institutions.<sup>1</sup>

While there is no single model or requirement linking initial teacher preparation and teacher accreditation and registration, most employers require four-year graduate training for permanent employment. In two States, Queensland and Tasmania, the education component requirement is for not less than two years (though with accelerated offerings the programs are sometimes completed in 18 months). The scale of teacher education reflects the demand for new entrants to the profession; the variety reflects diverse views about the most appropriate type of settings for initial training including the balance and sequence of the different components. This is a continuing debate.

The question of what constitutes adequate pre-service education for teaching has been a long-running debate. Over a decade ago, the Ebbeck Review preferred the pre-service degree as the first stage of a two-stage program. Students would take the second stage part time in conjunction with half-time work in schools as an 'associate teacher'. Thus the process of becoming a teacher would be spread over five years, with students working in schools (on pro rata salary) with a reduced teaching load during the final two years. The one-year postgraduate diploma was regarded as inadequate as a preparation for teaching and Ebbeck recommended that it be recast: 'requiring the graduate trained in such courses also to undertake an associateship (internship) of at least one year, involving a reduced teaching load, pro rata salary, and supervision and assistance: or significantly extending the Graduate Diploma of Education course to strengthen it academically and provide for substantial periods of practical experience in schools'.<sup>2</sup>

Over the years, it has been argued that two years of teacher education should be the minimum requirement to qualify as a teacher. The Australian Council of Deans of Education concluded in 1998 that initial teacher preparation programs should include at least two academic years of professional studies covering the theoretical and practical aspects of education, including professional experience.<sup>3</sup> Both the undergraduate and the dual degree pathways fulfil these requirements, as also do the two-year (and eighteen month compressed) end-on programs. The one-year postgraduate diploma is, however, a firmly established element among teacher education pathways. There is clear support among employers and from students for increasing the balance of programs towards the end-on routes, especially for secondary teachers specialising in the upper secondary years.

The impetus, now, is not to lengthen courses or prescribe in detail what they should contain. Attention has turned to the challenge to make teacher education, in whatever form, relevant to the demands of classroom learning in the 21<sup>st</sup> century, more flexible to respond to generational and changing expectations, and more of a close working partnership between the higher education institutions and the schools. As noted by the Queensland Deans of Education Forum: 'there is no one model of teacher preparation that can purport to be the most effective way of preparing teachers'.<sup>4</sup>

This does not imply that all pathways are of equal value or that present arrangements for initial teacher education are the best of all possibilities. To the contrary, there are several widely acknowledged weaknesses, discussed below. As the momentum for professional standards increases and registration requirements are further reviewed, through both the established bodies and the new State institutes, initial teacher education programs will be more closely scrutinised and institutions need to be prepared for this. Further outstanding issues are: the quality and the nature of and shared responsibility for the practical professional experience component; and the most suitable arrangements for school-based induction into the profession.

## 5.2 Pathways for teachers of science, technology and mathematics

In Chapter 2 it was shown that changes will be needed in teacher education to meet future requirements for teachers of science, mathematics and technology and to raise literacy levels in these areas among all teachers.

Teachers of high quality are required in all areas of the curriculum and at all levels in order to lay the groundwork and to provide the educational scaffolding for Australia's future as an innovative knowledge economy and society. All teachers themselves need scientific, technological and mathematical literacy and to understand their importance to schooling and beyond.

## 5.2.1 Primary teachers

Policy initiatives including incentives, as discussed in Chapter 4, are required in order to attract and retain teachers with an interest in, enthusiasm for and a sound background in science, technology and mathematics, and focused on the early and middle years of schooling. Specialist science and mathematics teachers as such, or teachers who have developed particular expertise in these fields and may act as leaders within the school teaching team, will be required. All teachers in primary schools will need to have a good grounding in science, technology and mathematics to teach in these areas.

There are pathways actually or potentially available for this purpose at the early childhood and primary levels, mainly within the structure of the undergraduate Bachelor of Education. A double degree teaming a BSc with a BEd or a graduate degree or diploma following a science degree are alternatives which might be considered as alternative routes for primary and early childhood teachers intending to develop a specialism in science.

The review of undergraduate primary BEd programs undertaken by Lawrance and Palmer shows no standard pattern either of balance between education and disciplinary staff in the faculties offering programs, or of availability of science, technology and mathematics subjects, whether optional or compulsory for all students.<sup>5</sup> There appears to be lack of clarity about just what course structures and requirements might be most appropriate.

A sequence (major or minor) of general offerings from the science faculty was available to primary students in almost half the programs surveyed by Lawrance and Palmer. These programs provide for the development of science and mathematics specialities at primary level, or could do so. Relatively few students chose this option, however, with most primary education students preferring to choose non-scientific discipline areas, according to staff interviewed. Only in a very small number of programs were the electives tailored for education students (for example, Edith Cowan University). Almost a quarter of the programs had compulsory science foundation subjects specially designed for primary education students offered by the science faculty (only 10 per cent had mathematics foundation subjects; and there were no technology subjects of this type). Almost half had compulsory foundation subjects (mathematics and science) offered by education staff (one-tenth had technology foundation subjects of this type). Almost a third offered education electives combining content and pedagogy in science, technology and mathematics. Nearly all programs included one compulsory curriculum methods subject combining content and pedagogy. Many programs had more than one curriculum methods course.

It appears that there is no shortage of opportunities for prospective primary teachers to study disciplinary science and pedagogical science. However, they are not in practice available in all institutions and, where they are, course requirements and uptake of options are quite variable.

Specialist teachers of science, technology and mathematics have much to offer in primary schools by providing a focus of science for young people and building the capacity of the school to improve science teaching and learning. For all schools to provide quality science education in the early and middle years, significant reconsideration is needed of recruitment to appropriate teacher education courses in course content and availability and in the balance of required and optional courses.

## 5.2.2 Secondary teachers

There is a greater propensity for those qualifying to teach mathematics and science at the secondary level to do so through an undergraduate degree plus a graduate teacher education pathway than is the case for those qualifying to teach other secondary specialisations. The most common pathway is the one-year graduate diploma through which 4 out of 5 secondary mathematics and science teachers qualified in 1999. Although figures are not available nationally, both Queensland University of Technology and the University of Melbourne remark on the significant presence of mature-age career-change entrants in end-on training programs in science, technology and mathematics.<sup>6</sup>

Technology education programs (in the sense of design and technology, not ICT) were found by Lawrance and Palmer to be relatively uncommon; most undergraduate courses being BEd-type programs for which content studies were provided by engineering faculties and TAFE. Industry placement components were available in several programs. A small number of graduate programs exist, many of which accept students with industry experience rather than a university degree.

Effective and ongoing dialogue between the science and technology community, the teaching profession, curriculum developers and education faculties is essential to achieve the right mix between content and skills knowledge and the pedagogical skills necessary to teach science, technology and mathematics. The importance of this dialogue is heightened by the advances in science, technology and mathematics that can cause foundation knowledge and skills to lose currency quickly.

The Committee notes that strong cross-faculty links and partnerships are required to strengthen the links between discipline, education and curriculum studies within universities in order to develop well-prepared teachers with high expertise in their content area and with a thorough grounding in pedagogical practice. The Australian Council of Deans of Science advocated stronger partnerships between science, mathematics and education faculties to better develop appropriate programs and to market and promote teaching in science, technology and mathematics as a career.<sup>7</sup>

From a practical perspective, collaboration between education, science and mathematics faculties is likely to enhance quality through maximising use of resources. Certainly, more collaboration will be required between teacher education, science and mathematics faculties if progress is to be made in increasing the numbers of students specialising to become science, technology and mathematics teachers. It will be a marked challenge to the universities to review present arrangements and to ensure the necessary strengthening of cross-faculty cooperation.

Since 1989, Australian students in government-funded university places have contributed to the cost of their education through the Higher Education Contribution Scheme (HECS). Initially, all students in all courses contributed the same amount, but since 1997, HECS contributions have been differentiated into three broad groups depending on the field of study. This has led to a variation in the costs to students preparing for teaching, as those undertaking science, technology and mathematics subjects have been charged at a higher rate than those undertaking education subjects only, or arts and humanities subjects. From 2005 the Australian Government intends a further change, with education (and nursing) subjects being paid at a separate and lower rate, in recognition of the 'national priority' accorded to training in these fields.

This should have a positive effect on teacher recruitment for, in relative terms, the costs incurred by students training for teaching will be comparatively lower than they are at present. The greatest effect will be for those taking four years of education subjects, and the smallest effect (within four-year courses of teacher preparation) will be for those taking three years at the science rate and one year at the education rate. In the foreshadowed arrangements there will be three main and different rates of contribution for prospective teachers.

Taking four-year courses as the baseline, the lowest cost will be for an education degree where all subjects (or units) are from the education field. An intermediate cost will be levied for, say, an arts degree and a one-year education course, and the highest cost will be for a science degree and a one-year education course. This basic outcome will be complicated by the proposed capacity of institutions to charge at less than the standard rate, or up to 30 per cent above the standard rate within individual courses, but the broad principle and effect of differentiation still holds.

From this starting point, the Committee arrived at two conclusions. Firstly, the higher HECS debt incurred by people who qualify as teachers of science, technology and mathematics compared with teachers of other disciplines is anomalous, because teachers' salary structures do not differentiate between teachers' specialisations. Teachers of science, technology and mathematics commence teaching on the same salary as teachers of other specialisations but, because of the higher HECS charge for science, technology and mathematics units, begin teaching with a greater HECS debt.



Secondly, submissions to the Review indicated that the higher HECS charges which apply to science, technology and mathematics units are perceived as a deterrent by those contemplating a career in teaching or undertaking a course of teacher education and considering a discipline specialisation. The Committee acknowledges that there are a number of factors that students take into consideration when choosing teaching as a career, including career prospects in terms of salary and conditions, job satisfaction and the higher HECS charges that apply to science, technology and mathematics units.

At a time when expertise in science, technology and mathematics is in high demand, and when Australia needs to produce more high calibre teachers of science, technology and mathematics, it is imperative to send a clear signal that the teaching of science, technology and mathematics matters by taking steps to ensure that teachers of these discipline areas do not pay more HECS than other teachers.

Specific and targeted approaches are needed to achieve this outcome. Enhancing the attractiveness of specialising in science, technology and mathematics among teacher education students (both primary and secondary) will ensure that future teachers have a level of science, technology and mathematics knowledge appropriate to the needs of the knowledge economy.

### 5.3 New and flexible pathways

Flexible pathways are needed through teacher education, especially for mature-age students, and as a means of attracting people who might otherwise not enter teaching. All pathways must, as a minimum: convey good teaching practice; provide prospective teachers with ample professional experience in schools, classrooms and educational settings; and ensure an appropriate knowledge, skills, values and attitude base. Those requirements can be met in quite different ways.

In most cases, flexible study requirements are designed around career change professionals with industry or vocational experience. Many are supported by State and Territory education authorities seeking to attract different cohorts into teaching, and to draw on the diverse backgrounds of mature-age students. These pathways are responding to the needs of a more demanding labour market and changing lifestyle expectations. This was borne out by those submissions which supported more flexibility in the delivery of teacher education courses—through part-time and evening courses, flexibility in entry and exit points and flexibility in the recognition of learning pathways—not only for career-change entrants, but also for students in regional and rural areas who are generally only able to study by distance education.<sup>8</sup>

Creative solutions for course design, delivery and evaluation are needed. New pathways may need to be developed and supported by education faculties and education authorities, such as:

- special intensive courses for those changing mid-career from another profession;
- accelerated courses involving summer schools in which students are able to finish their courses in less time and so start teaching and earning earlier;
- bridging programs containing discipline subjects and associated pedagogy subjects to allow students with insufficient content knowledge to become successful secondary specialist teachers, such as in science and mathematics<sup>9</sup>; and
- initial postgraduate science, technology and mathematics programs, in a similar vein to the Diploma of Education.

More widespread formal recognition of prior experiential and non-formal learning rather than Year 12 results alone as a basis for entry to courses has enabled people with varied employment and other experience to enrol in university teacher education programs. A recent study by the Australian College of Educators (ACE) notes that career-change teachers commonly 'bring considerable richness of experience as well as a valuable maturity to teaching which contribute to positive relationships with students and staff. Almost invariably they bring a different perspective, different skills and a depth of technical expertise to their schools.'<sup>10</sup> Many career-change teachers are motivated by altruism, wanting to 'make a difference'—drawn to teaching often because they have had some formal or informal prior experience working with children or young people.

The ACE and Ministerial Council on Education, Employment and Youth Affairs (MCEETYA) Teacher Quality and Educational Leadership Taskforce (TQELT) surveys provide insights into a significant category of potential teachers. Their figures underline the value for recruiting to focus on mature-age entrants and provide appropriate pathways for them. Mature-age entrants are an important source of supply in the short term and can bring much valuable experience to teaching; it is extremely important that pathways that facilitate and support their distinctive needs are widely available.

Apart from professional learning programs for already qualified teachers, graduate diplomas and two-year degrees are the two most useful and practical pathways to draw people quickly into shortage areas. Further adaptations of these to maximise their attractiveness to prospective science, mathematics and technology teachers, are the most effective current way to address immediate shortfalls of teachers.

The significance of the mature-age category is shown by the numbers involved. MCEETYA/TQELT reports that about one in five teachers had careers before teaching. Of these, secondary teachers were more likely than primary teachers to have had a previous career (24.3 per cent against 15.0 per cent); males (28.0 per cent) as against females (15.3 per cent); teachers in government schools (18.8 per cent) against teachers in non-government schools (7.5 per cent). The TQELT survey also indicated that the men who are most likely to be attracted to primary teaching are those who have already had another career and who have experienced fatherhood.<sup>11</sup>

Teacher education, both initial and continuing, is critical in any moves aimed at increasing the proportion of young people studying science, technology and mathematics and acquiring competence in other fields of high knowledge intensity and application. Lawrance and Palmer have documented examples of innovative programs of teacher preparation for science, technology and mathematics teachers in Australia's universities, many depending on the initiative of single individuals or small groups. The continuing learning of teachers—the refreshment of their subject knowledge and their teaching strategies—is just as important as their initial training.

While the needs of mature age students have been the source of a number of innovative pathways, for teacher education in general some striking innovations are occurring. In their comprehensive review of innovations in teacher education, Lawrance and Palmer identified initiatives at both the program level and at the level of individual courses.<sup>12</sup> Many institutions have introduced complete new pathways into teacher education. Among them are: the Bachelor of Learning Management at Central Queensland University, the Knowledge Building Community program at the University of Wollongong, the Bachelor of Behavioural Studies/Education (Middle Years of Schooling) at the University of Queensland, and the Bachelor of Education (Design and Technology) at the University of Newcastle. (Box 5.1)

#### **Box 5.1 Examples of innovative teacher education programs**

The **Knowledge Building Community (KBC) program at the University of Wollongong** has a school-based, problem-based approach to primary teacher education. Problem-based learning had not been extensively trialled in teacher education, although examples exist in educating for other professions. The four 'pillars' of the program are: taking responsibility for one's own learning; learning through professional collaboration; identifying and resolving professional problems; becoming a reflective practitioner.

The KBC program began in 1997 on an experimental basis with a group of twenty-four of the student intake. Instead of taking the practicum in a block, KBC students spend two days per week at a school for an entire semester during each of the years of their course. The course operates in four different schools. While each student has an individual teacher mentor, they interact with and are a resource for teachers throughout the school, and work as a team with other KBC students. The program illustrates a shift from 'clinical-supervision-one-classroom-teacher-to-one-student' approach to the practicum to a 'mentoring-whole-school-participates' model, and has established a much stronger partnership between the university, the local schools, the major employing authority and the teachers' union.

The **Bachelor of Education (Design and Technology) at the University of Newcastle** is focused on retraining displaced industry workers as school teachers. It was established in 1997 in consultation with Broken Hill Pty Ltd (BHP) and the NSW Department of Education and Training. BHP contributed a fee to cover student tuition for the duration of the retraining program.

### Box 5.1 Examples of innovative teacher education programs continued ...

Strong use was made of the provision for recognition of prior learning (RPL), with previously obtained trade qualifications, extensive in-house training (provided in most cases by BHP), work history and experience valued and recognised as both a basis for entry and a basis on which to build the retraining program.

Degree-qualified employees were offered a two-year part-time study program while still employed at BHP, leading to a regular Diploma in Education (normally one year full time). For trade- and Associate-Diploma-qualified staff, the program was offered as two years of part-time study after the BHP closure. On graduation the award was a Bachelor of Education (normally four years full time). A 98 per cent retention rate was achieved, against a general figure across programs of 72 per cent.

The **Bachelor of Learning Management at Central Queensland University** is premised on a new way of thinking about teachers as learning managers who tailor appropriate learning experiences for each of their students. 'Learning Management' is the capacity to design pedagogic strategies that achieve learning outcomes in students, involving an artful arrangement of interventions, tasks, materials and circumstances into planned and goal-directed problem-solving activities.

Questions on which the approach is based are: 'what does my learner already know; where does my learner need or even want to be, or what are the outcomes to be achieved; how does my learner best learn; what resources do I have at my disposal; who will do what; how will I check to see my learner has arrived; how will I inform my learner and others about my learner's progress'. This program includes an exceptionally high amount of formal practicum (26 weeks).

**The Bachelor of Behavioural Studies/Education (Middle Years of Schooling) at the University of Queensland** is one of a very small number of new courses focusing on the middle years of schooling, in the context of growing linkages between feeder primary and secondary schools and a growing number of all-through schools in Queensland. The program is a four-year dual degree with the BEd beginning in the third year. A graduate entry program is also planned. Three key stimuli for establishment of the course were:

- the thematically organised New Basics program currently being trialled in Queensland, which aims to replace existing KLA curriculum structures with new curriculum organisers (chapter 7);
- middle schooling principles, identified as: integration; flexible learning pathways; authentic learning and assessment tasks (favouring higher order thinking, critical thinking and reflective practice); teamwork; negotiated curriculum and use of new technologies; and
- the 'learning to teach' literature.

Source: GA Lawrance and DH Palmer, *Clever teachers, clever sciences—preparing teachers for the challenge of teaching science, mathematics and technology in 21st century Australia*, Department of Education, Science and Training, Canberra, 2003, and submissions to the Review.

Themes which are illustrated in these and other innovative programs are:

- a re-conceptualisation of the role of the teacher as a facilitator and manager of students' learning (not as the didactic fount of all wisdom);
- a focus on instructional practices whereby teachers can foster inquiry methods and problem-based learning in schools;
- developing collaborative capacities in student teachers as a basis for successful participation in teaching teams and partnership arrangements at schools;
- the teacher as a reflective practitioner—building a personal knowledge base including through action research;
- increasing the diversity within the teaching profession through facilitating non-standard entry pathways;
- taking a fresh look at how appropriate teaching situations and levels for teacher preparation are defined and organised—spanning/linking levels, notably primary–secondary.

These and other innovative themes were supported, with examples, in submissions from universities. Many submissions posed challenges which in practice are not always met. For example: 'Teacher education needs to practice what it preaches, providing environments where students can take risks, examine a diversity of approaches to teaching, learn about themselves as well as having a strong discipline base and knowledge and understanding of learning, teaching, student and societal diversity'.<sup>13</sup> According to James Cook University: 'Pre-service teachers must be given the opportunity to establish themselves as generative and innovative teaching professionals through authentic participation in the university and wider educational community. Generative potential is a cast of mind that has to be carefully nurtured and, like a muscle, exercised.'<sup>14</sup>

The Australian Council of Deans of Education believes that teacher education will in future focus more on the overall aim of reflective practice.<sup>15</sup> This does not mean simply spending more time in schools, but rather a rethinking of how teacher education time is used, involving more project work, and greater collaborative learning between students, teachers and academics.

A key challenge for teacher education is to change students' understanding of new approaches to teaching when they have themselves been taught in schools by more traditional methods (chalk and talk, rote learning, transmission approaches). Analysis of the Programme for International Student Assessment (PISA) shows that insufficient attention is being given in teaching to higher order skills and the development of understanding. This is a challenge to both initial and continuing teacher education. Linked with this is a difficulty in drawing upon a sufficient number of high quality, innovative teachers able to mentor and supervise students during practicums and internships. Prospective teachers need to be practising and developing more creative learner-focused skills in these settings and not merely reproducing how they themselves may have been taught.

However, as the South Australian Commission for Catholic Schools notes, not all programs are well attuned to the theme of innovative pedagogy: 'It needs acknowledging that pre-service programs still embody a huge degree of lecturing to students en masse, thereby failing to model the very pedagogy underpinning innovative teaching. The professional knowledge, the professional practice and the professional attributes required for innovation call pre-service training institutions to innovate themselves in the area of teacher education.'<sup>16</sup>

*Professional Standards for Graduates* adopted by the Queensland Board of Teacher Registration in 2002, in the view of the Queensland Deans of Education Forum, is a move away from a former 'culture of compliance', and a major step forward in supporting innovation in teacher education across institutions in the State. A key feature is respect for the autonomy of higher education institutions to set their own course objectives, devise their own learning environments and monitor the quality of their own graduates' learning, in which the regulatory body acts to audit each institution's own quality assurance processes.<sup>17</sup>

The Committee welcomed evidence of efforts by many institutions to evaluate basic patterns of initial teacher education and to introduce new programs and new and more flexible study pathways to meet the varied needs of different kinds of students. Partnerships between education authorities and course providers, and with schools, are particularly important in the development of appropriate programming and support mechanisms. Universities have shown a readiness to provide appropriate and diverse pathways and need to be well supported, particularly in the practical aspects of training.

## 5.4 Assuring quality and relevance

Numerous submissions stressed that teacher education courses must be of the highest quality, effective and relevant to the needs of beginning teachers. Quality is two-edged: quality of provision and approach, and students able and willing to reach high standards in their learning. Quality teacher education is vital to the health of the teaching profession, teacher preparation and quality of student achievement. As Jasman noted: 'Teacher educators hold the practitioner knowledge of effective curricular, pedagogical and assessment practices that can shape the way in which new teachers are prepared for their work in the 21st Century and support the development of existing teachers'.<sup>18</sup>

According to the level of schooling being prepared for (which extends from early childhood to upper secondary), the focus and balance varies between: discipline content knowledge; educational and pedagogical knowledge; hands-on practical experience in schools and understanding of school culture; use of information and communication technology; and a wide variety of options and institutional opportunities for personal development. The time available for the different elements varies considerably, for example between a four-year BEd and a one-year Diploma following a three- or four-year degree. Some programs give considerable weight to the role of the school and the school environment as a setting but normally it is the higher education institution that is the base and has the principal responsibility.

From the many submission references to teacher preparation, the Committee concludes that the overriding need is for teacher education students to develop greater practical skills for the classroom environment. While this means more time and a higher priority for this goal in competition with others, it can be practically achieved in a variety of innovative ways, with different emphases that take account of circumstances, possibilities and constraints. Teacher education programs should also prepare teachers to effectively use ICT and impart to students how to use tools so essential to everyday life in the 21<sup>st</sup> century.

Regardless of the nature and focus of initial teacher education programs, new standards are needed to ensure that all prospective teachers are able to enter employment well prepared to meet basic challenges, including:

- organisation and management of effective learning by the students in their charge;
- constructive participation in the life of the school community;
- reflective analysis and rationalisation of their teaching and the ability to modify it as needed; and
- readiness to continue learning and to meet career progression requirements.

In addition, there must be more serious effort directed at ensuring teachers are properly prepared to teach Indigenous students. Pre-service Indigenous studies can better prepare teachers to understand their students and the community and to communicate with parents, and therefore better equip them to meet the needs of Indigenous students and their communities.

The School of Education, James Cook University notes the importance of teachers' understanding, through experience with the community, of community needs: '... in a culturally diverse regional community, with low retention and participation rates, developing teachers' engagement in community activities is an important step in assisting them to recognise their potential to influence and bring about change'.<sup>19</sup> James Cook teacher education students can choose several ways in which they can be involved, including internships with schools and in community service organisations and the community service component in the third year of professional experience.

Programs such as these and the Remote Area Teacher Education Program (RATEP), which successfully recruits Indigenous teachers in flexible and culturally appropriate ways, are critical to promote and reflect intercultural diversity in teaching and school leadership. RATEP, a partnership between James Cook University, Tropical North Queensland Institute of TAFE and Education Queensland, was introduced in 1990 to provide appropriate teacher training in schools and communities with a high proportion of Indigenous students. It provides teacher education courses on-site to Indigenous students, primarily in remote locations but also in urban areas such as Cairns and Mackay. The certificate III and IV and diploma courses allow Indigenous people to become registered teachers after five years of study. It is a stepping stone towards a Bachelor of Education degree and full registration as a teacher. There are currently over 160 people enrolled through RATEP: some 40 are undertaking the Bachelor of Education; almost 20 are in the diploma course and the remainder at certificate III or IV level. The majority of students are women. Since 1990 there have been about 90 graduates, of whom about 60 are employed in schools.

The RATEP course envisages that graduates will be able to work in a range of education fields including library/administrative assistant, cultural liaison officer, and general teaching assistant. Some graduates continue studying to become fully qualified teachers. A key part of each level of study is that the learner will act as cultural liaison officer assisting in the development of community and school partnerships.

Developments in registration procedures and moves to establish system-wide and possibly national standards will sharpen the focus on what beginning teachers know and can do.

Given the national importance of quality teacher education and the range of stakeholders with interests in quality teacher education, a national forum should be convened to set future directions and develop agreed common principles and protocols for teacher preparation, including effective recognition of prior learning arrangements, course structure, content and delivery arrangements, practical teaching experience, quality assurance and the delivery of flexible pathways into teaching.

## 5.5 Assessing aptitude for teaching

Some submissions expressed concern about the quality and motivation of students undertaking teacher education. In particular, links were often made between tertiary entrance scores and the quality of student teachers. Tertiary entrance scores required for teacher education have sometimes been relatively low. In the past two years they have been steadily rising. Tertiary entrance scores are important both as evidence of academic quality and a signal that teaching has a status comparable to other university-based professions. However, tertiary entrance scores are not the only or always the most accurate indicator of suitability for teaching. For instance, some submissions quite reasonably argued that there should be effective processes to ensure that applicants had the necessary aptitude for teaching.<sup>20</sup>

But difficult issues arise in determining aptitude and deciding on ways to appraise it. A range of indicators can be used to assess the suitability of applicants for teacher education. The Senate Employment, Education and Training References Committee, for example, noted the importance of prospective teachers' personal qualities, motivation, organisational ability and flexibility to ultimate teaching success.<sup>21</sup>

An unusual insight into the characteristics of teacher education students in Australia is given by data from the Longitudinal Surveys of Australian Youth (LSAY), from a cohort of young people selected in a nationally representative sample of more than 10 000 when they were in Year 9 in 1995. Table 5.3 provides data on the just under 3000 of the sample who had participated in university study, and with whom contact had been maintained up to and including 2001. Further to the discussion on gender imbalance in the teaching force discussed in Chapter 3, the preponderance of young women (83 per cent) among those entering initial teacher education is very high.



**Table 5.2: Characteristics of students in initial teacher education and other university courses, 1999–2001**

Characteristic	Category	Percentage of students in category	
		Initial teacher education	Other university courses
Gender	Male	17.1	43.9
	Female	82.9	56.1
Parental occupation	Professional	48.6	55.5
	Clerical	19.3	15.2
	Skilled	19.5	13.5
	Semi/unskilled	12.6	15.7
Parental education	Higher education	27.7	35.6
	Trade/technical	9.1	9.1
	Complete secondary	20.6	24.4
Parental birthplace	Not complete secondary	42.6	31.0
	Australia	73.2	62.6
	Other English-speaking	8.4	9.9
Location in Year 9	Non-English-speaking	18.4	27.5
	State capital	44.0	62.2
	Urban region	9.9	9.5
	Large provincial city	12.1	5.5
	Small provincial city	4.3	3.9
School sector	Other rural	29.7	18.8
	Government	58.5	56.5
	Catholic	27.6	25.0
	Independent	13.9	18.5
Year 9 achievement H	Highest (>1 sd)	14.8	27.2
	High (> mean)	49.4	47.2
	Low (< mean)	26.7	19.2
	Lowest (>1 sd)	9.1	6.4
Numbers		242	2829

Source: Longitudinal Surveys of Australian Youth (Y95 cohort).

Table 5.2 shows that participants in initial teacher education programs (or at least undergraduate programs) are a little more drawn from the middle of the socioeconomic distribution than either the top or bottom, compared with other university students. Initial teacher education had slightly lower representation among those whose parents worked in professional occupations and semi-skilled or unskilled occupations, and slightly higher representation among those whose parents worked in clerical or skilled trades occupations.

Similarly, participants in initial teacher education were less likely than their peers in other fields of education to have come from families where their parents had themselves attended university (28 compared with 36 per cent) and were more likely to come from families where their parents had not completed secondary school (43 compared with 31 per cent). Those in initial teacher education courses were a little less likely than their peers in other university courses to have grown up in State capital cities and a little more likely to have grown up in provincial cities and rural areas. There were relatively small differences in the type of secondary school attended. In terms of school achievement in reading and mathematics in Year 9, students in initial teacher education were less likely than their peers in other courses to come from the highest achievement group.<sup>22</sup>

The Australian Teacher Education Association suggested that: 'Those who have positive experiences of high quality teaching and contact with teachers who show commitment, enthusiasm and enjoyment of teaching are more likely to develop positive as well as realistic perceptions of teaching as a career choice'.<sup>23</sup> Such traits are better identified and assessed through interview and personal appraisals than in subject-based examinations at Year 12. Although time consuming and costly, interviews are a useful component of selection processes. The University of Tasmania was encouraged by research that found that interview ratings by academic staff of applicants for teacher education courses were accurate predictors of future teaching performance.<sup>24</sup> UK experience indicates that greater attention to selection processes (even within a system of multiple applications through a tertiary admissions centre) is accompanied by higher retention rates during study.<sup>25</sup>

The Committee believes that clear evidence of aptitude for teaching as a criterion for selection and enrolment in a teacher education program is important, especially when the quality of teaching and of student learning outcomes are the subject of intense national interest and so much emphasis is being given to 'new learning' (Australian Council of Deans of Education), 'New Basics' and other innovative curricula and pedagogies (Queensland, South Australia and Tasmania) and the role of schooling in supporting a 'culture of innovation'. Aptitude is certainly assessed as a criterion for entry to the profession on completion of initial training; it requires attention also in selection for entry to training.

On this point, the University of New England Faculty of Education, Health and Professional Studies entered a cautionary note regarding applicants from business and industry: 'Just because individuals have been in a professional career does not mean that they have the skills and attributes to make good teachers. Granting too "easy access" of entry into the teaching profession devalues the skills and training of those who have undertaken traditional programs. It also contributes to a subtle undermining of the teaching profession by the false implication that "anyone can teach".'<sup>26</sup> While this is a timely caution which refers to what may be a tendency to relax entry requirements, there is evidence that career-change entrants to teacher education courses, who would have been assessed using measures other than their Year 12 assessment, perform well in their courses and in subsequent teaching.<sup>27</sup> It is generally agreed that, provided their suitability is carefully appraised, they should be encouraged to prepare to become teachers.

The Committee regards suitable career-change entrants as a very important source of future teachers, and not only in the areas of current shortage. While there may be pressures, when demand is high and supply low, to lower entry requirements, whether for school leavers or mature-age candidates, requirements for entry to training must be stringent. This does not mean either rigidity or narrowness.

The several movements towards revitalising the teaching profession and the associated drive towards a national teaching standards framework and national mobility will affect entry conditions to the profession. The teacher accreditation and registration bodies and processes in all States and Territories may set their own conditions on entry requirements. This, together with the progress of the drive for agreed professional standards, should be a trigger to reviews by the universities of the adequacy not only of programs and course requirements, but also of their arrangements for identifying suitable teacher education candidates.

## 5.6 Relevant and effective practical experience

The Committee strongly agrees with the view expressed by the Australian Council of Deans of Education that: 'Professional practice must be at the heart of teacher education, and theory and practice must be seen as mutually informing. Enriching professional practice must be further facilitated by the expansion of mentoring and team teaching and the allocation of time for collegial discussion and feedback. All are vital to the goals of collaborative and flexible learning. Project orientated tasks, which both reflect and promote the importance of teamwork and collaborative scholarship, also need greater recognition in teacher education programs. Collaborative projects also need to be seen in the context of changing school and university environments.'<sup>28</sup>

The Review encountered no disagreement over the need for substantial and high quality practical experience within schools during initial teacher education. But there is no national norm, and minimum jurisdictional requirements for registration differ. Arranging practical experience requires a sound working partnership between the university teacher education staff and the school. This is not always achieved and there are differing views over what the balance of responsibility should be, and how teaching practice within initial training should be managed and financed. The major point of long-standing, inconclusive debates is over the extent, nature and control of the practical, experiential element of training within schools.

The Australian Parents Council captured the view of many of the respondents who offered views on teacher education: '... there ought to be more opportunity for trainee teachers to undergo longer periods of practical work in schools. Reforms to teacher training should include a greater emphasis on in-school classroom training experience.'<sup>29</sup> This recommendation raises in a very direct way issues of overall length of initial programs, and how the costs of practical school experience are to be met.

There are now considerable variations in how practical experience is organised in different teacher education programs, including blocks of supervised practicum in schools, dispersed days at schools, diversity of school settings and the ways students and institutions have of gaining access to them, and a variety of associations with particular schools over time. Undergraduate degree programs typically have 18–22 weeks practical experience in schools over four years for primary teachers, and 16–20 weeks practical experience for secondary teachers. Students taking a one-year diploma have 8–10 weeks practical experience, and those studying two-year graduate programs have 16–20 weeks in schools.<sup>30</sup> Variety and flexibility are needed to meet the circumstances of schools, particular programs and students. These requirements are not always based on educational principles; often they reflect organisational and financial exigencies.

Although the issues of quantity and quality of practical experience were aired in submissions, there is little hard evidence of the comparative value of different kinds of practicum experience around the country. Certain programs appear to be making more focused use of practical experience to foster problem-solving capacity and team skills in student teachers, along with a stronger appreciation of the life of the whole school as distinct from teaching in an individual classroom. The practical experience component serves many different purposes. Clarification and broad agreement on these and desirably directions for change could help to focus present debates about the nature and value of this very important part of teacher preparation.

There is no fixed length for practicums, and such factors as cost and administrative considerations appear influential in institutional decisions concerning length. The costs of teacher education courses, particularly the provision and administration of professional experience programs, have been of particular concern to education faculties.<sup>31</sup> It is pleasing to note then, that following findings in the Review's *Interim Report*, the higher education reform package includes a proposal to increase the Australian Government's funding contribution for teacher education provision in recognition of the costs associated with the practicum.

Welcome as this is, it would be desirable for State and Territory education authorities together with the education faculties to jointly review the school experience element of preparing to teach and entering employment and to find ways to further support the practicum. The Mathematics Education Research Group of Australasia recommended that State and Territory education authorities should provide more financial support for professional experience, arguing that: 'Many Vice Chancellors consider teacher education courses to be relatively expensive, so course quotas are kept tight. There is one reason for this perception: the cost of the practicum ... The solution here is state-based financial support for the practicum.'<sup>32</sup> While Australian Government funding will help, the practicum is but one element in a continuum of guided practical experience which extends into the initial year or years of appointment, and there are associated costs.

From various sources, a case has been built for a re-articulation of practical experience in teacher education. A number of submissions recommended that teacher education courses should facilitate closer partnerships between teacher education institutions and schools.<sup>33</sup> The Australian Secondary Principals Association argued that: 'Schools needed to be significant "players" in the preparation of teachers'.<sup>34</sup> Shadow Minister for Education and Training in Western Australia, the Hon Alan Cadby MP, advocated a full school-centred approach to professional experience.<sup>35</sup> In his examination of teacher preparation in New South Wales, Ramsey proposed a fuller integration of practical experience into educational programs for beginning teachers.<sup>36</sup> Similarly, the Australian Education Union argued: 'There is a need to invest more in the practicum and allow for more time for teachers-in-training in classroom situations. As well, there is a need for increased investment in the time of supervising teachers to assist the student. This will provide more time and financial recompense for the supervising teacher and lead to greater levels of initial teacher confidence at the start of a career.'<sup>37</sup> The University of Notre Dame, noting the limited place in the pre-service program reserved for in-school experience, said: 'There is a strong argument for this to be expanded in order to allow students to integrate the realities of school life and the work of the classroom teacher into the educational theory that underpins teacher education programs. This is an expensive option and difficult to deliver.'<sup>38</sup>

No-one appears to dissent from the very widely expressed view that many aspects of and arrangements for the practical experience component of initial teacher education need to be improved. Renewed attention should be given to the practicum issue in the context of a wider appraisal of a continuum of practical experience. The Committee envisages this occurring through both the concerted efforts of institutions, schools and education authorities in the case of specific programs, and for jurisdictions and nationally through the further development of registration procedures and professional standards.

Whichever way they are configured, genuine partnerships between higher education institutions, governments, education authorities and schools are essential to making teacher preparation courses, and particularly the professional experience component, as effective as possible. Through partnering, those involved in and sharing responsibility for initial teacher education can improve the preparation of teachers for the classroom.

### 5.6.1 Innovative approaches to practical experience

Many institutions have been pioneering new approaches to extending the amount of practical experience and diversifying its content. The Knowledge Building Communities program at the University of Wollongong provides for substantial engagement of students with a school setting by basing students at a school for two days per week over a full semester in each of the three years of the program. In other programs, dispersed days are balanced with block practicums of varying lengths. Three programs had exceptionally high amounts of formal practicum: the BEd at the Royal Melbourne Institute of Technology (38 weeks, with a maximum of 26 weeks in a primary school) and the Bachelor of Learning Management, Central Queensland University, and the BEd (Primary), Griffith University (Gold Coast), both with 26 weeks.

Several programs use the opportunity of practicums for students to undertake focused action research projects. The Bachelor of Teaching (Primary) at Northern Territory University provides for students to strengthen particular competencies during different practicums, and the Bachelor of Science/Bachelor of Education (Secondary) at Murdoch University provides greater continuity of university supervision on-site in schools during student practicums.

A number of teacher education programs provide student teachers with exposure to schools beyond the formal practicums, as illustrated in the University of Tasmania Landcare study which is organised as part of the curriculum methods program.<sup>39</sup> At Queensland University of Technology, students are involved in many university-school partnerships outside student teaching and field-based learning, including a number of large-scale evaluative and professional development research projects which are central to the Queensland education reform agenda.<sup>40</sup>

In a culturally diverse regional community with low school retention and participation rates, developing teachers' engagement in community activities can enable students to recognise their potential to influence and bring about change. For example, the community service component of James Cook University's professional experience program for third-year teacher education students provides opportunities for service learning which broadens students' experience of teaching and learning in quite varied settings. In this program, students contribute to a range of regional community service organisations for a minimum of 50 hours. Organisations providing social support (for example, The Smith Family) and a range of cultural organisations now recruit students annually to support their work.<sup>41</sup>

In the Bachelor of Teaching (Primary) at Northern Territory University, students choose competencies on which to focus during their practicum, thereby driving the learning process themselves. The practicum also has a strong teacher-as-researcher focus, with students conducting action research and a school/community outreach project. The competencies used are those of the National Competency Framework for Beginning Teaching, developed by the National Project for the Quality of Teaching and Learning, and fall within the groupings:

- using and developing professional knowledge and values;
- communicating, interacting and working with students and others;
- planning and managing the teaching and learning process;
- monitoring and assessing students' progress and learning outcomes; and
- reflecting, evaluating and planning for continuous improvement.

Students undertake three block-based practicums during their programs (of five, four and eight weeks duration respectively). Both university staff and school teachers help with showing students ways of providing valid evidence of their progress in achieving the identified competencies. Close collaboration is required between university and school staff.<sup>42</sup>

The country practicum is favoured by many as a way of encouraging more students to be prepared to move to rural and remote locations for teaching. Costs are, however, a real issue for students. A survey of some 200 Flinders University students indicated that for three-quarters of the students, costs were a significant factor in their not choosing a country practicum option, and more than half indicated that losing income from part-time work was a barrier to teaching away from their place of residence.<sup>43</sup>

The illustrations in this section show that many institutions—and these are not the only ones—are reshaping the practical experience component. They demonstrate that, despite financial and other constraints, there are ways to diversify practical experience and provide students with a wide range of opportunities to develop their practical expertise and understanding of how schools work.

### 5.6.2 Extending practical experience—the internship

As an extension or further development of the practical experience component of initial teacher education, internship programs have been introduced by many universities to facilitate 'in classroom' preparation of student teachers. Internships are an intermediate stage following completion of most requirements of initial teacher education and entry into employment. They take many different forms. According to the University of Canberra's submission, models of professional experience, such as teaching internships for pre-service teachers, also have the potential to close the gap between school and university perceptions and expectations of teaching. As they point out: 'Such programs could place professional experience as the central component of teacher education programs'.<sup>44</sup>

At the University of Canberra, students in the fourth year of the Bachelor of Teaching (Primary) complete a 40-day internship in a primary school. In its Bachelor of Education program, the University of Queensland has an internship for the secondary and middle years of schooling. These interns carry a 50 per cent teaching load for a ten-week period and are mentored by appointed colleagues at the school.<sup>45</sup> At the Queensland University of Technology, all students in a new Bachelor of Education program are to enter an internship in their final year, with their teaching responsibilities scaled to accommodate differing levels of preparedness. The Queensland Deans of Education Forum see internships as an important addition to university-based preparation of student teachers: '... induction as part of an internship program provides assistance in the transition to full time teaching but should not replace induction and mentoring support programs by employers for their beginning and other newly appointed teachers'.<sup>46</sup>

Internship has been mainly used within BEd and two-year graduate programs. In almost one-third of primary courses, the final practicum has been extended, taking the form of an internship in which students teach up to a full teacher's load. Final year teacher education students at James Cook University's Townsville campus undertake an internship involving collaborative work with a mentor on a project which supports the future direction of a school. Projects may include curriculum innovation, development of technology capacities of staff, or projects linked to broader aspects of engagement. The intern presents the project at a student organised conference. The involvement of interns in innovations strives to ensure that beginning teachers look beyond classroom survival, and begin to form a professional network within a school.<sup>47</sup>

The lessons learned by teachers in preparatory programs can be powerfully reinforced in initial teaching assignments. Professional experience, induction, mentoring and ongoing professional learning are all vehicles for universities and schools to work closely together. They can make teaching more attractive to potential teachers and assist retention of teachers, particularly in their initial years in the classroom.

Evidence before the Review shows growing support for viewing the practicum (under the responsibility of higher education authorities) and the induction period (under the authority of the employer) as a single developmental stage in the initial professional formation of new teachers, in which both schools and universities have important, continuing parts to play. Further, close consideration by education authorities, universities and school representatives, including examination of successful components already in operation, could lead to a considerable strengthening of the initial professional formation of teachers. It is time to rethink practical experience, particularly for end-on courses—seeing practicum, internships and induction as a single developmental phase, with a continuing partnership between schools, universities and employers.



## 5.7 Change over the recent past and future directions

The structure of programs through which people prepare to teach or enter the teaching profession and opportunities for developing innovative programs are, naturally, greatly affected by the nature of the universities and other higher education institutions in which teacher education largely takes place. Teacher education has faced several challenges since the introduction of the unified system of higher education in the early 1990s.

With minor exceptions, under the new system it became more difficult to establish teacher education as an institutional priority. Teacher education faculties had to negotiate internally and against competing priorities for a share of a university's Commonwealth block grant, and historical circumstances did not assist.

Institutional mergers resulted in considerable staff restructuring in education faculties occasioned both by 'early retirements' and by relocating 'methods' teachers to the faculties of their specialties (for example, moves to science and arts faculties). At the same time, there was a marked decline in teacher education enrolments (from a high in 1990 to a low in 1994). This decline in the number of teacher education students coincided with significant changes by the Commonwealth government in the basis on which it funded universities. Student load became an important factor in internal university planning. As universities refined internal mechanisms for allocating student places within their overall global budget, teacher education places became 'fixed' at a time of comparatively low teacher education enrolments. Thus the allocation of student places for teacher education came to be determined not by demand for the courses, or national supply need, but rather at individual institutional level in relation to competing demands from all faculties for student places, and with reference to allocations already made in previous years.

In the early 1970s, the Commonwealth government had assumed responsibility from the States and Territories for funding higher education, and thereby teacher education programs. State and Territory governments not only remained employers of the majority of the country's teachers, but were also responsible for the schools in which they taught. Moreover, they were the authorities responsible for legislation governing higher education institutions (now in accordance with a quality assurance framework established by national protocols). Many suggested that this has resulted in some mismatch between the setting of the number of teacher education places and the demand needs of school employing authorities.

The Australian Government's proposed higher education reform package, *Backing Australia's Future*, addresses these issues. Importantly, the Australian Government has recognised the importance of ensuring an adequate supply of high quality graduate teachers for the nation's schools by establishing education as one of two national priorities from 2005. By identifying teacher education as a national priority area, the reforms are intended to protect students from any increase in the cost of student contributions to education units. In addition, the increase in the Australian Government contribution for teacher education provision recognises the costs associated with teacher practicum.

To encourage greater flexibility and diversity in the sector, a new Commonwealth Grant Scheme (CGS) is planned to replace the current operating grants system. The Australian Government will provide a contribution, set by discipline, toward the cost of an agreed number of Australian-Government-supported places actually delivered in a year. Each higher education institution that receives funds under the CGS will enter into a funding agreement with the Australian Government, with annual negotiations to take place over the number of places and the discipline mix that the Australian Government will support. Places to be supported may be at the undergraduate level, the postgraduate non-research level in negotiated fields, and in enabling courses. Funding agreements will take into account the outcomes of discussion on labour market needs with States and Territories. The Committee welcomes the decision of State and Territory Ministers to work with the Australian Government in developing a mechanism for the distribution of university places.

This agreement is designed to ensure that the allocation of university places meets future research and workforce needs. In the case of teacher education specifically, these arrangements will need to take into account the challenges of disaggregating the breakdown of the allocation of places according to the needs for different types of teachers—between primary, middle and secondary, and between generalist and specialist. This creates two challenges: to improve workforce planning; and for universities and education authorities to provide the right mix of incentives to fill specified places with candidates.

The issue of preparing teachers is complicated by the considerable number of individuals trained to become teachers who never enter the profession or who leave within the first few years. Better retention strategies are required to stop this wastage. All the evidence suggests that it will be difficult to meet the demand for science, technology and mathematics teachers by focusing on new graduates alone. Therefore, increased secondary specialist places in teacher education, more effective teacher recruitment policies and practices and quality initial teacher education will not alone address teacher demand if serious efforts are not also made to address the issue of high rates of teacher attrition, particularly in the early years. The most crucial factor in ensuring an adequate supply of teachers for the future will be to retain and support as many of those teachers currently employed as possible, particularly those in the earlier years of their careers. Induction and mentoring are an important part of the solution to retaining teachers in Australia's schools.

The quality of the study programs that provide the foundation of professional knowledge and competence to teach is of prime national importance and should receive close attention in the context of the Australian Government's recent declaration of education as a national priority in higher education. All parties involved need to work in close partnership to ensure success.

Initial teacher preparation, the schools where teachers start their career, and the hands-on experience they have in that school are closely related elements that influence teachers' decisions about their careers and are of demonstrable significance for retention.

Initial teacher education in Australia has passed through more than a decade of considerable upheaval and restructuring. On the basis of a minimum of four years of initial preparation through a wide variety of programs and with recent improvements in funding arrangements, there is now opportunity for a decade of development focused on quality issues. Needs and priorities have been identified and, with sufficient commitment and determination by the various partners and responsible bodies, they can be met.

There is a continuum from the initial set of decisions whereby people embark on teacher education, through the years of formal study and practical experience, the entry to teaching and the initial years as a fully functioning professional. This continuum needs to be very well articulated and itself form the basis of continued professional learning and development. Induction and professional learning are not separate from or incidental to the process of initial preparation for teaching, but a natural progression which builds on and deepens a teacher's foundation knowledge and expertise.

## Key conclusions

The Committee considers that each of the following requires attention:

- changes in program content and course requirements to ensure that all students improve their broad understanding of the forces for change in Australian society and the importance of science, mathematics and technology in underpinning the knowledge economy and society;
- changes in program content and course requirements to ensure that all future primary school teachers have a trained capacity to teach the science, mathematics and technology components of the primary school curriculum and that there is a sufficient number of teachers with expert knowledge to provide school leadership roles in these areas of the curriculum;
- more collaboration between education, science and mathematics faculties to enhance quality through maximising use of resources and to increase the numbers of students specialising to become science, technology and mathematics teachers;
- improvements to both discipline knowledge content and pedagogical knowledge of future science specialists to help specific problems in school science education;
- teachers of science, technology and mathematics are faced with a greater HECS liability than their fellow teachers yet receive the same salary—submissions to the Review indicated that there is a perception that this acts as a disincentive for science, technology and mathematics graduates to take up teaching in those areas; the Committee believes that teachers of science, technology and mathematics should not pay more HECS than other teachers;

## ▣ Key conclusions continued ...

- further adaptations of initial science, technology and mathematics qualifications to maximise their attractiveness to prospective teachers, and to address immediate needs in an effective way;
- as the momentum for professional standards increases and registration requirements are further reviewed through State and Territory teacher registration bodies, initial teacher education programmes will be more closely scrutinised and institutions will need to be prepared for this;
- use of evidence of aptitude for teaching as a criterion for selection and enrolment in a teacher education program, especially when the quality of teaching and of student learning outcomes are the subject of intense national interest and so much emphasis is being given to ‘new learning’;
- strengthening and wherever possible enlargement of the practical and experiential components of initial teacher education preparation, to include a more systematic, cohesive program extending from the practicum through internship to well-structured induction;
- development of flexible and responsible pathways through teacher education to meet the needs of a diverse group of prospective candidates;
- establishment of genuine partnerships between higher education institutions, governments and schools, whichever way they are configured, to make teacher preparation courses, and particularly the professional experience component, as effective as possible;
- rethinking of practical experience—seeing practicum, internships and induction as a single developmental phase, with a continuing partnership between schools, universities and employers;
- allocation of teacher education places to meet future workforce needs, and arrangements to take into account the challenges of disaggregating the breakdown of the allocation of places according to the needs for different types of teachers—between primary, middle and secondary; and between generalist and specialist; and
- increased places in teacher education, more effective teacher recruitment policies and practices, and quality initial teacher education, will not alone address teacher demand if efforts are not also made to address the issue of high rates of teacher attrition, particularly in the early years.

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- <sup>1</sup> R Ballantyne, JD Bain and B Preston, Teacher education courses and completions. Initial teacher education courses and 1999, 2000 and 2001 completions, Department of Education, Science and Training, 2003.
  - <sup>2</sup> F Ebbeck, *Teacher education in Australia*, report to the Australian Education Council by an AEC working party, National Board of Employment, Education and Training commissioned report No. 6, Australian Government Publishing Service, Canberra, 1990, p. vi.
  - <sup>3</sup> K Adey, *Preparing a profession*, Report of the National Standards and Guidelines for Initial Teacher Education Project, Australian Council of Deans of Education, Canberra, 1998, p. 23.
  - <sup>4</sup> Queensland Deans of Education Forum, submission no. 65, p. 5.
  - <sup>5</sup> GA Lawrance and DH Palmer, *Clever teachers, clever sciences—preparing teachers for the challenge of teaching science, mathematics and technology in 21<sup>st</sup> century Australia*, Department of Education, Science and Training, Canberra, 2003.
  - <sup>6</sup> University of Melbourne, submission no. 85; Dr R. Nason, Queensland University of Technology, letter dated May 2003.
  - <sup>7</sup> Australian Council of Deans of Science, submission no. 45, p. 1.
  - <sup>8</sup> University of Tasmania, submission no. 84; University of Western Sydney, submission no. 89, p. 11; Frances Meeking, submission no. 7, p. 1; Association of Heads of Independent Schools, submission no. 58, p. 6; Aboriginal and Torres Strait Islander Commission, submission no. 70, p. 7; Queensland Deans of Education Forum, submission no. 65, p. 7; Faculty of Education and Creative Arts, Central Queensland University, submission no. 66, p. 10.
  - <sup>9</sup> V McClean, 'Attracting and Retaining Teachers of Science, Technology and Mathematics', *Educare News*, June 2003, p.26.
  - <sup>10</sup> Australian College of Educators, *Report on career change entrants to the teaching profession, unpublished draft* 2003.
  - <sup>11</sup> Ministerial Council on Education, Employment, Training and Youth Affairs, *Demand and supply of primary and secondary school teachers in Australia*, MCEETYA, 2003.
  - <sup>12</sup> GA Lawrance and DH Palmer, op cit.
  - <sup>13</sup> Flinders University School of Education in consultation with the Faculty of Science and Engineering, submission no. 206.
  - <sup>14</sup> James Cook University, School of Education, submission no 207.
  - <sup>15</sup> Australian Council of Deans of Education, submission no 222.
  - <sup>16</sup> South Australian Commission for Catholic Schools, submission no. 204.
  - <sup>17</sup> Submission no. 173.
  - <sup>18</sup> A Jasman, 'Initial teacher education: changing curriculum, pedagogies and assessment', unpublished paper, University of Melbourne, 2002.
  - <sup>19</sup> Submission no. 207.
  - <sup>20</sup> Nola Shoring, submission no. 19; Douglas Whitton, submission no. 21.
  - <sup>21</sup> Senate Employment, Education and Training References Committee, *A Class Act: inquiry into the status of the teaching profession*, SEETRC, Canberra, 1998, Chapter 7.
  - <sup>22</sup> This group was defined as those scoring at least one standard deviation above the Year 9 mean.
  - <sup>23</sup> Australian Teacher Education Association, submission no. 94, p. 4.
  - <sup>24</sup> University of Tasmania, submission no. 84.
  - <sup>25</sup> Reference to UK
  - <sup>26</sup> Faculty of Education, Health and Professional Studies, University of New England, submission no. 87, p. 2.
  - <sup>27</sup> Australian College of Educators, op cit.
  - <sup>28</sup> Australian Council of Deans of Education, submission no. 222.
  - <sup>29</sup> Australian Parents Council Incorporated, submission no. 93, p. 6.
  - <sup>30</sup> Lawrance and Palmer, op. cit.

- <sup>31</sup> IT Skills Hub Pty Ltd, submission no. 52, p. 6; Australian Association of Research in Education, submission no. 83, p. 5.
- <sup>32</sup> Mathematics Education Research Group of Australasia Incorporated, submission no. 30, p. 4.
- <sup>33</sup> Australian Academy of Science, submission no. 44, p. 3.
- <sup>34</sup> Australian Secondary Principals' Association, submission no. 138, p. 2.
- <sup>35</sup> The Hon. Alan Cadby MP, Shadow Minister for Education and Training, Western Australia, submission no. 51, p. 1.
- <sup>36</sup> G Ramsey, *Quality matters. Revitalising teaching: critical times, critical choices*, report of the Review of Teacher Education, New South Wales, Department of Education and Training, Sydney, 2000, p. 63.
- <sup>37</sup> Australian Education Union, submission no. 49, p. 9.
- <sup>38</sup> School of Teaching, University of Notre Dame, submission no. 77, p. 6.
- <sup>39</sup> Lawrance and Palmer, op. cit.
- <sup>40</sup> Queensland University of Technology, Faculty of Education, submission no. 155.
- <sup>41</sup> James Cook University, School of Education, submission 207.
- <sup>42</sup> Lawrance and Palmer, op. cit.
- <sup>43</sup> Flinders University, School of Education (in consultation with the Faculty of Science and Engineering), submission no. 206.
- <sup>44</sup> School of Teacher Education, University of Canberra, submission no. 72.
- <sup>45</sup> School of Education, University of Queensland, submission no. 57.
- <sup>46</sup> Queensland Deans of Education Forum, submission no. 65.
- <sup>47</sup> James Cook University, School of Education, submission no. 207.

## 6. The professional learning continuum

The processes of preparing to teach are not confined to the degree or diploma programs of universities and other higher education institutions. Beginning teachers still have much to learn about their craft and how to be effective in teaching. For many years it has been argued that the transition from teacher education institutions to employment as a teacher is too abrupt and that the notion of 'preparation' should be extended through more structured and better supported induction. There should be new patterns of shared responsibility to ensure smooth transitions and a better experience by beginning teachers of the very considerable demands of the early years of teaching.

A traditional view separates induction from initial preparation as an employment and 'professional learning' issue, since beginning teachers are already trained and employed. Further training and support, grounded in experience of full-time teaching responsibility, is a matter for schools/employers and the teachers themselves.

An alternative view, shared by the Committee, sees a well-articulated process extending from the preparatory theoretical studies, through experiential phases of practicum and internship, to well-structured induction and career-long professional learning, as a continuum calling for full partnership between the stakeholders.

According to the Australian Council of Deans of Education: 'Teachers must be encouraged to refine their skills, supported once they enter the profession, rewarded upon attaining postgraduate qualifications, given time to learn with their colleagues, and provided opportunities for international and other exchanges. Without this commitment to quality teaching, all other commitments are necessarily flawed'.<sup>1</sup>

### 6.1 Induction

Strategies to attract and prepare new teachers are important. However, they currently provide little assurance that teachers will be retained. There is every prospect of increasing teacher retention through improvements to initial teaching experiences, teaching conditions, career pathways, recognition and reward. Professional environments are amenable to improvement to ensure beginning teachers' success, enjoyment, satisfaction and high quality of experience.

Some State and Territory education authorities report high attrition (or low retention) rates early in teachers' careers.<sup>2</sup> This is possibly as high as 25 per cent within the first five years of teaching. The Queensland Deans of Education Forum described what faces beginning teachers:

The transition from graduate to beginning teacher is a time of considerable challenge and vulnerability for first year teachers ... The first years of employment are often a very isolating experience and a time of considerable stress and burnout. Many valuable members of the teaching profession resign and substantial teacher preparation resources are wasted.<sup>3</sup>

One of the best measures to assist teachers in the transition from teacher education to the classroom, and to ensure lower attrition and higher retention rates, is the provision of considerable support and guidance in the first years of their classroom-based career through a broad teacher induction program. Support for beginning teachers in their first years in the profession is being given higher priority by education authorities, as a logical complement to preparation through initial teacher education and orientation to the school working environment. The Australian Education Union is of the view that:

... sound practices of induction and mentoring should characterise the beginning of a teaching career. This would entail:

- a well-planned mentoring relationship from the first day of a teacher's appointment;
- the provision of release time for both beginning teachers and their mentors;
- support mechanisms such as consultancy, group meetings of beginning teachers, interaction with training universities.<sup>4</sup>

Effective induction programs can vary in activities, content, participation, roles of universities and schools, formality and evaluation. A well-designed induction program in each school, which provides guidance and support through the transition from novice to full-time teaching, is a key factor in making beginning teachers' transition to their new career a success. Induction programs should be a positive, constructive experience. There is considerable support for requiring induction programs to be accredited, based on recognised standards of good practice.<sup>5</sup>

Induction programs can be expected to achieve a decrease in the attrition rate of promising beginning teachers during the initial years of teaching. Indeed, evaluations of induction programs show evidence of higher retention rates among induction program participants.<sup>6</sup> Several respondents in a submission supported the notion that the quality of induction plays a strong role in the decision of a new teacher to continue in the career.<sup>7</sup> Increased job satisfaction and better adjustment to the school community have been reported to result from a formal induction program.<sup>8</sup> There is evidence from other countries that well designed and supported induction programs assist greatly with neophyte teacher retention, especially in locations that are difficult to staff.<sup>9</sup>



Another outcome of good induction is an improvement in the knowledge, skills and performance of beginning teachers. Effective induction programs help new teachers to learn subject-specific issues in curriculum and instructional practices and to create basic professional skills around lesson planning, assessing student work and communicating with parents.<sup>10</sup>

As noted by the Queensland Deans of Education Forum: 'Induction and structured mentoring should set the context for continuing professional learning'.<sup>11</sup> Further, university participation in induction programs, and follow-up with their graduates, would strengthen the teacher education curriculum by encouraging integration of theory and practice and tracking of teacher effectiveness.

There is evidence of the many benefits that accrue from well-organised induction programs. But induction arrangements in practice often do not measure up and there is much potential for improvement. Criticisms of induction are not new in Australia. A 1990 Schools Council report regarded induction as 'an important element in the professional development of a teacher', identified desirable characteristics of any induction process, and suggested a mapping exercise as the basis for 'the development of a model of induction to be generally applied'.<sup>12</sup>

Present moves to strengthen induction are largely based on voluntary standards and procedures, not mandatory requirements, although, as pointed out in the following section, this could be about to change. Much hinges on how ready schools are to address the concerns which have been raised. For example, young teachers and school principals have different views on just how effective induction has proved to be. Ways have been identified to improve induction: better structures to facilitate communication and dialogue; collegial networks; clear distinction between supervisory and developmental aspects of the school's role; and better partnerships between teacher education institutions and schools.

Closer attention to induction as a phase of professional orientation and development will be required. Principles need to be clear and agreed. Mentoring, teamwork, observation and professional discussion, a balance between the processes of support and appraisal, and supported entry into professional networks and associations, are among recommended practices. Funding and staffing of schools to strengthen induction are essential if increasing expectations are to be met. Induction should be part of a continuum which closely connects the phases of preparation and entry into the profession.

The Queensland Board of Teacher Registration's guidelines (Box 6.1), which are indicative, not mandatory, are an example of suitable induction processes, including introduction to school policies, resources and personnel and to the community.

### Box 6.1 Principles of good practice in induction

Induction is a significant phase in the continuum of teacher development. *It builds on prior learning and experience, and encourages a supportive culture of lifelong adult learning.*

Induction recognises the strengths and contributions of provisionally registered teachers. *It acknowledges their need for intense workplace learning.*

Induction involves a variety of approaches. *It involves approaches which are relevant to the individual's background and experience and are based on the current teaching contexts within and beyond the classroom.*

Induction represents a process of dialogue and professional collaboration. *It enables teachers to reflect on practice, and to contribute to school development and renewal.*

Induction is the responsibility of all those involved in the education process. *It allows for a balance between teachers' professional autonomy and their accountability to the profession and the wider community.*

Source: Board of Teacher Registration, Queensland 2002.

## 6.2 Mentoring the beginning teacher

A highly valued supporting activity to help new or retrained teachers is mentoring. Mentors provide positive reinforcement, guidance and understanding and are important in any profession. Mentoring is not a one-way process—new teachers have recent knowledge and ideas to communicate and often a wealth of experience from other careers to bring to schools.

The testimony on mentoring of new entrants to the profession is not always positive. There are no established standards or structured training for those who mentor beginning teachers. Some guiding principles for mentoring would include:

- selecting mentors who meet the needs of individual beginning teachers;
- using appropriately prepared and trained mentors (universities and employers may be able to work together to establish structured training programs for mentors);
- making sufficient time for effective mentoring;
- providing effective mentoring for geographically and otherwise isolated beginning teachers; and
- establishing effective performance indicators and evaluation processes.

The Victorian Institute of Teaching, concerned about the high rates of attrition from the profession and the need for a more systematic approach, is trialling a mentoring program for first-year teachers. More than 400 new and experienced teachers are participating, in 115 schools from the government, Catholic and independent sectors. Drawing on studies of best practice, an interim standards framework of professional competence has been developed, thus tying induction and full registration to the broader movement to establish clear standards of professional practice.<sup>13</sup>

There are many different aspects of mentoring that must be incorporated in the development of comprehensive and systematic schemes. One example is the provision of multiple mentors for different types of support. A beginning science teacher may need a mentor to assist with classroom management as well as a science mentor to assist with subject-specific challenges. If the new science teacher is the only science specialist in the school or is in a regional or remote location, the Internet might be used for networking with mentors. One way this is achieved in Western Australia is through the provision of online support programs for new graduates.<sup>14</sup> In New South Wales, for example, teachers who retrain in science, technology and mathematics are provided with 12 months' mentoring from an experienced teacher.<sup>15</sup>

Another useful practice is that of supportive peer networks. Many new teachers can feel overwhelmed, so learning that their peers are going through the same kinds of experiences helps them understand that their difficulties are not an indication of their lack of ability or lack of preparation. Such a peer network for beginning mathematics teachers, for example, might be facilitated by an experienced and highly competent mathematics teacher. Similar sources of support mechanisms and networks might be found in subject professional associations, which should be supported by employers.

Other kinds of support given to beginning teachers might include more varieties of teaching observation and the use of technicians and other support staff. Gaining an appreciation of broader school life in addition to appropriate teaching assignments is part of the challenge for beginning teachers. Some advocate a system whereby promotional positions are created for highly experienced teachers who take on specific staff mentoring responsibilities—such mentor teachers might specialise in aspects of induction for trainees undergoing internships and for beginning teachers in their first three years of service.<sup>16</sup>

The Australian Council of State School Organisations recommended consideration of the use of a Scandinavian workload-sharing concept of a 'phase-in' for younger teachers and 'phase-out' for older teachers, whereby newer teachers are assisted on the learning curve while those closer to retirement age can wind down but still make a contribution and have greater opportunity to act as mentors, rather than leaving teaching abruptly.<sup>17</sup>

Providing good support for beginning teachers should be based on sound, system-wide principles and requires an allocation, at the school level, of appropriate expertise, time and resources. Principals who acknowledge this when organising school timetables can do much to ensure that beginning teachers have the opportunity to learn and develop in their first year of teaching. As one new recruit put it: 'Our school has the rule that first year teachers don't take on any extra responsibilities. The first year is purely to find your feet.'<sup>18</sup>

Well-planned and effective induction with organised support structures, mentoring and constructive evaluation is one part of a comprehensive set of features to improve teacher quality and retain teachers in the profession. Support for new teachers in dealing with concerns about student management, curriculum, parents' meetings and other issues is equally important. Coming to terms with school cultures and the many and varied roles of teachers in a school is an enormous challenge for beginning teachers, for which they should be better supported in the future than many have been until now.

### 6.3 The necessity of continuing professional learning

A feature of all professions is that the knowledge base developed during initial training is but a foundation. Teaching is a dynamic and lively profession. Initial teacher education cannot be expected to suffice for a whole career or even extended periods. Professionals require opportunities for well-structured reflective analysis of their own practice and that of fellow professionals, together with continuing access to the findings of research and scholarship in their field. They must also progressively update their knowledge and skills to keep abreast of broader changes in their fields and of trends and issues in culture and society that are relevant to education. Knowledge is increasing and changing rapidly. This goes to the heart of what is known as 'lifelong and life-wide learning'. In the words of the Australian Council of Deans of Education:

Lifelong learning means that education is no longer located at a discrete time of your life, your one chance to learn, a time when you learn things that are significant for life. Specific skills and knowledge learnt today may be obsolete in twenty years time or even five years time, and we will increasingly need to retrain and relearn throughout life.<sup>19</sup>

Professional learning provides a sense of teachers as active and alert professionals. As noted by the Australian Council of Deans of Science, 'teachers are professionals who have needs for professional refreshment in their fields of expertise'.<sup>20</sup> An additional consideration is the responsibility of professions—and especially the teaching profession—to the public. The exercise of this responsibility requires a response to changing social norms and community expectations. Effective teachers are alert to and knowledgeable about current ethical and social issues and are able to make considered and well-informed judgments about them. These issues are often complex and controversial, calling for insight and understanding, especially in the way they arise in schools and school-related settings. Good teachers are able to contribute to the growth of educational knowledge about children's learning and behaviour.

The Committee believes that lifelong professional learning for teachers needs now to be seen as a central developmental element of a teaching career. It is not something apart, but a continuum with the first phase of professional orientation that encompasses the period of initial teacher education, practicum, internship and induction. To achieve improved learning outcomes for students, wherever they may be, and to ensure consistency and opportunity for all teachers, regardless of location and situation, a more coherent, national approach to professional development is required. An appropriate framework, incorporating the variety of existing provisions and aligned to professional teaching standards, can provide a context for professional learning, meet community expectations of professional competence and enhance public perceptions of teaching as a high status profession.

Broadly speaking, the process of continued learning by teachers has two aspects. First, teachers, like other professionals, continue to learn to meet personal, social and civic needs, generally through individual choice and responsibility. Second, teachers learn in order to maintain the currency of their professional knowledge, to be able to meet new social demands and educational challenges and to serve as role models of lifelong learning. Opportunities to share experience and to analyse work with fellow professionals are a key to professionally engaged or connected learning. Links with universities through advanced courses, participation in R&D projects, meetings and conferences are important for teachers and could be more widely used, with further attention to issues such as cost-sharing and accessibility.

The difficult issue of the relationship of professional learning to the formal career structure of teaching will eventually have to be addressed, as the movement to establish professional standards and differential levels of teacher competence progresses.

An important dimension of professional learning is the personal intellectual journey—the desire of individuals to extend their own understanding of teaching and learning. Often such a need emerges after a few years teaching—following initial mastery of classroom teaching and school settings and as a search for a next level of expertise and practical accomplishment. This might be a personal journey in which individual teachers seek out sustained learning opportunities through, for example, networks of like-minded others (for example, the Professional Enhancement of Effective Learning project<sup>21</sup>) or higher degree studies. Professional learning is a route to reflective, creative practice. It is often important in enabling a re-commitment to the profession, especially for teachers who, after a few years of teaching, are uncertain about their future.

## 6.4 Settings for professional learning

According to the University of Western Australia: 'Pre-service education can no longer equip a teacher for their entire professional career. There needs to be systematic on-going professional development available to teachers ...'<sup>22</sup> This need for continued learning is fully recognised in the career dimensions mapped by the MCEETYA (Ministerial Council on Education, Employment, Training and Youth Affairs) Teacher Quality and Educational Leadership Taskforce in its *National Framework for Professional Standards for Teaching*: '... teachers develop their knowledge, skills and practices throughout their professional lives'.

In this context, teacher development does not reflect a simple linear process. Beyond 'graduation' and 'competence', the levels of 'accomplishment' and 'leadership' are identified as elements within a career. While this career is a continuum, it incorporates dimensions which can be recognised in terms of the attainment of progressive standards of professional expertise.<sup>23</sup>

Formal programs for continuing professional development have become increasingly widespread, to update professional knowledge and to develop new skills appropriate to different stages of the career. In a number of other professions, such updating has become a requirement of continued registration. While this is not currently the case with teaching in Australia, it is an issue which has been raised in several States.

There are many substantial issues to address in relating professional learning to career development. They include shared responsibility for professional learning, the expectations of employers, individual 'ownership' of career development and the relationship between continuing professional learning and formal career development. The issue of obligatory professional learning is a matter of principle and practicalities. In the years ahead, issues of principle are likely to be strenuously debated. Similarly, there are numerous practical issues including: responsibility for initiation; forms and procedures of learning; costs and cost-sharing; and access to learning sites. It is important that these issues be taken up to ensure that lifelong professional learning becomes a universal, structured and well-articulated feature of a teaching career.

To date there has been no systematic mechanism for recognising or rewarding professional learning by teachers although, as already indicated, recognition of professional learning is a central plank in the *National Statement from the Teaching Profession* which declares that 'a nationally coordinated, rigorous and consistent system should be established to provide recognition to teachers who demonstrate advanced standards'.<sup>24</sup> It is unclear at present how broadly and in what ways 'advanced standards' might be interpreted.

The importance of establishing forms of recognition for ‘accomplishment’ in teaching has become increasingly accepted, notably in relation to retention of teachers. Through development over the past year of ‘standards’ of accomplishment for teachers of science, mathematics and English language by relevant professional associations, the ground is beginning to be mapped. Articulation of these subject-specific ‘standards of accomplishment’ and of generic professional standards, such as those established by Education Queensland, will serve as important reference points for professional learning activities. These can be seen as putting substance to a step beyond ‘standards’ for graduate or beginning teachers, which a number of organisations have established in recent years.

In a parallel fashion, the Australian Principals Association’s Professional Development Council has undertaken development of ‘standards’ for ‘leadership’, which map out reference points for those types of professional learning which might best be thought of as a step leading in a different direction to that of accomplishment. Leadership can complement accomplishment, but is a specialist direction that not all accomplished teachers should feel the need to take (see section 6.8 below).

Mapping of the ground for professional standards is helping to clarify the meaning of development and recognition of teaching capability. How different types of professional learning relate to this in a systematic way has yet to be determined. It is in many respects a formidable challenge, not least because of the diversity of existing provision and providers.

The pluralistic nature of professional learning and development is shown in the diversity of providers—State, Territory and non-government authorities, universities, TAFE, subject associations, various professional organisations, community bodies, teacher unions and private providers. While this is a healthy diversity which should be encouraged, it does not make any easier the linkage of professional learning to standards that refer to teaching practice.

Professional learning opportunities span postgraduate education, specialist diplomas, research, projects, workshops, conferences, speaker rostrums, panels, development projects, study tours, visits programs, individual guidance and tuition, summer schools or camps and industry placements. School-based curriculum development and assessment and school self-management contribute to professional learning through well-grounded experiential learning. It is important to keep in mind non-formal and unstructured learning as well as formal learning.

As the submission from Flinders University School of Education, in consultation with the Faculty of Science and Engineering, puts it: ‘Teachers need time to reflect on practice, have well-designed professional development plans, and need to be encouraged and supported to have “time out” for study, examining good practice elsewhere’.<sup>25</sup>

The vast majority of Australian teachers participate in many forms of professional learning during each year, although their experiences are highly diverse.

Professional learning is encouraged and supported by teacher employers (both authorities and individual schools), unions and professional associations. However, provision and opportunity are uneven and much is left to individual choice. Some formal requirements exist. For example, provision of a set number of days per year for school-level professional development is commonly part of industrial awards, Enterprise Bargaining Agreements and other contractual specifications. Employer responsibility for professional development is discharged in different ways and can be variable. Issues to do with incentives, remuneration and cost-sharing were raised in submissions, several urging that professional development and career structures and progression be brought closer together.

Professional learning can be on-the-job, a function of taking on additional responsibility in the school. The 1999 Australian College of Educators' national teachers survey indicated the percentages of teachers with responsibilities additional to classroom teaching: professional development (25.9 per cent); curriculum design and development (20.0 per cent); school planning (17.7 per cent); marketing (12.7 per cent); community relations (11.9 per cent); information technology (10.9 per cent); and workplace health and safety (8.7 per cent).<sup>26</sup> Risk management, legal compliance and financial management, to some extent covered by the above, are of increasing importance, due to the devolution of responsibility to schools. Such school-level roles and responsibilities can themselves be the source of a very substantial volume of non-formal professional learning.

In *PD 2000 Australia*, a study which mapped authority- and school-initiated professional development programs, McRae et al. indicated that, in 1999, some 90 per cent of teachers participated in a professional development activity, including school-based or system-organised professional learning.<sup>27</sup> In addition, universities provide a wide range of both award and non-award professional learning activities. Despite considerable diversity among providers, McRae et al., taking a national perspective, noted a convergence of priorities in the topics addressed: 'the educational uses of ICTs, literacy, numeracy, science and VET in school topping the curriculum issues, and school leadership at the head of the human resource and management list'.<sup>28</sup> Other priorities were also noted as significant, for example, education of boys and education of gifted and talented children.

State and Territory education departments give prominence to guidelines and statements of principle in their professional development programs. In all jurisdictions there are activities which are organised and funded at the system level to meet declared system-wide priorities, such as literacy and citizenship education. While there is continuity of funding and activity within systems, major professional development activities are still very much a function of changing overall policy priorities.

Although not a direct provider of professional learning, the Australian Government is a major funder through a range of partnerships, including with State and Territory education authorities. A significant measure to date is the *Teachers for the 21<sup>st</sup> Century* initiative, underpinned by the Quality Teacher Program (QTP), with \$159 million over five years to June 2005. The program aims to update and improve teachers' skills and understanding and to enhance the status of teaching in both government and non-government schools. Most of the funds, nearly \$100 million to date, have been directed to teacher professional



learning activities in the key priority areas of literacy, numeracy, mathematics, science, technology, vocational education, safe and supportive schools, and the development and implementation of professional standards. In the first three years of the program, approximately 168 000 teacher participants were involved.

QTP's success in generating a continuing momentum of professional development in science, mathematics and technology education in schools will be a most important factor in translating the needs identified in this Review into effective and enduring developmental strategies nationwide.

Alongside more specific and discrete systemic and school-organised professional learning activities, many teachers participate at a deeper level for sustained professional learning and for personal growth and development, and also engage in longer term advanced academic study. Generally these are self-initiated and self-funded activities, although schools sometimes contribute to costs of further academic study of staff members. While some jurisdictions have established linkages between university awards and the vast array of non-formal, unaccredited professional development courses, workshops, and so on, they still largely operate as two independent arenas of professional learning.

In broad terms, enrolments have been falling in some conventional advanced academic programs and universities have been targeting new, often niche, markets. 'A quantum shift in the kind of postgraduate training offered by universities—less conventionally packaged units for courses and more customised professional development delivered in tandem with top practitioners' is the pattern anticipated by Edith Cowan University.<sup>29</sup> A significant new development over the past decade has been the professional doctorate, now increasingly widely offered as an alternative to the PhD. The professional doctorate provides the opportunity to undertake studies arising from problems of practice, very often in teachers' own professional workplaces.

The Faculty of Education, University of Melbourne calls for partnerships between schools and other organisations, agencies and institutions (including universities) to be extended, 'with those involving universities to move beyond traditional arrangements for practicum and school experience to include research and professional development'.<sup>30</sup> According to the South Australian Department of Education and Children's Services: '... postgraduate options could be made available which relate directly to classroom practice. This would provide opportunities for teachers to remain cognisant of educational theory and practice while attaining additional qualifications. Greater recognition of the experience teachers bring with them so this can be accredited as part of completing postgraduate qualifications could also assist in achieving these aims'.<sup>31</sup>

An important consideration, advanced in submissions to the Review, is the lack of career advancement value of higher degrees and specialist diplomas in many systems. The Australian Council of Deans of Education recognises that graduate studies for teachers represent a major form of professional development, particularly for those who have the potential to be leaders in schools. 'Current policy settings, however, do not provide incentives for teachers to take up graduate studies ... Despite the need for teachers with graduate-level competencies, the evidence is that education systems as employers neither provide an adequate system of incentives (such as paid time off to do courses—part time or full time) nor encourage teachers to undertake graduate studies'.<sup>32</sup>

The Queensland Deans of Education Forum supports this, stating that: 'In most system jurisdictions in Australia, especially so in Queensland, there are no incentives or requirements for teachers to undertake further study following the completion of their undergraduate degree. As a result, professional development is concentrated on system agendas. When this is the case, the complacency of insularity rather than the energy of innovation in professional learning prevails.'<sup>33</sup>

Several conclusions can be drawn:

- that there is a great diversity of types of learning opportunities, settings and providers;
- that preferences are being expressed by many educators for a better articulation of formal, customised and recognised professional learning (for example, award courses) and non-formal professional learning; and
- that there is a lack of clear relationships among professional learning, professional standards and career advancement.

The Committee believes that more sustained professional learning should become an integral part of remaining in the profession, that a quantum shift in the kinds of postgraduate courses offered by universities be advanced and that there needs to be greater recognition and accreditation of the experiences that teachers bring with them. Systematic provision and incentives for well-organised study, including advanced academic study, will be needed, together with better articulation of the diverse elements.

## 6.5 Learning communities and networks

Devolution policies of several State and Territory education departments pose new challenges for schools and teachers. Many previously highly regulated and centrally controlled decisions are now the province of the school. Responsibilities have been gradually transferred to, or assumed by, schools in such areas as curriculum, aspects of staffing, resource allocation and assessment. This trend has been reinforced and in part inspired by the findings of numerous school-level and school-based research projects.<sup>34</sup>

Among the achievements of devolution are increased financial and management responsibilities, school-initiated and school-directed staff learning and development, engagement with universities in initial teacher education and increasing involvement in the recruitment and career advancement of teachers. Current programs at both State/Territory and national levels are focusing on ensuring that school managers, principals and teacher leaders are suitably qualified and trained for these more diverse and responsible roles. System-wide policy and steering mechanisms will need to be squared with school autonomy, as discussed further in the final part of this report.

Research evidence from UK schools with high levels of student achievement and teacher engagement demonstrates how they build infrastructure for staff development both within the school and in networks of schools. Portions of the school week are devoted to staff development activities such as curriculum development and implementation, discussion of teaching approaches, regular observation sessions, and on-site coaching. While the workshop '... is where teachers gain understanding, see demonstrations of the teaching strategy they may wish to acquire, and have the opportunity to practice them in a non-threatening environment ... skill acquisition and the ability to transfer vertically to a range of situations requires "on-the-job-support". This implies changes to the workplace and the way in which staff development is organised. In particular this means the opportunity for immediate and sustained practice, collaboration and peer coaching, and studying development and implementation.'<sup>35</sup>

School-focused and school-based professional learning activities may involve the whole school teaching team, or a variety of smaller groups within the school or working closely with staff in neighbouring schools. Eltham College proposed that professional learning be tied directly to a school's mission: '... we have been much more focused on PD that supports the school's directions first and the individual's needs second'.<sup>36</sup>

Professional learning which is primarily focused on the situational needs of the school, where decisions are made within that school community, helps strengthen the creative and innovative capacity of the school. It exemplifies both individual learning by teachers and the school as a learning community. The school itself can become a key site of professional development as a culture of professional, lifelong learning—a centre of analysis, reflection and creativity. School-based and school-focused professional learning are a valued part of broader strategies for professional development and a means of focusing on system-wide priorities.

Professional learning has to have a context. While that context will be significantly influenced by the values and purposes of schools and school systems, the profession does need to look beyond current imperatives. The Education Faculty of the Queensland University of Technology succinctly encapsulates the concept that professional learning, while necessarily grounded in the immediate needs of students and schools, has a wider role when it says '... teachers need to be proactive in generating, trialling and refining their own ideas that may have been stimulated by a professional development experience'.<sup>37</sup> The Regional Council of Western Sydney Parents and Citizens' Associations

comes at this issue from another perspective when it says: 'Teachers need to be able to demonstrate principles of lifelong learning by engaging in lifelong learning practices'.<sup>38</sup> These may be in quite different kinds of settings.

Participation in professional learning communities beyond the school encompasses a wide range of professional associations. There are also bodies which link schools and teacher educators and curriculum associations, and school clusters of various kinds have provided a focus for and stimulus to professional learning in specialised areas. A trend over many years has been towards greater specialisation and away from more holistic professional communities.

Access to professional learning communities has a particular importance for teachers in remote and rural locations. The Isolated Children's Parents' Association of Australia noted that teachers experiencing 'professional isolation' due to lack of contact with and support from their peers, where they may be the only mathematics, science or information technology teacher in a small school, would benefit from 'the opportunity to share ideas, concerns and issues' through regular professional development activities, establishing and maintaining networks.<sup>39</sup>

At the school level, direct participation in national and international learning communities appears more limited than for teacher educators, but associations are generally aware of developments nationally and internationally in their field of interest. Also, some schools support staff to attend state, interstate, national and international conferences. In some circumstances, sabbaticals (for example for principals) and long service leave are used to give direct access to new educational frontiers, wherever they be.

The impact of electronic communications, notably the Internet, has opened new possibilities for participation in interactive professional learning communities. Web-based data banks have been established within many professional learning networks. The Queensland Consortium for Professional Development in Education stresses the value of innovative teachers sharing their practices with their peers, particularly through utilising more fully existing networks and platforms (for example, 'the Learning Place'). They note that employers already have high expectations for teachers' use of electronic means of support and sharing, but caution that 'at this point teachers rely more on the social dimensions of learning rather than the electronic opportunities that may or may not be available'.<sup>40</sup> This may prove a generational change within the teaching profession.

The Australian Literacy Educators Association argues for greater involvement of universities in every State with the professional associations and for tailor-made professional learning opportunities for the teaching profession.<sup>41</sup> For technology lecturers at the Australian Catholic University School of Arts and Sciences, teacher education activities that include the development of joint industry- and school-based peer networks can provide mutual support structures for classroom teachers; teachers will have the opportunity to be better informed and to have access to up-to-date and relevant information and practice.<sup>42</sup>

The value of learning communities was recognised in submissions. The National Council of Independent Schools of Australia argued that teachers should be provided with opportunities and resources to meet with other teachers to compare and contrast pedagogical strategies.<sup>43</sup> The Australian Council of Deans of Education suggested that ‘educators need ongoing experience in understanding and using the new technologies in ways that genuinely enhance learning, and opportunities to share innovative learning experiences with other teachers. The sharing of experience should occur within schools, through team teaching and mentoring practice; among schools, through the facilitation of international exchanges and learning communities; and between schools among educators’.<sup>44</sup>

It is evident that teachers have potential access to a very large and varied array of learning communities and networks. In principle, at least, they can extend their inquiries and professional learning needs to anywhere accessible through information and communication technology and have numerous opportunities for shared and communal professional learning. What is less evident is the conceptual restructuring of schooling and of teacher roles and responsibilities which would enable opportunities to become part of normal professional learning practice. Heavy workloads and daily pressures can inhibit the take-up of opportunities. Future schooling designs and practices should be treating structured professional learning as an integral part of the teaching, not a more or less incidental extra.

## 6.6 Learning to foster creativity and innovation

To date, the fostering of creativity and of innovation in school students has not itself been a major focus of professional learning activity. Submissions drew attention to a number of relevant dimensions which will need to be interrelated and given more systematic analysis in future strategies for enhanced professional learning. Building the capacity of teachers to foster a culture of innovation and support students’ innovative learning capacities involves a range of knowledge, skills and attributes, including:

- professional flexibility to act creatively and autonomously, but with greater rigour, accountability and ‘informed professional judgement’;
- creating, developing and maintaining network and partnership management—a teaching environment which is more integrated with local communities, and with virtual communities;
- integrating learning in both formal and informal environments;
- making rapid assessments about information and taking responsibility for decisions and self-evaluations;
- having a good working understanding of values and ethics;
- assisting students to own and have responsibility for what they are learning and how they are learning;

- using new ‘technologies’ of teaching that engage learners as partners in a learning community;
- understanding the local landscapes of their schools, and to situate them socially, economically and politically within a national, regional and global context;
- having the capacity to be at the vanguard of ‘practitioner-led innovation’; and
- ongoing commitment to continuous professional development.<sup>45</sup>

These are very substantial challenges. They set a demanding agenda for professional learning which would need to bring together clusters and networks of schools, education authorities, higher education institutions and others. Central Queensland University argues that the knowledge and skills base of teachers needs to be broadened to include ‘transdisciplinary elements that meet the requirements of the emergent society and the role of education within it’. Professional development programs for educators will be embedded in workplaces where learning is the purpose of the activity, so that professional learning is developed and delivered in and through work-related activities and problems. The University’s Master of Learning Management was cited as an example of a highly flexible program with good enrolments, which students can tailor to their own needs and relate to their working environment.<sup>46</sup>

The Australian Council of Deans of Education (ACDE) argued that both professional development and pre-service education ‘... need to be reconsidered in the light of changing expectations to manage higher order diversity, local and international, and the expansion of e-learning and life long and life wide orientations to knowledge and learning’.<sup>47</sup> Institutional boundaries are blurring and this is one cause of a dramatic change in the role of formal educational institutions and hence in teacher responsibilities and learning needs. Schools will no longer be able to be self-contained and institutionally separate; they ‘... must become more open and more closely connected with wider communities’. For example, they will:

- operate 12 by 7—by offering learning outside the formal curriculum, open 12 hours a day, seven days a week;
- develop socially responsible and socially useful work for adolescents;
- expand cross-institutional links with other educational institutions considerably;
- ease sometimes difficult and traumatic learning transitions from home to school, from early to middle to later years of schooling and from school to vocational and higher education;
- involve retired people in schooling, on either a voluntary or a paid basis;
- become focal points for social action rather than being a relatively closed, institutionally isolated system; and
- re-energise as centres of community, reducing rigid and formal boundaries and connecting with other service providers and community groups.<sup>48</sup>

There is a particular challenge to link the specific needs of individual teachers and schools with system-wide strategies. Several submissions moved between these two poles. Deborah Arthurs argued that courses that directly relate to classroom teachers' needs and interests rather than a 'packaged course' would assist educators to become more self directed learners.<sup>49</sup> The Australian College of Educators argued for facilitating the development of structured professional learning activities for teachers and leaders based on innovative teaching which would be evidence-based and conducted in the context of their daily practice. Considerable opportunity exists to enhance the skills of teachers in applying ICTs to learning and teaching.<sup>50</sup> In this context, Dr Renata Phelps, of the School of Education, Southern Cross University, presented an approach to computer education relevant for all teachers. It is designed to develop lifelong computer capability rather than specific competencies or specific skill sets, which tend to become outdated, given the rapid rate of evolution in computer technology.<sup>51</sup>

The National Food Industry Strategy noted that while there is no single model for success, 'access for teachers to professional development which enables them to interact with industry and to learn within industry has a strong and proven propensity to foster innovation in schools'.<sup>52</sup> The Victorian Teacher Release to Industry Program was cited as an example of a professional development program delivering this highly desirable outcome.

The Australian College of Educators proposes that additional incentives for teachers and leaders could usefully be provided to prepare and maintain *professional portfolios* which include evidence of innovation. These portfolios could then be used by teachers for the purposes of professional recognition and professional and performance appraisal.<sup>53</sup>

Professional development which encourages innovation and creativity in students needs to move beyond the normal boundaries. The Australian Council of Deans of Education believes non-monetary awards should be part of any vision for continuous teacher education. Paid leave (full-time or part-time), including study tours, structured community-based learning and teacher exchange with other countries in the world in which travel and other expenses are supported, would all be worthy pursuits. At a relatively small cost, this would expand the global horizons of education, bringing international teachers to work on exchange in Australian schools as well as providing invaluable international experiences for Australian teachers. Secondments of teachers into community organisations, businesses and government in order to broaden their experience and to expand the school's networks would also break down the arbitrary boundaries separating education and various other social institutions.<sup>54</sup>

The School of Education, University of Queensland, described this as 'ownership of one's professional learning and the ability to form professional relationships and engage in ongoing professional dialogue with colleagues underpins effective professional growth for teachers'.<sup>55</sup>

The Committee was greatly encouraged by the number and quality of submissions dealing with ways of extending the boundaries of professional learning to foster creativity and innovation—within schools, among teachers, among providers and among education systems. The richness and variety of ideas and practices indicates a capacity and readiness within the profession to take the whole domain of professional learning forward to achieve new levels of quality and impact. Together with the impetus of major investments in professional learning by education authorities, schools and governments, this vision and the demonstrable capability of the profession itself provide a very strong platform upon which powerful strategies for professional renewal and development can be built.

## 6.7 Professional learning needs of teachers of science, technology and mathematics

The submission from the Australian Science and Mathematics School (ASMS) argued that: 'What the rapid changes in science and mathematics imply is that it is no longer tenable to believe, if it ever were, that a qualification received at the start of a teaching career will keep a teacher current in these areas throughout their career, and in a position to bring to life the challenges and opportunities that they present. Subject specific professional development must be an essential part of teachers' working environment, linked with curriculum review and development'.<sup>56</sup>

Discipline knowledge in the fields of science, mathematics and technology is evolving very fast and there is, and will continue to be, a need for updating the discipline knowledge and understanding of specialist teachers throughout their career. But it needs to be in terms which have discernible value for the learning of primary and secondary students. In this respect, the ASMS, which embodies an active partnership between a university faculty of science and a State education department, is well placed to realise one of its aims in taking a leading role in professional development for teachers throughout the State and beyond.

Equally important as updating and expanding disciplinary knowledge is continuing development of teachers' pedagogical knowledge in the science, mathematics and technology fields. The Australian National University argued that: 'The demonstrated rate of knowledge growth in science each year demands that science teachers undertake continuing professional development by way of knowledge updates or risk losing their capacity to engage their students in the excitement of what is truly contemporary science'.<sup>57</sup>

Given the levels of student enrolments at senior secondary level in the sciences, and the trend toward a lower level of mathematics engagement, there is need within schooling and the teaching profession, as discussed in Chapter 2, for a significant re-evaluation of the way in which these disciplines are presented and taught within primary and secondary schools. The Australian Academy of Technological Sciences and Engineering drew attention to the lack of adequate professional development opportunities for teachers, especially in-service training aimed at the needs of those teaching science and technology in primary schools.<sup>58</sup>



Another issue is relevance and currency of qualifications. The Faculty of Science at the Australian National University (ANU) further identified the need for adequate resourcing to ensure teachers have up-to-date knowledge of developments in their field.<sup>59</sup> The ANU's new Master of Contemporary Science degree, designed for teachers and comprising a set of on-line courses, is one example of how this need is being addressed.

## 6.8 Professional learning for educational leaders

Numerous conferences, reports and publications on leadership, including contributions to international symposia, testify to Australia's current active engagement with educational leadership issues.<sup>60</sup> Two of the four components of the Australian Government's policy initiative, *Teachers for the 21<sup>st</sup> Century: Making the Difference*, are Quality School Leaders and Quality School Management. The MCEETYA Teacher Quality and Educational Leadership Taskforce (TQELT) is looking at ways to better support school leaders in their roles. Leadership is well and truly on the agenda of school innovation and development.

A consequence of enhanced school leadership responsibilities is movement at the national level to enhance professional learning for educational leaders. Since the second half of the 1990s, principals from all sectors and all levels have been brought together under the auspices of the Australian Principals Associations Professional Development Council (APAPDC), supported by Australian Government funding. Programs of leadership training have become common in all systems and sectors, both government and non-government. Leadership is not confined to schools, but it is school leadership that is the central theme. School leadership, however, is not confined to principals, important as they are. The Committee believes it is important to recognise and support distributed leadership within schools, identifying a range of significant teacher leader roles. Thus the Committee welcomes the announcement by the Australian Government of the establishment of the National Institute for Quality Teaching and School Leadership.

The ACDE has suggested that teachers, and particularly those with the potential to be leaders, should be supported to undertake graduate studies. The Council stated that 'such studies are a means by which teachers can keep abreast of development in their respective fields and be cognisant of advancements in pedagogical methods. Moreover when graduate teacher education students embark upon studies which include a significant research component, particularly research projects directly related to school-based issues, valuable knowledge is transferred and used at the school level to resolve problems and induce change.'<sup>61</sup> However, the Council cites up-front fees and lack of incentives provided by teacher employers as deterrents from undertaking graduate studies.

## 6.9 Articulating an inclusive framework for professional learning

While formal pre-service education is obligatory for teachers, continuing learning or professional development remains to a considerable degree a matter of choice—by schools and/or individuals. This has led to a situation where, while much professional learning of undoubted high quality happens within the country, it tends to be episodic and unevenly distributed and without necessary consequence for the teacher's future career or clearly discernible outcomes for student learning and school improvement. Inevitably, any account of provision and take-up has to confront the huge diversity and unevenness of professional learning for and by Australian teachers.

As a principal purpose of professional learning is achieving changes in teaching and student learning outcomes, there is need, first, for a national clarification of principles. Should continued professional learning in some form become a condition of maintaining registration or accreditation to teach? This issue is on the agenda; it is complex, but it will need to be resolved, perhaps in the context of the development of professional standards. As part of the resolution of the issue, attention will need to be given to kinds of professional learning that are most likely to achieve positive changes in student learning and to kinds of programs and activities best able to promote those kinds of professional learning. While it can scarcely be said that present knowledge is adequate for answering such questions, what is important is to avoid merely formal requirements and to find ways to link continuing teacher learning to benefits for students and the wider community.

Evaluative research on outcomes is generally very limited. The outcomes of professional learning activities are hard to establish except in cases where the professional learning has been very specific (for example, tied to changes in curriculum frameworks or new approaches to science themes/topics in primary schools). Research in this complex area is under way, but more is needed so that issues can be teased out and both individual schools and education authorities can have clearer indications of where best to invest their professional learning time and money.

Teacher professional learning and development have primarily been provided on the grounds of social or public benefit (that is, benefits to schools, students and the community), although there is a private, intrinsic benefit for the individual teacher. Professions other than teaching often place the main responsibility for funding professional learning with the professionals themselves because the benefits are more directly linked to their income. The link is much more indirect in teaching, at least financially. While there is a private benefit for teachers in good, continuous professional learning, teacher employers and the public generally (including students) are the chief beneficiaries from the outcomes.

Nonetheless, teachers need to take some responsibility for their own professional learning. According to Maureen Burns: 'We should appreciate that seeking our rights as individuals to professional development and renewal has to be offset by acknowledging our duties as individuals to contribute to it'.<sup>62</sup>

If progress is to be made, agreements have to be reached about how costs are to be distributed and the kinds of activities that should properly be funded by employers. A common theme from submissions was that the Australian Government should use the influence it derives from funding universities to achieve specific outcomes from the professional learning provided by education and other faculties. There were two underlying assumptions in submissions:

- every teacher must have adequate professional learning; and
- professional learning is a shared responsibility between the teacher employer and the teacher.

Many submissions, such as those from the Australian Education Union and the Independent Education Union, assigned the Australian Government an important role. The Australian Education Union indicated its preference for the former National Professional Development Program model that was predicated on Australian Government funds supporting partnerships between industrial and professional organisations representing teachers, and professional development providers, mainly from the higher education sector. 'The National Professional Development Program ... created extremely effective partnerships between groups of educators, teachers, schools, parents, unions and universities ...'<sup>63</sup>

Many submissions also saw it as essential that employers should exercise responsibility and, because the major employers of teachers are State and Territory governments, also saw a major funding role for teacher professional learning for these governments.

Acknowledging underlying agreement that teacher professional learning is a shared responsibility is an excellent starting point for developing an approach to teacher professional learning that requires the major players to work together. As the submission from the Australian National University Faculty of Science points out, 'responsibility for this essential maintenance of currency in science will be balanced between science teachers themselves and the organisations which employ them ...'<sup>64</sup> The Faculty, whose suggestions related specifically to a set of on-line courses it has under construction, makes suggestions that can apply more broadly, including that a realistic fees subsidy be provided by education authorities, that recognition of additional qualifications be made in the pay and promotion structure of teachers and that assistance with travel and other costs necessary for research experience be provided to teachers.

From a school perspective, a very practical aspect of renewing cultures of innovation is the issue of costs associated with teacher release. There is a financial and organisational burden on individual schools where attendance at in-service educational programs and other related activities is during school time.<sup>65</sup>

Since, increasingly, schools have global budgets, formal recognition of the need for continuing professional learning would have important implications for school funds.

Agreement on the fundamental principle of sharing the costs of professional learning provides a basis, but little more than that. There are many complex issues to resolve and they will require skilful negotiation. Further impetus will be given by the efforts under way to achieve national agreements on standards, provided that agreements can be reached on the relationship between continuing professional learning and the roles and responsibilities of teachers, principals and other educational professionals. There is a great deal of ground to cover, but there are many positive indications that the profession is ready to move forward.

It has become clear in the course of the Review that more comprehensive and coherent policies and structures for professional learning are required. These can provide a framework and a means of better articulating the vast array of professional development activities across the country, varying in length and focus. The plethora of providers, State/Territory and non-government education authorities, universities, subject associations, various professional organisations, teacher unions, community bodies and private providers, will benefit from a more articulated framework. It should be possible to achieve considerable efficiencies from a collaborative national approach to the numerous issues requiring attention.

Striking features of the professional learning landscape in Australia are that systematic linkages do not exist either between teacher participation in professional learning and their individual career trajectories, or between different forms and elements of the professional learning programs. In particular, there is little formal linkage between the large range of systemic professional development programs and school-based activities, on the one hand, and award-bearing postgraduate programs offered by universities and other tertiary level institutions, on the other, with little recognition of advanced study awards within a teaching career. Too little is known about the impact and outcomes of professional learning and its relationship to improved student learning outcomes and quality teaching. There is a need to strengthen connections between research and evaluation evidence and professional learning programs.

## ■ Key Conclusions

Several conclusions can be drawn.

- There should be more support through formal induction programs for new teachers to meet concerns about student management, curriculum, parents' meetings and other issues that teachers encounter as they come to terms with school cultures and the many and varied roles of teachers in a school.
- There is a strong basis for a coherent national approach to the development of an inclusive system of continuing professional learning for all teachers.
- Professional learning is a shared funding responsibility between teacher employers, governments and teachers.
- Future schooling designs and practices should be treating structured professional learning as an integral part of the teacher's role, not a more or less incidental extra.
- There should be an expectation of all teachers to take part in recognised professional development activities throughout their teaching careers.
- There should be more formal procedures for relating career professional advancement to participation in recognised professional learning activities.
- There should be a quantum shift in the kinds of postgraduate courses offered by universities, and there needs to be greater recognition and accreditation of the experiences that teachers bring with them.
- There is support for the development of a national framework for professional learning which is linked to professional standards.
- The richness and variety of ideas and practices indicates a capacity and readiness within the profession to take the whole domain of professional learning forward to achieve new levels of quality and impact. Together with the impetus of major investments in professional learning by education authorities and governments, this vision and the demonstrable capability of the profession itself provide a very strong platform upon which powerful strategies for professional renewal and development can be built.

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<sup>1</sup> Australian Council of Deans of Education, submission no. 222.

<sup>2</sup> New South Wales Department of Education and Training, submission no. 141, p. 15.

<sup>3</sup> Queensland Deans of Education Forum, submission no. 65, p. 8.

<sup>4</sup> Australian Education Union, submission no. 49, p. 9.

<sup>5</sup> G Dowling, 'Beyond survival: supporting beginning teachers through effective induction', *The Practising Administrator*, 1998, pp. 18–20; S Holden, 'Induction + mentors = retention + promotion: induction and mentoring in Australia', *Educare News*, 110, 2000, pp. 1–5; M Khamis, 'The beginning teacher', in S Dinham and C Scott (eds), *Teaching in context*, ACER Press, Camberwell, Victoria, 2000.

- <sup>6</sup> For instance, through the provision of induction programs, the State of California has succeeded in reducing the attrition rate of beginning teachers in the first five years of teaching from 37 per cent to 9 per cent. E Hirsch, J Koppich and M Knapp, *Revisiting what States are doing to improve the quality of teaching: an update on patterns and trends*, Center for the Study of Teaching and Policy, Washington, 2001, p. 35. See also M Hinds, *Teaching as a clinical profession: a new challenge for education*, Carnegie Corporation of New York, New York City, 2002, p. 10.
- <sup>7</sup> Andrea Foster, Craig Haran, Sandra Robinson and John Arton-Powell, submission no. 130, p. 4.
- <sup>8</sup> A Watson, N Hatton, D Squires and I Soliman, 'School staffing and the quality of education: teacher adjustment and satisfaction', *Teaching and Teacher Education*, 7, 1991, pp. 63–77; N Hatton, A Watson, D Squires and I Soliman, 'School staffing and the quality of education: teacher stability and mobility', *Teaching and Teacher Education*, 7, 1991, pp. 279–293.
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## Part 3 Schooling for the future

No topic is more important to the future quality of life and standard of living in Australia than education. What is done by teachers and students together in the nation's schools and how well this is supported and guided by education authorities and by the community at large will have profound consequences for everyone's livelihood and well-being.

To target science, technology and mathematics is to recognise their fundamental roles in the processes of innovation that increasingly underpin economic growth, and to recognise the transformations they are effecting in social and cultural life. In a democracy everyone needs to gain scientific and mathematical knowledge and develop technological understanding to enable them to make informed decisions about their own lives and to engage intelligently in the public arena of discussions and debate about the country's future.

While the Committee has been charged with a focus on science, technology and mathematics, it sees these learning areas in the context of a broad education which balances the many different requirements teachers and schools have to meet. And since, in the decade ahead, such large numbers of teachers will reach retirement age, the Committee has set its analysis in the context of the very substantial challenges and the great opportunities presented by this generational change in the teaching profession.

For the third and final part of the Review report, the numerous and diverse threads of the first two parts are brought together in a consideration of the processes of schooling. What are the implications of the rapid changes in society, culture and economic affairs for schooling in the future? How different is the future school likely to be from schools of today? What kinds of changes in the roles and relationships of teachers and other education professionals are occurring, and will be needed to provide the depth of knowledge and understanding, the skills and the innovative capacity which students in future will require? Answers to these questions are widely debated, but there is no disagreement about their relevance for the education profession and for the wider community.

Teachers alone cannot achieve all that is needed but, in partnerships and through many different kinds of collaboration and networking, the tight nexus between the single teacher and the class group can be extended to the farther reaches of the community and to the emerging global society. The culture of innovation that has been one of the framing concepts of the review sets directions for the future of schooling. Conversely, and in no small part, that culture of innovation will be a product or outcome of teaching and teachers, of students and their learning.



## 7. Future schooling

The school of the future will:

- belong to the knowledge era, not the industrial era;
- exhibit new norms around questioning, trialling, evaluating—surmounting the old boundaries of rules and regulations;
- exhibit a radically changed design;
- nurture creative thinkers; and
- find ways to engage all students in learning that will become lifelong.

The above points summarise views widely expressed in submissions and in many recent studies of future directions for schooling, in Australia and other countries. They signify a readiness to meet the challenge of the knowledge economy and society and recognition that schools can and will be in the forefront of change.

### 7.1 Building future schooling

Confidence in the future and the ability of teachers, schools and education systems to lead change are very positive features of Australia's contemporary educational landscape. Individual schools and teachers are not working alone but are part of very complex professional networks and systems which can provide both leadership and a strong platform of support. Central to this is the school, an institution which has proved to be one of the most enduring and successful of all of society's institutions.

The evidence reviewed in Parts 1 and 2 shows that Australia's educators are well placed to take the steps that are needed. There must, however, be the will to concentrate and consolidate efforts to form alliances, coalitions, partnerships and other collaborative arrangements from the local to the national level.

There is, therefore, a continuing challenge to create and re-create schools as universal centres of successful learning for all. This does not imply a single, simple model, or a formula for learning. There are many different developments and practices which are working well now. These can be drawn upon and combined with the expectations of stakeholders, research findings and the well considered experience of the education profession, in pointing directions for change.

There are admitted shortcomings and weaknesses in Australia's schools which need to be remedied. The tide of innovation should carry everyone forward and not just the frontrunners and it can do so through exercising the full capability and resourcefulness of teachers, schools and the whole education system.

The powerful instruments that are available include:

- a generally well-qualified and competent teaching profession whose quality and effectiveness are demonstrated in the performance of most—but not all—students;
- leadership of the highest order able to provide the direction, encouragement and support required to reach agreed educational goals and targets;
- actual and potential financial resources, support and backing from both public and private sources which could be sufficient to ensure adequate resources and facilities in every school in the country;
- evidence of an increasingly concerted, national and policy-led drive and collaborative efforts to raise standards where they are low, to work more consistently and intensively on behalf of under-performing groups and to benchmark against the best performance anywhere;
- the knowledge and professional capability to set and to meet firm and realistic targets addressing each of the identified shortcomings and weaknesses in science, technology and mathematics education: in teacher supply and school staffing and deployment, in curriculum, teaching and learning, in pre-service teacher education and in professional learning for all teachers;
- a community that is coming to recognise the necessity for lifelong learning grounded in quality learning in early childhood, in schools and at the tertiary stage;
- a substantial body of expertise and evaluated knowledge of what works in educational development strategies and programs;
- outstanding schools and teachers that can serve as exemplars and role models, to demonstrate that success can be achieved;
- stable structures and capable organisations and systems through which policy making, strategic planning and steering, resourcing, monitoring, evaluation and reporting of outcomes are already being performed;
- a strong system of initial teacher education which has the potential to work ever more closely with schools and system authorities in comprehensive and inclusive strategies for continuing professional learning for all teachers;
- an emerging, transforming, technology which has the potential to transform universal learning; and
- research capability and a growing receptiveness to the idea that social policies and practices will be grounded in systematic inquiry and evidence.

Nothing short of well coordinated national effort led by the education profession and drawing in all stakeholders will suffice. This is a very large undertaking which will extend into the future. However, teachers, their organisations and schools are not waiting. Many are already showing the way ahead. These are exemplified by the schools that the Committee visited and where they had the privilege of meeting many outstanding teachers and students. While they cannot be treated as a representative sample of schools across Australia, they do typify initiatives and developments that most other schools and teachers would readily recognise and respond to. They demonstrate the fact that success does not depend on ideal conditions but on effective leadership and the energies and goodwill of teachers, students and communities. They show that the highest standards can be attained even when conditions may be unfavourable and seem unyielding. The fact that they have indeed yielded to determined effort, leadership and knowledgeable intervention is indicative of the capability and underlying strength of Australia's educators and their communities.

## 7.2 Innovative cultures of learning

In preparing young people for the future, all schools will need to:

- develop and sustain among students systematic studies in all the core learning areas defined in the National Goals for Schooling;
- teach a wide repertoire of learning skills and learning processes;
- define and teach towards definite, clear learning outcomes;
- assess and evaluate to enhance student learning and provide public accountability; and
- set all of the above in the context of Australia as an innovative, knowledge economy and society in a globalising world.

In order to foster the talents and capabilities of all students, it will be necessary to devote more effort to intensive studies of the difficulties that many students now face in the basic literacies of science, technology and mathematics, and to continue to concentrate on English language learning, the key literacy and foundation of later learning in all subjects.

It will be advantageous in a sustained national, collaborative effort to achieve more precise learning goals for all students and clearer standards of attainment, not just for the early years, but throughout schooling.

Generating processes of continuous enrichment and improvement of learning on the part of both students and teachers, through all the years of schooling and into adulthood, should be the goal. This requires flexibility in school organisation, supporting structures for teachers and outstanding leadership. No country is better equipped or better able to address these challenges, and it is right that Australia should envisage the school of the future as the emblem of challenges that can be met, through the kind of concerted and concentrated national effort of which the country is certainly capable.

To develop an innovative learning capacity in students, teachers need a repertoire of teaching–learning strategies and appropriate pedagogy for the students in their charge. These, the Australian Literacy Educators’ Association said, should be based on clearly articulated beliefs to enable them to sometimes step outside the usual way of doing things and to take learning risks with their students.<sup>1</sup>

Teachers are crucial but, as pointed out by the Queensland Deans of Education Forum, teachers and teacher educators are no longer the guardians of the gateway—either to content or even learning processes.<sup>2</sup> For instance, ICTs have the potential to be powerful facilitators of students’ imaginations, innovation and creativity. ‘With the new media [digital and electronic], in school and outside of it, we are putting very powerful tools of inquiry and communication into the hands of students. The new media transfer a great deal of educational control to the student [and] amplify the power of communication and interaction that each young person can employ. A pedagogy of open-ended inquiry, which once would inexorably end in frustration and mystification, can now dependably lead to a deep, expansive engagement with powerful ideas and concepts.’<sup>3</sup>

Thanks to technological innovation, students now can access information at will. The classroom is but one gateway to knowledge. Teachers need to find ways to identify their students’ learning capabilities in the full understanding that so much of the students’ intellectual and personal lives is now conducted in worlds remote from those of classroom and teacher.

Teachers draw for their pedagogical effectiveness on practical curriculum guidelines, useful resources, facilities and equipment of good standard in schools, and sound procedures for monitoring and assessing student learning outcomes. Together with a wide range of other services for meeting children’s welfare and health needs, such systemic elements provide the context for effective teaching. However, some submissions questioned whether these elements are in fact coming together as they should, to provide the clear policy frameworks and supportive structures that are needed to enable teachers to get on with their core business of teaching and the organisation of learning. For example, it was suggested that there is undue emphasis on assessment tasks and on academic ability especially of the most senior school level at the cost of a broader and more inclusive concept of quality and different kinds of learning.<sup>4</sup>

While there is a great deal of evidence of high quality teaching and sound learning in our schools, recent studies also pinpoint such further challenges for future schooling as:

- lack of coherent and systematic learning in the middle years;
- insufficient attention to science in primary schools;
- mathematics and science teaching that fails to capture the interest of students, particularly in the middle years; and
- insufficient use of evidence-based evaluation strategies to test the effectiveness of innovative teaching.<sup>5</sup>

Close attention to the conditions affecting student learning, to monitoring and reporting by teachers, and to system-wide data collecting, analysis and public reporting of outcomes would help to overcome these weaknesses. Schools will need to become more capable in these respects, not only as teaching and learning centres but as nodes in powerful networks of educational knowledge.

Already, various kinds of support is available to teachers and schools to strengthen their own knowledge capability and their capacity to analyse the quality of their performance, in addition to the general frameworks, curriculum guides and learning resources available through system authorities. In the areas of science, technology and mathematics education, for example, teachers have ready access to a great array of effective teaching and learning strategies. The World-Wide Web makes it possible for teachers to draw on a vast array of resources both national and international in preparing and evaluating their own teaching and introducing innovative practice. All of this, together with what teacher employers have available and the expertise in the universities, demonstrates that there is no lack of resources, guidance and advice (Box 7.1). The question is whether they are being sufficiently used and with what effect.

### Box 7.1 Examples of useful web-links

Australian Academy of Sciences <http://www.science.org.au>  
Australian Association of Mathematics Teachers <http://www.aamt.edu.au/>  
Australian Council for Educational Research <http://www.acer.edu.au/>  
Australian Council for Education through Technology  
<http://www.pa.ash.org.au/tefa/acet.html>  
Australian Mathematical Society <http://www.austms.org.au/amswelcome.html>  
Australian Science Teachers Association  
<http://www.asta.edu.au/st2003/index.html>  
Commonwealth Quality Teacher Program <http://qualityteaching.dest.gov.au>  
CSIRO <http://www.csiro.au>  
Curriculum Corporation <http://www.curriculum.edu.au/index.htm>  
The Learning Federation <http://www.thelearningfederation.edu.au/tlf/>  
The Learning Place <http://education.qld.gov.au/learningplace/>  
National Library of Australia <http://www.nla.gov.au/oz/sciencew.html>  
National Science Week <http://www.scienceweek.info.au/>  
Science Education Resources  
<http://www.library.jcu.edu.au/Educ/resources/science.html>  
School Innovation in Science <http://www.scienceinschools.org/home.htm>  
Science in Schools  
[http://www.eduweb.vic.gov.au/curriculumatwork/deet/sis\\_index.htm](http://www.eduweb.vic.gov.au/curriculumatwork/deet/sis_index.htm)  
Queensland Museum <http://www.qmuseum.qld.gov.au>  
Questacon <http://www.questacon.edu.au>  
Technology Education Federation of Australia <http://www.pa.ash.org.au/tefa/>

Over and above the rich resources of materials, guidelines and expertise available to teachers, more attention must be given within schools and by system authorities to teaching itself and to research-based knowledge about conditions for effective learning. Identifying and proclaiming the characteristics of good and effective learning and conditions that enable all students to become successful learners is a professional responsibility which goes well beyond classroom instruction and marking of assignments. This responsibility will need to be exercised further at both the system level and in the specific circumstances of the individual school, classroom and student.

In the gathering momentum of educational policy making and research, no topic is more important than achieving improvements in student learning, particularly in areas of low or mediocre performance. The former Director of the Australian Science and Mathematics School, Mr Ron Lake, called for a relentless focus on improved school performance, improved teacher performance and improved student performance, and for examples of radical innovation and excellence to showcase.<sup>6</sup>



A proportion of Australian students performed to the best international standards in PISA assessments of scientific, mathematical and reading literacy, and there is evidence of good overall standards.<sup>7</sup> A high proportion of Year 3 and Year 5 students achieved the national numeracy benchmarks in 2000 but, as in practically every other aspect of school performance, Indigenous students performed at significantly lower levels. There are other categories of students who generally do not perform well. Where individual students and identifiable categories of students do not reach standards that are, in principle, attainable by all, they are all too likely to have reduced opportunity for full and active participation in society and the economy. Successful learning by every student is a worthy school motto.

Efforts are under way to improve learning outcomes. They need to be intensified and focused on the already well documented weaknesses. As a nation, Australia has for too long tolerated serious inequities in the conditions that affect learning performance. For social and economic reasons, as well as personal ones, better results must be achieved for those students whose learning outcomes are weak or poor. Systems and schools can do more to attend to these challenges.

For a culture of innovation, teaching needs to focus more on conceptual underpinnings of knowledge and understanding, creativity, the play of ideas, 'know-how', technical knowledge of how and why things work and the capacity to act, to make things happen according to plans and designs, to manipulate materials, to manage situations and to act effectively in social situations. This knowledge is often implicit, highly personal and not always readily verbalised. Its assessment calls for additional criteria from those used in highly verbal and mathematical performances and may require careful observation over time.

Learning is effective when it builds on students' present capabilities and generates a depth of understanding—demonstrated for example in the ability to use and apply knowledge in a variety of situations. It is meaningful when it engages students, connects with their existing knowledge and relates in discernible ways to their interests and experiences. Students themselves construct meaning by actively reflecting on their own knowledge and using a repertoire of strategic skills identifying and solving problems, experimenting, modelling, crafting, conjecturing and testing.<sup>8</sup>

Australia's Chief Scientist, Dr Robin Batterham, believes that 'teaching in context rather than teaching core principles with only minor reference to the outside world is the way of the future'.<sup>9</sup> To achieve this, schools need to build closer links with home and community ways of learning, knowing and doing and to heed the call for 'meaningful', 'deep' and 'relevant' learning. The challenge is to connect student interests and motivation to the more formal structures of school learning as manifested in stated goals, curriculum frameworks, designs and projects, and texts and other materials. This can be extremely difficult when strong home support is lacking and children have already experienced failure at school. Teachers themselves need collegial support, mentoring and access to specialist and expert advice. They are increasingly using research and drawing upon sophisticated designs for schooling. In doing so, many are striving to create maps of what and how to learn and ways students can achieve successful learning.

Improving learning, both in terms of the proportion of young people who complete a full secondary education or its equivalent, and raising standards of performance, has become the target of governments and education systems worldwide. While there is strong evidence of good standards in our schools, learning and, more generally, schooling and teaching are not sufficiently effective when some 15 per cent of our young people do not complete a full secondary education or its equivalent and gain a qualification of value. Schooling is less than fully effective when specific groups of students perform at a much lower level than the general population, and when what is learnt and how it is learnt by these students fail to meet basic criteria of quality and relevance to labour market requirements, and do not enable students to progress and continue learning.

A distillation of the literature drawn on for this report, many of the submissions and the evidence gathered by the Committee in site visits suggests that learning is effective when students:

- are valued and taken seriously, with their different ways of learning, and treated as co-partners in learning with their teachers;
- know about, understand and actively participate in setting the goals and purposes, and so feel ownership of the process of learning;
- are helped to analyse and understand their own ways of learning and ways in which they can become more successful, effective learners;
- are enabled and encouraged to analyse their experience, to construct their own meanings and understandings and to evaluate their performance;
- understand relationships between educational objectives, values, learning tasks and processes, assessment and outcomes, and see them as mutually interdependent;
- can apprehend, understand and value the immediate as well as the longer-term consequences of their learning;
- experience pleasure, satisfaction and a sense of achievement in the context of the time and effort that learning tasks require;
- experience a whole-school organisational climate and style which fosters learning—the school as a learning culture, learning organisation; and
- are encouraged and well-supported in their homes.

Is this a counsel of perfection? Perhaps, but it is no more than a summation of what the Committee has seen and heard. These criteria of effectiveness in learning are being widely adopted as principles to aspire to even when practice falls short. Doubtless, effective learning in and through schooling is developmental and requires many years of sustained effort by students and teachers together, with all the active family and community support that can be mustered. Learning is an achievement as well as a process. Effective, successful learning is demanding; students need a lot of encouragement and reinforcement which should be steady and continuous.

The purpose of learning is to foster and facilitate continuing growth and fulfilment of potential; it is not just to help students solve an immediate problem, assimilate a discrete item of information, engage in some fleeting experience or pass tests and exams. The breakdown of learning tasks into lessons, units of study, projects and semester courses reflect efforts by schools to make learning stimulating and manageable for students. This works well when students develop understanding and are able to apply knowledge and competencies gained cumulatively to new situations and tasks.

In both their initial education and through the professional learning continuum, teachers will need to develop ways to relate their discipline knowledge and their practical skills to the varied learning needs and capabilities of all students. Lectures, textbooks, short courses and so on can all help, but teachers usually seek practical demonstrations and they need opportunity to practice learner-oriented teaching. The weaknesses in science teaching demonstrated by, for example, Goodrum et al. highlight the need for all teachers to have both a very clear understanding of how and why students learn and of the teaching strategies that will foster enthusiasm and success in learning. Their science knowledge is necessary but it is not sufficient. Student teachers during the practicum, through internship and induction and in the initial years of teaching need very good advice and support in their efforts to move from the pedagogical tradition of 'teacher talks or demonstrates' toward student-centred learning.

### 7.3 National goals

Teachers have considerable freedom in designing syllabuses, adapting curricula and selecting learning resources. Nevertheless, they are also working toward system-wide and national goals.

The Adelaide Declaration on the National Goals for Schooling in the Twenty-first Century (Box 7.2) were agreed in 1999, and performance measures for reporting purposes continue to be developed and refined through the MCEETYA Performance Measurement and Reporting Taskforce (PMRT).

The Adelaide Declaration is not merely a formal agreement between Australia's education Ministers. It is a powerful statement of purpose which, when systematically and thoughtfully used, gives clear directions for advancing teaching and learning. It provides a framework, not just of goals, but of expected learning outcomes. Kept under review, progressively modified to meet changing circumstances and requirements, the Declaration can serve as an enlightened guide to further action by education authorities as well as schools and teachers. The Adelaide Declaration is a resounding charter of educational rights and responsibilities and a milestone in national partnership and agreed directions. The goals provide a platform for further, coordinated action to strengthen and improve learning for all Australians.

### **Box 7.2 The Adelaide Declaration on National Goals for Schooling in the Twenty-First Century**

The Adelaide Declaration was made in Adelaide, in April 1999, by the State, Territory and Commonwealth Ministers of Education at the 10<sup>th</sup> Ministerial Council on Education, Employment, Training and Youth Affairs.

- 1 Schooling should develop fully the talents and capacities of all students. In particular, when students leave schools they should:
  - 1.1 have the capacity for, and skills in, analysis and problem solving and the ability to communicate ideas and information, to plan and organise activities and to collaborate with others
  - 1.2 have qualities of self-confidence, optimism, high self-esteem, and a commitment to personal excellence as a basis for their potential life roles as family, community and workforce members
  - 1.3 have the capacity to exercise judgment and responsibility in matters of morality, ethics and social justice, and the capacity to make sense of their world, to think about how things got to be the way they are, to make rational and informed decisions about their own lives and to accept responsibility for their own actions
  - 1.4 be active and informed citizens with an understanding and appreciation of Australia's system of government and civic life
  - 1.5 have employment related skills and an understanding of the work environment, career options and pathways as a foundation for, and positive attitudes towards, vocational education and training, further education, employment and life-long learning
  - 1.6 be confident, creative and productive users of new technologies, particularly information and communication technologies, and understand the impact of those technologies on society

### **Box 7.2 The Adelaide Declaration on National Goals for Schooling in the Twenty-First Century continued ...**

- 1.7 have an understanding of, and concern for, stewardship of the natural environment, and the knowledge and skills to contribute to ecologically sustainable development
- 1.8 have the knowledge, skills and attitudes necessary to establish and maintain a healthy lifestyle, and for the creative and satisfying use of leisure time
- 2 In terms of curriculum, students should have:
  - 2.1 attained high standards of knowledge, skills and understanding through a comprehensive and balanced curriculum in the compulsory years of schooling encompassing the agreed eight key learning areas:
    - the arts;
    - English;
    - health and physical education;
    - languages other than English;
    - mathematics;
    - science;
    - studies of society and environment;
    - technology.and the interrelationships between them;
  - 2.2 attained the skills of numeracy and English literacy; such that, every student should be numerate, able to read, write, spell and communicate at an appropriate level;
  - 2.3 participated in programs of vocational learning during the compulsory years and have had access to vocational education and training programs as part of their senior secondary studies; and
  - 2.4 participated in programs and activities which foster and develop enterprise skills, including those skills which will allow them maximum flexibility and adaptability in the future.
- 3 Schooling should be socially just, so that:
  - 3.1 students' outcomes from schooling are free from the effects of negative forms of discrimination based on sex, language, culture and ethnicity, religion or disability; and of differences arising from students' socio-economic background or geographic location;
  - 3.2 the learning outcomes of educationally disadvantaged students improve and, over time, match those of other students;

### **Box 7.2 The Adelaide Declaration on National Goals for Schooling in the Twenty-First Century continued ...**

- 3.3 Aboriginal and Torres Strait Islander students have equitable access to, and opportunities in, schooling so that their learning outcomes improve and, over time, match those of other students;
- 3.4 all students understand and acknowledge the value of Aboriginal and Torres Strait Islander cultures to Australian society and possess the knowledge, skills and understanding to contribute to, and benefit from, reconciliation between Indigenous and non-Indigenous Australians;
- 3.5 all students understand and acknowledge the value of cultural and linguistic diversity, and possess the knowledge, skills and understanding to contribute to, and benefit from, such diversity in the Australian community and internationally; and
- 3.6 all students have access to the high quality education necessary to enable the completion of school education to Year 12 or its vocational equivalent and that provides clear and recognised pathways to employment and further education and training.

Australia is well down the track of developing a national reporting system that will enable definite statements about students' learning outcomes in priority learning areas. Reporting against Literacy and Numeracy standards is well established, and the first assessment of Year 6 science will occur through a national sample survey in the latter half of 2003. MCEETYA has agreed that PISA will provide measures for secondary reading, numeracy and scientific literacy; and the first civics assessments for Years 6 and 10 are being trialled in 2003. Australian and international reports and declarations about what young people need to learn, know and be able to do call for more clarity, rigour and direction, and for fuller reporting on outcomes to families and the community. There are creative moves in this direction in Australia.

Building on the first set of national goals, during the 1990s all States and Territories developed new curriculum frameworks, with periodic cycles of review and redevelopment. These frameworks are supported by guidelines, resources and access to advice. There is a variety of approaches to what are generally referred to as essential learnings, but most cut across traditional disciplines (Box 7.3).

### **Box 7.3 Examples of new curriculum, pedagogical and assessment frameworks for the compulsory years**

#### **Queensland:** New Basics

- Life pathways and social futures
- Multi-literacies and communication media
- Active citizenship
- Environments and technologies

#### **South Australia:** Curriculum Standards and Accountability Framework

- Futures
- Identity
- Interdependence
- Thinking
- Communication

#### **Tasmania:** Essential Learnings

- Thinking
- Communicating
- Social responsibility
- Personal futures
- Work futures

#### **Notes:**

1. Each of these frameworks is further subdivided to indicate directions for curriculum content and accompanied by guidelines on pedagogical practice, assessment and reporting.
2. Each adopts trans- or inter-disciplinary constructs and indicates learning outcomes with varying degrees of specificity and at different levels.

Many submissions expressed concern that the traditional model of the subject-centred curriculum, with timetabled slots for each separate subject, militates against 'a culture of progress' in that it inhibits multi-disciplinarity and team work; that there is content overload; that the key learning areas and generic competencies should structure content; and that curriculum should be more responsive to student interests. Concern was also expressed that some curriculum requirements by systems do not incorporate the notion of innovation.<sup>10</sup>

Increased mobility in the labour market makes the acquisition of these skills essential for young people. Such skills enable people to change careers readily and adapt effectively to changed circumstances. These skills, by their nature, cannot be acquired solely at school and rely on effective partnerships between schools, parents, business, industry and the community. These were supported by the Australian Society for Educational Technology and the Queensland Teachers Union, as against 'narrow discipline-based criteria' in curriculum and assessment. Rather, curriculum models that give scope for teacher initiative and student creativity were advocated.<sup>11</sup>

Broad views were expressed in submissions about trends and issues in school curriculum and assessment, and these reflect trends and concerns across the education profession and within the community. Action is occurring across the country to take up many of these issues. In a discernible move towards connecting curriculum to future pathways, recent Australian curriculum framework documents referred to above (Box 7.3) have picked up the themes of process, cross-disciplinary, present student life, and scientific, mathematical, technological and other literacies. Learning is being structured according to templates of contemporary individual and social experience. The Smart State initiative in Queensland and the Schools for Innovation and Excellence initiative in Victoria are designed to help schools connect and reorient their organisational structures, curriculum and pedagogy. These are piloting innovative ways of structuring the curriculum and organising learning and should be carefully studied and evaluated.

In the educational reforms of recent years in Britain, content has been specified at the national level within subjects, including science, technology and mathematics, structured into sequences and tested nationally at several stages throughout a student's time in school. How subjects are taught is for teachers to decide. While these reforms appear to have been responsible for significant improvements in student learning outcomes, they have also been the subject of intense debate. There has recently been some relaxation of the highly specific requirements with greater freedom to schools that are succeeding in reaching targets that have been set centrally. 'An intelligent accountability framework: providing the basis for targeted intervention in inverse proportion to success is how the new policy has been characterised.'<sup>12</sup> Along with its determination to set many definite targets for student learning in specific subject areas and the testing programs to accompany these targets, the British government has taken steps to focus support and resources on the most needy schools, where student learning difficulties are severe. Similar approaches have been adopted in several American States.

The direction taken by Australian States and Territories, and largely adopted in non-government schools, has consciously differed from that in England and Wales and parts of the United States. Here the focus is wider and the aim is to provide more opportunities for teachers to select and gear content to the characteristics and needs, as they see them, of the students they teach. The extremes of performance testing have been avoided while systems have been progressively gathering data on student learning and made this available to teachers and parents. There is a heavy onus on teachers to become curriculum developers of a kind, for example in designing courses, constructing learning tasks and mapping the curriculum into which daily classroom events fit. Teachers are in a very real sense mediators of learning.



Curriculum guidelines and frameworks in Australia for the compulsory years of schooling are reflecting demand for learning that is very closely related both to children's experience and to the changing socioeconomic and cultural environment. There is a strong commitment in pedagogy and curriculum structure to the development of thinking across the curriculum, multi-literacies, cognitive strategies, self-directed learning and laying the foundations of lifelong learning, with a move away from strictly delineated learning. Many teachers, in responding to curriculum guidelines, construct their own materials, use extracts from texts, draw on the web and on local, community resources. These trends are based on an expectation that young people should not be treated as an undifferentiated mass and need to be active and engaged participants in their own learning and in the wider environment.

Nevertheless, since for the early and middle years of schooling formal specifications of necessary learning in specific learning areas tend to be broad, it is difficult to make informed judgements about the adequacy of what is being taught or to know what is being learnt, in science, technology and mathematics—or any other subject domain. Current knowledge is based on a number of tests of what students know and can do, on observational studies, surveys and reports on how guidelines are being implemented and on inspecting the texts and other resources widely used.

From a national perspective there has been until recently relatively little systematic, well-analysed data on learning outcomes for students before the upper secondary stage. Now though the national reports on literacy and numeracy are beginning to provide a picture of changes over time for some kinds of learning, and the first national sample assessment of primary science is being undertaken in October 2003 with results expected to be available in 2004. The first national sample assessment of students' ICT knowledge and skills at years 6 and 10 is to take place in 2005. It is expected that separate monographs will be published containing rich data on students' achievements across the range of performance—along the lines of the reporting from PISA. Enhanced reporting and improving access to information serve several purposes: to ensure that high standards are being set and achieved; to help clarify the debate; and to assist in building a knowledge base for future school policy.

## 7.4 Learning from international comparisons

Australian results in PISA and TIMSS outlined in Chapter 2 are, on the one hand, confirmation of a generally good performance. On the other hand, they are a means to identify problems in learning. They provide an opportunity for school improvement strategies.

Systems and schools can learn much from PISA and TIMSS about quite specific comparative strengths and weaknesses in learning which can be used to develop targets for improvement, including benchmarking against the very best performers in all areas. Teachers must learn as much as possible about every individual student in their care. For this purpose, systems and school authorities can use results such as those of TIMSS, PISA and other surveys and studies of attainment, including State-wide testing,

to build up profiles of the scientific, mathematical and reading literacies of their student populations. In other words, these are valuable data not only on past performance but as guides to future action to strengthen and improve learning. TIMSS and PISA results have been closely analysed and systems and schools can use these analyses constructively. According to the Australian Council for Educational Research (ACER): 'In Australia, the amount of homework done by 15-year-old students; instructional time in science; teacher morale; disciplinary climate of the school; and teacher support were all related to achievement. These are all factors that schools can do something about.'<sup>13</sup>

The Australian scores in TIMSS and PISA are very encouraging. They also help pinpoint in very precise ways where action is needed and what can be done. Schools and teachers will need the support and stimulus of very public declarations by governments, policy makers and leading community figures to carry forward the momentum of school improvement. The TIMSS/ PISA findings are helpful in this regard. Equally important is the need to identify as goals a thorough grounding for everyone in the literacies of science, technology and mathematics. As stated in Chapter 2, it is necessary to extend this basic competence as far as possible.

TIMSS and PISA have helped to highlight areas where an already fine performance could be further improved, including science and mathematics teaching. These and other findings indicate target areas for the whole of schooling, in which renewed efforts are needed to improve learning outcomes:

- further extending the range of early childhood education facilities, developing collaborative national strategies and investing more in programs attuned to laying foundations from the beginning of schooling and in pre-school for scientific, mathematical and technological literacies;
- focusing expertise, material resources, community effort and cross-sectoral policies on the two groups most at risk of underperforming: Indigenous students and students from low socioeconomic backgrounds—in addition, the reading competence of some boys requires special attention;
- in both initial education and professional development programs, and regardless of discipline, ensuring greater teacher understanding of constructivist learning and equipping teachers with the competencies to manage learning which is both student-centred and focused on definite outcomes;
- providing more support and publicity to collaborative programs involving schools, universities and TAFE colleges and industry, to give students concentrated learning experiences in the uses and real-life application of science, technology and mathematics and other subjects;
- strengthening and extending procedures for monitoring, evaluating and reporting student learning outcomes.

These are not new requirements, but they have assumed greater urgency as a consequence of the present drive to achieve higher and more consistent overall performance and to improve school retention. Improvements in these and other areas will enhance Australia's innovative capacity, raise levels of human and social capital and provide more just and equitable opportunities for successful learning.

The Committee sees, in the focus on learning outcomes in TIMSS and PISA and in related Australian policy initiatives, significant implications for teachers and teaching and for teacher education, both initial and continuing. PISA and TIMSS achievements by Australian students and teachers should be sustained, at the very least. Australia should be benchmarking against the very top international performers—as there is no hesitation in doing in sport or the arts—and this requires understanding the conditions that lead to their success. This means that, over and above high quality teaching and learning, Australia needs to better analyse, report and evaluate student learning processes and outcomes.

## 7.5 Achieving better outcomes in science, technology and mathematics

Submissions advanced strong arguments for mathematics, statistics and technology as distinct subject domains in school.<sup>14</sup> The Australian Bureau of Statistics and the Statistical Society of Australia have argued that 'statistical literacy is a vital skill for living and working in the information age' and proposed the development of a new subject area.<sup>15</sup> The Committee also discussed financial literacy, the knowledge and skills students need to manage their own finances and to understand the kinds of financial transactions they are likely to encounter as they grow toward adulthood. In its recent discussion paper, *Financial Literacy in Schools*, the Australian Securities and Investment Commission noted that 'efforts to improve fundamental mathematics and problem-solving skills can foster knowledgeable consumers who can take advantage of the sophisticated financial services offered in an ever-changing marketplace'.<sup>16</sup>

It has been useful to extend the debate about 'basics' beyond the traditional '3 Rs' and some core subject matter. The Committee has been advised in submissions to support many extensions and developments of the school curriculum. It has also been advised of the risk of curriculum overload. It is not possible to simply add content and whole new subjects to already overloaded school days. But what is possible is to review what is already there, select what is deemed essential and find ways to integrate new with existing content. If 'the literacies' are to be of greater heuristic value to schools and teachers than the declaratory and commendatory purposes they often serve at present, sharper curricular and pedagogical analysis will be required. Teachers cannot be expected to teach for multiple literacies if their scope and expected outcomes in learning are not clearly and realistically specified.

What is at issue is more than required subject content in the school curriculum. The question to address is how to improve the quality of teaching and learning in subjects that resist mass appeal and do not grip the imagination of many of the brightest students. Why, for example, are science and mathematics so often seen as arcane fields of specialisation for the few beyond the middle years of high school? And why are careers in science apparently unattractive to very able students?

One reason, surely, is their projection in the public mind as difficult, technical and irrelevant to everyday life. But this can be only part of the explanation. The way knowledge is structured and presented to students has a huge impact on their perception of its value and likely interest. Schools such as Sacred Heart Girls' College, Geelong, have demonstrated success in attracting students to study science (Box 7.4).

**Box 7.4 A Victorian girls' college shows how to increase secondary science enrolments and engender enthusiasm among primary students for science**

Under the guidance of an innovative principal and with a publicly articulated commitment to change management, Sacred Heart Girls' College in Geelong has vigorously embraced innovation in education and made a strong commitment to a revitalised science program, underpinned by new pedagogies based on individual learning styles.

Upon entry to the College, students are actively engaged in exploring the brain and the way it works. Each student's unique learning style is assessed and girls are encouraged to discover more about how they learn and how this knowledge can facilitate their own learning processes. These activities support the College's commitment to recognising differences among students and begins the process of responding to individual needs.

At the same time, the College strongly supports science curricula, with biology, chemistry, environmental science, physics, psychology and robotics. Consistent with using learning styles, students are first taught various ways of thinking, so that they are able to understand and analyse the subject matter. They are then taught subjects with methodologies that are strongly connected to the real world. Emphasis is given to a rich, broad curriculum which, through participatory learning, aims to maintain high academic standards and develops basic skills by providing programs which respond to changing needs of the school community.

**Box 7.4 A Victorian girls' college shows how to increase secondary science enrolments and engender enthusiasm among primary students for science continued ...**

Through the teaching of science in an innovative way, based on strong understanding of different learning styles among students, the popularity of science-based subjects has grown considerably in recent years. In contrast to many other schools, and particularly girls' schools, enrolment in elective science-based subjects has increased at Sacred Heart College; in Middle School, for example, about 65 girls now do physics as an elective subject, whereas in many other girls' school physics is no longer even offered.

The College has a science mentoring program that links secondary students with students from six neighbouring primary schools. The benefits of this program have been seen not only in increased enthusiasm for science among primary students, but has also been seen in learning gained by secondary teachers through the observation and incorporation of primary teaching methodologies into secondary teaching.

The College has made a considerable investment in IT resources (hardware and software), supported through dedicated computer technicians. The College is working towards a whole-school radio system which will see wireless computer technology throughout the College precinct.

Sacred Heart College considers professional development 'neither a privilege nor an optional activity', but forms an integral part of a staff member's duties and the College's responsibility. Professional development activities occur in three modes: offsite, on-site and work-embedded (the latter focuses on teamwork to incorporate the best of off-site and on-site PD offerings). Teachers are strongly supported in IT learning and the College has a comprehensive orientation/induction program for new teachers and provides mentors for them.

With an enrolment of 1360 and support staff of 150 teachers and ancillary staff, the College fosters strong links with the wider Geelong community and, especially, the Catholic community which assists the College in many ways. The College also fosters partnerships with industry: for example, one company provides funds for the College to showcase past students in a 'gallery of achievements in science', a source of inspiration for younger girls in their assessment of science as a career.

Source: Secretariat report on Review visit (May 2003).

The fundamental principles of novelty—inquiry, speculation, experimentation, criticism and the quest for useful ways to solve problems—which find expression in science, mathematics and technology are accepted parts of Australia’s way of life, yet the silos of specialised knowledge into which they have been elevated may be poorly understood and are often undervalued. The idea of ‘Australia’s ability’ cannot, on the one hand, be separated from the expertise and knowledge embedded in these silos or, on the other, restricted to the few. Between these two extremes lie the ideas of the public understanding of science and scientific literacy.<sup>17</sup>

Chapter 2 documents a retreat from science in education or, at least, no great forward movement, especially at the upper secondary level. Several issues have been raised:

- insufficient emphasis is being given to appealing to student interests and motivations;
- it may be difficult to deploy innovative pedagogical strategies in the senior years when complex and difficult subject matter is being taught to meet tightly controlled examination requirements;
- there are disproportionate opportunities for students to learn science, technology and mathematics; these reflect socio-economic differences, gender and geographical location which are having an adverse effect on student learning outcomes in the sciences and mathematics; and
- recent moves to make science and mathematics more attractive and engaging to students (for example, interdisciplinary approaches) have led to divided views among science and mathematics educators about how best to structure and organise content and pedagogical practice, but there is relatively little evaluation and research data to aid decision making.

Australia produces outstanding scientists, technologists and mathematicians, but needs to do considerably better, to increase numbers and to raise standards where they are low. This means focusing on teachers, on schools and on students, but also on families and communities and the scientific enterprise itself. Attracting more people to science, technology and mathematics means thinking about the whole range of professions and occupations which, in some way or other, are connected with or dependent on the science and innovation systems. It also means being more strategic in fostering student interest and more effective in educating students in these fields.

From this it appears to the Committee that education authorities in partnership with professional associations and higher education institutions throughout the country must undertake a set of extremely important tasks:

- publicise and promote the three literacies of science, technology and mathematics and careers in these fields;
- reach agreements on definitions, scope and coverage of the literacies;
- review and develop teaching strategies and learning procedures for science, technology and mathematics, benchmarking collectively against best international evidence-based practice;
- target expertise and resources to raise low performing students and schools to an agreed acceptable level; and
- work closely at all stages with schools and teachers and with teacher education institutions.

## 7.6 Vocational and enterprise education in schools

The scope of learning at school has been greatly extended at all levels. Major developments are occurring in the upper secondary years and in programs at junior secondary levels designed to better prepare students for the world of work.

More career information and guidance are needed to help young people make informed choices about the opportunities available in science, technology and mathematics. Industry has an important role to play in marketing itself in order to provide young people with a contemporary understanding of the nature of work in particular industries, to dispel misconceptions about some industries and to emphasise that study in particular fields like science, mathematics and technology is highly desirable for entry into specific industry areas.

One of the objectives in developing an innovative culture is to increase the numbers of innovators, including entrepreneurs. Present labour market demand is not a sufficient indicator for this purpose. Predicting future demand requires long-term forward thinking, not an unduly close reading of present career openings. This means looking ahead to emerging jobs and to opportunities for creating new kinds of jobs.

Business and industry expectations are contributing to shaping the broad goals and purposes of schooling. Over the past decade, the business community has shown a growing interest in the outcomes of schooling and in direct involvement in schooling. This interest includes, but goes beyond, Vocational Education and Training (VET) in schools. Moves to incorporate vocational preparation are exerting a powerful influence on education policy developments across the country. Many schools are developing broad, vocationally oriented programs as a means of strengthening students' interest in learning. In 2002, more than 95 per cent of schools with senior secondary school programs were offering vocational education and training programs with the number of students participating in Vocational Education and Training as part of their secondary schooling growing from 60 000 in 1996 (16% participation) to 185 520 in 2002 (44% participation). Also, the number of Training Agreements in place for School Based New Apprenticeships rose from 1 500 in 1998 to 7 390 in 2002.<sup>18</sup> These have been remarkably swift developments, leading secondary schools to become diverse, multi-faceted community- and work-linked learning centres.

As business and industry have grappled with the changing nature of the workplace they have identified new types of skills needed by people to continuously adapt and upgrade their knowledge and skills. Business and industry, for obvious reasons, emphasise the importance of young people being able to transfer their knowledge and skills to different learning areas and situations. They expect a solid foundation for lifelong learning to be laid in schools. Several changes of career during their working lives is the reality facing increasing numbers of people, hence the importance of generic competencies and a readiness to continue learning.

Increased mobility in the labour market makes the acquisition of these skills essential for young people. Such skills enable people to change careers readily and adapt effectively to changed circumstances. By their nature, these skills cannot be acquired solely at school. They rely on effective partnerships between schools, parents, business, industry and the community.

Student perspectives are also changing. The stimuli and the experiences young people have outside school are increasingly sophisticated and fluid—their informal learning is now much more ICT-dependent and more heavily influenced by a global culture than was the case with their parents and teachers. Many students work part-time while at school. In 2002, over 7000 students commenced a school-based New Apprenticeships program and 112 403 students spent a total of 7 399 871 hours in Structured Workplace Learning (an average of 66 hours per student) which brought them into regular contact with the expectations and demands of the world of work.<sup>19</sup> Students also participate in voluntary organisations, sporting and recreational groups and in community development activities. As a result of the combined impact of all these factors, young people are increasingly seeking relevance and connection between what they can do and learn outside school and what they do, make and learn about at school.



The composition of the student population is more culturally diverse and, in terms of the total cohort of young people aged under 19 years of age, is quite different from the recent past. As recently as 1982, the apparent retention rate from Year 7/8 to Year 12 was around 36 per cent. By 2002, the rate had more than doubled to 75 per cent.<sup>20</sup> Policies to improve participation rates are being implemented but their success depends on further innovations—in curriculum, school organisation and pedagogy—to provide a valuable experience for an even broader cohort of young people.

Vocational education has now become an integral part of general education across Australia. It has been responsible for strengthening the links between education and the changing needs of the labour market and shaping the education and training system to be more responsive to the needs of all young people, not just those who would complete their secondary schooling and move on to tertiary studies. Extending opportunities for vocational education in schools and in partnership with TAFE and industry will encourage more students to gain competence and confidence—and lead schools toward more adult ways of teaching and learning.

Major increases in the rates of student retention in the senior secondary school years, during the early part of the 1990s, were in part driven by higher rates of youth unemployment. With restricted work opportunities, young people sought higher educational levels to improve their competitiveness in labour markets, placing new pressures on schools which had been largely focused on preparation for university.

The commitment to vocational education in schools is reflected in the National Goals for schooling which clearly identify vocational education in schools as a key element of education for all young people. In response to the National Goals relating to vocational education, the MCEETYA VET in Schools Taskforce (now the Transition from School Taskforce) developed a new framework for vocational education in schools. In January 2001, MCEETYA broadly endorsed the new framework for implementation from the beginning of the 2001 school year. This new framework embraced the need for improved transition pathways for all young people moving from school to work and further education and training and signalled a broadening of the agenda for vocational education. Vocational education in schools now encompasses a broad range of activities including vocational education and training (VET) in schools, School-Based New Apprenticeships (SBNAs), enterprise education, employability skills, structured workplace learning, and the provision of careers education and services.

There is no doubt that there are opportunities through VET in schools to strengthen student capabilities in scientific, mathematical and technological literacies and to achieve greater student participation in scientifically and technologically based studies in industries such as electro-technology, renewable energy, information technology, engineering, mining, conservation and land management and agriculture, including silviculture and viticulture.

Teacher education courses generally do not prepare school teachers for vocational education in schools because of an historical focus on preparation for teaching academic disciplines (at the secondary level). This is reflected in the educational and work experiences of most teacher educators and in the backgrounds of most initial teacher education students. Consideration could be given to ways to use teacher education staff with relevant expertise and experience related to vocational learning in schools, developing VET components in initial teacher education courses and attracting to teaching people with relevant work or VET teaching experiences.

Several points about vocational education in schools are of particular significance for the Review:

- the introduction and rapid growth of VET in schools as a flexible, innovative response to the diverse learning needs of many students;
- the school–industry–community partnership models applied in VET are ideal examples for schools to build on when connecting with scientific and technological communities;
- VET is a significant bridge connecting schools with business and industry—a bridge into a dimension of the knowledge economy; and
- VET in schools is resulting in the development of innovative curricula and pedagogies for applied knowledge and skills.

In addition to the school-based VET programs which provide students with the opportunity to gain credit towards a senior secondary certificate while at the same time gaining a national industry-recognised qualification or credit towards this qualification, there is also a growing demand for enterprise and general vocational or employability skills.

The development of programs in enterprise education is another acknowledgement of the need to make schooling more relevant to students' lives and to forge better connections with community and working life. Enterprise education is a cross-curricular approach to student learning which supports students to cultivate creativity, self-reliance and the ability to generate, recognise and seize opportunities. It is particularly relevant in the areas of science, technology and mathematics. It aims to develop in students the willingness, skills and ability to take a proactive, self-determining and flexible approach to understanding, influencing and shaping their own future. It is relevant to all the years of schooling, and is particularly applicable to the middle years.

'Enterprise education has been introduced in schools across the country as a response to a range of issues affecting student outcomes. At one level, it reflects a commitment by schools to making schooling more meaningful and practical for students. At another level, it is a commitment to teach students a range of essential knowledge, skills and values to underpin their life journey, including their employability. It also provides a challenge for very able students to apply their learning in authentic (real life) situations.'<sup>21</sup>

The Australian Government is currently undertaking research in almost 200 Australian schools to identify and record innovative approaches to enterprise education.<sup>22</sup> Initial findings from this research indicate that students gain most benefit from a whole-school enterprise focus that then acts as the centre point for the development and implementation of the curriculum across the learning areas. The research has also found that the development of enterprising skills in students is maximised when the learning is provided in 'real life' situations. A broader understanding of the curriculum is also provided when the school boundaries are stretched to form partnerships with parents and families and with the community.

'Employability skills' are also emerging as a key issue for consideration by schools. Industry is seeking young people with a ready understanding of the world of work and who have general, employment-related skills and a broad range of personal attributes that contribute to employability.

The *Employability Skills for the Future* report<sup>23</sup> developed by business and industry sets out a framework that incorporates the personal attributes and skills that employers expect young people to have developed through their schooling, before they enter the workplace. Personal attributes such as loyalty, commitment, honesty, integrity, enthusiasm and adaptability, and a set of key skills that build on the Key Competencies, all contribute to employability and the overall development of people.

The set of employability skills includes:

- communication skills that contribute to productive and harmonious relations between employees and customers;
- teamwork skills that contribute to productive working relationships and outcomes;
- problem-solving skills that contribute to productive outcomes;
- initiative and enterprise that contribute to innovative outcomes;
- planning and organising skills that contribute to long-term and short-term strategic planning;
- learning that contributes to ongoing improvement and expansion in employee and company operations and outcomes; and
- technology skills that contribute to effective execution of tasks.

These employability skills are cross-curricular. Their development in schools depends very much on the 'how' of teaching and the opportunities students have to acquire and use them in different settings, both within and beyond the classroom. Just as the literacies require practical application, employability skills require teachers to focus on active learning by students and relating school learning to real-life situations. To do this, teachers must themselves be creative and innovative and schools must become closely connected with the world of work.

The emerging skill requirements identified by the Australian National Training Authority in information and communications technology, creativity, problem solving and critical thinking are analogous to those sought in reforms of secondary school science, technology and mathematics. Changes implemented by States and Territories in structures for curriculum and assessment of learning in upper secondary education have resulted in large increases in the number of students enrolling in vocational programs and, in time, should help to reverse the trend away from science, technology and mathematics, at least in application of these disciplines. The new vocationally oriented gateways into tertiary education resulting from changes to tertiary entrance requirements, and the reforms of the end of Year 12 examinations, have the potential to increase the number of applied science students in tertiary institutions.

The traditional gateway to higher education and advanced technical and further education is the Year 12 examination. Already replaced in some jurisdictions by moderated assessment, this examination and internal assessment in Years 11 and 12 are, by common consent, often cited as sources of great pressure for students, families and teachers. Despite the many reforms and the much higher participation and completion rates of recent years, too many students still do not achieve good results and others, for a variety of reasons, elect not to continue schooling beyond Year 10 or 11.

The learning that takes place in Years 11 and 12, as well as assessment of student performance at Year 12, serves a variety of social and educational objectives, such as screening for tertiary entry and for vocational training and occupations. It can be valuable in motivating students and providing them with goals in their learning and in enabling them to make future career choices. The development of new vocational pathways in science, technology and mathematics is a way to meet the growing and diverse needs of these students.

## 7.7 Responding to needs in early childhood and middle years

The South Australian curriculum framework points out that learning begins in the first year of life. Terms like 'literacies' and 'culture of innovation' have application beyond the formal years of schooling. The foundations of the literacies are nurtured in the early childhood (birth to 8) years, and social and emotional development are vital during these years, as are physical and cognitive development more broadly. Important dispositions which favour creativity, inventiveness and innovativeness are being formed in these years. As the Faculty of Education of the Queensland University of Technology and the Faculty of Education and Creative Arts of the Central Queensland University point out, there is evidence that what happens in the early years of life shapes every child's future in relation to later educational and health outcomes, career prospects, reliance on welfare and undesirable entanglements in substance abuse or the criminal justice system.<sup>24</sup> Advocates of early childhood education and care have long argued for better facilities and equipment and a strengthening of initial and continuing teacher education

directed at the learning needs of very young children. Research has shown that it is Indigenous children and those from non-English speaking backgrounds who benefit most from participation in quality early childhood education.

With the considerable increase in the number of places available in recent years, through both public and private channels, pre-schooling across a variety of early childhood education and care settings is becoming the norm. This highlights the problem of those children who would benefit but are not receiving pre-schooling. With the growth of places has come closer attention to the learning potential and needs of young children and the professional preparation and continuing professional development of their teachers and other responsible adults. In addition to regulations and guidelines, curriculum mapping is under way.

Primary schooling, especially in the context of the literacies, has been considered in several places in this report, as have the 'middle years' that bridge primary and secondary schooling. There is a particular significance in this transition period in that it is a time when too many students lose interest in school learning and begin to make choices that often lead them away from systematic study, whether in science and mathematics or in other subject areas. Raising educational standards in the middle years is an essential element of a longer term strategy of improving learning outcomes for all students.

The transition from primary to secondary school has long been identified as difficult for some students. The Australian College of Educators argues that more attention needs to be given to teacher expectations, student learning outcomes and innovation in the upper primary and junior secondary years. Some systems and some schools are restructuring to create an extended transitional phase of middle schooling to provide a more supportive environment for students and enable them to ease into the more specialist studies of later years of schooling.<sup>25</sup> This is leading to a reconfiguring of teacher roles and responsibilities and changes in the initial education of teachers and their continuing professional development.

Middle schooling as a more clearly articulated zone of teaching and learning has been proposed as a way to improve literacy and numeracy among some specific groups, namely, students from low income families, Aboriginal and Torres Strait Islander students, those with language backgrounds other than English, students in rural and remote areas and others struggling for myriad reasons with transition to secondary schooling. In a national survey of middle schooling, Luke and colleagues reported mixed results. There were outstanding programs and an improved overall awareness of literacy issues but 'little consistency and coherence in approach in literacy and numeracy within and across States and Territories or across systems'.<sup>26</sup> Since there was insufficient evidence of benefits, they called for a second generation of middle year theory, research, development and practice. While learning improvements do occur, together with positive changes in individual behaviour and social relationships where middle schooling is identified as a 'zone' or phase for specific, targeted intervention, according to Luke it would be premature to draw firm conclusions about policy directions for teaching and the organisation of learning. Hence the call for more evaluative data.

### Box 7.5: Innovations in learning—the middle years

The middle years that bridge upper primary and lower secondary are an important transition period for both the quality of learning and school retention beyond the permitted leaving age. As was said of middle schooling and schools participating in the Innovation and Best Practice Project (IBPP): ‘Research within these schools showed a remarkably high level of engagement in fundamental issues. While the changes the schools had succeeded in implementing were often preliminary, tentative and partial, the thinking that had motivated the changes ran deep and the groundwork was being prepared for much more substantial reform. Indeed, when all the disparate pieces were fitted together, what emerged was the outline of a paradigm shift in thinking about the nature of schooling in the middle years and beyond. The schools were clear about the changes they wanted to bring about in their students. Among the most frequently cited were:

- arresting the decline in students’ levels of engagement in learning and in their liking of schooling;
- promoting students’ sense of identity, belonging and esteem; and
- developing students’ capacity and confidence to function as autonomous learners in the new knowledge society ...

In these schools there was a belief that a significant turnaround in affective outcomes was a precondition to improving student learning outcomes.<sup>27</sup>

Middle years schooling has certainly attracted a lot of interest. The South Australian Commission for Catholic Schools notes that while middle school initiatives are potentially valuable, school assessment practices and tertiary institution entry requirements inhibit or constrain innovative school practices. The creation of space for innovation in schools carries with it the expectation of changes in upper secondary and tertiary level requirements.<sup>28</sup>

It cannot be disputed that targeting the middle years is important. There is sufficient evidence of disengagement with school during these years to warrant the increased attention they are now receiving. But, for many students, this is too late. Even at the primary stage, the incidence of behavioural problems, poor performance, and reluctance to learn at school or through school activities is well entrenched in some children. Unless the foundations of fully inclusive schooling and successful learning into adulthood are laid at the preschool and kindergarten, later learning difficulties are almost certain to occur for some students.

## 7.8 Better schooling for Indigenous students

Schooling is not fully effective when specific groups of students perform at a significantly lower level than the general school population. While some Indigenous students are achieving good results, PISA results testify that too many have relatively low scores in mathematical and scientific literacy. In the primary years, Australia's Year 5 Indigenous numeracy benchmark results are approximately 26 percentage points lower than the results of all Year 5 students. Serious gaps remain between Indigenous and non-Indigenous outcomes in literacy, numeracy, student attendance, retention in secondary school, Year 12 certificates and some completion rates in VET and higher education.<sup>29</sup>

While there are small improvements overall and many Indigenous students are achieving good results, this large gap in performance is a serious problem and must be addressed. The schooling process must provide a security of cultural identity and the best educational outcomes for Indigenous learners. This will entail:

- a particular focus by education authorities, schools teachers and other professionals on improving the educational outcomes of Indigenous students;
- setting and maintaining high performance expectations for Indigenous students; and
- ensuring Indigenous parents and caregivers are engaged productively in the education process.

### Box 7.6 Centralian College – Innovative support for school-to-work transitions

Centralian College places significant emphasis on finding innovative ways of supporting school-to-work transitions for its many full-time and part-time students. Opening in 1979 as an open-plan high school for Years 7-12, Centralian moved towards the 'Canberra' college model in 1985, separating Years 11 and 12 into a senior secondary college (Sadadeen Secondary College). Evolving again, in 1993, at the instigation of the then NT Chief Minister, Sadadeen was amalgamated with Alice Springs College of TAFE and the new Centralian College became the first Australian institute to offer integrated programs across three sectors of education (senior secondary, TAFE and higher education) under the one administration. It now has a senior secondary student population of about 350.

Since 1993, Centralian has explored a variety of innovative ways to link education with employment. The major approach adopted has been the collocation of secondary college students and TAFE sector students and the streaming of secondary students into TAFE courses while still undergoing secondary education. This approach has provided opportunities for multiple pathways into tertiary education for many students who are not necessarily looking for TER ranking.

### **Box 7.6 Centralian College – Innovative support for school-to-work transitions continued ...**

In 1999, in partnership with Group Training Northern Territory, Centralian College started the first school-based apprenticeship program in the NT – the ‘Pathways Program’. Established initially as a pilot project in response to a chronic skills shortage in the automotive industry in Central Australia, the program gives students the opportunity to enter an apprenticeship or traineeship on a part-time basis while still studying their Year 11 subjects and attending TAFE. In 2002, the program catered for students in a range of areas including automotive, cookery, horticulture, construction, retail and office administration. The Program is strategically linked to industry demands in Central Australia and satisfies employer needs for appropriately trained employees. Centralian College also takes an active role in seeking out employment opportunities for its students who are part of the Program.

The commercial arm of the College incorporates Training Solutions, Centre Learn and the Australian & New Zealand College for Seniors. Accredited and non-accredited training programs are offered to individuals and corporations on a fee for service basis. Adult language, literacy, numeracy and computing are available on a flexibly timetabled basis at the Literacy Centre. Students of any adult age and of any standard can undertake course work to improve their skills. An individually tailored program is developed which can be undertaken on or off campus.

The College caters to the different learning styles and needs of Indigenous students through programs which have high levels of flexibility in delivery and assessment. As part of its Indigenous Education Strategy, the College employs two Aboriginal and Islander Education Workers and convenes an Aboriginal Student Support and Parent Awareness Committee which promotes parent awareness of their children’s education and improves student access and education outcomes.

Not only has Centralian College increased its retention rates among secondary students and increased dramatically the number of vocationally trained secondary students, it provides a significant source of appropriately trained and skilled people for employers in the Central Australian region. Under a current proposal, Centralian College will be amalgamated with the Northern Territory University on 1 January 2004 to become the Charles Darwin University, although it will still include a secondary college component.

Source: Secretariat report on Review visit (June 2003).



Much effort is going into Indigenous education. Highly dedicated and capable teachers, researchers, system administrators and policy makers are working hard to pinpoint difficulties and achieve better results. Their experience is an extremely valuable resource, as is that of those members of Indigenous communities and organisations who have set educational improvement as a key target for concerted effort. A number of providers and community leaders have indicated that when Indigenous students experience success, their attendance and active participation in learning improve. These are growth points for individual students and their peers which must be built up by close analysis of achievement and conditions that lead to successful learning.

The education of Indigenous students should be seen as a mainstream responsibility. All teachers need to be able to meet the challenge of delivering quality outcomes to Indigenous students through knowledge and understanding of Indigenous cultures. And all schools require leadership to support innovation and excellence.

#### **Box 7.7 Gillen Primary School – Innovation in literacy education benefits students and teachers**

An obvious and increasing disparity between learning outcomes for Indigenous and non-Indigenous students, coupled with teacher frustration at widely disparate abilities within classes, led a group of proactive teachers at Gillen Primary School to become involved, in 2001, in the Scaffolding Literacy Project (now known as the Accelerated Literacy Project – ALP).

As a medium-sized co-educational government primary school, located in the west urban area of Alice Springs, with an enrolment of 425 students and an Indigenous population of some 65%, English as a second language had become a significant component of Gillen's teaching focus. In 2000, it was clear that students at Gillen were achieving reasonable levels of literacy until about Year 3, but many showed a marked decline in literacy development in subsequent years.

Initiated and supported by researchers at the University of Canberra, plus a grant from DEST, the project was rapidly embraced by teachers at Gillen who saw great potential in the methodology for raising literacy among all students, not just those experiencing difficulties. In the pilot, which concluded on 20 June 2003, a total of 124 students, comprising 114 Indigenous students and 28 non-Indigenous students from Years 1-6, were specifically monitored. These included ESL students and students identified as having special needs, as well as mainstream students. One of the most important features of the program was the collection of data which allowed progress to be monitored and achievements recorded by staff, students and parents. 'Before' and 'after' videos of reading skills provided clear evidence of skill development.

### **Box 7.7 Gillen Primary School – Innovation in literacy education benefits students and teachers continued ...**

A whole-school focus was developed, staff trained to deliver the program and a project coordinator appointed to support teachers in delivering the program. Staff employed under the Aboriginal Tutor Assistance Scheme were also taught and mentored in the program. Support was also offered in other ways including: encouragement of teachers to work with the program coordinator (shared planning and team-teaching lessons); self reflection is enhanced by videoing and observation of lessons; and provision made for teachers to observe the practice of colleagues. Collegial support was a crucial factor in the project's success.

The benefits of introducing ALP to Gillen have been immense, with ongoing assessment and work samples providing evidence of significant increases in literacy skills of almost all students, above those which would have been achieved using previous teaching methodologies. The most important impact of the program is that now emphasis is placed on educating all children in the classroom, regardless of their level of ability. Increased literacy has also had a positive impact on learning in other subject areas. Other positive outcomes include increased student attendance (which is currently about 82%) and increased teacher satisfaction and retention.

Teacher input, flexibility and ownership of the program played a vital role in the sustainability of the project and assisted teachers stay motivated. Since its inception at the school, Gillen has attracted and recruited teachers who have wanted to teach using this methodology and the program has spread to other, non-pilot schools through the movement of teachers from Gillen to other areas.

Other innovations at Gillen include a Transitional Indigenous Unit for students who have low attendance rates to encourage these students to attend school. This unit eases the integration of Indigenous students coming into school, particularly those who have previously had little or no formal schooling. It allows family groups to start school together and delivers programs which concentrate on the social skills necessary for participation in mainstream classes. After students successfully complete the transition process, they are relocated to mainstream classes.

Source: Secretariat report on Review visit (June 2003).

The Committee has seen at first hand evidence of success and responsiveness and of the conditions that promote them, in regional settings in Alice Springs schools. The Accelerated Literacy program at Gillen Primary School (Box 7.7), for example, is achieving outstanding results with primary-aged Indigenous and non-Indigenous students. This, and other examples of collaboration to raise educational levels and standards of Indigenous people demonstrate that more substantial gains can be made in order to meet the needs of students and their communities and to reduce the gap between the average performance of Indigenous and non-Indigenous students. In this, Australia can and must do better.

### **Box 7.8 Alice Springs High School – Innovative team teaching reconnects students**

With a current enrolment of 450 students, a majority of whom are Indigenous or disadvantaged non-Indigenous students, adoption of team teaching has resulted in radical changes at Alice Springs High School where high levels of absenteeism and transience, combined with significant behavioural problems, previously eroded teacher morale and impacted on the ability of all students to learn. An initiative of a small group of teachers who were convinced that conventional approaches to teaching were no longer appropriate, team-teaching was introduced for Year 10 students several years ago.

The new approach blends large classes of students (some 60 in each group) in a home base 'mess-hall'. Students are actively encouraged to work at their own pace and different subsets of students work on different projects according to their needs. Small groups of students are withdrawn at various times for special programs so that it is rare that all students are in the mess-hall at the same time. Teachers cover subjects in a more generic manner than is the case in more conventional high schools and with a methodology that is more akin to primary school teaching. Specialist teachers are brought in for subjects such as LOTE and music. Ex-students are encouraged to come back and assist in the classroom and fit in well with the open-plan classroom approach.

There are three time blocks in each day and timetables have become highly flexible, with teams developing their own schedules at the beginning of each term or semester. Because of the team approach, teachers operate in much smaller groups than before which assists students with learning. Learning is based on mixed age groups, large 'rich' projects and reality-based learning.

In conjunction with team teaching, Alice Springs High School places a very strong emphasis on catering for each individual and believes that relationships are the key to successful student learning. The school works extensively with both Indigenous and disadvantaged non-Indigenous students to provide primary needs such as food, shelter, welfare and social support. It places particular emphasis on valuing Aboriginality and supports Indigenous families to manage behavioural problems, rather than just students.

With a Student Support Team comprising a police officer, a nurse, an Aboriginal liaison officer, a home liaison officer and a trained psychologist, the School is highly proactive in behaviour management and provides early identification of at-risk students. Serious discipline issues are dealt with through the Restorative Justice system which is being piloted with considerable success at the school.

### **Box 7.8 Alice Springs High School – Innovative team teaching reconnects students continued ...**

Most senior students become involved in VET programs and many have part-time jobs. With the new team-teaching approach and individually tailored programs, students can readily move between school, skills-training and employment. In addition, because there is a much higher degree of flexibility and a far greater individual approach, students who drop out of the system for a while can come back in more easily than in conventional education systems. Academic rigour is still applied, though, and students are still required to fulfil formal educational qualifications before they leave Year 10.

The change to team teaching has benefited both students, and particularly Indigenous students, and teachers alike. Students are now more interested in learning, retention rates have increased dramatically and behavioural issues have decreased. The benefits have impacted positively on teachers too who are, on the whole, much more satisfied with the team approach – there is now much less absenteeism among teachers and thus less need for relief teaching.

The success of this approach has led to plans to introduce team teaching into middle school years (Years 8 and 9). In this case, some 180 students will be grouped into three mess-halls of 60 students each and the groups will become almost entirely self managing. The school is also moving away from strict age-based Year classes and towards having three sub-schools: Year 7 as a Foundation School, Years 8 and 9 as Middle School and Years 10, 11 and 12 as Senior School.

Source: Secretariat report on Review visit (June 2003).

An excellent example of the support and extension of professional learning is modelled through the Indigenous Education Training Alliance (IETA). Based in Cairns, IETA facilitates State-wide professional development and training in relation to Indigenous education for Education Queensland staff and their school communities, as well as for other agencies, including Police and Health departments.

The main objective of IETA is to provide professional support to remote, rural and urban school communities through facilitating and brokering a range of development options including new staff induction projects, Indigenous staff leadership and career development, cultural and cross-cultural awareness, curriculum initiatives in remote communities, micro-skills for managing behaviour and second language and literacy pedagogy.

IETA focuses on linking teachers and educators in networks and promotes genuine partnerships between schools and Indigenous communities (Link and Learn), and building the capacity of local educators through accredited professional learning programs (Grow Your Own). These two models form the basis of IETA's learning communities and professional development activities. Currently IETA is involved with many projects including:

- upgrading of 50 Remote Area Teacher Education Program (RATEP) trained Indigenous students from remote communities to their four-year education degree majoring in second language pedagogy;
- induction programs for new teachers appointed to 35 rural and remote Aboriginal and Torres Strait Islander communities in Queensland;
- facilitated professional development and training for over 350 Aboriginal and Islander Education Workers for the last year;
- providing cross-cultural awareness to staff in schools (650 in 2003 so far);
- facilitating professional learning programs for over 3500 teachers in the last year; and
- development of a professional development package for the use of 'Indigenous Bandscales' as a process for measuring English literacy development in those students who have English as a second or third language or dialect.

Not prescriptive of either content or pedagogy, the IETA's professional development package is an example of ways to support teachers' reflections on their own beliefs and practice and the decisions they make on the structuring and organisation of learning. Assuming a high degree of teacher professionalism, the guidelines encourage teachers to enable very young children to make progress in understanding—of themselves and others and in terms of health and the physical, cultural and social environment.

Prospective Indigenous teachers need to be attracted to the profession in greater numbers. Such teachers serve as role models, infuse a broader range of cultural perspectives into schools, and bring a capacity for closer rapport and identification with students from Indigenous backgrounds.

The outstanding work of Aboriginal and Islander Education Workers (AIEWs), in community liaison and teacher assistant roles, warrants further support. AIEWs are integral to the delivery of education to Indigenous students, and in developing networks with communities. Greater encouragement and practical assistance ought to be applied to enable many more of these highly regarded paraprofessionals to qualify fully as teachers.

## 7.9 Moving toward future schooling

Future schooling is in many respects here already—schools visited by the Committee in very different settings Australia-wide are vivid illustrations of many of the developments commended in submissions and sought for by the Review Committee. They demonstrate leadership of the highest order, creative and imaginative teaching, successful learning and high professional standards. The challenge is to achieve comparable quality and results in all schools. At issue is not so much resources for teaching and learning (although this can always be improved), or the overall supply of teachers (although there are specific areas of shortage); rather, the crucial question is how best the human and material resources can be brought together to focus on key learning needs.

- Overall student learning outcomes, as far as they have been measured, are generally either satisfactory or very good. But there are well-identified areas that should be the target of national improvement strategies. Priority in this regard should be placed on Indigenous students' outcomes.
- Australia has a clear national policy framework, the National Goals for Schooling, which set directions and expected outcomes. These goals should continue to be systematically and comprehensively implemented and efforts should continue to ensure data are gathered to assess outcomes being achieved nation-wide.
- Schooling reforms of recent years have resulted in a broadening and diversification of educational opportunities for students in upper secondary schools. The middle years of schooling have also been brought into focus. It is essential that strong facilities for continuing, successful learning be found for all students, early childhood education and in care settings including pre-school, kindergarten and the early years of primary school.
- Australia has a long way to go in ensuring quality learning opportunities and outcomes for all Indigenous students and systematically building on successful cross-sectoral programs such as the Indigenous Education Training Alliance.

## Key conclusions

In the wide terrain of future schooling traversed in this chapter, several points stand out.

- 'Future schooling' is a convenient device for pointing up outstanding quality and achievements in present teaching and learning and identifying schools that are outstanding exemplars.
- Important as the discernible features of 'future schooling' are, it is the conditions for their successes and the processes that they use that must be understood and used in strategies for spreading high quality teaching and innovative practices across the whole system.
- Due to technological innovation, students now can access information at will. The classroom is but one gateway to knowledge. Teachers need to find ways to identify their students' learning capabilities in the full understanding that so much of the students' intellectual and personal lives is now conducted in worlds remote from those of classroom and teacher.
- Knowledge about learning and the conditions that foster and support it in schools has greatly increased. Australia will need to continue to develop initial teacher education, professional development programs and projects in educational research and development to ensure that a 'culture of innovation' is also an inclusive culture of learning.
- Efforts are under way to improve learning outcomes. As a nation, Australia has for too long tolerated serious inequities in the conditions that impact on learning performance. For social and economic as well as personal reasons, better results must be achieved for those students whose learning outcomes are weak or poor. Systems and schools can do more to attend to these challenges.
- Despite many good performances in TIMSS and PISA, there are quite specific weaknesses in student performance to be addressed; they will require highly concentrated, systematic effort by education authorities and teachers, and through teacher education and professional development programs.
- Successful future schooling entails a very wide repertoire of strategies and interventions. Several have been highlighted: more inclusive high quality early childhood education and care; vocational and enterprise education in schools; and middle years schooling.
- The education of Indigenous Australians remains a matter of great concern; notwithstanding some improvements and examples of successful projects, the average performance of students remains far too low and is a barrier to their full and equitable participation in the knowledge economy and society.

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- <sup>1</sup> Australian Literacy Educators Association, submission no. 154; Australian Council for Educational Leaders, submission no. 212.
  - <sup>2</sup> Queensland Deans of Education Forum, submission no. 173.
  - <sup>3</sup> R McClintock, *Cities, Youth and Technology: Toward a pedagogy of autonomy*, Columbia University, September 200, viewed 12 March 2003, <[http://www.ilt.columbia.edu/publications/cities/cyt\\_print.html](http://www.ilt.columbia.edu/publications/cities/cyt_print.html)>
  - <sup>4</sup> These and similar points were made in several submissions: School of Education and Humanities, Christian Heritage College, submission no. 165; Faculty of Education, University of Southern Queensland, submission no. 176; Australian Education Union, submission no. 178; Regional Council of Western Sydney Parents and Citizens' Associations, submission no. 164; Australian Council of State School Organisations, submission no. 171; Martin Keogh, submission no. 182.
  - <sup>5</sup> J Lokan, P Ford, and L Greenwood, *Maths and science on the line: Australian junior secondary students' performance. Third International Mathematics and Science Study*, TIMSS Monograph No.1, Australian Council for Educational Research, Melbourne, 1996; J Lokan, P Ford, and L Greenwood, *Maths and science on the line: Australian middle primary students' performance in the Third International Mathematics and Science Study*, TIMSS Monograph No 2, Australian Council for Educational Research, Melbourne, 1997; J Lokan, L Greenwood and J Cresswell, *15-Up and counting, reading, writing, reasoning ... how literate are Australia's students? The PISA 2000 Survey of students' reading, mathematical and scientific literacy skills*, Organisation for Economic Cooperation and Development Programme for International Student Assessment, Australian Council for Educational Research, Melbourne, 2001; D Goodrum, M Hackling and L Rennie, *The status and quality of teaching and learning of science in Australian schools—a research report*, DETYA, Canberra, 2001; Cuttance, 2001.
  - <sup>6</sup> Australian Science and Mathematics School, submission no.186.
  - <sup>7</sup> Lokan, Greenwood and Cresswell, op. cit, Organisation for Economic Cooperation and Development and United Nations Educational, Scientific and Cultural Organization, *Literacy skills for the world of tomorrow*, OECD and UNESCO, Paris, 2003.
  - <sup>8</sup> P Black and JM Atkin (eds), *Changing the subject—innovations in science, mathematics and technology education*, Organisation for Economic Cooperation and Development, Paris, 1996; D Clarke, 'International comparative research in mathematics education', in A Bishop, K Clements, C Keitel, J Kilpatrick and F Leung (eds), *Second international handbook on mathematics education*, Kluwer Academic Publishers, Dordrecht, London and Boston, in press; A Craft, *Creativity across the primary curriculum*, Routledge, London, 2000; Cuttance, op.cit.; H Gardner, *Intelligence reframed. Multiple intelligences for the 21<sup>st</sup> Century*, Basic Books, New York, 1999; E von Glasersfeld, 'Learning and adaptation in the theory of constructivism', in L Smith (ed.), *Critical readings on Piaget*, Routledge, London and New York, 1996; A Hyland (ed.), *Multiple intelligences. Curriculum and assessment project final report*, Education Department, University College, Cork, 2000; R Jupp, C Fairly and T Bentley, *What learning needs*, Design Council and DEMOS, London, 2001; MA Runco (ed), *The creativity research handbook. Vol.1*, Hampton Press, Cresskill, New Jersey, 1997.
  - <sup>9</sup> R Batterham, 'The chance to change?', discussion paper, August 2000.
  - <sup>10</sup> Faculty of Education, University of Technology Sydney, submission no. 157; School of Education and Humanities, Christian Heritage College, submission no. 165; Australian Science Teachers Association, submission no. 180; Australian Science and Mathematics School, submission no. 186; National Council of Independent Schools Associations, submission no. 197; Australian Association of Christian Schools Inc, submission no. 199; South Australian Commission for Catholic Schools, submission no. 204; Queensland Teachers Union, submission no. 205; Australian Society for Educational Technology Inc., submission no. 208.



- <sup>11</sup> Australian Society for Educational Technology Inc., submission no. 208; Queensland Teachers Union, submission no. 205; also South Australian Commission for Catholic Schools, submission no. 204.
- <sup>12</sup> D Hopkins, *How to Teach Better: Good Pedagogy is good learning*, Curriculum Corporation Conference Paper June, 2003, <<http://www.curriculum.edu.au/conference/2003/pdfs/hopkins.pdf>>
- <sup>13</sup> Lokan, Greenwood and Cresswell, op. cit., p. xv.
- <sup>14</sup> School of Mathematical and Physical Sciences, University of Newcastle, submission no. 145; Ken Milton, submission no. 149; Australian Bureau of Statistics and the Statistical Society of Australia Inc., submission no. 159; Ian Roberts, submission no. 163; Minerals Council of Australia, submission no. 184; Australian Science and Mathematics School, submission no. 186; Australian Association of Mathematics Teachers Incorporated, submission no. 209.
- <sup>15</sup> Australian Bureau of Statistics and the Statistical Society of Australia Inc., submission no. 159.
- <sup>16</sup> Australian Securities and Investment Commission, *Financial literacy in schools*, ASIC discussion paper, ASIC, 2003, viewed 10 July 2003, <[www.asic.gov.au/asic](http://www.asic.gov.au/asic)>, p. 13.
- <sup>17</sup> HM Connell, 'Are science and technology of waning interest to the youth of OECD countries?', background paper for OECD DSTI Conference on Public Understanding of Science, Tokyo, November 1996.
- <sup>18</sup> *National Data on Participation in VET in School Program for the 2002 School Year*, compiled by the MCEETYA Taskforce on Transition from School from data provided by the States and Territories, July 2003, p.5 and p. 23.
- <sup>19</sup> *ibid*, p.18 and p.23.
- <sup>20</sup> Australian Bureau of Statistics; *Schools Australia 2002*, Canberra, Table 11, P.18
- <sup>21</sup> Erebus Consulting Partners, *Enterprise Education - Case Studies from the Project: Action Research to Identify Innovative Approaches to, and Best Practice in, Enterprise Education in Australian Schools*, DEST, Canberra, 2003. p. 1.
- <sup>22</sup> *Ibid*, p. 1.
- <sup>23</sup> Business Council of Australia and Australian Chamber of Commerce and Industry, *Employability skills for the future*, Department of Education, Science and Training, Canberra, 2002, pp. 36–49.
- <sup>24</sup> Queensland University of Technology, Faculty of Education, submission no. 155 and Central Queensland University, Faculty of Education and Creative Arts, submission no. 156.
- <sup>25</sup> Australian College of Educators, submission no. 202.
- <sup>26</sup> A Luke, J Elkins, K Weir, R Land, V Carrington, S Dole, D Pendergast, C Kapitcke, C van Kraayenoord, K Moni, A McIntosh, D Mayer, M Bahr, L Hunter, R Chadbourne, R Bean, D Alverman and L Stevens, *Beyond the middle: a report about literacy and numeracy development of target group students in the middle years of schooling*, University of Queensland, Brisbane, 2003.
- <sup>27</sup> PW Hill, AD Mackay, VJ Russell and V Zbar, 'The middle years', in P Culltance and the Innovation and Best Practice Project Consortium (eds), *School innovation: pathway to the knowledge society*, Department of Education, Training and Youth Affairs, Canberra, 2001, pp 101–102. See also: Eltham College of Education, submission no. 170; Association of Heads of Independent Schools of Australia, submission no. 230 (Middle Schooling network, Midnet); and middle schooling project supported by the Victorian Schools Innovations Commission.
- <sup>28</sup> South Australian Commission for Catholic Schools, submission no. 204.
- <sup>29</sup> B Nelson, *National report to Parliament on Indigenous education and training*, Department of Education, Science and Training, Canberra, 2001, p. xviii.



## 8. Energising schools for innovation

# 8

The knowledge economy and society and the press for innovation are national—and international—and Australia must be able as a nation to respond to these challenges. A culture of innovation is not and will not be introduced in schools unless schools, teachers and the education sector more broadly recognise its benefits. New forms and styles of teacher leadership are in demand. Knowledgeable and highly capable leadership is important at all levels and in the many different settings of educational decision making. Teams, partnerships and networks of different kinds are also essential in order to take advantage of resources and meet the challenges of the knowledge society. Teaching practices which improve classroom relationships, and find new ways to maximise time spent teaching have the potential to be productive for teachers. It is timely to consider alternatives to current approaches to teaching, acknowledging that many teachers have non-teaching administrative responsibilities which take them away from core teaching responsibilities. Beyond the classroom, there is also a need to connect schools to the wider community. All students, teachers and schools are part of a broader community including a global community. Connecting with such communities is a challenge for all.

### 8.1 Transformation or incrementalism?

In a new wave of discourse on educational policy, the term ‘transformation’ has been introduced to distinguish innovations that are more radical and profound than simply incremental change. Caldwell defines transformation as ‘change that is significant, systematic and sustained. Transformation means that the school of the future will look quite unlike the school of the present.’<sup>1</sup> For Hargreaves, transformation ‘implies a profound or fundamental change, a metamorphosis that involves a new vision for education, grounded in some radical (or discontinuous) innovation, not just incremental (or evolutionary) innovation’.<sup>2</sup> A transformation would occur, he says, were schools to become places where students learn how to learn, to develop thinking skills and other metacognitive strategies, to learn in teams, to cope with ambiguous situations and unpredictable problems, to communicate well in speech and not just in writing and to become ‘creative, innovative and entrepreneurial’.<sup>3</sup> In other words, ‘transformation’ denotes the kinds of deep structured change in schooling being sought by many professional leaders.

What these commentators characterise as ‘transformation’ is what is both being sought and is already under way in many Australian schools. Whether that means what is occurring is a discontinuous, rapid fundamental change, a metamorphosis guided by a new vision or a systematic building on what already exists depends on the perspective from which the changes are viewed.

The directions identified in the language of transformation are in fact widely acclaimed and sought for in Australian education today and are being actively pursued—by policy makers, school leaders, professional bodies, teacher educators and others. Many of the features defined as ‘transformative’ are to be found in existing schools. At least, that is, according to the evidence before the Committee. While the pace is highly variable, an increasing number of schools show themselves very well able to lay down markers for innovation and creativity. The culture of innovation, so far as schooling is concerned, is not some remote feat of the imagination, but an emergent feature of present day education.

The issue is not whether there are schools that are living and vivid examples of creative, entrepreneurial and innovative learning centres, but whether the tide of which they are part is deep and wide enough to carry forward all schools, all students, all teachers. A further issue is whether, within this tide of change, there is a sufficient concentration on high quality scientific, technological and mathematical education for all.

Whatever specific physical form and structure may characterise the school of the future, it is already clear that new institutional settings will be technology-rich and that teaching and learning will be technology-intensive. Information and communication technologies provide a powerful mechanism for fostering networks and for breaking down the constraints on learning of time (timetabled school days) and space (physical presence of teachers and students together in the classroom). The already existing networked knowledge economy and society has made access possible to knowledge and ways of doing things far beyond any national boundary. Schools must take advantage of this but, to do so, will have to change.

The school of the future can become an agency of knowledge access, management, creation and construction. Students will need the capability to become members of a networked society. In some respects, many of them already have that capability in that they are computer literate and often well in advance of some of their teachers in using ICT for their own ends. The challenge for schools is to connect that capability to worthwhile learning tasks, to use their networking skills productively—for example, in becoming scientifically and mathematically literate. Glen Waverley College in Victoria is one school, visited by the Committee, where these connections are well in evidence.

### **Box 8.1 Glen Waverley College – A Navigator school using sophisticated learning technologies**

Since its establishment as one of seven Navigator Schools by the Victorian Government in 1995, Glen Waverley Secondary College has pioneered the integration of learning technologies to improve teaching, learning and school administrative practices. Navigator Schools aspire to support the development of students as autonomous learners whose preferred learning styles are facilitated and extended by teachers who have a wide range of teaching strategies to draw on. They are committed to sharing their experiences and continuing journey of whole-school change and innovative pedagogy within the broader educational community.

Glen Waverley, in particular, has a strong commitment to new learning technologies among teachers, and students are encouraged to take primary responsibility for their learning. Academic and extra-curricular programs at the College are designed to provide challenges, promote participation, encourage improvement, support questioning and experimenting, and allow individual and group learning. The College has trialled innovative approaches to curriculum delivery and is moving towards team teaching.

Glen Waverley works in a technology rich environment with over 450 networked desktop computers delivering high-end programs and a world-class Science and Technology Centre with modern science laboratories, computer-aided-design rooms, high-tech audio-visual and communications facilities, and smart screens in lecture theatres and classrooms. A highly sophisticated, state-of-art Intranet not only provides a large range of services for students and their parents, but provides a platform for improved teacher learning through documented learning projects, activities and their outcomes.

The College has placed a very strong emphasis on professional development for its teaching staff based on transformational leadership practices. Each teacher works to an individual Teacher Learning Improvement Plan, as does the College's Leadership Team.

As a Navigator School, teaching and learning support to the school is provided by links with higher education institutions and a rich resource of qualitative and quantitative data for research and development. Strong links to national and international best practice in learning methodologies, which provides a constant source of new and exiting learning ideas, are maintained. For example, the College has been involved in the Supernova Stars Spiders in Space project on a collaborative basis with NASA, RMIT and Melbourne Zoo.

*Source: Secretariat report of Review visit (May 2003).*

While communication and information technologies are not the only source of new ways of teaching and learning, not the only foundation of future schooling, they are undoubtedly a major transformative force. They already challenge long-established teaching practices and relationships between teachers and students.

What Beare calls the myth of the unchanging school<sup>4</sup> is being exploded by those schools that are already remaking themselves in new and different images. One of the most powerful of these images is that of the cluster or network of mutually supportive relationships among different institutions. Clusters may bring together, in looser or more integrated coalitions, schools that find mutual benefit in collaboration. Networks are increasingly those of ICT where individual schools or teachers may never meet but exchange information and ideas and work together electronically. For these rapidly changing environments, leadership, teamwork and partnerships have assumed a new importance.

There has always been a measure of collaboration and shared responsibility; schools have not worked in isolation from their communities. What is different now are the enlarged opportunities and greatly heightened expectations of what can and should be delivered.

New forms and styles of teacher leadership are in demand. Teachers are having to deepen their knowledge and inquiry skills for intellectual leadership, to show greater flexibility and resilience as members of teaching teams and to demonstrate initiative in exercising other kinds of shared responsibility within and beyond the school perimeters. Schools are entering into active partnerships on a scale and of a variety never before experienced. Networking is no longer arcane jargon but part of teachers' common understanding of their professional world. Students too are being expected to show initiative and leadership, for example in mentoring younger students, organising group work, constructing their own knowledge maps, and becoming skilled inquirers. For the Committee, this is evidence of a vibrant culture of innovation in which more and more schools are participating.

## 8.2 Educational leadership for a culture of innovation

As Mulford says: 'Knowledge societies, based on creativity and ingenuity resulting from individual and collective intelligence, first require the building of strong communities'—and it is school leaders who have a vital role to play in community building, not only in the school itself, but in the wider society.<sup>5</sup>

Who, then, are the school leaders and what is happening to the principalship? From one perspective, the leaders are, as they always have been, people in designated positions of authority: the school principal, heads of departments and sections, individuals who are prominent in some aspect of the school's life and have been accorded a formal role. The sports coaches, organisers of camps, excursions and visits, coordinators of summer programs and so on, are leaders. Whether their roles are formally structured often matters less than their inspiration to students and fellow teachers and the impact they have on school and community life.

There is also, as pointed out by the Flinders University School of Education and Faculty of Science and Engineering, a dispersed or distributive form of leadership which could, in principle, extend to all members of staff and to students.<sup>6</sup> Leadership does not depend on positional authority; nor is leadership the exclusive prerogative of the adults or the teacher professionals in the school. Students too can be leaders. Dispersed forms of leadership are being increasingly valued in more open, flexible and democratic school communities in which authority and responsibility are shared as never before.

But what or who is being led, and why has leadership become of such importance? Several submissions make the point that new kinds of leadership are necessary if innovation is to become a dominant motif of schooling, on the principle that there must be people of vision and determination, with the capacity to understand what needs to be changed or strengthened and the ability to move things forward. So leaders are innovators themselves or they support innovation in others. As the Association of Independent Schools of Victoria says, the creation of an innovative culture in schools requires school leadership that supports student and teacher initiatives by allowing exploration of new ideas.<sup>7</sup>

Knowledgeable and highly capable leadership is important at all levels and in the many different settings of educational decision making. A national capacity for educational leadership through structures within the profession such as professional associations is a marked feature of Australian education. The Committee sees this as a great asset, for example, in the current development of professional standards and in the generation of policy agendas. Governments and education authorities, teacher education institutions, and other institutions and agencies are performing more visible roles than in the past in setting goals and directions and in developing strategies for educational improvement. Combinations and coalitions of these authorities and groups are needed as national driving forces for change. This is a third form of leadership—neither positional, nor distributed but coupled or coalesced leadership. This is of particular importance in developing agreed national priorities and strategies for change.

Neither positional nor distributed leadership alone would suffice, according to Mulford, in the absence of organisational learning, or a collective teacher efficacy. For this, there are three sequential developmental stages: 'trusting and collaborative climate; shared and monitored mission; and taking initiatives and risks'.<sup>8</sup>

Competent leadership invests situations, problems and issues to be resolved with definite features. Leaders define and create. They don't simply respond. Leaders must, as well, mobilise a collective capacity to move in the directions that have been determined, agreed and understood to be appropriate. It is important that educational and ethical values inform leadership and be a central part of the dialogue about effective leadership and how to exercise it. It has been suggested that innovative organisations intuitively accept that ideas are non-hierarchical and require both individual and collective advocacy and engagement, if they are to materialise in creative achievement or productive practices. Such an environment will identify, endorse and support 'lighthouse leaders and teachers', provided that the innovation is owned and valued by all participants.<sup>9</sup>

A very high proportion of all submissions lent support to a style of leadership defined—in an early and now classic study of group behaviour by Kurt Lewin and colleagues—as democratic.<sup>10</sup> The common expectation among contemporary Australian educators is that leadership can no longer be concentrated in a few positions of authority, nor should it just be by assent or delegation but actively shared, participatory and negotiated. This implies important changes in style and relationships—a different kind of school organisation and culture and teachers with personality attributes and dispositions very different from the authority models of the past.

Democratic styles of leadership are highly consistent with the dynamics of an innovative culture. Freedom for schools and teachers from imposed requirements, less central control over staffing and funding, more flexible internal structures in schools and a balance between authority figures and distributed leadership were called for in several submissions.

The Committee is convinced that the styles of leadership exercised by those in positions of authority have a profound influence on the motivation and effectiveness of teachers and on a positive climate of achievement. Members noted the importance of leadership of a very high quality in all of the schools visited during the course of the Review.

That leadership matters a very great deal is shown by the results of two important studies of Australian schools. Research on the conditions of teaching of science in Australian schools by Goodrum et al. paints a disturbing picture of low morale and professional dissatisfaction, a sense of an unsupportive, inhospitable environment for their work.<sup>11</sup> Cuttance, in a study of more than one hundred innovative schools across Australia, identified three distinctive dimensions of school-based leadership in the many examples of successful innovation that they observed: focused action; culture building; and organisation-wide processes of learning.<sup>12</sup> 'School leaders responded strategically to crises (perceived or real), they pursued intrinsically motivating challenges and they facilitated and encouraged the innovative ideas of others. There was clear recognition of the importance of both individual and group leadership. Where educational innovation is successful, the leadership that underpins it is likely to be characterised in part by shared leadership among teachers and school managers ... Principal-leaders and teacher-leaders are both important in successful school reform ... Successful innovation requires effective articulation of the roles of those exercising leadership as much as the leadership capacities and capabilities of the individuals involved.'<sup>13</sup>

Without capable, positive and clear-sighted leadership at both the school and system level, teachers' work suffers. This often has adverse effects on the self-image of teachers and their commitment to the profession. Conversely, according to the Western Australian Department of Education and Training: 'Supportive leadership at the school level can have a real and positive effect on teacher retention. Research undertaken in Western Australia confirms the importance of leadership at the school level, particularly for the principal and other members of the administrative team.'<sup>14</sup> Similar views about the relationship between successful leadership and the retention of teachers were expressed by the Association of Independent Schools of Queensland.<sup>15</sup> And, as noted by the Australian Association of Christian Schools, 'invariably good schools have good principals'.<sup>16</sup>



The relationship of school climate to styles of leadership was raised in several submissions which advocated what Chapman and her colleagues commend: 'shared meanings, connectivity for service and the valuing of people'.<sup>17</sup> These are criteria of good leadership styles.

Distributed leadership, or opportunity and encouragement to take leadership roles regardless of positional authority, signifies trust and professional responsibility; it both draws upon and assists in building social capital. From a philosophical perspective, it is arguable that all teachers who have the qualities of a knowledgeable, caring and capable professional are in fact educational leaders. This is taken from the notion of education as a process of drawing out or leading the learners, a model of the teacher-leader as someone who, to paraphrase Howard Gardner, envisions goals, affirms values, motivates, manages, explains and serves as a symbol or model.<sup>18</sup>

The Committee believes that effective policies for identifying leaders and effective programs for leadership development must focus on educational conditions and requirements and include a readiness to deal with the lived experience of educational leaders. It is necessary for the leaders themselves to clarify their own experience, through reflection and dialogue. If there are leaders, there are also followers or colleagues and partners and their experience of leadership situations needs to be drawn out. Educational leadership is subtle and multi-layered; it falls into a pattern of complex, shifting, interpersonal relationships. The education of educational leaders cannot, then, be thought of as a decontextualised training regime, independent of concrete educational values, settings and relationships.

Citing the work of Gardner, Mitchell identifies nine functions of leadership which he characterises as 'states of existence' rather than traits or learned behaviours:

- envisioning goals;
- affirming values;
- motivating;
- managing;
- achieving workable unity;
- explaining;
- serving as a symbol;
- representing the group; and
- reviewing.<sup>19</sup>

Becoming a leader, on this view of functions, requires reflection on, and deep analysis of, educational settings and processes and the values that inform them.

It is important, in considering ways to acknowledge and reward leadership, to recognise that there are many different forms of leadership and different leadership actions performed by teachers, both in schools and in the wider professional community, and that there are qualitative differences among people carrying out these actions. Student leadership, too, needs recognition, not only in the more familiar forms of elected and appointed positions in the class and the school, or in music groups, science or chess clubs and sporting teams, for example, but in the 'ideas market'—that is, students who show creativity, initiative and other qualities of the innovative mind.

Student leadership initiatives have been fostered under various guises in recent years, for example, 'Discovering Democracy' and participation in Tournament of the Minds.<sup>20</sup> These have great potential for students to learn about leadership, responsibility and decision making, which are also components of successful innovation. Student leadership extends to their own learning—taking responsibility for self and others, sharing initiatives, being reflective.

Within the school, a capable, self-confident and thoughtful principal will see distributed and democratic leadership across the whole institution as assets which help to make the school itself stronger and its educational work more effective. Similarly, effective and considerate teachers will foster leadership qualities in students.

Capacity for innovation is supported and greatly enhanced by strong leadership, agreed and clearly articulated beliefs and goals, professional learning, regular review and reflection, and professional trust. Support for good ideas should not depend on where they come from or who originates them. The positional leader can show productive leadership in drawing on the leadership of others and by bringing about a congruence between learning culture, organisational structures and management.

Encouragement of risk taking and tolerance of errors as part of the learning process—for teachers and students—is the kind of leadership that fosters innovation and entrepreneurship. To figure out a solution to a problem, to try it out and then to come back to it again if the first solution does not work requires persistence by the problem solver and patience by the mentor. In this kind of situation, educative leadership of a high order is required if the learning is to be productive. It is important that leaders work hard to develop innovative capacity in both (fellow) teachers and students and that they have the courage themselves to be innovative.

Selection and preparation of people for positional leadership must now take into account different concepts of leadership, patterns of shared responsibility, changing roles in schools, the enhanced professionalism of teachers and other changes in authority relations. To be educational leaders, school principals and others in authority must be much more than inspirational planners, managers and administrators, important as those functions are.

There are programs operating to assist the development of effective leadership in schools, and proposals in the submissions for more. The Tasmanian Educational Leaders Institute, a joint initiative of the University of Tasmania and government schools, provides a professional accreditation process for school principals. In Victoria, government school principals can undertake the School Leadership Development Program, which outlines capabilities and knowledge requirements in providing a development framework for school leadership.<sup>21</sup>

The many initiatives that have been taken in recent years by education systems, principals' associations, professional associations, universities and schools to analyse leadership and to develop leadership capability testify to the growing recognition of its importance in education. This is further borne out by submissions and by school visits undertaken by the Committee.

Leadership at the school level has emerged as a key factor in devolution and educational development policies. If schools are to assume greater responsibilities, becoming largely self-governing within the framework of broad policy and system-wide steering, it is essential that they be very well led. Governments, education authorities, parents and communities have to be assured that highly competent, responsible leadership is being exercised at the school level. This leadership must be consistent with educational values and with schools as settings for distributed responsibility among a team of well-qualified professionals. Leadership principles and practices must be well-grounded in knowledge and experience and become a focal point for both training and research. The Committee warmly welcomes the Australian Government's recent announcement of the National Institute for Quality Teaching and School Leadership as a major step toward developing strategies and capabilities for enhanced educational leadership across the nation.

### 8.3 The school principal as educational leader

An underlying theme in the report by Bolster and Stevens, prepared for the MCEETYA Teacher Quality and Educational Leadership Taskforce, is empowerment of the profession to lead itself.<sup>22</sup> Two aspects deserve attention here: the changing roles of the principal/leaders within the school and its community; and the changing pattern of relationships between the principal/leader and the employing authority or larger system of which the school is a part.

Victorian schools and principals have gained considerable autonomy in staffing and budgeting. Some other jurisdictions are moving in this direction but there are many bridges to cross before government schools could be described as fully self-managing.

In all schools, the leadership roles and responsibilities of the principal and other senior staff are part of a wider system of authority. Thus, the educational leadership role for the school is necessarily contingent in crucial respects on policies, strategies, powers and resources, the control of which is beyond the principal. When comparisons are made with heads of small and medium-sized business, public companies and large corporations, these different authority contexts must be borne in mind.

In calling for more authority to be vested in school principals, the Committee is mindful of the various statutory and accountability obligations of the State and Territory authorities. Nevertheless, it would be highly beneficial to confer greater authority and responsibility for decision making on the school principal and to strengthen and make more effective many existing school governance arrangements.

School leaders, and especially principals, need regularly to be refreshed and challenged anew in their roles in order to maintain their motivation and effectiveness. Principals should not be expected to remain in a single role for the balance of their careers. Periodic time away from their schools to undertake research, to guide a process of change in other schools, to become teacher educators within a faculty of education, or to take on positions in government or industry, for example, would do much to ensure that principals continue to provide the leadership and enthusiasm on which their effectiveness depends.

Adroit leadership by school principals enables a passage to be steered between forces that can pull in different directions. Strong and effective performance in the role is extremely important since, as Mulford points out, school leadership has an impact upon teacher satisfaction, performance, recruitment, retention, professional learning, student learning and school culture, in addition to the organisation and smooth running of the school.<sup>23</sup> The leadership opportunities and roles of teachers and students are affected in different ways by how the principal's role is performed, as are the standing and image of the school among parents and in the community. For example, how the principal addresses priorities such as science, technology and mathematics education in the school and in community relations can have a noticeable effect on student and parental attitudes.

From several different sources, a strong case is being advanced for a more concerted national effort to provide leadership in education, to facilitate its expression and to develop leadership capability. The Committee believes that building leadership capacity in education is a national requirement, and has noted that many submissions underline the necessity of educational leadership for the fostering and support of innovation. It is thus of great concern that there is evidence of a growing shortage of positional school leaders and the possibility of a declining pool of candidates for school principal positions. Different claims on this point are made and need to be further examined, taking into account demographic and organisational changes that can affect demand and the changing expectations and roles not only of principals but of other positions of authority. Changes in systemic steering and institutional governance would need to be considered too. To attract and retain outstanding people to lead schools is of the utmost importance and must be high among the priorities of systems and communities. As noted above, establishment of the new National Institute for Quality Teaching and School Leadership is a significant step forward in this regard.

## 8.4 The school team

School teams, whether of teachers, teachers and other staff, or teachers and students, are an acknowledgement of dispersed authority, of shared responsibility, and of new ways of organising teaching and learning. The highly educated specialist teacher will also be a willing and capable team member.

In the course of the Review, in discussions of the future of schooling, the Committee has been made aware not just of the prevalence of teams and team ownership of school innovation, but also of the considerable variety of teams already functioning in and through schools (Box 8.2).

The 'school team' can be a loosely coupled group inclusive of everyone and operating along formal lines of designated roles and responsibilities, or see itself more as an integrated community unified around a shared set of values and common interests. Depending on size and other factors there may be several groups or teams within the overall set. To get the maximum effectiveness out of schooling it is clearly necessary to go beyond the well-educated individual professional, the teacher, and the material resources, facilities and equipment at the teacher's disposal. Combinations and recombinations of school people with varied roles and responsibilities are the way ahead.

### Box 8.2 Types of school teams and clusters

- The senior management team.
- Two or more teachers working together with a larger group of students than the normal class, either on a single subject, or on a topic or theme to which the teachers individually and jointly contribute their own special expertise and experience.
- One or more teachers, with paraprofessional, ancillary or technical staff providing a variety of complementary and back-up roles.
- A larger group of teachers with or without the complementary and back-up staff, for example, a subject department or a multidisciplinary team.
- Teams responsible for various activities, such as community outreach, or for a special event, such as a summer school, which might be hosted by one of the participating schools or by another institution, a university for example.
- Cross-school teams either at the same level or for example, primary–secondary.
- Teams, whether based in a single school or including several schools, working with partners in industry, the community or perhaps a TAFE college or university.

Teams, partnerships and networks of different kinds are essential in order to take advantage of resources and meet the challenges of the knowledge society. Through collaboration and a pooling of resources and expertise, participants in teams will gain a richer learning experience, develop valuable professional expertise and provide students with powerful learning experiences.

Membership in school teams of people from the wider community has increased as their contribution has come to be better understood and valued. Many schools include on their school boards people with skills, experience and interests developed in the wider community which they are able to make available as part of the school governance or management team. Their vision and capability as both team members, advisers and leaders can be a highly significant factor in the strategic directions taken by the school. Governance is a means whereby the knowledge and contribution of all partners—students, teachers, parents, administrators and the community—can be brought together.

Stronger and more effective school governance and new patterns of relationship with education authorities will become increasingly important as schools move further in the direction of self-management.

The 'school team' is not confined to adults but has a definite pedagogical connotation. The class, comprising teacher or teachers and a group of students is a learning team. The Committee understands that the idea of the classroom teacher as leader and manager in a class team is a response to changes in the social climate. These include greater informality in social relations, the impact of chat rooms and other linkages made possible by ICT and peer group attitudes. Such changes are as likely to influence teacher expectations and behaviour as professional knowledge about, for example, the value of a positive learning climate or cross-disciplinary and flexible groupings of students. There are indeed increasing professional demands on teachers to work together to orchestrate and manage learning as a collective enterprise, whether their direct teaching is individual or in teams. In all of this there are cultural and linguistic filters which mediate teacher attitudes and values. The Committee observed several examples of effective team teaching. Calamvale Community College in Queensland was one of them (Box 8.3).

### **Box 8.3 Innovative curricula and a novel organisational framework in a Queensland Community College ranging from Pre-School to Year 9**

The opportunity to create a new, purpose-built, Preschool to Year 12 school, based on an innovative structural framework, has led to the realisation of radically different pedagogical processes in Calamvale, Brisbane. Opening in 2002 with 1150 students ranging from Preschool to Year 8, Calamvale Community College will grow to 2200 students by 2006, catering for the full range of Primary and Secondary education.

Divided into home precincts with staggered break times, students operate on a day-to-day basis within smaller communities. The Junior School, for example, is divided into three components: Preschoolers (100 students); the Lower Juniors (Years 1-3 with 450 students) and the Upper Juniors (Years 4-6 with 420 students). Students and staff have the feel of working in close-knit communities, while still having access to a rich set of resources provided through the larger enrolment base.

Each sub-school is based, both physically and organisationally, on a 'POD' structure which comprises teams of four teachers and groups of students who stay together for three years. The continuity of PODs over the years provides the basis for pastoral care of students, as well as academic excellence.

Learning at all levels is based on a MAYOP (Move At Your Own Pace) approach which readily caters for target groups including non-ESB, gifted and talented students and those with learning difficulties or disabilities. Processes for monitoring and reporting progress of all students ensures that the needs of every student are identified and addressed. Calamvale also strongly supports multi-age learning with different learning groups formed in different ways at different times; a concept which is greatly facilitated by the clustering of PODs.

### **Box 8.3 Innovative curricula and a novel organisational framework in a Queensland Community College ranging from Pre-School to Year 9 continued ...**

Part of the Queensland Government's New Basics curriculum trial, Calamvale is encouraging innovation among its students through practices based on productive pedagogies, which highlight deep understandings, problem solving and real world connections, supported by an IT-rich environment. 'Design, make and appraise' projects help provide students with a futures orientation for survival in the changing world in which they live.

The College believes that in the new knowledge economy, students need to be: problem solvers, communicators, creative, team players, adaptive, technologically skilled, life-long learners and intellectually equipped. It also believes that its teachers need to be 'people' people who are willing to risk take and push boundaries, are interested in holistic development of creative students, who bring a range of experiences and understanding to the team, and are trained for these new challenges. The College acknowledges that it must work hard to keep innovation at the top of the list and that a culture of innovation involves taking risks.

Designed to be a hub for the community and to promote lifelong learning through a range of links with local government agencies, businesses, clubs and interest groups, the College has a strong focus on developing partnerships with parents and other community members, involving them in the planning and implementation of learning programs. These links will serve to enhance the learning programs for students within the school, provide educational, social and sporting opportunities for local community members, and facilitate continued facility upgrade and upkeep for the benefit of all.

*Source: Secretariat report on Review visit (May 2003)*

Organisational and administrative requirements and school layout can make innovative, cooperative teaching more difficult to plan and implement, however willing teachers may be to work with one another in some model of team teaching. A number of submissions made such points, including claims that: 'In many classrooms, management has replaced good pedagogy. Welfare issues and administrative requirements impact on the effective teaching of even the best teachers.'<sup>24</sup> Many submissions argued that innovative practice, including the planning and organisation of cross-disciplinary teamwork, required classroom conditions that hard-pressed teachers simply do not have.

Teaching practices which improve classroom relationships, along with finding ways to maximise time spent teaching, have the potential to be productive for teachers. Teaching is unusual among the professions in that such a wide and diverse array of responsibilities are centred in one person. These responsibilities have increased, not least because of the variety of external demands made on schools. However, the back-



up that teachers need to meet these responsibilities is often not available. For example, science and technology teaching need technical support for experimental and practical work. In mathematics, the use of information technology has opened up whole new territories. Arts and crafts teaching need technical support as much as appropriate workrooms and equipment. For the maintenance and servicing of equipment, and the preparation of the classroom as itself a learning laboratory, new approaches are required. Teachers working alone and unsupported by technical or ancillary staff are ill-equipped to handle an increasing variety of roles and responsibilities. More teamwork and differentiated team roles are required.

Teachers working in isolation, without the benefit of support and close peer interaction, is not the way ahead. Broad workforce planning models of the future are likely to require different classroom practices from those of today. One option to unlock the full potential of a school workforce and to engage more students in intensive, active learning is through employment of people, including people with specialist or technical skills, in a variety of non-teaching positions. This would be intended to give teachers more time to concentrate their expertise on the central task of teaching and learning. The Committee believes there is merit in a careful analysis of this option in future workforce planning and in examining the recent experience of the United Kingdom, where the government has introduced a major program to pay undergraduates and postgraduates to return to schools during their studies and support teachers and pupils in the classroom.<sup>25</sup>

A range of roles for support staff, teaching assistants, non-teaching experts and community members within teaching and learning teams merits further consideration. The teachers' role would be pivotal and such additional resources would support teacher expertise and student outcomes in school and other learning environments.

The *2001 National Report to Parliament on Indigenous Education and Training* reflected that 'Indigenous people regard it as important to have an Indigenous presence in the schools their children attend'. In 2001, there were 1764 Aboriginal and Islander Education Workers (AIEWs) in government, and 411 AIEWs in Catholic, primary and secondary schools. As paraprofessionals, AIEWs have an important part to play helping to improve Indigenous student outcomes. They also contribute to the strong working relationships that are needed between schools and communities. This role can also provide a pathway into teaching for Indigenous people.

Another dimension of a team approach is older students mentoring younger ones, for example high school science students mentoring students from feeder primary schools. Some university students—in engineering and science, for example—assist teachers in their classroom activities. Proposals from science and technology academics have been made to earmark school funding for this purpose.

School-based teams might include people, such as tertiary students, playing a variety of ancillary roles. There are many opportunities for industry to participate, including two-way exchange. There is a role for industry in undertaking school placements and working directly with students and teachers in projects linking school with industry. Some schools already invite artists, writers, poets, actors, theatre directors and musicians to take up residencies and to work on projects. This practice could be extended to science, mathematics and technology, and indeed to all areas of the curriculum.

According to the research of Dinham and Scott,<sup>26</sup> satisfaction for teachers lies in their ability to deliver their 'core business', which includes working effectively with others. Team teaching is one way of doing this. It is not a new idea, nor are partnerships and links with community, industry, other schools, universities and TAFE colleges. Networks existed before the invention of the Internet, and teachers have shared experiences professionally in professional associations, unions and various informal groupings for a very long time. What is different now is the rapid growth of professional links and collaboration made possible by electronic communications. There is, too, the realisation that quality learning and teaching depend on rich and stimulating environments that relate well to the world beyond the classroom and the school.

The benefits of teamwork are not always easy to achieve in the practice of schooling but the Committee sees a definite trend away from the highly individualistic and inward looking approaches common in the past toward more collaboration and openness in teaching. In preparing for the forthcoming generational change in the teaching profession and in professional development programs, initial and continuing education of teachers will need to provide more opportunities for collaborative learning and skills of team membership and team building.

One kind of team in which many teachers have successfully participated in a variety of roles is in curriculum development. Starting several decades ago in the US, with major national projects in mathematics, then science, and eventually spreading across the whole curriculum, the project model of curriculum development was quickly picked up in other countries, including the UK, Sweden, Germany, Ireland and Australia. It has been closely studied and the lessons drawn continue to feed development work. Since the 1970s there has been a succession of development activities through which highly successful educational partnerships have been formed between teachers, scholars, researchers, teacher educators and teaching and learning specialists.

In Victoria, the development projects Project for Enhancing Effective Learning (PEEL) and Science in Schools (SiS) are successful examples of school-focused networks. PEEL, a loosely coupled network, has been running for 19 years under the control of its members, who are school teachers, together with a handful of researchers and teacher educators based at Monash University. See Box 8.4. SiS is more tightly structured with more definite central funding coordination but, again, is notably teacher-centred.<sup>27</sup>

#### **Box 8.4 Project for Enhancing Effective Learning (PEEL)**

The PEEL story provides several pointers concerning partnerships, innovation and professional learning. PEEL has grown into a large, self-supporting network, including international participation of subscribing members. It is essentially a self-help model. Teachers, in school-based groups, use the web to communicate with one another, sharing pedagogical ideas and practices. They draw upon what is now a very substantial pool of good practice to help solve their own problems or to gain ideas to adopt themselves. PEEL includes science, technology and mathematics items, but is not confined to any subject area or level. It can be thought of as a broad-based innovation network largely under the control of teachers, whose active members are engaged in self-initiated and self-directed professional learning.

Another example is the recently established National Quality Schooling Framework, (NQSF) website ([www.nqsf.edu.au](http://www.nqsf.edu.au)),<sup>28</sup> which is an interactive school improvement tool to support pre-primary, primary and secondary Australian school leaders and teachers implement evidence-based projects to improve student learning outcomes. The NQSF consists of a range of resources to support school improvement projects and access to a professional learning environment in which teachers and school leaders share their understandings of what works and does not work, in their specific contexts.

The curriculum development project and looser networks, as models of teamwork and networking, provide a structure and organisation to which teachers readily relate, both in the sharing of experience and in a range of development activities which enhance their professional skills. However, with but few exceptions, these projects and networks engage a relatively small number of teachers. Procedures for dissemination of what is often very high quality material and quite innovative ideas for teaching and learning throughout large systems of education are seldom on the scale or of the duration that is necessary. So the schools and teachers that participate in named projects, and others that are closely connected, tend to get the benefit, whereas many other teachers and schools are not touched. While these large-scale projects continue they can make a valuable contribution in supporting teaching, with opportunity for professional learning.

In recent years, the focus has broadened from the individual or group of teachers, on the one hand, and the system-wide project, on the other, to a variety of connections and partnerships that the school, or substantial parts of it, enter into. Information and communications technology has greatly expanded such opportunities.

Many examples of such collaboration are reported by Cuttance.<sup>29</sup> The various professional development projects under the Australian Government's Quality Teacher Program are bringing teachers and schools together in a great variety of collaborative activities. As a result, large numbers of teachers now experience the value of working in teams that bring together different perspectives and experiences, including those of different sectors and kinds of school, rather than working in isolation or within the confines of a single class, school or sector.

Structural and organisational changes taking place, especially in secondary and middle schools, are bringing about vertical and horizontal linkages. New guidelines and curriculum frameworks are facilitating more collaborative cross-disciplinary teaching and setting learning tasks that are meaningful to students. These require greater capacity on the part of teachers to work together, not just in planning but in the teaching process itself, in assessment and in reporting. They also require organisational and management skills and an ability to respond flexibly to the dynamics and interactions of students in groups of varying sizes from the quite large to the very small, often working on tasks that may not correspond closely to the subject expertise of the teacher responsible for a specific area of activity.

The Committee was most impressed in visiting several schools where a shared vision was manifest and the school community had, through dialogue, teased out and agreed upon a set of educational values and purposes. Buranda Primary School (Chapter 1) is an excellent example. Regardless of particular ways of grouping students, whether in single classes or larger constellations, it is the sense of a common purpose or, as in some schools, a common, clearly articulated philosophy that binds the whole school community together. This is to see the school as a community of shared values and common purposes.

Quite substantial gains in learning can occur when there is a shared vision, when purposes are common and when the whole school community—students, teachers, parents and others—work together. Schools which are providing teachers with these opportunities are enhancing their professional competence, both drawing upon present capability and extending it for further growth and application.

Flexible multidisciplinary teams are a feature of innovative organisations, and schools are no exception. The Committee sees enormous benefit from an extension of the principle of collaborative teaching, where expertise and experience are pooled and relationships between subjects and between school learning and practical applications are drawn out. Teachers can learn a great deal from one another and in interactions with students working together. Students can benefit from cooperating with others and the realisation that knowledge is a resource for sharing experience and for collective inquiry and problem solving. These are important lessons for social living and working in the knowledge economy.

## 8.5 Partnerships, networks and clusters

Distinctions drawn between teams, partnerships and networks can often seem artificial. Within-school models of teams are often extended to include external partners and the teams may comprise people with quite different kinds of talent, training and responsibility. That is, they are not only professionally trained teachers. Through ICT and development projects, school teams are combining with individuals and groups in other schools or in universities, TAFE colleges, enterprises and community organisations.

According to the Queensland Deans of Education Forum, 'learning partnerships must become the new orthodoxy of Australian education'.<sup>30</sup> They will be numerous, varied and, to a considerable extent, self-directed. Partnerships range from large-scale combinations, often loosely coupled, that marshal scientific knowledge, financial resources and the expertise of teachers and industry, to schemes for teachers and older students such as the Teacher Release to Industry Program (TRIP) of the Victorian Department of Education and the Victorian Employers Chamber of Commerce and Industry, to school and workplace learning programs based on partnerships with industry and other key community stakeholders.<sup>31</sup>

Establishing a wide range of community links and working collaboratively are in many ways more demanding—albeit often more rewarding—for teachers than working individually or in the circumscribed environment of the single classroom or school. It is not always possible—for practical reasons of location, cost, or other responsibilities—for teachers to take an active part in face-to-face partnerships beyond the school environment. However, through the changes occurring in ICT, new kinds of networks are emerging. There is also a growing expectation that teacher professional networks will become key instruments of change management and innovation within the profession.

Networking is swiftly becoming a staple of knowledge capital—the knowledge resource of industry and business and of every part of the science system, from fundamental research to the diffusion of innovations throughout the economy and society. Like the Web itself, these networks are global and they are very largely in the control—or the possession—of the users. The organisational structure of the network may be informal, flexible and trust-based, or more formal. Networks form and re-form; they may be long-lasting or short-lived. Thus boundaries tend to be open and fluid and there is a balance of power reflecting the quality and frequency of use, in contrast with formal organisational power relations. From international studies of business firms there are messages about the features of networks that are relevant to education—an increased scale and scope of activities; shared costs; improved ability to deal with complexity; enhanced learning effects; increased efficiency; flexibility; and speed.<sup>32</sup>

Commercial organisations can innovate alone, but also with partners. Commercial organisations collaborate in partnerships and networks but they also compete, so the sharing of information through a network may be less than complete. Schools, as they assume more responsibility—for budgets, educational decision making and in some instances, staffing—are challenged to become more innovative and creative. It can be expected that they will find much in common with knowledge-intensive commercial organisations. Indeed, schooling is itself a knowledge-intensive industry and has much to learn from how knowledge is used in different settings to achieve organisational goals and to add value to its various tasks. Schools and teachers also have expertise to share with other sectors and knowledge workers.

Networks have been extensively studied but remain elusive because of their flexibility, openness, changeability and the great diversity of interests, values, projects and ideas they can encompass. In his analysis of the information technology revolution and its transformation of economic life, Castells seeks to capture the network as a culture: ‘It is a culture, indeed, but a culture of the ephemeral, a culture of each strategic decision, a patchwork of experiences and interests ... It is a multi-faceted, virtual culture.’<sup>33</sup>

The Australian and State and Territory Governments are working collectively to progress a joint project entitled The Le@rning Federation: Schools Online Curriculum Content Initiative. New Zealand is also participating. The Initiative will bring many benefits including production of a pool of material which will be free to all jurisdictions to distribute. Online curriculum material will be available in the areas of: Science; Mathematics and Numeracy; Literacy; Studies of Australia; Innovation, Enterprise and Creativity; and, Languages other than English. This material will be highly interactive and support leading education practice. The Initiative is also advancing the development of: articulated standards for educational soundness; interoperability and intellectual property rights consistent with other sectors of Australian education and training; and, international standards. Finally, it is contributing to the development of systems, tools and services to support the distribution of, and access to, the content and management of educational products across school systems.

School leaders and education authorities will need to have a close understanding of how knowledge networks function and to use this understanding to connect schools, teaching and learning to the global virtual knowledge networks. While this might seem a far cry from the present realities of many classrooms, it is a direction that innovative schools are already taking. Virtual networks and e-learning will not displace face-to-face contact and interpersonal relations. Electronic networking can still be difficult and inefficient for many teachers and schools. Broadbanding, for example, is a major issue, as pointed out by the Learning Federation. Looking ahead, and comparing schools now with only a decade or so ago, it is evident that the concepts of knowledge networks and flexible e-learning for both teachers and students will become normal features of school life, where they are not so already.

To move from a team of people working together in the concrete reality of a school to the ephemeral domain of a virtual culture is for many schools a very big step, yet to be taken. It is through the continuing development of ICT, including essential infrastructure, that this step will be taken. As there is increasing exchange and interaction through the Internet, there are likely to emerge very different conceptions of what it means to cooperate, exchange information and ideas and work together in education. Already, as the Queensland Consortium for Professional Development remarks, teacher professional networks are being seen as a key instrument for change management and innovation within the profession, a major site of knowledge technology, that is, knowledge of how to use knowledge.<sup>34</sup> Networking involves technological capability and is yet another facet of emerging or new professionalism.

While much of the debate about networks and their extension throughout the education system deals with teachers and other professionals, the more active users of information technology are students, who have their own networks. On the one hand, they have the procession of adults and institutions encountered each day: the family, the neighbourhood, and personal associations. On the other, they are able to log on to sites anywhere on the globe and form associations quite independently of family, school, peers and community.

Schools from all sectors can now, much more readily than in pre-ICT days, share their experiences as a way to develop an innovative capacity through an informal partnership of ideas. Systemic leadership can provide start-up opportunities where these may be needed but the onus will increasingly be on the schools themselves to take the initiative. Several submissions saw the value of partnership with industry and business for establishing a school culture of innovation.<sup>35</sup> Partnerships and networks range from the global to the local and teachers and schools are engaging increasingly across the whole range.

Partnerships with business, industry and the community are one way to increase the number and diversity of learning pathways for students to balance the academic pathways into universities. This implies a multiplicity of routes out of school into further learning and worthwhile employment. It is suggested that the design and implementation of such pathways could draw science, technology and mathematics into productive relationships with other learning areas and experience, and with student career trajectories. According to a submission from the Enterprise and Career Education Foundation, community-focused partnerships not only generate increased learning opportunities for students and teachers, but also help to build social and economic capacity at regional and other levels.<sup>36</sup>

In summary, local community and industry partnerships can help to:

- connect the work of the school and the subjects studied to the wider world of the community and the workplace, and even to the global environment;
- extend the range of opportunities to students beyond that which the school alone can provide;
- develop relationships between students and community members that result in continuing mentoring arrangements and further involvement of students in work or community activity; and
- strengthen community support for the school and the curriculum it provides.

Partnerships as a way of promoting real-life experiences of industry for students and teachers have been commended in submissions. They are most advantageous when well planned, with clear purposes in mind. The industry partnership model for schools, as distinct from TAFE, has yet to produce the depth and variety of industry experience and the changes in the experience of learning that many students need. But this is changing. Networking, partnerships and mixed teams of teachers and other professionals are not ends in themselves but ways to achieve more relevant and effective learning outcomes.

Many submissions strongly supported more active community–business/industry partnerships that enable teachers to have direct experience of how these organisations function and the kinds of activities that characterise them. Changes all round are required—by industry and the community, to develop a greater readiness to share responsibility for education with schools, and by schools, to show willingness to invite different agents into the classroom and school building to become partners in the learning process. In turn, teachers need to get out of their classrooms and into the community more often.



Community-wide and global resources for effective teaching and learning are, in principle, widely available. The knowledge and expertise to mobilise them are also available. What appears to be lacking is the coordinated, concentrated effort to bring all this together and, just as important, a nation-wide sense of community and shared responsibility to lead and effect change. These are difficult to build up and much depends on education authorities, schools, professional organisations, universities and educators taking the initiative. The Committee believes this would be greatly facilitated by the establishment of national networks to pool knowledge and expertise, to draw together ideas, research findings and exemplars of best practice and to serve as a stimulus.

## 8.6 Achieving greater collaboration nationally

Effective, efficient action is dependent on better communication and more sharing, mutual understanding and active collaboration. Within systems and schools the trend toward school self-management, combined with strategic steering, clearly calls for partnership building. Networks of cooperating institutions (crossing traditional boundaries) and a variety of new roles for key players are increasing in scope and scale.

There are two intertwined strands: more steering and policy coherence, common goals, steering instruments and strategies; yet greater operational diversity and considerable and increasing variety in practice at the local (school) level. Within a broad framework of common goals and requirements, considerable effort must be made to achieve working partnerships and the sharing of experience. Problems like shortages of teachers in key areas of science, technology and mathematics, the need to strive for high standards of learning, the needs of particular groups and calls for national leadership training are among the many reasons for a more collaborative national approach. The knowledge economy and society and the press for innovation are national—and international—and Australia must be able as a nation to respond to these challenges.

Concerted national efforts are taking place, on a very considerable scale. They promise rewards for the future. Working educational partnerships that are cross-jurisdictional and cross-sectoral are increasing in number and scope. To make more effective use of human and material resources requires pooling of expertise and sharing experience. There are substantial benefits, now universally accepted in all advanced sectors of industry, from partnerships. They are no longer an optional extra.

Despite very real progress, especially over the past 15 years, there is a systemic challenge to achieve much more. In an increasingly competitive global environment, there is a continually growing premium on products and services of high quality, efficiently delivered and attractive to the market—whether the market is for products, services, knowledge or ideas. Educators need to join forces to achieve these outcomes for schooling.

The network society is based on such principles as ready access to knowledge and best practice, collaboration and partnerships even among competitors, open communication and a constantly shifting pattern of relationships for mutual advantage. The quest for a common framework for teacher professional standards is one example where the value of a common, national approach is recognised and all the stakeholders are actively involved. Another is the work currently under way through the Learning Federation to pool costs and obtain benefits of scale through cooperation in developing the technological underpinnings of learning systems. Such approaches reflect a new level of partnership and a fuller understanding of the benefits which can accrue to teaching and learning in all schools.

There is a unique opportunity over the next decade to recruit large numbers of talented and creative people to teaching. In this way, and through coherent policies of professional learning and career advancement, the teaching profession can fulfil the highest expectations for student learning and creative schooling.

## Key Conclusions

In order to energise schools for innovation, work is required on several fronts:

- the emerging desire for agreed goals, directions and priorities for innovation;
- the moves toward a national profession of teaching with an agreed national framework for professional standards to articulate the elements of teacher preparation, professional learning and career progression;
- closer working partnerships between educational institutions, business and industry, and the community;
- the role of educational leadership in initiating and steering innovation and change and in directing more autonomous schools;
- the role of teachers and the educational community in building the educational foundations of the knowledge economy and society; and
- the restructuring of schools to take advantage of teaching teams and information and communications technology.

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- <sup>3</sup> *ibid.*, p. 66.
- <sup>4</sup> H Beare, *Creating the future school*, Routledge Falmer, London, 2001; H Beare, 'The future school: seven radical differences', *Principal Matters*, November 2002, pp. 40–45.
- <sup>5</sup> W Mulford, 'The role of school leadership in attracting and retaining teachers and promoting innovative schools and students', paper commissioned by Review of Teaching and Teacher Education, 2003.
- <sup>6</sup> School of Education (in consultation with Faculty of Science and Engineering), Flinders University, submission no. 206.
- <sup>7</sup> Association of Independent Schools of Victoria, submission no. 168.
- <sup>8</sup> Mulford, *op.cit.*
- <sup>9</sup> Queensland Deans of Education Forum, submission no. 173; Australian Education Union, submission no. 178; Faculty of Education and Social Work, University of Sydney, submission no. 189; Australian Curriculum Studies Association, submission no. 215.
- <sup>10</sup> K Lewin, R Lippitt and White, 'Patterns of aggressive behavior in experimentally created social climates', *Journal of Social Psychology*, 10, 1939, pp. 271–199.
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- <sup>14</sup> Department of Education, Western Australia, submission no. 102.
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- <sup>16</sup> Australian Association of Christian Schools, submission no. 199.
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- <sup>18</sup> H Gardner, *Intelligence reframed. Multiple intelligences for the 21<sup>st</sup> century*, Basic Books, New York, 1999.
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- <sup>21</sup> Mulford, *op. cit.*
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- <sup>23</sup> Mulford, *op. cit.*
- <sup>24</sup> National Council of Independent Schools' Associations, submission no. 197.
- <sup>25</sup> *Investing in Innovation: a strategy for science, engineering and technology*, HM Treasury, July 2002, viewed 5 March 2003, <<http://www.hm-treasury.gov.uk>>. *SET for Success : The supply of people with science, technology, engineering and mathematics skills—The Report of Sir Gareth Roberts' Review*, April 2002 viewed 5 March 2003, <<http://www.hm-treasury.gov.uk>>
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- <sup>27</sup> Project for Enhancing Effective Learning, submission no. 234; School Innovations in Science Project, Department of Education and Training, Victoria, submission no. 235.

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- <sup>31</sup> National Research Council (USA), *Strategic Education Research Partnerships*, National Academies Press, 2003, viewed 14 September 2003, <<http://www.nap.edu/catalog/10670.html>>; National Food Industry Strategy, submission no. 196.
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# Appendices

## Appendix 1

### Terms of Reference

#### Review of Teaching and Teacher Education

The Prime Minister, in launching the Government's Innovation Statement *Backing Australia's Ability* in January 2001, announced a range of measures to pursue excellence in research, science and technology and to build an even more highly skilled workforce. In this statement the Prime Minister announced a number of initiatives for immediate implementation and a number of strategies for longer-term implementation.

One of the major long-term strategies announced was to:

... ensure that talented people are attracted to teaching as a career, especially in the fields of science and technology education, teaching and teacher education will be reviewed, in consultation with State and Territory Governments.<sup>301</sup>

To implement this strategy, a Review Committee will be established to conduct a review of teaching and teacher education. Particular emphasis will be placed on the fields of science, technology and mathematics. The review will focus on teacher work force needs in these areas in the short term and skills teachers need to build a culture of continuous innovation in Australia's Schools in the longer term (2012).

The review will:

1. build upon comprehensive work that analysed teacher supply and demand undertaken by the then Commonwealth Department of Education Training and Youth Affairs (DETYA) under the auspices of MCEETYA;
2. draw upon recent literature and initiatives to describe the teaching skills needed to develop a culture of lifelong learning and innovation in Australia's school students;
3. explore the impact of innovative pre-service and in-service education programs on the development of teachers' pedagogic practices to enhance their students' appreciation and capacity for learning, creativity and innovation, with particular emphasis on the fields of science, technology and mathematics;

4. map current skills and propose strategies for equipping teachers with the knowledge and skills to create an innovative learning culture amongst their students;
5. examine leadership practices that attract and retain teachers, especially in the areas of science, technology and mathematics;
6. produce an interim report, by end 2002, on strategies to attract and retain science, technology and mathematics teachers in Australia's schools; and
7. produce an innovation action plan for the school sector, by mid-2003. This action plan will encapsulate a shared understanding of the school exit outcomes necessary to equip school graduates for the knowledge economy and society. The action plan will consider the current situation and future scenarios.



## Appendix 2

### Review Committee

**Professor Kwong Lee Dow AM—Chair**  
**Deputy Vice-Chancellor (Students & Staff)**  
**The University of Melbourne**

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**Ms Elizabeth O’Leary**  
Director  
Talent Zone Asia Pacific Pty Ltd

**Dr Peter Tannock**  
Vice Chancellor  
University of Notre Dame

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**Ms Helen Paphitis**  
Principal  
Salisbury High School

**Mr Ken Rowe**  
Retired Principal  
Frankston High School

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**Professor Anne Edwards**  
Vice Chancellor  
Flinders University

**Dr Ian Paterson AM**  
Retired Headmaster  
Knox Grammar School

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**Professor Janet Greeley**  
Executive Dean  
James Cook University

**Mrs Jill Healey**  
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Flinders Christian Community College

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**Professor Steve Dinham**  
Chair of Teacher Education, Pedagogy  
and Professional Development  
University of New England

**Mr Phillip Kiely**  
Executive Director  
Net Return Pty Ltd

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**Mrs Marianne Nicholas**  
Science Teacher, Walkerville  
Primary Recipient, Prime Minister’s  
2002 Prize for Excellence in Science  
Teaching in Primary Schools

**Mr Stuart Hamilton AO**  
Secretary, Department of Education  
and Training Victoria  
(Committee Member:  
August – December 2002)

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**Dr Martyn Forrest**  
Secretary  
Department of Education, Tasmania  
(Committee Member from April 2003)

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### Review Secretariat – Department of Education, Science and Training

Ms Di Weddell—Manager

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Ms Susan Smith  
Ms Marie Hird  
Ms Renae Houston  
Ms Margaret Carruthers

Dr Shannon Smith  
Mr Scott Lambert  
Ms Millennia Pullen

---

Emeritus Professor Malcolm Skilbeck and Dr Helen Connell  
Dr John Ainley and Ms Catherine Underwood

## Appendix 3

### Reference Group

Ambassador, National Indigenous English Literacy & Numeracy Strategy	Ms Naomi McCoy
Australian Association of Mathematics Teachers Inc.	Mr Steve Thornton
Australian Chamber of Commerce & Industry	Mr Joe Moore
Australian College of Educators	Mr Jim Cumming
Australian Council for Computers in Education	Ms Cathy Crook
Australian Council for Education Through Technology	Mr Brian Webberley
Australian Council of Deans of Education	Professor Terence Lovat
Australian Council of Deans of Science	Professor David Finlay
Australian Council of State Schools Organisations Inc.	Ms Julian Golby
Australian Curriculum Studies Association	Professor Alan Reid
Australian Education Union	Mr Roy Martin
Australian Parents Council Inc.	Ms Josephine Lonergan
Australian Principals' Associations' Professional Development Council	Mr Don Zoellner
Australian Science Teachers Association	Mr Peter Russo
Australian Society for Educational Technology	Mr Ian Thomas
Business Council of Australia	Ms Maria Tarrant
Federation of Australian Scientific and Technological Societies	Ms Jan Thomas
Independent Education Union of Australia	Mr Patrick Lee
Independant Schools Council of Australia	Ms Audrey Jackson
IT Skills Hub	Ms Deirdre Mason
Mathematics Education Research Group of Australia Inc.	Ms Judy Mousley
MCEETYA Teacher Quality & Educational Leadership Taskforce	Mr Paul Leitch
MCEETYA Teacher Quality & Educational Leadership Taskforce	Dr John Roulston
National Catholic Education Commission	Dr Michael Gaffney
Technology Education Federation of Australia	Mr Ralph Leonard

## Appendix 4

### List of submissions

Submissions to Discussion Paper: *Strategies to Attract and Retain Teachers of Science, Technology and Mathematics*

- 1 Ms Glenda Murray
- 2 Mr James S Page
- 3 Australian Association of Mathematics Teachers Incorporated
- 4 Ms Jill Finch
- 5 Mr Malcolm Solomano
- 6 Mr Peter Fox
- 7 Ms Frances Meeking
- 8 Commerce Queensland
- 9 Mr Chad Gallaher
- 10 Ms Rosemary Jacob
- 11 Mr Peter Best
- 12 Mr Peter Lennox
- 13 Sr Barbara Bochat
- 14 Professor A G Shannon AM
- 15 Ms Betty Jacobs
- 16 Mr Tim McMullen
- 17 Iona Presentation College
- 18 Mr Colin McFadyen
- 19 Ms Nola Shoring
- 20 Senior Lecturer Neville Hatton & Associate Professor Alan Watson
- 21 Mr Douglas Whitton
- 22 Australian Catholic University Ltd
- 23 Mr Barry Hardy
- 24 Association of Independent Schools of South Australia
- 25 Centralian College
- 26 Australian Society for Educational Technology
- 27 Dr Warren Beasley
- 28 Mr Wayne Muir
- 29 Associate Professor Alan Watson
- 30 Mathematics Education Research Group of Australasia Incorporated
- 31 Australian Mathematical Sciences Council
- 32 Charles Sturt University

- 33 Mr Neil McLennan
- 34 University of Adelaide
- 35 Ms Leonie Stott
- 36 Australian College of Educators
- 37 Confidentiality requested
- 38 Mr Ivan Chester
- 39 Science Teachers' Association of Victoria
- 40 Dr Penelope Webb
- 41 Curtin University of Technology
- 42 Mr Henry Condon
- 43 Women in IT Tasmania
- 44 Australian Academy of Science
- 45 Australian Council of Deans of Science
- 46 Faculty of Education, Deakin University
- 47 Technology Education Association of Victoria
- 48 Isolated Children's Parents' Association of Australia (Inc)
- 49 Australian Education Union
- 50 Board of Teacher Registration, Queensland
- 51 The Hon. Alan Cadby MP, Shadow Minister for Higher Education (including TAFE), Western Australia
- 52 IT Skills Hub Pty Ltd
- 53 Education Queensland
- 54 Design and Technology Teachers Association of WA
- 55 Australian Science Teachers Association
- 56 Faculty of Biological and Chemical Sciences, University of Queensland
- 57 School of Education, University of Queensland
- 58 Association of Heads of Independent Schools
- 59 Confidentiality requested
- 60 Australian Association of Mathematics Teachers Inc. (second submission)
- 61 Confidentiality requested
- 62 School of Mathematical and Physical Sciences, James Cook University
- 63 Dr Allan Harrison
- 64 Faculty of Education, Queensland University of Technology
- 65 Queensland Deans of Education Forum
- 66 Faculty of Education and Creative Arts, Central Queensland University
- 67 University of Technology, Sydney
- 68 School of Mathematics, University of New South Wales
- 69 Council of Private Higher Education Incorporated

- 70 Aboriginal and Torres Strait Islander Commission
- 71 University of Sydney
- 72 School of Teacher Education, University of Canberra
- 73 Edith Cowan University
- 74 Ms Debra Turley
- 75 Dr Robyn Ewing
- 76 National Council of Independent Schools' Associations
- 77 School of Teaching, University of Notre Dame
- 78 Dr Barry Golding
- 79 Australian Mathematical Society Incorporated
- 80 Home Economics Institute of Australia Incorporated
- 81 Queensland Indigenous Education Consultative Body
- 82 Murdoch University
- 83 Australian Association of Research in Education
- 84 University of Tasmania
- 85 University of Melbourne
- 86 Australian Council for Education Through Technology
- 87 Faculty of Education, Health and Professional Studies, University of New England
- 88 Minerals Council of Australia
- 89 University of Western Sydney
- 90 Australian Associations of Christian Schools Incorporated
- 91 Monash University
- 92 Ms Lorraine Tran
- 93 Australian Parents Council Incorporated
- 94 Australian Teacher Education Association
- 95 Association of Independent Schools of Western Australia Incorporated
- 96 Professor Alison Elliott
- 97 Ms Genevieve Loughnan
- 98 La Trobe University
- 99 The Association of Independent Schools of Queensland Inc.
- 100 Australian Computer Society
- 101 Christian Heritage College
- 102 Department of Education of Western Australia
- 103 Ms Anne Forbes
- 104 Engineering Employers Association, South Australia
- 105 Australian Council of English as a second or other language Association
- 106 Technology Education Federation of Australia Ltd
- 107 National Catholic Education Commission

- 108 Questacon—The National Science and Technology Centre
- 109 Australian Science Education Research Association Ltd
- 110 Australian National University
- 111 Association of Independent Schools of Victoria
- 112 Non-Ministerial members of the Council for Knowledge, Innovation, Science and Engineering, Victoria
- 113 Australian Council of State School Organisations
- 114 University of South Australia
- 115 Lutheran Education Australia
- 116 Department of Education, Tasmania
- 117 Australian Science and Mathematics School
- 118 Confidentiality requested
- 119 University of Newcastle
- 120 Professor Tim Brown
- 121 Catholic Education Office, Diocese of Parramatta
- 122 University of Western Australia
- 123 The Institution of Engineers, Australia
- 124 Department of Education and Training, Victoria
- 125 Dr Vilas Jayanthi
- 126 Mr Robert Lutton
- 127 University of Ballarat
- 128 Australian Council of Deans of Education Incorporated
- 129 Mr Gerald Daly
- 130 Ms Andrea Foster, Mr Craig Haran, Ms Sandra Robinson and Mr John Arton-Powell
- 131 Independent Education Union of Australia
- 132 National Tertiary Education Industry Union
- 133 Science Teachers' Association of Western Australia
- 134 CSIRO
- 135 Ms Karen Wade
- 136 Ms Erica Jolly
- 137 Enterprise and Career Education Foundation
- 138 Australian Secondary Principals' Association
- 139 Australian Academy of Technological Sciences and Engineering
- 140 Ms Kathleen Partridge
- 141 New South Wales Department of Education and Training
- 142 Australian Primary Principals Association
- 143 South Australian Department of Education and Children's Services

Submissions to Discussion Paper: *Young People, Schools and Innovation: towards an action plan for the school sector*

- 144 Mr Kevin Beck
- 145 School of Mathematical and Physical Sciences, The University of Newcastle
- 146 Ms Gaye Cranfield
- 147 Mr Charles MacLean
- 148 Confidentiality requested
- 149 Dr Ken Milton
- 150 Mr Ian White
- 151 Mr Keith Vickers
- 152 Ms Margaret Blanch
- 153 Mr Ian Thomson
- 154 Australian Literacy Educators' Association
- 155 Queensland University of Technology
- 156 Central Queensland University
- 157 Faculty of Education, University of Technology, Sydney
- 158 The Wireless Institute of Australia
- 159 Australian Bureau of Statistics and the Statistical Society of Australia Inc.
- 160 Dr Anne Graham and Dr Renata Phelps
- 161 Animals Australia
- 162 University of Southern Queensland
- 163 Dr Ian Roberts
- 164 Regional Council of Western Sydney Parents and Citizens' Associations
- 165 School of Education and Humanities, Christian Heritage College
- 166 Ms Deborah Arthurs
- 167 Australian Council of Deans of Science
- 168 Association of Independent Schools of Victoria
- 169 Edith Cowan University
- 170 Eltham College of Education
- 171 Australian Council of State School Organisations
- 172 Faculty of Science, Australian National University
- 173 Queensland Deans of Education Forum
- 174 Mr Andrew Taylor
- 175 Faculty of Education, University of Tasmania
- 176 Faculty of Education, University of Southern Queensland
- 177 Technology Lecturers, School of Arts and Sciences (NSW), Australian Catholic University
- 178 Australian Education Union

- 179 Victorian Commercial Teachers Association
- 180 Australian Science Teachers Association
- 181 Business Educators Australasia Inc.
- 182 Mr Martin Keogh
- 183 Board of Teacher Registration, Queensland
- 184 Minerals Council of Australia
- 185 Queensland Consortium for Professional Development in Education
- 186 Australian Science and Mathematics School
- 187 Faculty of Education, Griffith University
- 188 Primary English Teaching Association
- 189 Faculty of Education and Social Work, University of Sydney
- 190 Home Economics Institute of Australia Incorporated
- 191 Emeritus Professor Arthur Cropley and Dr Iouri Gribov
- 192 Mr Robert Valerio
- 193 Science Teachers Association of Queensland
- 194 Lutheran Education Australia
- 195 University of Melbourne
- 196 National Food Industry Strategy
- 197 National Council of Independent Schools' Associations
- 198 Australian Secondary Principals Association
- 199 Australian Association of Christian Schools Inc.
- 200 Catholic Education Commission of Victoria
- 201 Bachelor of Teaching students specialising in information technology, University of Tasmania
- 202 Australian College of Educators
- 203 Department of Education, Tasmania
- 204 South Australian Commission for Catholic Schools
- 205 Queensland Teachers' Union
- 206 School of Education (in consultation with Faculty of Science and Engineering) Flinders University
- 207 School of Education, James Cook University
- 208 Australian Society for Educational Technology Inc.
- 209 Australian Association of Mathematics Teachers Incorporated
- 210 Association of Independent Schools of South Australia



- 211 Australian Parents Council Inc.
- 212 Australian Council for Educational Leaders
- 213 Mr Scott Strawbridge
- 214 Bright Minds Group, University of Queensland
- 215 Australian Curriculum Studies Association
- 216 Enterprise and Career Education Foundation
- 217 Ms Kate Baulch
- 218 National Catholic Education Commission
- 219 Council of Australian State Libraries
- 220 Western Australian Aboriginal Education and Training Council
- 221 Tournament of the Minds (Victoria) Inc.
- 222 Australian Council of Deans of Education
- 223 Catholic Education Commission, New South Wales
- 224 Independent Education Union of Australia
- 225 Teachers Registration Board of South Australia
- 226 Education Queensland
- 227 Australian Business Ltd
- 228 Australian Association for Environmental Education
- 229 Library Council of New South Wales
- 230 Association of Heads of Independent Schools of Australia
- 231 Australian Primary Principals Association
- 232 Questacon—The National Science and Technology Centre
- 233 South Australian Department of Education and Children’s Services
- 234 Monash University, Project for Enhancing Effective Learning (PEEL)
- 235 Ms Janice Youl and Mr Paul MacKinnon
- 236 Mr Wal Thornhill
- 237 The Association of Independent Schools of Queensland Inc.
- 238 National Affiliation of Arts Educators
- 239 NSW Commission for Children and Young People
- 240 School of Education, Victoria University of Technology
- 241 Faculty of Education, The University of Melbourne

## Appendix 5

### Papers and site visits

#### **Papers commissioned by the Review Committee and available on the Review website:**

Deborah Tyler and Helen Stokes: Youth Research Centre, University of Melbourne, *Teacher Education: Students' views about their intentions to teach.*

David Smith with Robyn Ewing, Anne Jasman, Phillip Jones and Gerard Sullivan: Faculty of Education and Social Work, The University of Sydney, *Learning, Teaching and Innovation—A Review of Literature on Facilitating Innovation in Students, Schools and Teacher Education with particular emphasis on Mathematics, Science and Technology.*

Helen Stokes and Debra Tyler: Youth Research Centre, The University of Melbourne, *Senior Secondary Students' Attitudes to Teaching as a Career.*

Bill Mulford: Leadership for Learning Research Group Faculty of Education, University of Tasmania, *The Role of School Leadership in Attracting and Retaining Teachers and Promoting Innovative Schools and Students.*

Roy Ballantyne, S Vianne McLean and Ian Macpherson: Faculty of Education, Queensland University of Technology, *Knowledge and Skills Required for Creating a Culture of Innovation: Supporting Innovative Teaching and Learning Practices.*

Ross Clare and Douglas Connor: ASFA Research Centre Association of Superannuation Funds, Australia, *Superannuation arrangements for Australian teachers and their impact on retirement decisions.*

#### **Site Visits Undertaken by the Review Committee**

Redeemer Baptist School - Sydney  
Cherrybrook Technology High School - Sydney  
Buranda State Primary School - Brisbane  
Calamvale Community College - Brisbane  
Salisbury High School - Adelaide  
Australian Science and Mathematics School - Adelaide  
Sacred Heart Girls College - Geelong  
Glen Waverley Secondary College - Melbourne  
Alice Springs High School - Alice Springs  
Gillen Primary School - Alice Springs  
Centralian College - Alice Springs  
Questacon, the National Science and Technology Centre - Canberra





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