Building schools in the 21st century and Current thinking about learning for a lifetime

May 2009

Every child, every opportunity

2009 Update

Since the writing of this 2008 report, the Commonwealth Government has committed significant funding to provide new facilities and refurbishments in Australian schools to meet the needs of students and teachers through the Building the Education Revolution (BER) program. The BER program provides opportunities to build learning environments that will support achievement, develop learning potential and bring communities together. Information on the elements of the BER are online at: http://www.deewr.gov.au/Schooling/BuildingTheEducationRevolution/Documents/09-099%20BER%20guidelines_APPROVED.pdf

In 2009, the Department of Education and Early Childhood Development's School Infrastructure website was updated. It now includes information on Victorian school designs together with a range of useful resources including planning principles for linking pedagogy and space. The website is at: http://www.education.vic.gov.au/management/infrastructure/schooldesign.htm

The Melbourne Declaration on Educational Goals for Young Australians was launched by the Ministerial Council on Education, Employment and Youth Affairs (MCEETYA) in December 2008. The Declaration commits to eight areas of action in support of these goals, including a commitment to promoting world-class curriculum in eight agreed learning areas. The Declaration is available at: http://www.mceecdya.edu.au/mceecdya/melbourne_declaration,25979.html

Launched in September 2008, the Blueprint for Education and Early Childhood Development outlines the Department's new vision for Victorian education and early childhood development over the next five years. It sets out a reform package to achieve high quality education and early childhood services and brings together an integrated approach to service delivery as a means of opening up opportunities for children and young people. The Blueprint can be accessed at: http://www.education.vic.gov.au/about/directions/blueprint2008/default.htm

Overview

The following two reports were developed during the 2008 Research Interns Program, which is an initiative of the Office for Policy, Research and Innovation within the Department of Education and Early Childhood Development.

The Research Interns Program aims to build partnerships between higher education institutions and the Department. It is part of a suite of partnership programs with world class researchers designed to inform effective policy making.

The program provided opportunities for two university students to be involved as research interns in key education research activities and to draw on their knowledge and research interests to support the Department's research agenda. The Education Policy and Research Division selected two students from a number of candidates presented by Victorian universities. Over an eight-week period, the interns undertook research aligned with the Department's Research Priority Areas of Interest.

This paper presents the two reports developed by the interns through this research activity. The first report titled: *Building schools in the 21st century* comprises three areas of interest: environmentally sustainable school design, classroom design for personalising learning and learning spaces for creativity and innovation. The wide range of examples and photographs is particularly interesting.

The second report *Current thinking* about learning for a lifetime investigates some of the current themes in education in two main areas: learner-centred environments, and lifelong learning.

Report One:

Building schools in the 21st century

Contents

Introduction

To develop the human capital needed to excel in the digital information age, Australia's education system must provide high-quality learning environments where students are engaged, stimulated and encouraged to be creative thinkers and learners.

The first section of this paper looks at the environmental principles which underpin the development of policy to implement ecologically sustainable planning and energy management. It investigates energy efficient building design and explores innovative ways of creating comfortable and healthy school buildings which encourage creativity and accommodate student-centred learning activities.

This paper maintains that schools provide an opportunity not only to demonstrate practical examples of energy efficient building design and landscaping but also to provide a valuable learning tool to actively engage students in best practice environmental management. It explores Victorian initiatives which demonstrate a commitment to environmentally sound principles.

In section two, some examples of planning for better education provision are included. The plans are based on Building Futures, the conceptual framework that guides all capital investment in government school infrastructure in Victoria. The framework ensures that the educational needs of every student inform the planning and development of school infrastructure. It enables new facility design and the organisation of education services to better meet contemporary education needs.

The third section of the paper examines the features classrooms and schools of the future might incorporate to provide the environments needed to facilitate the trend towards personalised learning. It explores the research which suggests that there may be causal linkages between building design and student outcomes and that structural and cosmetic factors have a significant impact on student performance and behaviour.

Environmentally sustainable school design

Background

Schools provide an opportunity to demonstrate practical examples of energy efficient building design and landscaping that preserve and enhance biodiversity and water conservation. They can also provide a valuable learning tool to actively engage students in best practice environmental management.

The Victorian Government's vision of an assured future includes the commitment that 'protection of the environment for future generations is built into everything we do'. For the Department of Education and Early Childhood Development, this means it will consider the following environmental principles in undertaking all aspects of operations and delivery of curriculum services:

• maintaining and restoring natural assets
• using resources more efficiently, and
• reducing everyday environmental impacts (Department of Education & Training 2005).

In November 2005, the Department developed *The way forward: an environmental sustainability strategy for the Department of Education and Training* (Department of Education & Training 2005a). Many initiatives were successfully developed and implemented from this strategy to produce positive environmental outcomes, such as the Quick Wins program achieving a 12.6 per cent decrease in energy consumption in 2006 compared to 1999–2000 levels.

The strategy is currently under review to ensure consistency with whole-of-government policy and targets as outlined in *Our environment, our future – Victoria's Environmental Sustainability Framework* (Department of Sustainability and Environment 2005).

In matters related to ecologically sustainable planning and energy management, the Department is developing Ecologically Sustainable Development (ESD) Guidelines, a companion to its Building Quality Standards Handbook (Department of Education and Early Childhood Development 2008b). These establish a common approach for incorporating ESD into the design of Victorian schools. They place ESD outcomes for departmental projects within a context of national best practice, and are linked to the Green Star – Education Tool developed by the Green Building Council of Australia. The Guidelines also establish performance measures for energy and water usage as well as waste disposal.

Green Star covers a number of categories that assess the environmental impact that is a direct consequence of a project's site selection, design, construction and maintenance. The nine categories included within the Green Star Education rating tool are:

• management
• transport
• land use and ecology
• indoor environment quality
• water
• emissions
• energy
• materials
• innovation

Designing sustainable buildings

National and international literature explores innovative ways of creating energy efficient, comfortable and healthy school buildings that can be used as a learning tool for students by teachers, and provide an example to the broader community of the benefits of buildings which produce a small environmental footprint.

Energy efficiency

Energy efficient building design incorporates features that optimise the use of natural energy sources.

Features of energy efficient design include:

• building orientation to maximise natural light and capture winter sun to reduce heating costs
• appropriately designed shading and the use of low emissivity glass and double glazing to control heat transfer through windows
• provision of cross ventilation to provide summer cooling
• adequate insulation in walls, ceilings and floors
• draught proofing
• efficient, low energy lighting.

Such design features help schools to be more comfortable places to learn and work, reduce energy costs, save money and reduce greenhouse pollution.

Generating electricity in schools

In combination with energy efficient design, school buildings can be used to generate renewable electricity for internal consumption and export to the grid. Large roof areas can support photovoltaic (PV) cells and small-scale unobtrusive wind turbines can be attached to buildings to generate electricity.

Peak electricity consumption in the community occurs during the summer months when households switch on air-conditioning units. Since schools are in recess at this time, their energy consumption is minimal and most of the electricity they might generate at this time could be exported to the grid.

Teachers could then use energy meters which measure electricity consumption and export to the grid to demonstrate to students how the school can contribute to carbon emission reduction.

A well-designed and optimally sited building will reduce energy consumption by taking advantage of natural lighting, passive solar techniques and insulated walls and ceilings to reduce heating and cooling costs. If supplementary heating and cooling is required, an alternative method to refrigerated air-conditioning or evaporative Building schools 5 in the 21st century Building schools 6 in the 21st century cooling is a geothermal heat pump system. Geothermal heat pumps use the stable temperature

of the ground as a heat source to warm buildings in winter and as a heat sink to cool them in summer. According to the United States Government Department of Energy (2008) website over 500 schools in the USA are successfully using this method across a range of climates.

Heating and cooling can also be influenced by window treatments, for example the use of double glazing and low-emissivity (low-E) glass. Low-E glass controls heat transfer through windows. Windows manufactured with low-E coatings typically cost about 10–15 per cent more than regular windows, but they reduce energy loss by as much as 30–50 per cent. Low-E coatings can be retrofitted to existing windows and have a life expectancy of 10–15 years (US Department of Energy 2005)

Ventilation is closely linked to heating and cooling and in most modern buildings heating, ventilation and air-conditioning which is known as HVAC is designed as a system to be managed automatically to minimise energy costs and human interference. However, it is possible to design hybrid systems that combine natural ventilation with mechanical heating and cooling.

Whitmore Lake High School

Whitmore Lake High School in Minneapolis, USA, uses a geothermal HVAC system that uses demand control ventilation to further increase energy efficiency (McQuay International 2007). The ventilation rate, calculated through the American Society of Heating, Refrigerating and Air-Conditioning Egineers (ASHRAE) Standard 62, is based on a rise in CO_2 levels in the space using CO_2 as a predictor of occupancy. When people are not in the building, a minimum amount of outside air is introduced. When the building is occupied, and the air becomes concentrated with CO_2, more outside air is brought in.

Studies have shown that improving ventilation and air quality reduces a range of respiratory illnesses, including common colds and influenza. Kats (2006) reports on a number of studies which evaluate the impact of improved indoor air quality and show an average reduction of 51 per cent in colds and flu in buildings with improved air quality and ventilation. Kats also reports on a study by the American Lung Association which found that pupil absenteeism due to asthma is exacerbated by poor indoor air quality in schools. Schneider (2002) adds that the build-up of CO_2 in a poorly ventilated classroom reduces a student's ability to concentrate, thereby affecting their academic performance.

Ideally a building would be designed to be naturally cooled and ventilated. According to the NSW Government Asset Management Committee website (2008), the National Capital Exhibition Hall in Canberra is such a building (following page).

In this building the temperatures ranges from 19ºC in winter up to 26ºC in summer with no control of humidity. This naturally ventilated building has been well received by the occupants, who have expressed feeling healthier due to the improved indoor air quality.

National Capital Exhibition Hall in Canberra

Another area of sustainable building design is the use of natural lighting. Building design that optimises daylight will not only reduce energy consumption, it will also create a healthier learning environment that could result in improved student performance. A US study found that in classrooms with the most daylight, students' learning progressed 20 per cent faster in mathematics and 26 per cent faster in reading than similar students in classrooms with the least daylight (Heschong et al. 1999).

Energy-efficient building shell

The Australian Commercial Building Sector Greenhouse Gas Emissions 1990–2010 Report (Australian Greenhouse Office 1999) states:

> *The use of electricity is responsible for 89% of commercial buildings' greenhouse gas emissions. Specific operational energy applications principally responsible for greenhouse gas emissions are cooling (28%), air handling (22%), lighting (21%) and heating (13%). Heating, ventilation and air conditioning (HVAC) and lighting thus account for 84% of commercial building sector greenhouse emissions. Building shell performance has a large impact on the heating, cooling and illumination requirements for commercial buildings. Improvements in the thermal, daylighting and natural ventilation performance of commercial building shells will reduce greenhouse gas emissions. Increasing the efficiency of artificial lighting will reduce emissions directly by lower energy consumption, and indirectly through lower cooling requirements (AGO 1999).*

Insulation thermal resistance is measured in R-value. The higher the number, the more effective is the building's insulation. Increasing the R-value of the insulation in walls and ceiling will help to reduce heat loss and gain and improve occupant comfort. Light coloured exterior walls and roofing material will reflect sunlight and help to reduce cooling requirements impacting on air-conditioning costs.

The insulation values of wall cladding varies from R1.3 for typical brick veneer construction with reflective foil (Sustainability Victoria 2005) through to around R6.0 for rendered straw bale walling (Thomas 2004). The greater the insulation properties

the greater reduction in heat loss and gain. The choice of materials for walls will be based on costs, aesthetics and practicality.

Buildings can also be designed with high thermal mass to reduce heating and cooling costs. Building materials with high thermal mass include concrete, rammed earth or stone. According to the Australian Greenhouse Office website (2005) building design using high thermal mass wall cladding:

> *is most appropriate in climates with a large diurnal temperature range. As a rule of thumb, diurnal ranges of less than 6°C are insufficient; 7°C to 10°C can be useful depending on climate; where they exceed 10°C, high mass construction is desirable. Exceptions to the rule occur in more extreme climates. In cool or cold climates where supplementary heating is often used, houses will benefit from high mass construction regardless of diurnal range. (e.g. Hobart 8.5°C). In tropical climates with diurnal range of 7–8 (e.g. Cairns 8.2°C) high mass construction can cause thermal discomfort unless carefully designed, well shaded and insulated.*

If economically viable, ceiling and wall insulation should exceed the minimum standards required in the building code for school and commercial buildings. The materials used for insulation are many and varied and in an ecologically sustainable design, the product should be selected for its lowest environmental impact. Insulation materials such as recycled PET, wool or cellulose fibre made from recycled paper would meet the criteria.

Green roofs

An area of building design that is receiving increasing attention around the world is the concept of green roofs. The highest density of green roofs occurs in Germany, widely considered a leader in green roof research, technology and usage, where it is estimated that 10 per cent of all flat roofs are green (Michigan State University 2002).

According to the Michigan State University:

> *Modern green roofs can be categorized as 'intensive' or 'extensive' systems depending on the plant material and planned usage for the roof area. Intensive green roofs use a wide variety of plant species that may include trees and shrubs, require deeper substrate layers, are generally limited to flat roofs, require 'intense' maintenance, and are often park-like areas accessible to the general public. In contrast, extensive roofs are limited to herbs, grasses, mosses, and drought tolerant succulents such as Sedum, can be sustained in a substrate layer as shallow as 2.0 cm, require minimal maintenance, and are generally not accessible to the public.*

With its swathes of manicured lawn Parliament House Canberra provides an excellent example of an intensively maintained, park-like green roof.

Benefits of green roofs

The key benefit of a green roof, in the context of this report, is its potential to insulate buildings to reduce energy consumption on heating and cooling. The thermal mass of the soil media and vegetation provides an internal stable temperature of around 22 degrees.

In addition to reducing energy consumption a green roof can also provide numerous other benefits including:

• aesthetics - the building becomes part of the landscape
• moderation of the urban heat island effect
• mitigation of stormwater runoff – vegetation retains and slows down runoff reducing flooding and erosion in urban areas
• a net gain in biodiversity if native vegetation is used on the roof.

A green-roofed building, if correctly sited and designed to take advantage of passive solar heating and natural lighting, can significantly reduce the ecological footprint by minimising energy consumption. The design will also provide significant economic benefits due to the reduction in air-conditioning and running costs.

Victorian examples

Marine and Freshwater Resources Institute

MAFRI is located at Queenscliff in Victoria. Opened in November 2004, the building was constructed for the Department of Primary Industries (DPI) based on ecologically sustainable development principles. It has a native grass clad 'green' roof; the concrete structure is exposed internally and the timber cladding insulates from the outside, maximising the benefits of thermal mass. Its walls and ceiling absorb heat in summer and naturally warm its interiors in winter. Windows automatically open and close to let heat out, light sensors detect natural light coming through the skylights and windows; the artificial lighting is turned on only when needed. The building has been awarded a six star energy performance rating by the Green Building Council of Australia.

The Marine Discovery Centre as well as DPI office space and laboratories are located within the building. The Marine Discovery Centre includes a visitors' aquarium, student laboratory, classroom and a resource room. Landscaping with indigenous

The native grass roof of MAFRI emerges from the wetland
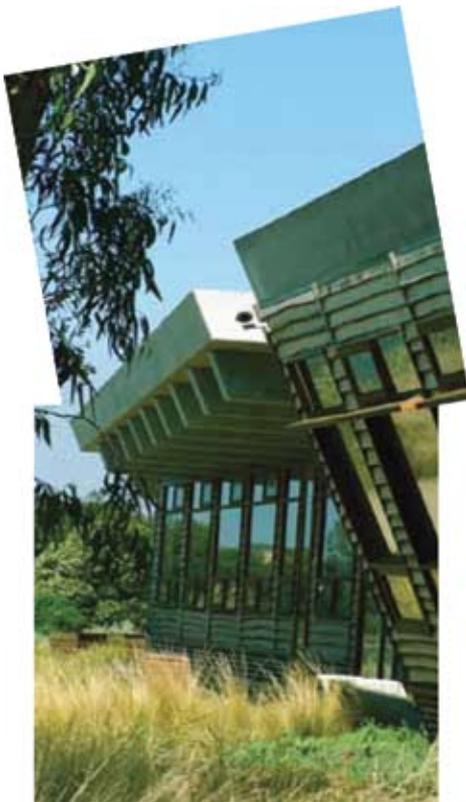
The concrete structure is exposed on the inside and timber cladding insulates from the outside, maximising the benefits of thermal mass.

The reinforced concrete roof structure is exposed in the section of the building in the background where the windows have not been inclined to the edge of the roof to allow for undercover seating.

Secure fencing and the wetland prevents public access to the roof. The sloping section of the building is used for storage and services

The Outward sloping windows maximise lighting and act as solar controllers. The exposed rough sawn timber imitates coastal architecture where the building faces Swan Bay.

plant species surrounds the site and explanatory signage supports the environmental and educational themes. The landscaping also features a reed bed wetland that retards and filters storm water before it enters Swan Bay.

The 'living green' roof ensures the structure nestles into the landscape, becoming an extension of the environs. Low energy use and sustainable practices inherent in the design aims to ensure that students, staff and community members develop an understanding of low impact environmental building practices in a facility that does not compromise the educational function in reducing its ecological footprint.

The formal entry to the building (which faces the road) uses more refined timber cladding.

The Ecolinc Science and Technology Innovations Centre

Ecolinc is located at the Bacchus Marsh Secondary College Campus and provides innovative curriculum programs for P–12 students which focus on sustainable environmental development practices.

Like the Marine And Freshwater Resources Institute building, the Ecolinc is also based on environmentally sound design principles and includes features such as:

• passive solar design where the thermal mass of internal block work walls and concrete slab store heat generated by the winter sun
• double-glazed windows to reduce heat loss and gain
• vents to draw in cold air at ground level and roof top cowls to expel excess heat
• PV cells for generating electricity and solar hot water
• an indigenous landscape setting featuring a wetland that is fed by, and filters, storm water.

The Ecolinc building has been designed to be used as an educational tool in itself. With its angular lines and vibrant contrasting colour scheme the building makes a bold statement in the landscape.

The main entrance to the Ecolinc building

Low water use plantings at the main entrance. The bottom of the windows opens to draw in cool air.

A view of the building from across the wetland which has been designed to filter storm water runoff from the site.

The bold colour scheme of the laboratory. The white ceiling reflects light to reduce the need for artificial light.

A light and airy classroom.
(This photograph is used with the permission of Lyons-Architects. Photograph credit: Gollings Photography)

**A futuristic workshop space.
The circular drop down ceiling
panels form part of the ventilation,
heating and cooling system.**
(This photograph is used with the
permission of Lyons-Architects.
Photograph credit:
Gollings Photography)

Landscape design for sustainability

In addition to improving site aesthetics, landscaping can influence the thermal
comfort of buildings. Trellises, pergolas and the placement of trees to provide shade
from the summer sun can moderate the temperature inside the building. According
to the Sustainability Victoria Landscape Design fact sheet (2007), shade from trees
to roofs and windows can reduce indoor temperatures by 6–1°C in summer; similarly
groundcovers reduce surface temperatures by up to 6°C. Careful species selection is
necessary to ensure that winter sun can penetrate into the building to provide natural
warmth. Achieving these aims will have direct impact on energy use for heating
and cooling.

Involving students in the design and planting of the garden around the building can
develop their sense of ownership and pride in their school, giving them a practical
example of how plantings can be used to create a microclimate and influence
internal building comfort and energy use. Extending beyond the immediate building
surrounds, the school grounds present an opportunity to showcase and demonstrate
sustainable land management practices. A landscape design based on indigenous
local provenance plantings provides habitat for native fauna and increases
biodiversity values in the local area. This approach provides an opportunity to extend
the educational value of the school facility by engaging the community in the design
and planting of the school site and can serve as an example to students and the
community of best practice land management.

Newham Primary School

Newham Primary School in north-central Victoria has developed a partnership with the local Landcare Group and children actively participate in the propagation and planting of local species of plants in the school grounds and along the adjacent, formerly, weed infested watercourse. The watercourse, known as Deep Creek, is a major tributary of the Maribyrnong River and education officers from Melbourne Water (which is responsible for catchment management) have visited the school to discuss with students, teachers and community members the importance of riparian vegetation for water quality and river health. The children under the guidance of a local Landcare group member (a retired secondary science teacher) monitor the water quality in the creek and gain a practical understanding of sustainable practices and environmental responsibility. The school, through the Landcare group has accessed grants to build a plant propagation house on site, and community members are involved in demonstrating to students the skills of plant identification and plant propagation.

Students and parents planting out the creek bank with native vegetation.

Classroom design for personalising learning

Background

Personalisation in education has been discussed in research and policy papers for about ten years. Personalised learning, as a concept, was used first in the United States and was subsequently expanded and deepened through work in the United Kingdom as it became embedded in a wider argument for the reform of all public services. This reform aimed to create services that responded more directly to the diverse needs of individuals rather than imposing uniform solutions on all people. Descriptions and definitions of personalising education have emerged at national and international levels. As a key driver of education reform, personalising education has the following common themes:

• learners are central
• information and communications technology (ICT) is a key enabler
• lifelong learning
• communities of collaboration.

Reviews of research studies on the causal linkages between building design and student outcomes suggest that student academic achievement improves with improved building conditions and that structural and cosmetic factors have a significant impact on student performance and behaviour (Fisher 2001).

More recently, in a report titled Linking pedagogy and space, Fisher (2005) demonstrated that the physical learning environment is linked to pedagogical and curriculum design. According to Fisher, the curriculum context including the teaching and learning principles, the essential learning strands and domains, and key pedagogical approaches, are linked to the learning setting principles. The learning setting principles are in turn linked to the planning principles that allow the creation of various learning models or hubs (Fisher 2005).

In a presentation to an education research forum hosted by the Department of Education and Early Childhood Development, international design expert Prakash Nair indicated that one of the future trends in learning is that 'each student will receive a personalised education, learning different things at different times, in different places in different ways from different people' (Nair 2006a). According to Nair, the seven elements of best practice in educational facilities are to:

1. enhance physical comfort and wellbeing
2. support 21st century teaching and learning principles
3. demonstrate environmental responsibility and school as 3-d textbook
4. serve the educational needs of the larger community
5. incorporate design principles that make buildings work better, last longer, cost less to build, be more inspiring, and adapt to changing needs
6. apply open, transparent and collaborative processes
7. be accountable through meaningful, measurable results.

The Department of Education and Early Childhood Development encourages and supports innovative practices which support personalised learning through initiatives such as Schools for Innovation and Excellence and the Next Practice program.

Next Practice program

Building on the Schools for Innovation and Excellence initiative, the Department's Innovation and Next Practice Division recently introduced its Next Practice program which is informed by the UK next practice model and intended to take current best practice in Victoria to a new level.

While developing the new program, the Department hosted a forum for educators in February 2007, with Valerie Hannon, Director of Strategy, Innovation Unit, UK. Hannon discussed the concept of 'disciplined innovation', which enables a system and its schools to move beyond what would generally be called 'best' practice in order to generate what might be the 'next' successful practice (Hannon 2007).

As in the UK, personalised learning is intrinsic to the Next Practice program in Victoria. The Innovation and Next Practice Division identifies the elements of personalised learning in practice as:

• tailoring education to individual need
• ICT-rich learning environments
• student voice
• schools as networks
• reorganisation of school curriculum, administration and space.

Next Practice: Design Teams Pilot Project has set up design teams of teachers, researchers, and other experts to work collaboratively in producing and sharing new professional thinking and practice including tailoring education to individual needs. The work will extend beyond current 'best' practice in two content areas: Pedagogy and Space, encompassing the relationship between teaching and learning practices and learning environments; and Literacy, encompassing established and emerging forms of twenty-first century literacy. These two content areas have been selected for trial projects as they address key departmental priorities, namely Building Futures and Literacy (Department of Education 2007).

Building Futures

Building Futures is the conceptual framework that guides all capital investment in government school infrastructure in Victoria Building Futures ensures that the educational needs of every student inform the planning and development of school infrastructure. It enables new facility design and the organisation of education services to better meet contemporary education needs.

The design of schools must:

- promote individualised learning
- create settings for innovative teaching
- incorporate new technology
- be environmentally sustainable, and
- support community involvement (Department of Education and Early Childhood Development 2008).

During 2004 and 2005 groups of schools across Victoria began investigating how to best deliver education to their communities. Two examples of school communities examining the quality of education in their localities are the Bendigo Education Plan and the Broadmeadows Schools Project.

Bendigo Education Plan

The Bendigo Education Plan documents the issues and processes undertaken by six government secondary colleges in Bendigo in the development of new models of education provision (Department of Education & Training 2005a). The plan recognised that that the best outcomes for students cannot be achieved in the type of buildings currently in use, and all colleges are committed to ensuring that new paradigms for teaching and learning will be supported by a radical approach to school design.

The plan recommended that the regeneration of secondary school facilities in Bendigo should be based on a series of design principles that will lead to school buildings that support a wide variety of teaching and learning approaches and contribute significantly to the improved learning outcomes for all students.

These principles are:

- Designs should provide large, flexible spaces to allow teams of teachers to work with up to 125 students in learning neighbourhoods using a range of approaches and activities.
- Design should maximise student access to the learning environment and, in doing so, must promote use and ownership of the facilities by the learner. Open access to ICT and audiovisual facilities along with access to all other learning spaces and the use of formal/informal furniture will be some of the outcomes of this principle.
- Spaces must be designed for multiple users and multiple purposes concurrently and consecutively. Spaces designed for single purposes limit the capacity of schools to provide programs based upon individual learning plans. Spaces should be both formal and informal to support both teacher and student centred learning.
- Spaces should have inherent flexibility to ensure learners can undertake a range of activities as individuals and teams. ICT should be ubiquitous and flexible Building schools 17 in the 21st century furniture should enhance usage and support flexibility.

- Design should ensure use of the vertical dimension in facilities — primary school classrooms already provide many positive examples with student and learning materials displayed on walls and from the ceiling.
- Design must integrate previously discrete functions so that eating areas, formal/informal areas, outdoor areas and circulation areas all represent opportunities for sharing and learning at all times of the school day.
- Design features and functions must maximise teacher and student relationships through the use of open staff rooms and visual connections between areas. Schools should have very few locked areas — space must be accessible to all.

Proposed master plan for the Weeroona College site.
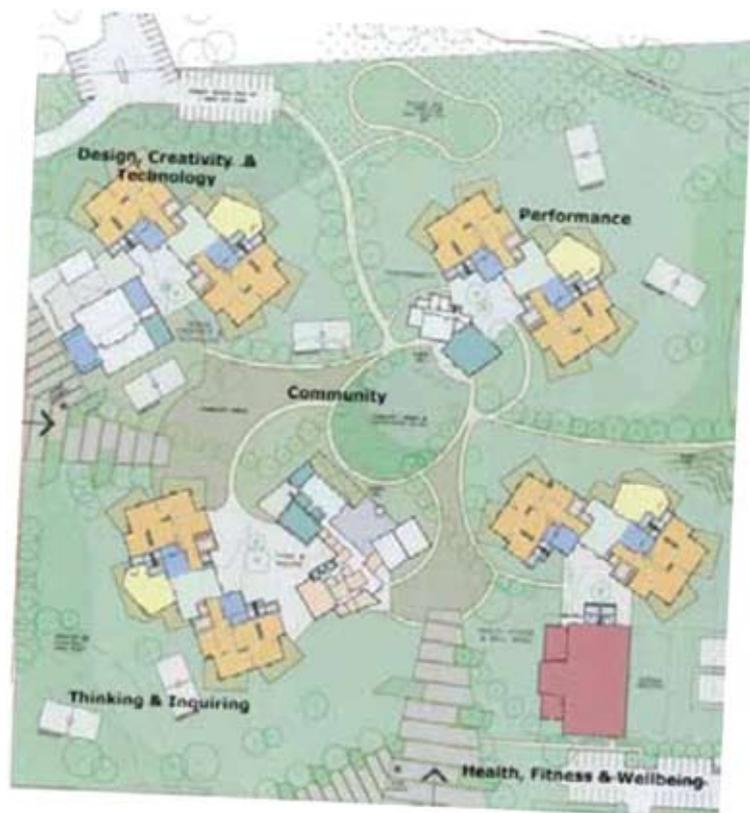
Resulting school buildings should focus on the student as the learner. They should be welcoming to the student and should provide a variety of settings which promote a range of teaching and learning activities.

The learning environment should feature an array of ecologically sustainable design features, including natural lighting and ventilation, the use of sustainable materials, and dispersed technology. The school buildings should be living and learning buildings where users are constantly aware of the relationship between the building and the environment.

The Bendigo Plan goes on to state that the resulting schools should also be part of their community rather than being isolated facilities that operate for only a small part of each day. Designs should promote sharing of a range of facilities with the community along with the opportunity to promote the school facilities as a focal point for a whole range of community activity.

Broadmeadows Schools Project

Similarly, the Broadmeadows Schools Project documents the development of an education proposal for the Broadmeadows community involving the collaborative reorganisation of 17 schools. The schools are being rebuilt to become 10 new state-of-the art modern schools to revitalise education in the area. The project recognised that the current school buildings are a significant inhibitor for schools trying to reverse the data trends in a socio-economically disadvantaged community. To provide better education, new purpose built facilities are required (Department of Education & Training 2005b).

In May 2008 the Minister for Education announced the Ideas Lab, an initiative designed to boost global research into using new technology in the classroom and an important part of the Broadmeadows Schools Regeneration Project. A new think tank will bring some of the world's best technology brains to Broadmeadows to share and test their ideas in a culture of innovative practice (Pike 2008).

Designing classrooms for the future

The literature on personalised learning indicates that information and communication technology (ICT) will be a key enabler in a student-centred learning environment in the 21st century.

Eadie (2001) in The Schools of the Future Report states:

Empowering learners to engage in meaningful, challenging and enlightening tasks is the aim of all educators and ICT has a powerful role to play in this in every school classroom and beyond.

The key term used in the literature regarding design for the ICT-rich classroom is flexibility. School buildings and classrooms of the future need to be flexible enough to adapt to the development and integration of new technologies. Patel (2006) reports that:

Electronic whiteboards, broadband access, laptop computers and wireless networks have already significantly altered the way students learn and teachers teach. In most countries, governments have moved quickly to integrate these new technologies into new and existing educational facilities. But is school design sufficiently flexible to continue to respond to the development and integration of new technologies in society and the educational process? (p. 19)

In the foreword of a report titled Classrooms of the Future, David Miliband, while Minister for Schools in the British Government, wrote:

We need to look at ways of designing inspiring buildings that can adapt to educational and technological change. ICT can give schools the option of teaching children as individuals, in small groups and in large groups, and can provide electronic links to other schools and facilities in thi country and abroad. That will not happen if we do not design spaces in schools that are flexible and will facilitate various patterns of group working. Flexibility is key, because whatever visions of education we design our buildings around, we can be sure that they will need to perform in a very different way in a few years' time (Miliband 2002).

Purpose built new classrooms that cater for ICT-enabled learning often reflect an open floor plan. Millennium High School, New York City, is housed in an office building and the layout resembles a modern office with glass partitions. Each classroom includes an alcove that serves as a reading, conference and library area. Student work is tacked to the walls and read by others (Nair 2006).

Greenwich Millennium Primary School

'Cutting edge' ICT was incorporated into the design of the building, in a government attempt to see if sophisticated infrastructures would help improve standards and encourage new ways of teaching and learning (British Educational Communications and Technology Agency 2004; Priest, Coe, Evershed & Bush 2004). Key findings included:

- ICT skills of both staff and students increased
- laptops for teachers and interactive whiteboards improved planning and better quality lessons, although more time was needed to keep up-to-date with the technology
- numeracy and literacy improved with high-quality software
- internet usage increased
- engagement, motivation, concentration, confidence of students increased, including special needs students
- evaluation showed marked improvement of this school over others in the area
- parents were positive, but home-school links were in the 'early stages'.

Common design guidelines

In its report on designing learning spaces for the 21st century, the Joint Information Systems Committee in the UK found that the design of its individual spaces needs to be:

- flexible – to accommodate both current and evolving pedagogies
- future-proofed – to enable space to be re-allocated and reconfigured
- bold – to look beyond tried and tested technologies and pedagogies
- creative – to energise and inspire learners and tutors
- supportive – to develop the potential of all learners
- enterprising – to make each space capable of supporting different purposes.

A learning space should be able to motivate and inspire learners and promote learning as an activity. The space should support collaborative as well as personalised learning. It is important the classroom be an inclusive environment, and be flexible in the face of changing needs (Joint Information Systems Committee 2006).

Eadie (2001) maintained that classroom design should have:

• flexible room layout and furnishing
• large-screen video display
• individualised access to network resources – wireless networking
• cheap, light-weight notebook computers, with student access to the school intranet and internet 24/7
• group working space with networked computers.

Nair (2006a) listed the following as design features which might be considered when designing learning environments for adolescents:

• a variety of spaces and sizes to reflect different learning modalities
• enhanced flexibility (operable walls, internal glass and inter-connectivity of adjacent spaces)
• provision of project learning areas
• maximising use of natural light and ventilation and acoustic control
• incorporation of individual space 'ownership' to promote more personalised and independent learning, for example a workstation for each student in Grades 9 and 10, including a secure 'locker' that they will 'own' for the year
• an innovative information resource centre incorporating online learning and vocational education and further education resource information
• full service school offices and a community access entrance
• community access facilities, for example a performing arts/catering complex,
• innovative furniture and equipment
• seamless information communication and technology (ICT) provision supporting the notion of 'anywhere/anytime learning'.

The overwhelming theme for the design of the 21st century, ICT-rich classroom is that it must have a flexible layout. This flexibility is required to not only satisfy pedagogical requirements but also to future proof the space thus allowing for the inevitable evolution in teaching methods and equipment and technology development.

Large spaces must be able to be broken down into smaller units to facilitate group work and to cater for children with different learning styles. Students also should also have access to individual learning spaces for personal study and provide a sense of ownership.

The use of wireless technology will enable students to move within spaces inside and outside the classroom while continuing to access the wealth of information available online and retain the ability to maintain contact with fellow learners whether in the same room or across the world.

Learning spaces for creativity and innovation

Background

Australia's education system must provide high-quality learning environments where students are engaged, and stimulated. Learning environments should encourage students to be creative thinkers and learners and provide them with the skills and opportunities to contribute and prosper in the knowledge society.

The Victorian Government is committed to a major school rebuilding program over the next ten years with a plan to rebuild or modernise every public school in Victoria (Brumby 2007). Building Futures (Department of Education & Training 2006) recognises that student learning outcomes, and how quickly they become engaged and willing participants in their education, are not only dependent on the quality of teaching and the richness of the curriculum but also on the design of learning spaces.

Designing learning spaces

Kube (2006) reported on US research which shows that where children learn matters as much as what they learn. A number of studies found that the quality of educational environments has a profound effect on the performance, health, safety, self-esteem and wellbeing of their occupants.

The modern teaching space needs to accommodate both current and evolving pedagogies. The changing emphasis of education from 'one size fits all' to a more personalised and student centred learning environment requires a rethink about learning space design. The classroom of the future according to Fisher (2005) should be designed to cater for a range of learning styles and group sizes. Best example 21st century learning settings would include areas for:

- collaboration and incubating ideas
- presentation
- project space and wet areas
- display
- teacher meetings
- individual student home base
- group learning
- specialised focus labs
- Outdoor learning
- student breakout
- place to think space

Fisher (2005) adds that these multi-modal learning settings should be co-located and clustered to allow students to move around the various learning environments to suit their particular learning task.

The learning spaces outlined above require a greater area than the traditional single group/grade classroom and are well suited to a team teaching arrangement where a cohort of students are located within a large learning space that is zoned into different learning areas. In this arrangement, team or collaborative teaching becomes possible with varied student group sizes and numerous activities happening at the one time. A classroom divided into various zones that support different learning styles is well

suited to personalised student learning plans. With the increased use of multimedia, lap top computers and personalised learning plans this arrangement can work very well particularly if wireless connectivity is part of the design. The OECD report titled 21st Century Learning Environments (2006), states that:

> *Quality design can inspire students to learn and teachers to teach, and can have a positive effect on the local community and environment (p. 47).*

Regardless of whether a facility is renovated or newly built, a school designed to meet the needs of its users (this includes the community) in the 21st century should according to Patel (2006) be based around the following themes:

- Facilities should be **flexible, adaptable and relocatable,** incorporating a range of spaces, such as clusters of classrooms, which are responsive to future changes, including ICT.
- Facilities should provide **social spaces and informal study areas**. School design should maximise circulation while avoiding long, narrow corridors. The heart of a school can be created through design, with open access learning areas, attractive dining and toilet areas, and breakout spaces for small groups.
- Buildings and the surrounding landscape should be **inspirational,** capturing the imagination and demanding the respect of the community it serves.
- Design should be **inclusive and accessible** for both students with special needs and the school community, inside and outside school hours.
- Design should use innovative ideas to maximise the **comfort and sustainability** of school facilities, through effective use of energy, natural daylight, ventilation, acoustics and sustainable materials.

The OECD publications, *PEB Compendium of Exemplary Educational Facilities – 3rd Edition* (2006) and 21st Century Learning Environments (2006) present excellent examples of schools from around the world, both refurbished and newly built, that meet the criteria listed above.

Wooranna Park Primary School

Built in the early 1970s, Wooranna Park is a typical light timber construction (LTC) school building. However, its external facade is deceptive. The internal appearance of Wooranna Park Primary is colourful and multi-faceted having been transformed into in an inspiring, stimulating and exciting learning space. The wide central corridor with classrooms either side, a feature of the period, has been eliminated by removing the walls and creating large open spaces. The open spaces have been divided into different zones of learning with amphitheatres for performances or listening to stories, a media room with a chroma-key green wall for special effect video making, nooks for private or individual reading or play, and wet area art spaces and computer pods.

External appearances can be deceiving.

A classroom computer-pod – children face each other to facilitate interaction

Children-sized soft furniture provides a comfortable reading and study space for students (this photograph used with the permission of Mary Featherston)

Notable Melbourne designer, Mary Featherston, worked collaboratively with the staff and students to create a space that provokes creativity, exploration and expression in a variety of children and teacher friendly settings. The steel truss design of the building has allowed the designer to remove non-structural internal walls and open up spaces and rearrange the layout. The excellent natural lighting provided by the wall of windows and clerestory high lights has ensured that the space is bright, airy and filled with daylight. Mary Featherston and the faculty at Wooranna Park have drawn their inspiration for design from the theories of Howard Gardner and George Betts in the upper school and in the lower primary a major influence is the educational approach of the schools located in the northern Italian town of Reggio Emilia.

A space for small group work or play. Students can also access the top of this room for study or collaborative work

The work, to quote Mary Featherston, is occurring on a 'shoestring budget'[1] using off-the-shelf furniture and cheap medium density fibreboard (mdf) for storage facilities and any specially designed furniture.

The impact of colour on learning

A search of literature reveals that many researchers believe that colour and lighting may affect us on a cognitive and physiological level. Mahnke (1996) writes that factors such as light and colour can affect a person's mood, attention, creativity, feeling of safety, and comfort level in a space.

In a report for the Australian Government titled The impact of school infrastructure on student outcomes and behaviour, Fisher (2002) states that:

although no quantitative measures have been identified in the published research, colour is believed to influence student attitudes, behaviours and learning, particularly student attention span and sense of time. It is also believed that carefully planned colour schemes can influence absenteeism, promote positive feelings about the school and, if students like the colours, can also influence muscular tension and motor control.

The suggested uses and effects of a range of colours are summarised in the table below.

Colours and their Impact on Students (adapted from Fisher 2002)											
	Activity areas	Passages	Dining areas	Entertainment areas	Study areas	Stress areas	Offices	Play areas	Entrances	Lecture rooms	
Red	Y	Y				N	N	N			Alert, increased pulse, activity
Orange	Y		Y	Y	N	N					Dance and movement, lightness, joy
Yellow	Do not use										Detachment, shallow breathing, mature minds
Green	N					Y					Balance, judgement, arrests movement, stasis
Turquoise	N						Y	N			Cool, calming, soothing
Blue			N	N			Y				Relaxing, sleep inducing
Violet										Y	Meditation, dignity
Magenta			N						Y	Y	Contentment, self respect
Black	Do not use										Heightens emotional response
White	Do not use										Stark

1 Personal Communication – Mary Featherston 11 February 2008.

Engelbrecht (2003) urged school administrators and designers 'to take a more studied stance of colour in the educational environment'. Engelbrecht claims that the mental stimulation passively received by the colour in a room helps the student and teacher stay focused. In the paper, she cites studies that say colour can affect a student's attention span, eyestrain, work productivity and accuracy.

Engelbrecht adds that monotone environments may induce restlessness and anxiety leading to irritability and an inability to concentrate resulting from under stimulation.

She notes that younger children find high-contrast and bright colours such as red, orange and yellow stimulating, so those colours may work better in a preschool or elementary (primary school) setting. Adolescent students may respond better to colours such as blue or green that are less distracting or stress-inducing. Engelbrecht writes: 'Being sensitive to each age group's different responses to colour is key in creating an environment stimulating to their educational experience'.

Many authors discuss how colour can be used to define an area and as means to provide direction for students and visitors to the school. Engelbrecht states 'The use of colour and graphics to aid wayfinding is particularly important for primary school children'.

According to Engelbrecht a school's overall colour scheme should support the function of the building and the tasks that are carried out in it; avoid over-stimulation and under-stimulation; and create positive emotional and physiological effects.

Papadatos (1973) suggested that the proper use of colour in schools can convert an atmosphere that is depressing and monotonous into one that is pleasing, exciting and stimulating. He concluded that such change in colour schemes in schools would reduce absenteeism and promote positive feelings about schools.

Lighting

As discussed previously daylight or natural light in the classroom is claimed to create a healthier learning environment that could result in improved student performance. If artificial lighting is necessary, full spectrum lighting is the closest approximation of daylight. Full spectrum fluorescents combine the benefits of energy efficiency and full colour rendering and they can be retrofitted in existing fluorescent lamps. Young (2003) reports that full spectrum lighting in classrooms can improve student attendance and performance.

Fielding (2006) says it is natural to want lighting that closely matches the full spectrum of daylight. He adds that bright lighting can be used to light the centre of the room, with lower illumination in a niche or bay that serves as a breakout space with higher illumination on display walls

The attention paid to details such as the colour of a classroom and its lighting has the potential to improve academic performance, reduce absenteeism and alter the moods of students and teachers. Adding colour and changing lighting is a relatively inexpensive way of creating a classroom setting that may prove more conducive to learning, creativity and innovative teaching.

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Note: The Energy Toolbox available at ‹**http://www.energy-toolbox.vic.gov.au/**› is an excellent resource that assists energy managers to understand and implement the sustainable energy targets of the Victorian Government. The site also provides links to information specific to schools; curriculum resources for teachers; and information for students on a range of topics regarding energy awareness issues. Building schools 33 in the 21st century
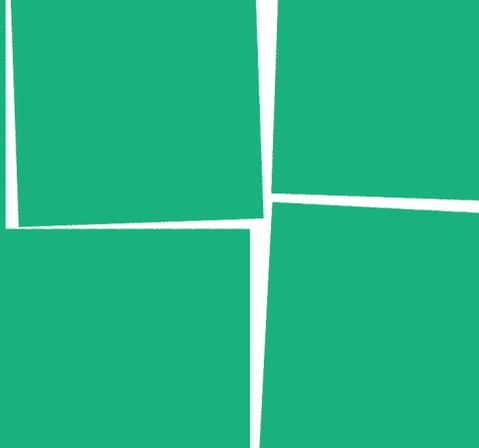
Report Two:

Current thinking about learning for a lifetime

Contents

Introduction

In the 21st century, curriculum reforms across Australia and other OECD countries are reflecting new orientations towards learning and teaching in the compulsory years of schooling. Research in cognitive and social psychology, in child development and in neuroscience is providing insights into the nature of learning and teaching within different contexts. There is a new emphasis on how children's sociocultural experiences define their development, and that this should not be just an adjunct to the developmental model (Edwards 2003; Lubeck et al. 2001). There is recognition that successful teachers have implicit and explicit skills that can be shared with others, and that emerging technologies can provide opportunities for enhancing and guiding learning that were never previously possible. Societal expectations about education have also changed: the demand is for thoughtful, highly literate citizens who have a commitment to lifelong learning (Bransford, Brown & Cocking 1999). Bransford, Brown and Cocking outline the new challenges and expectations for schools in the following way:

> *Society envisions graduates of school systems who can identify and solve problems and make contributions to society throughout their lifetime –*
> *who display the qualities of 'adaptive expertise' (p. 133).*

The authors believe that, in order to achieve this new orientation, new decisions should be made about the content of curricula, the ways learners learn, and the ways teachers teach.

The 21st century is bringing new challenges in the form of rapid communication, change, mobility, new forms of social activity, and new knowledge. A successful educational environment for the 21st century would thus focus on intertwined and mutually supportive understandings about learning, knowledge and community. This review investigates some of the current themes in education that reflect the new foci in learning and teaching for the 21st century. It focuses on two main aspects: learner-centred environments, and lifelong learning.

Learner-centred environments

Within formal education the concept of learner-centredness has a rich history spanning the last 100 years, from such non-mainstream approaches such as Montessori, Steiner and Reggio Emilia schools, which are still contemporary alternatives, to a present focus on 'personalised' and 'individualised' learning within current curricula in OECD countries. Learner-centred environments pay attention to the knowledge, skills, attitudes and beliefs that learners bring to the educational setting. Within such a setting, teacher practices are culturally responsive, appropriate, compatible and relevant (Ladson-Billings 1995). Teachers start from the structure of the learner's knowledge, and proceed to observe, question and converse with students, and finally there is a mutual reflection on the products of student activity, in order to encourage deep understanding and transfer (Bransford, Brown & Cocking 1999). The positive impact of deep thinking and learning strategies is that they organise shallow knowledge and allow the learner to reason, infer and apply knowledge in practical situations (Graesser, Person & Hu 2002).

Young children start their formal education already equipped with a strong base of social and cultural learning, language, and thinking strategies. They are already accomplished learners. In learning to talk, they have opened a conduit between the mind and the outside world that allows the transfer of knowledge from the knower to the learner (Wells 1986), and the informal settings of home and community have provided a context for incidental learning. The formative role of adults, social interaction and communication have facilitated a process of joint construction between the learner and the knower (Wood 1998). Through talking, listening and thinking, learners are engaged in an interactive process of imitation and using the experiences of others to build a bridge between the known and the new. The challenge for education is to acknowledge and build on the manifest capabilities of young people to learn within a supportive and stimulating environment.

A learner-centred environment in schools encourages discussion and collaboration among peers and with the teacher, where there is a joint exploration of problems in order to construct meaning (Miller 2003). Effective discussion in the classroom provides a forum for the exploration of ideas and experiences. It encourages the sharing of experiences, promotes active listening and effective communication, and facilitates the acquisition and refining of skills such as reporting, explaining, justifying, evaluating and exploring. This sharing of personal perspectives and experiences is valued in the early years of schooling, but it is also an effective strategy for learning throughout life. Interaction in the classroom is a powerful tool for the co-construction of understanding and knowledge through collaborative problem-solving and, if the learning process is documented in some way, it becomes a reference of what was achieved and what additional learning might occur (MacNaughton & Williams 2004). Documentation of activities and achievements through techniques such as conversations between teacher and student, digital photographs and video recordings, support learning for even very young child because they can immediately respond to seeing themselves working towards solving a problem (MacNaughton & Williams 2004). Over time, they would also see

their development of expertise, and be able to reflect on the learning process in the same way older students can respond to written, visual or oral feedback.

The interconnection of perception, language and reflection echoes Vygotsky's (1968) socio-cultural emphasis on talk, discussion and the 'scaffolding' of experiences to develop understanding through communication of ideas, and Dewey's (1933) concept that thinking is a product of social interaction. For schools to develop as collaborative learning communities, teachers are pivotal agents in providing appropriate scaffolding for their students in order to help them progress from 'novice to expert' (Bransford, Brown & Cocking 1999), and to acquire a broad range of high-level skills that can be applied creatively. Thinking 'out loud' in a supportive environment, for example, allows learners to articulate their experiences and attitudes and share their creative responses.

Learning in ways that lead to understanding produces knowledge. Expert teaching focuses on the kinds of information and activities that help learners construct their own knowledge and sense-making through inquiry. A 'progressive formalisation' of the curriculum by the teacher transforms students' initial understandings about the world through a structured, developmentally appropriate building of concepts and methods (Bransford, Brown & Cocking 1999). As learners make connections within the curriculum, they become more expert at integrating their experiences and understandings into a body of knowledge. The curriculum thus becomes an important framework for learning, encouraging learners to acquire skills and understandings sequentially, according to their personal development.

As 'an idea and as a practice', a curriculum reflects the choices of a society about what happens intentionally in schools (Print 1993). It is culturally based, embedded in the social, political and economic structures of society (Brady & Kennedy 2003). In recent years there has been much more interest in curriculum by governments in OECD countries as 'an instrument of social and economic development' (Brady & Kennedy 2003). In the Victorian Blueprint for Government Schools, for example, it is defined as the combination of content, pedagogy and assessment in 'a sound interrelationship' (Department of Education and Training 2003), which reflects one of the goals of The Adelaide Declaration on National Goals for Schooling in the 21st century (Department of Education, Science and Training 1999). A successful curriculum is also democratic in that it supports learners regardless of their abilities, and allows all students to develop successful learner identities (Rose 2005).

Glatthorn (2000) considers that quality curriculum development includes a focus on depth, rather than superficial coverage of topics, which will lead to greater understanding and be supportive of efforts to teach critical thinking and problemsolving. Problem-solving, in his view, is a better focus than isolated thinking skills, because it can be conducted within a context of meaningful, complex problems. A curriculum, in his view, should facilitate the mastery of essential skills and knowledge within and between subject areas in a coordinated way, and be organised for sequential study, although the use of 'stand-alone' subjects may be useful for enrichment.

Learning for understanding and knowledge requires a cross-curricular approach that values literacy as a means to participate and perform in each learning area (Rose 2005). Literacy is perhaps the most valuable component of a learner-centred environment, because it is essential for accessing and understanding many forms of information. It has developed increasing importance over time, as information and education became more democratised and less elitist, and the written word more accessible as a powerful tool for the dissemination of ideas. Literacy is linked to the capacity to use higher order thinking and information processing skills (Australian Association for the Teaching of English 2005), and to concepts such as justice and equality. Freire (1985) described illiteracy as 'one of the concrete expressions of an unjust social reality'. He also emphasised that literacy is political because it can serve particular interests, and that literacy is not neutral but embedded in culture. In the 21st century, the concept of literacy encompasses not just reading and writing, but also multiliteracies: modal and multi-modal representations and information conveyed in an array of social, cultural and political formats that have to be deconstructed and reconstructed according to the existing knowledge of the 'reader'. Critical literacy across contexts, therefore, has become an essential skill for the 21st century.

There has been much research about how to maximise student achievement in literacy, particularly for students who are struggling or failing. Rose (2005) argues that, despite learner-centred environments, classroom practices 'engage and enable different learners unequally' through 'practices that construct, maintain and evaluate inequalities between learners'. He describes a hidden curriculum that favours some abilities over others, and that teachers have open preferences for certain types of participation and performance. In his view, the different attitudes of teachers that affect literacy attainment among young children are related to parent-child reading practices before the compulsory years of schooling, and are 'cultural in origin'. Children with experience in reading practices at home, for instance, will benefit from the way schooling is organised throughout the compulsory years, while children from oral cultures lack this initial 'head start' and may continue to struggle throughout their school years. In Australia, this finding has obvious implications for Indigenous learners, and for migrant learners from strong oral cultures. Rose suggests that more should be done to identify the students who need explicit teaching because, with extra help, they are able to acquire the necessary skills relatively rapidly (Rose 2005).

Modern pedagogy embraces the concept that all teachers are teachers of literacy, and critical literacy in particular. Students must become literate in the various disciplines and learning areas in order to construct their knowledge and understandings. Literac across the curriculum increases student exposure to a variety of texts in a variety of social and cultural contexts, and encourages 'inferential critical comprehension skills' (Australian Association for the Teaching of English 2005). Specialised text and language structures, vocabulary and graphics are specific to each subject

area and may not necessarily be learnt in others. As society becomes increasingly globalised, there is a need for a wide range of literate practices – multiliteracies – to encompass knowledge management, information and information transfer (Australian Association for the Teaching of English 2005).

Globalisation is exerting pressure on education because the rapidity of change presents a challenge for educators to decide what knowledge and skills might be valuable. The growing demand from businesses worldwide is for 'human resources' who can communicate and be innovative and creative. New ideas are now driving economies in the USA: key corporations are no longer in manufacturing or industry, but in communications, entertainment, science, information and technology, and creative industries such as leisure software, publishing and advertising (National Advisory Committee on Creative and Cultural Education 2004). 'Soft skills', such as problemsolving, thinking, synthesising and interpersonal skills are becoming important for employment prospects (Suggett 2007). Change is also manifested in the expectation that jobs for life have given way to different occupations over a lifetime, depending on what skills are needed in various sectors, and freelance work, short contracts and self-employment are becoming the norm (National Advisory Committee on Creative and Cultural Education 2004). The new work climate demands high-level skills of adaptability, creativity, soft skills and communication. A productive and rewarding life, however, is more than just work; high-level skills are also needed to participate fully in a democratic society.

In the UK, the report *All Our Futures: Creativity, Culture and Education* (Department for Education and Employment 1999) argues for a national strategy for creative and cultural education as a means of embracing the positives of globalisation:

> *The intention of the national strategy is to encourage purposeful and stimulating activities that will contribute to a successful creative economy. The challenge of globalisation requires creativity, innovation and imagination in education generally, and pedagogy specifically, in order to equip citizens with the skills and knowledge to prosper.*

Lifelong learning

At the end of the 19th century Dewey (1897) articulated that education should be conceived as 'a continuing reconstruction of experience' that is important for social progress and reform (Dewey 1897). Building on the insights of Dewey and Piaget, Kolb considers that knowledge is 'created through the transformation of experience' (Kolb 1984), and that experience is a strong organising focus for learning. Learning and the acquisition of knowledge are, therefore, better seen in terms of processes rather than outcomes. In Kolb's view, differentiations in ways of learning, such as 'learning styles', are not fixed personality traits but are 'adaptive orientations' learned through experience, which change slightly from situation to situation (Kolb 2000). Encouraging learners to experience and develop different ways of problem-solving, through collaboration and social learning, is a powerful way to help them become flexible in their thinking about problems, rather than static in their responses and approaches.

In the 21st century, there is recognition that learning is a lifelong process, and that skills learned in the formal years of schooling need to reflect the qualities required for a productive society (Field 2000). These qualities extend the curriculum from merely reflecting subject-centred knowledge, to include 'the development of individuals who can prosper in a complex and changing social, cultural and economic worlds' (Seaton 2002). Contemporary learning and teaching can include forms such as open learning, blended learning, online learning, flexible learning, e-learning, p-learning and m-learning, which require learners and teachers to embrace new and different orientations and roles. The new technologies are dramatically increasing the quantities of available information, and new skills are needed for accessing, navigating, sharing and validating this information. Many teachers are part of the lifelong process of learning, as digital immigrants challenged by the digital natives in their classrooms, and the dynamics of learning and teaching have undergone a change within this new structure.

The current and emerging modes and mixtures of educational delivery have a learner focus in that they broadly cater for different learner needs for access and information. They contribute to lifelong learning in the way that they can free the learner from the constraints of time and place. The strength of the new electronic modes lies in their flexibility: m-learning or 'mobile learning' for example, has a focus on learning with mobile devices. It takes advantage of the learning opportunities offered by portable technologies, either across locations or by interacting with other portable or fixed technology. The emphasis is on the mobility of learners to navigate their way through information in order to inquire, communicate, publish, deliver, track or develop content (Geddes 2004). It is an important aspect of lifelong learning because it provides support to enhance teaching and learning that is not delivered from a fixed spot, or in 'real time'. It is an effective tool for both school and professional applications. However, it also has social and educational challenges such as accessibility and cost barriers – the digital divide – and how to support learning across many contexts.

P-learning, or 'pervasive learning' resembles m-learning, with the addition of the ability to be an effective teacher's tool to supplement student learning where it

may be needed. The teacher can deliver specific content to particular learners, who may need to improve certain skills or gain more knowledge. The use of technology in this instance may be very engaging for learners because it allows for more interactivity and personalisation of learning. Carey (2005) considers that ICT enhances personalisation through its adaptability and the opportunities for simultaneous study and discussion, and Dix (2005) reports positive changes in student attitudes towards learning and self-esteem.

The flexibility of the new technologies has the potential to provide access to information and learning for learners who may otherwise lack resources because of socio-economic factors or geographical isolation. It also has the potential to tailor learning to individuals or groups. The application of technologies such as m-learning and p-learning may invigorate future learning environments by providing 'access, context, collaboration and appeal' (Geddes 2004), not just for school students, but for lifelong learners beyond the compulsory years of schooling. Learning hubs may be crucial here, as they can facilitate access to technological resources within communities. The 21st century is already illustrating that the information age is accelerating. People require ever-faster and more effective access to information to increase their employment options, the success and development of their businesses, and personal advantages (Lowey 2003). Technology is able to provide both access and opportunity advantages for individuals and collections of individuals without the problems associated with location and time, and both federal and state governments may need to take the lead in addressing access and equity issues, in order for us to remain 'the clever country'.

The Adelaide Declaration on National Goals for Schooling in the 21st Century (Department of Education, Science and Training 1999) emphasises schools as 'learning communities' composed of teachers, students and their families, business, industry and the wider community. Both children and adults learn effectively from their families, their communities, and each other. The school community, therefore, is only one of several communities where learners and teachers interact and share their ideas with others; other influences on learning come from the out-of-school environment, mass media and the new technologies. In recent research, Black (2007) reflects the ideas of community learning as having a wide application. She notes that Australia is beginning to 'close the gap' in student achievement in individual schools, but 'the challenge remains to do it to scale'. The link between educational disadvantage and geographic disadvantage is clearly creating a 'circular pattern of disadvantage' that affects student outcomes, despite the focus of both policy interventions and years of additional funding (Black 2007). Black's findings are inclusive of all learners. Her model for deep change includes the following strategies: student-centred schools that help build capacity for their communities; schools that are also community learning hubs, to help build social capital and partnerships across government, business, community organisations and philanthropic organisations; schools working together across districts to share resources and build community capacity to meet needs.

Pedagogy is undergoing a change within the 21st century environment: the teacher becomes a guide, a facilitator, a learner, a designer, a consumer, an editor and censor. However, when technological change occurs, teachers may find that they are no longer in complete control of their methodologies, and that in some areas of learning they have become novices relying on more expert colleagues or students. As lifelong learners, teachers are able to gain knowledge and understanding about their practice through their own informal or formal action research, their interactions with learners, with other teachers as colleagues or mentors, through professional development and in-service education, and through their memberships of professional bodies. Specific training in particular areas, such as cooperative learning and personalised learning, also add to teacher learning, as do ongoing studies in specific educational techniques, discipline areas, and ICT applications. Teacher learning is a powerful exemplar of personalised learning, where perceived needs drive the acquisition of various skills and techniques, and learning is accepted as a lifelong commitment (Paludan 2006).

Crick and Wilson (2005) discuss how lifelong learning can be related to personalised learning, because the learning is consciously personalised in terms of choice, worth and value to the individual, and its potential to be transformational. The authors argue that this focus is what should be encouraged in schools. Learning becomes an intentional act by a learner who is self-aware and capable of taking responsibility for his or her own learning. Personal learning throughout life is also an advantage for society because it contributes to potential competitive advantage in the global economy (Falk & Dierking 2002).

The recent rise of 'personalised' and 'individualised' learning approaches has focused on the individual needs of all learners, in recognition that each one is different in their experiences, and they require specialised relationships with their teachers. The goal of personalised learning is to maximise learning for all through careful needs assessment, curriculum design and class organisation. The use of ICT becomes important in its ability to allow for access and dissemination of information, self-pacing, and creativity (Miliband 2003). Leadbeater (2004) describes it in the following way:

> *The aim is to promote personal development through self-realisation, selfenhancement and self-development. The child/learner should be seen as active, responsible and self-motivated, a co-author of the script that determines how education is delivered (p. 70).*

Leadbeater envisages networks of schools that share resources and spaces that can cater more widely for particular needs, and in this way help to address the equity gap among schools. His vision may apply equally well to all learners and contexts for learning.

In personalised learning, the needs and interests of learners are central. It accommodates diversity and flexibility, and can provide a range of educational pathways to suit learning needs (Keamy et al. 2007). It has a focus on learner engagement and achievement within a flexible learning environment, and addresses

issues of equity through a 'capacity to tailor an education for the individual' in order to improve retention and attainment (Council for the Australian Federation 2007). It provides for timely individual support in response to perceived needs, and is applicable to learners of all ages.

When Knowles (1984) presented his two theories of pedagogy and andragogy, he posited that adults have particular foci for their learning: firstly, they need to know why they need to learn, and what its value might be for them; secondly, they have a problem-solving orientation to learning; and thirdly, they wish to be responsible for their own learning. He considered that younger students did not have the same foci. Current research and practice in education, however, accepts that school students have the same requirements of their learning as older learners, and have the ability to learn in a self-directed way independently of the teacher. All learners, for example, need time to learn through reflecting, absorbing and adapting in order to create understanding and knowledge. All learning may thus be considered to be personalised by the learner (Keamy & Nicholas 2006).

Smith and Lovat (2003) track the linear development of educational practices in the western world in the following way: in the 1970s, curriculum was based around issues of justice and equity in a 'democratic imperative' that encouraged participation by parents and students; in the 1980s and 1990s, curriculum decision-making was influenced by world economics, and politicians and bureaucrats took charge. Education in the future, in their view, will encourage problem-solving and creative thinking and promote individualised learning to cater for different styles and strategies for processing information, and to achieve career goals. School buildings will become learning centres for the whole community, and virtual schooling, courtesy of the new technologies, will encourage a new perspective on learning: 'school as process rather than school as place'. They suggest that virtual schools might suit private providers and global media corporations using techniques such as virtual space and ICT, but they may only suit some learners. Virtual learning has its strengths and weaknesses for learners: it can be easily accessed in time and place, and can be self-paced, but it is not conducive for constructivist learning or social learning, and there may be problems with authenticating learners' work (Smith & Lovat 2003).

Conclusion

In the 21st century, the impact of globalisation on educational practices is clearly apparent, and there are indications of the power of its influence in the increasing use of electronic and media communications, distance learning and personal technologies. In Victorian schools, for example, ICT is expected to have an impact on teaching and learning by linking school communities, and supporting communication and knowledge management. There is a direct connection made between its use in schools and the future prospects of learners in terms of skills needed for future employment. Traditional methods of transmission by the teacher and assimilation by the student lack the weight they once had as effective teaching and learning strategies, and there is now a clearer focus on both content and process. As the 21st century unfolds, there will undoubtedly be further innovations in learning and teaching, particularly through technology. Learning activities will be delivered in a variety of ways to lifelong learners who are personally motivated and oriented to learn.

Some less optimistic trends are potential impacts such as the erosion of democracy. Porter (1999), for example, writing about the UK, argues that 'political, social and cultural functions have been diminished at a time of unprecedented challenge from the forces of globalisation'. For Porter, the economic purposes of the school are dominating the political agenda, and schools have lost some of their function to shape society and disseminate culture and values. In his view it is now even more important to develop the individual's sense of personal identity and capacity for creative response. The solution for Porter is the 'reflexive school' which is decentralised, and where students can experience a reflective and responsive focus in learning.

Fullan (2001) is also concerned about democracy and the forces of globalisation. He describes the change processes inherent in globalisation as being challenging, liberating or relationship-building in terms of society's attitude towards learning. Capacity building, in his view, is one solution to the negative aspects of globalisation, because it can focus on the internal commitment and context-specific expertise of the learning organisation. Shared commitments that encourage purposeful interactions are able to make meaning from change, and he believes that 'a strong public school system and a strong democracy are closely connected' (Fullan 2001).

In Australia, there are still many students and schools disadvantaged by lack of access to opportunities because of geographical, socio-economic and cultural factors, and the gap between successful learning and poor outcomes seems to be widening (Black 2007). These issues of equity and justice are being addressed at the levels of policy and practice, and with strategies such as community-based learning, rich and challenging curricula, collaborative partnerships and better access to opportunities for learning. The 'democratic imperative' is to create opportunities for lifelong learning across Australia despite the technological, social and personal challenges.

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