Creating 21st Century Learning Environments

Phan Pit Li,

John Locke,

Prakash Nair,

Andrew Bunting

OECD

CREATING 21ST CENTURY LEARNING ENVIRONMENTS

What is involved in creating learning environments for the 21st century? How can school facilities serve as tools for teaching and meet the needs of students in the future? What components are required to design effective schools, and how does architecture relate to the purposes of schooling? These are some of the questions addressed at the seminar on "Creating 21st Century Learning Environments" organised by the United Kingdom's Department for Education and Skills and the OECD Programme on Educational Building (PEB).

The answers provided by four people with first-hand experience in building schools are summarised here. A development and management professional explains how the school building can serve as a three-dimensional learning tool. A school principal describes how his recently-built public school in New Zealand was designed to meet the learning needs of 21st century students. A building planner presents what he considers the essential components for developing effective facilities for tomorrow, supported by his own experience in planning schools. Finally, the director of an architectural firm defines the common purposes of secondary schooling and their relation to design.

Other concepts that will shape the future of education and the architecture that gives it expression will be examined at the upcoming forum on "Emerging Ideas Connecting Education and Architecture". The event, organised by US-based DesignShare in collaboration with PEB, will take place in Barcelona, Spain, on 23-25 June 2005.

The school building as a learning tool

This article looks at how learning opportunities can be woven into the structure of a school, making the building and grounds an active part of the educational process. School architecture can be a three-dimensional learning tool, a stage set that is designed to create awareness, communicate ideas and impart lessons.

Current thinking on learning suggests education has shifted from expecting students to be passive recipients of knowledge, to encouraging students to be active constructors of knowledge. Current learning theory also calls for a multi-disciplinary approach, where students learn concepts as an integrated whole instead of as fragmented ideas. In an interdisciplinary context, students are able to see the connections between subjects. This realisation creates authentic learning, learning which students can apply to the world around them.

A natural extension from interdisciplinary learning is collaborative learning. Learning takes place in discovery teams and investigative groups where students work through problems and situations in a co-operative and collaborative way.

What possible form might a school building take if the educational values of active participation, integration and collaboration were translated into steel, concrete, glass and space?

This discussion focuses on three key ideas:

• Using architectural elements as teaching props.
• Exploiting building systems for lessons on real-life connectivity and sustainability.
• Creating outdoor classrooms and living laboratories.

Architectural elements as teaching props

School walls commonly serve as a silent backdrop for posters and other educational displays. Is it not possible for walls and other elements to be active components in the learning process, with their own stories to tell? Wouldn't learning be so much more fun if building elements became life-sized props enabling students to link mathematics, music, culture and arts through an engaging and participatory process? For example, windows can be placed on the wall to suggest musical notes of a familiar song, floor patterns can be inspired by geometrical shapes, the school façade can speak of the culture and tradition of the community which it serves, or the ceiling of the lobby can reflect the mysteries of stars and constellations. Doors, windows and entryways can become playful objects to teach about shapes, sizes and patterns. Columns can provide texture and scent, and planar elements can become dynamic canvases that capture the varying moods created by light and shadow, enhancing students' awareness of changing conditions at different times of the day, and teaching about concepts of lightness and transparency.

Ceiling patterns relating to constellations, Victoria School, Singapore
(CPG Consultants Pte Ltd)

Architectural elements reflecting maths and science concepts, NUS High School for Science and Mathematics, Singapore
(CPG Consultants Pte Ltd)

The idea of the school as a three-dimensional learning tool was incorporated into the design of the new NUS High School for Mathematics and Science in Singapore. This project is the first of its kind in the country – a high school developed and managed by a university (the National University of Singapore) to provide a challenging setting for students with aptitude in science and mathematics. The campus was envisaged as an active and lively environment, weaving a series of learning opportunities into its architectural fabric. For example, a "Pi-Wall" traces the spine of the school. The architectural design of this façade wall is guided by the numbers in pi, expressed as different panels of varying colours. The embedded code can be used as a trigger for students to explore and investigate complex mathematical concepts. Another façade was designed as an abstract version of the periodic table, and the stairway at the entry lobby draws inspiration from the nanotube.

These examples illustrate different ways in which curriculum concepts can be brought to life through the use of architectural elements as teaching props, embedding stories which can be a stimulus for active learning to happen in school, making learning fun, making learning real, getting students excited about learning.

Building systems for lessons on real-life connectivity and sustainability

The school building has excellent potential to showcase real-life connectivity. Typical buildings house different structural systems, lighting systems and service elements to manage rainwater discharge, air-conditioning, fresh air, etc. These systems, if strategically exposed around the school and installed with hands-on learning tools such as meters and gauges for observation and investigation, can provide valuable lessons on how they work, how buildings come together, or how physics, chemistry and environmental science can be linked.

The school building also offers a prime opportunity to teach about sustainability, how buildings effect the environment, what they consume, pollution they produce in terms of waste and noise, and the overall impact of pollutants on climatic change, wildlife and vegetation. Examples of successfully incorporating sustainability concepts into design include two schools in the United States: IslandWood, a school in the woods of Washington State, and the Roy Lee Walker Elementary School in Texas.

Outdoor classrooms and living laboratories

Schools' buildings and landscaping are often designed independently, with more focus given to the building component. In their post-occupancy years, their users sometimes introduce various improvements to the landscape, such as a small eco-garden or a vegetable patch. How can the building and landscape be better integrated to create a total learning environment? Landscaping should be seen as an important resource for learning – not as a secondary element but as an opportunity to extend learning outdoors. This idea was implemented in two recently completed projects in Singapore.

Henry Park Primary School was a small primary school when it was first established in 1978. It soon became one of Singapore's top primary schools, and in the late 1990s, a decision was made to rebuild the school to cater to its enlarged enrolment and to enhance it with new and improved facilities. One of the key ideas for the new school was to transform the green area into a "Green Trail", consisting of a series of thematic gardens aimed at teaching students about the local flora and fauna, and providing a setting for hands-on lessons on science and ecology. Specialised outdoor learning areas were created, from a water habitat, to a fern garden, a cacti corner and a butterfly garden, each providing a rich resource for teaching and learning.
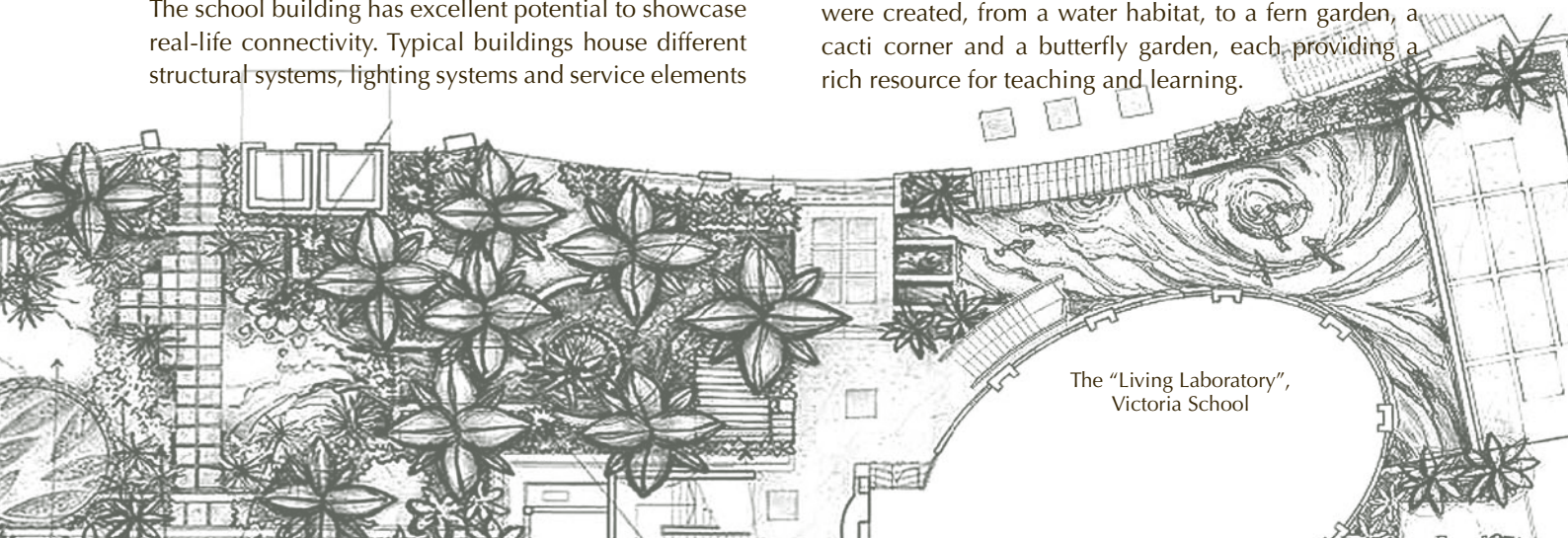
The "Living Laboratory",
Victoria School

The "Outdoor Classroom", Victoria School

The second project was the redevelopment of Singapore's second oldest school, Victoria School. The outdoor spaces were redesigned to become the heart of the school itself. Its new "Eco-Street" forms the school's central artery and is the organising element for the linear plan. The boundaries between building and landscape are blurred, with linkways, bridges and footpaths weaving through the lush greenery, revealing a tapestry of nature enriched by student activity and interaction within an outdoor classroom. The Eco-Street assumes the two important roles of social and learning spaces rolled into one. In line with the school's emphasis on integrating nature and ecology into the curriculum, the Eco-Street is carefully designed as a "living laboratory", providing opportunities for hands-on experiments and examination, enabling students to learn about ecology and the life sciences.

At this secondary school, the teachers draw up lesson plans using the outdoor spaces as classrooms for a variety of subjects, including literature. They recognise the benefits of the outdoor features as a stimulus for their lessons. The teachers have seen their students become less inhibited and more expressive. The informal setting offered by the Eco-Street makes students less afraid to act spontaneously in front of their classmates. They enjoy their classes and activities much more and are more attentive.

Conclusion

The concept of using the school building as a learning tool is not new; good examples already exist in various parts of the world. Designing a school building for use beyond its conventional function involves educators and school designers working together to identify lessons the building can teach and seeking new and exciting ways for students to interact and learn.

As the educational experience becomes increasingly active, interdisciplinary and collaborative, schools must be designed as integrated environments, providing a setting that enhances and supports the way students learn. The physical environment must align with pedagogical change to achieve educational objectives. Using the school building and grounds as a learning tool is one way to connect pedagogy and design – a way forward in creating learning environments for the 21st century.

Article by:
Phan Pit Li
Senior Vice President
CPG Consultants Pte Ltd, Singapore
Fax: 00 65 63574469
E-mail: phan.pit.li@cpgcorp.com.sg

Alfriston College for 21st century learners in New Zealand

When Alfriston College opened in January 2004, it was the first state secondary school built in New Zealand in over 20 years. The new construction presented an opportunity to reflect on the learning needs of 21st century students.

Alfriston College in Auckland

The College serves students aged 13 to 19 (years 9-15) from a predominantly multicultural urban fringe community with a wide range of socio-economic backgrounds. The school has the capacity for 1 500 places.

Four major educational trends influenced the school design:

- Changes in learning and teaching expectations.
- Relationships, both intra-school and between the school and the community.

- Flexibility in learning spaces.
- Access to information and communications technology (ICT).

Changes in learning and teaching expectations

In recent years expectations of learning and teaching have increased enormously, reflecting the growing importance of knowledge in the economy and society. Schools no longer have a gate-keeping function but are required to focus on the successful development of all students. This places greatly increased demands on the quality of the learning relationship between the student and the teacher. Quality teaching practice has not changed; we have always known how to teach effectively but in the 21st century this is the *only* type of teaching and learning that is acceptable.

In much the same way as 19th century school buildings and curricula no longer meet 21st century needs, 19th century terminology has begun to exhibit its limitations. Schools are learning institutions, and key terminology should reflect their fundamental purpose: learning and leadership. Alfriston has thus adopted the following 21st century terms.

19th century terminology	21st century terminology
• Senior management team	• Senior leadership team
• Teacher	• Learning leader
• Teaching	• Learning leadership
• Classroom	• Learning space
• Classroom management	• Organisation of learning
• Head of department	• Head of learning
• Subject	• Learning area
• Teacher aide	• Learning assistant

Learning does not occur normally in discrete subject-based parcels. Real learning takes place in context and transcends boundaries. Students must "see the point" of what it is they are expected to learn. They must also be able to comprehend how any new learning fits into the framework of what they already understand.

Learning is cross-curricular but secondary teaching is specialist. This presents a challenge to create breadth and authenticity in learning yet retain the rigour of specialist study. Alfriston's solution is to work towards an integrated curriculum through collaborative planning. The broad framework of the curriculum is planned by all heads of learning acting in concert. Individual learners and members of the wider community are encouraged to participate in some sections of curriculum planning. Learning leaders then deliver the courses.

The Alfriston curriculum focuses on the development of the independent learner: students who are capable of planning and managing their own learning.

Students experience six different learning pathways:

1. **Thematic, synchronised cross-curricular subject-based or "blended" courses.** Teacher led curriculum "must-knows" within programmes respond to cross-curriculum themes.

2. **"Rich task assessment".** The timetable is suspended for a few days to enable students to demonstrate their learning by preparing and delivering a project-based assessment task using material delivered in the core programme.

3. **Three-day learning episodes.** The timetable is suspended for three days once a term. Students work in vertical groups within *Whanau* (described below) to carry out an intensive integrated-curriculum episode of project-based learning culminating in assessment by performance.

4. **Learning to Learn programme.** Core skills such as collaboration, problem solving, literacy and thinking are delivered explicitly.

5. **Tutor programme.** This focuses on developing a sense of belonging to the school community by fostering personal growth and the development of emotional intelligence.

6. **Independent learner class.** Individual students apply for a "license to learn" for one term at a time on a negotiated project. Students are released from the timetable and supported but not supervised.

Approximately 25% of learning in a school happens outside the classroom. Students learn about justice and equity from the values demonstrated every day. They also learn important skills about how organisations operate and make decisions. An area that is sometimes neglected is the learning acquired from a familiarity with their built environment.

Alfriston's school buildings and grounds have been used as tools for learning. The school is a theme park where the theme is learning. Environment quality and sustainability are explored through such features as a wetland eco-system to collect rainwater, network monitors of CO_2 and "truth windows" to show the construction of ducting and cabling behind walls. Location, distance, volume and proportion are illustrated by a walkway marked out in ten metre sections, a cubic metre sculpture of solid granite, mathematical patterns in the courtyard, lines of longitude and latitude marked in the paving, a transparent lift, a glass room in the library containing the five network servers, and

door signage that includes GPS co-ordinates. The entrance to the school is reached through a virtual forest complete with artificial bird song. Mosaic paving on walkways is added to yearly by students from the local primary schools in their final year before entry to the college.

Relationships, both intra-school and between the school and the community

Raised learning expectations place increased demands on the quality of the relationship between teachers and students and the school and its community. These relationships are fostered by the *Whanau* or house system. Each *Whanau* (*whanau* is the Maori term for family) functions as a community of up to 300 located in a purpose-designed two-story building. Classrooms or learning spaces are clustered around a general purpose commons area that contains lockers, toilets, kitchen facilities and furniture.

Students and teachers remain in the same *Whanau* for their entire school careers, however not all lessons are delivered within the *Whanau*.

The structure is used to select student leaders, deliver emotional intelligence programmes and carry out Learning to Learn programmes, and is the basis of a competition covering four areas: academic, sporting, culture and community.

The wider community is encouraged to use school facilities such as the theatre, *Marae* (ceremonial meeting house), cafeteria and gymnasium. Most of these are located in the "spine block" close to road access and parking.

Flexibility in learning spaces

The one hour, one lesson, one room, one class, one teacher structure is the basic unit of secondary curriculum delivery for many schools. Although effective, it is not always the best way to enhance learning. Alfriston uses 100-minute periods and exploits the flexibility offered by operable walls to respond to the particular needs of a learning activity and the number of students and teachers involved. Learning spaces can be configured to suit groups from 15 to 120.

Access to ICT

Students have access to an information and communications technology system than can be used anytime and anywhere in the school. Students share PCs on trolleys, rather than using individual laptops.

Music and sound are important learning tools for teenagers. The school has invested in a hardware and software sound control package that delivers a "soundscape" or a variety of up to eight sound environments through 320 speakers distributed throughout the campus.

Article by:
John Locke
Principal, Alfriston College
Auckland, New Zealand
Fax: 00 64 9 2690083
E-mail: j.locke@alfristoncollege.school.nz

Developing effective facilities for tomorrow's schools

Tomorrow's schools will reflect answers to two key questions. First, what is the most important condition for learning? And second, what are the most essential human qualities for success? Research now points to student engagement as the most important condition for learning and notes that social and emotional skills are more important determinants for success than technical expertise in any given area. To these findings are added the undeniable reality of a rapidly globalising society where competition for jobs comes not from one's neighbour or even a neighbouring town but from across the continents.

Today's educational model must change to conform to these realities. The present educational model is based upon uniformity, which goes against the grain of student engagement. Secondly, the current model focuses so much on academic achievement that it leaves little room for the full development of social, emotional and other aspects of human potential, aspects that are key to success and happiness. Thirdly, a changing global economy demands a level of training imbued with so much rigor and relevance that it renders today's curricula obsolete and irrelevant.

An argument can be made that facilities need to be ahead of the educational systems curve. Being modern and futuristic means that buildings designed today need to remain relevant and useable many years from now. In fact, buildings can actually become catalysts and drivers of change, accelerating a process that may otherwise have taken much longer. School buildings can become real symbols of change, but for that to happen it is necessary to reengineer the process by which they are created.

Developing effective school facilities requires five essential components: process, site selection, building design, high performance and post-occupancy evaluation. If applied, tomorrow's schools can become viable instruments of change.

Process

The purpose of the school development process is to shift the focus away from the building and toward the goals for the facility: to support the teaching and learning modalities of the 21st century, to serve as a centre of community, to strengthen links between the education and business sectors, to provide a forum for continuing education, to support research, to partner with higher education institutions and so on. Such purpose-built schools will almost never look and feel like their tradi-

tional counterparts because they do not begin with the assumption that classrooms and corridors are the basic building blocks for every school.

A good development process starts with involving as many stakeholders as possible during the early conceptual and planning stages of the school. For example, the Department of Education in Western Australia created a broadly representative Project Control Group to be the key decision-making body on all matters pertaining to planning, designing and constructing the new secondary school Canning Vale College. The Project Control Group was supported by technical working parties, each with community representation, dealing with issues such as curriculum, technology and shared community facilities.

Canning Vale College, Perth, Australia,
developed through a collaborative planning and design process
(architect: Spowers/Vitetta, planner: Prakash Nair)

For consulting also, it is important to acquire a team that meets many qualifications not traditionally required from school design teams. At Canning Vale, competing planning and design firms were expected to demonstrate these five qualifications:

1. The ability to deliver excellence in school design.
2. An understanding of the connection between school facilities and learning outcomes.
3. Familiarity with the latest research in the field of education pertaining to the way children learn.
4. Experience engaging communities in the task of school planning.
5. The capacity to build consensus within a diverse stakeholder community.

"An educated consumer is our best customer." This advertising slogan used by a clothing chain is valid for school

planners today. No modern school should be planned without some attempt to "educate" the client community about research-supported evidence connecting the built environment and learning outcomes. This can be done by facilitating a discussion around exemplar school designs from around the world in order to isolate aspects that may be transferable to the local context. But transference is not a one-way street. The purpose of real dialogue between and within the practitioner and stakeholder communities is to develop a shared vision for the school – one that will guide every aspect of its development. However, a vision should not be developed to the point where it becomes a prescription instead of a roadmap.

Site selection

One of the problems that plagues site selection is that it commences after a decision has already been made about the school that will be built. A more appropriate approach would be to first find good sites for the school. The school should be placed at the heart of its community, preferably, for elementary populations, within walking distance from where students live and, for secondary school populations, near a diverse range of activities. Even the size of the site is not as important as its location. If one is planning to build a 600-student school and can only locate a marginal site in an industrial part of town, it could be better to build two 300-student schools in converted commercial buildings or on infill sites in the heart of the community.

In the United States, the Inter-District Downtown School in Minneapolis, Minnesota, the Harbor City International School in Duluth, Minnesota, and Millennium High School near Ground Zero in New York City are all located in existing, non-traditional commercial buildings, and each takes advantage of the special attributes of its location where there is a rich interplay between the school and the surrounding community assets.

Building design

Although school clients are leery of allowing building design to proceed without all the ground rules being set, too much pre-planning is almost as poor a way of eliciting good design as one that is too open-ended. The school system in Seattle, Washington (United States), has found a way to solve this problem by defining a set of design guidelines that are performance-based. The Seattle approach is to set the goals for design but not to limit the designer's creativity. Here is a list of performance-based guidelines that, when tailored to the situation at hand, can not only serve the design team but also help the community to evaluate the quality of the work that was done:
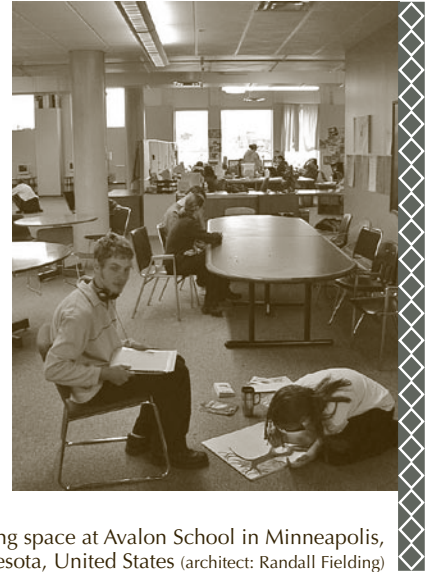

Millennium High School, housed in a commercial building near Ground Zero in New York City
(architect: HLW International, planner: Fielding/Nair International)

1. Does the building layout respect the idea of creating small learning communities – preferably smaller than 150 students and six teachers within discrete clusters? Do these truly elicit a feeling of belonging, or are they simply architectural sleights-of-hand that the school community will not recognise as distinct units?

2. Are the primary developmental differences among children respected by separating the youngest from the oldest?

3. Has there been an attempt to reduce or eliminate long double-loaded corridors and replace them with highly articulated "learning streets" and other areas that encourage socialising and provide opportunities for informal learning?

4. Are the common and community use spaces designed and laid out so that they can be utilised before, during and after school hours without disrupting the academic areas?

5. Do all classrooms or other principal learning areas have adequate natural light, and are classroom wings oriented in a predominantly east-west direction?

6. Has the media centre been located to maximise views and to support reading and small group work?
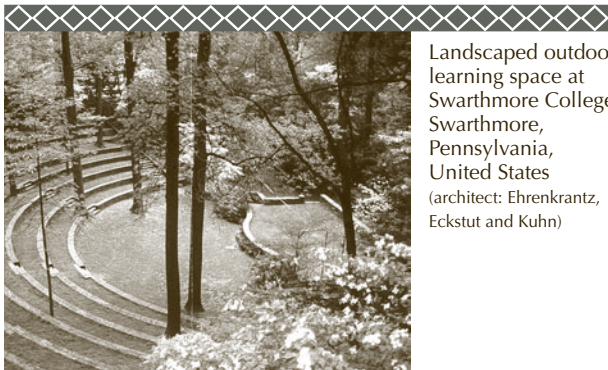
Media Center at Skagg Catholic Center, Draper, Utah, United States (MHTN Architects)

7. Are there comfortable areas within and around the school to encourage independent study and reading for pleasure?

8. Do children have access to food and beverages in formal as well as informal zones – "cafes" instead of cafeterias?

9. Is there anytime/anywhere access to appropriate educational technologies in the media centre and within the rest of the school? Are mobile computers, wireless networking and distance learning elegantly integrated?

10. Do students have adequate areas outside classroom spaces to work with technology on their own and/or with others?

11. Are opportunities to create outdoor learning areas maximised?

Landscaped outdoor learning space at Swarthmore College, Swarthmore, Pennsylvania, United States (architect: Ehrenkrantz, Eckstut and Kuhn)

12. Does the building design maximise opportunities for 21st century teaching and learning modalities (*e.g.* team teaching, peer tutoring, advisories, interdisciplinary curricula, multi-age groupings, co-operative learning and project-based learning)?

13. Does the design allow users to reconfigure spaces as needed on a daily basis in the short term, and is the building itself flexible enough to allow for more significant changes over time?

14. Does the building serve as a community centre with a strong visual and functional presence while at the same time being seen by its students as "intimate" and non-institutional?

15. Are laboratories and other specialty rooms designed with flexibility in mind? For example, are science laboratories laid out with fixed services like sinks and gas lines at the periphery with mobile work tables that can be rearranged at will?

16. Is there a "home base" for every student? In the higher grades this could be a workstation and in the lower and middle grades this could be a dedicated cubby or locker.

Flexible learning space at Avalon School in Minneapolis, Minnesota, United States (architect: Randall Fielding)

High performance

High performance design is not only about energy conservation and environmental sensitivity, but about an intelligent planning and design process. The idea is to utilise our knowledge of the connections between sustainable architecture and its impact on human physiology, psychology and behavior to design buildings that will improve learning outcomes as well as physical, spiritual and emotional well-being.

Post-occupancy evaluation

Post-occupancy evaluation can be a useful tool to maximise the benefits of the built environment for the current users of a building and also to gather valuable feedback that can serve in planning and designing future schools. The need for an effective evaluation is even more critical for schools with innovative designs since they have few precedents. In a post-occupancy evaluation, two key questions need to be asked:

• Have teachers and staff been exposed to an in-service training programme to help them maximise the benefits of the new school facilities and facilitate the utilisation of the building as a "3D-textbook" for students?

• Have the design expectations been realised – how does the building rate with the user community?

Article by:
Prakash Nair
President, Fielding Nair International
New York, United States
Fax: 00 1 718 263 1635
E-mail: prakash@designshare.com
www.FieldingNair.com

Secondary schooling purposes and design

A strong link exists between the purposes of schooling and school designs. As we advance into the 21st century, it is crucial to clarify our ideas of the purposes of secondary schools. Not only is this important to ensure that the physical facilities do not hinder the learning process, but also to guarantee that the enormous investment made in school facilities gives a sound return. Only when the purposes of secondary education are identified can school facilities be suitably designed. This article presents the common purposes and sub-purposes of secondary schooling with their design implications, along with scenarios for the future of schooling.

Balwyn High School auditorium, Balwyn, Australia

Shenton College (secondary school), Perth, Australia

Throughout history, education systems have aligned to differing purposes – often more than one at a time. Generally the four common purposes are considered to be:

1. **Socialisation** – to replicate society, to imbue local and national culture, and to promote citizenship.

2. **Vocation** – to train people for employment.

3. **Self-fulfilment** – to develop individuals to their maximum potential.

4. **Transformation** – to provide equal opportunity for learning and to encourage change for a better world (Sterling, 2001).

Most secondary schools are designed with a combination of these purposes, however the following sub-purposes can also influence design:

• Discipline and supervision.

• Organisational efficiency and economies of scale.

• Filtration, channelling and caretaking.

• Equality and equity.

The purposes and sub-purposes of schooling are being re-examined in a world which is experiencing great societal, economic and educational change. This has led some to create scenarios of what schooling may be like in the future.

Purposes of schooling

Different stakeholders within the broader education system have different expectations. Governments equate success with an educated workforce that contributes to economic growth and promotes good citizenship. Since the introduction of mass education, governments have consistently striven for a process of socialisation and nationalisation. Employers are also looking for an educated workforce; they seek team workers and problem solvers. Students and their parents desire individual success. For the majority of students and parents, this may emphasise the vocational purpose. Some academically-gifted students may have a more liberal attitude to the educational experience and find self-fulfilment in learning as much as possible (Vick, 1998).

Let us consider secondary school design in the light of the four generally accepted purposes of schooling mentioned above.

Socialisation

Schools designed to promote socialisation address the concept of the community within the school as well as the relationship of the school to the external community. Specific design features include:

• Geographic connection to the hubs of community.

• The house model and/or the studio model of learning.

• Traditional or café type dining precincts.

• Boarding or motel type accommodation.

• Amenable places for informal gathering and learning.

Vocation

Secondary schools are less commonly required to provide vocational accreditation than in the past. Societal and employment changes have had the dual effects of eliminating some avenues of employment while increasing the technical requirements of others. "Credentials inflation" has increased the entry requirements into many fields of employment pushing more students to seek tertiary qualifications, in universities or technical colleges, before entering the workforce.

Nevertheless, secondary schools are providing more applied learning to cater for students who are not suited to traditional academic learning. Rather than have these students drop out of school all together, it is considered preferable to keep them in formal education for as long as possible. Moreover, given the difficulty in obtaining university places and the concern about declining trade skills within society, there is a return to applied learning in secondary schools with alternative pathways leading to the completion of compulsory education. For example, courses are offered in areas such as hospitality, graphics and technology as alternatives to the traditional academic subjects.

Specialised facilities are required for these subjects but not all schools are able to provide for them. Networks of schools and technical colleges have therefore been formed to share this learning.

Cooking facilities at the Goulburn Ovens Institute of TAFE, Seymour Campus, Seymour, Australia

Self-fulfilment

Whilst self-fulfilment takes place through formal learning activities and socialisation at school, it is also facilitated by such activities as sport and performing arts. These extra-curricula subjects are offered to provide students with a more well-rounded general education, rather than necessarily as career alternatives, although for some, they will be. Sport, in its various forms, requires specialist facilities as does music and drama. Often such facilities are also available for community use.

Designs for self-fulfilment activities create spaces which encourage individual learning, reflection and research, as well as spaces for discussion and team work to allow for informal learning between students.

Transformation

Schools as places of transformation must focus on student development. This should happen through both the formal and informal learning processes.

If secondary schools are to be successful in the Knowledge Age, then students need to leave them having acquired a desire to continue the process and engage in lifelong learning. Unfortunately many leave with negative experiences that almost ensure they will never return to places of learning. Various factors can contribute to this, and the physical environment is one of them. Many of our schools are not spiritually or educationally uplifting places to be. They may be functional to an extent but they fail to produce any aspect of delight.

Public schools are intended to be places of equality of opportunity both educationally and in the provision of facilities. Too often in practice this is not the case. To achieve equality with the provision of facilities, governments tend to produce standard space-schedules based on enrolment numbers. Although not impossible to overcome, this constraint creates a tension with architectural innovation.

As places of transformation, schools are increasingly required to adopt the provision of additional social services for students, their families and the wider local community. Health practitioners of various guises and other social and

Quadrangle of the Carey Baptist Grammar School (kindergarten to year 12), Melbourne, Australia

psychological consultants and/or business activities are put forward as potential partners to schools. Incorporating these additional activities is designed to break down the notion of the isolationist school and assist students to enter into society. At the same time, schools become more efficient and effective. Transforming schools into education centres which are accessible for greater periods of time is a vehicle to enable this.

Sub-purposes of schooling

Sub-purposes of secondary schooling also influence school designs to various degrees. Some of these conflict with the main purposes.

Discipline and supervision

Schools are understood to be places of discipline. In the broader sense, discipline is the shaping of the student in a controlled and positive environment, often with the purpose of "social engineering". Discipline can also mean punishment for wrong-doing or breaking the rules.

Supervision is an integral part of discipline, and the "duty of care" for students is one aspect. Physical supervision is mostly achieved by visual oversight or, more recently, electronic surveillance. Traditionally sight lines were important and had the unfortunate consequence of reinforcing the long and straight corridors of many public schools. Providing a safe school also involves identifying all staff and visitors who enter the grounds. However this creates a tension with the school's projection as an open and friendly community facility.

Organisational efficiency and economies of scale

School design has always been subject to organisational efficiency and economies of scale. In the post-war period when large numbers of students had to be accommodated in schools, standard designs utilising low-quality and low-priced materials prevailed. Currently, design and building efficiency is maintained by standard space-schedules, which tend to emphasise minimum rather than optimum spaces, and lower-end construction budgets.

Economies of scale are also achieved by increasing the size of schools. Whilst this has an economic impact, there are also arguments for the benefit of larger course choices due to size. Opposite points of view maintain that there is a loss of community as the size of the school increases. Some of this may be overcome by introducing sub-schools or house groupings.

Filtration, channelling and caretaking

Some view secondary schools as a filter for students progressing to further education or employment. In a positive sense, students' inherent intelligence, talents and aptitudes can be identified and channelled in suitable directions. However this filtering process can sometimes result in type-casting students as academic or not. When students who are disaffected by this sorting process want to leave school before completing compulsory education, schools can be reduced to the role of caretakers.

Equality and equity

Equality and equity have significant implications for school design. Equality of opportunity and provision means giving every student the same learning environment, and is an important element of schooling as a transformative purpose. Regrettably, because of the interplay of various elements, this is rarely achieved in practice.

Equity, on the other hand, means giving students what is necessary to extend them to their full potential. Some may need additional tuition to bring them to the standard of the rest of the group, while others may need additional tuition to take them beyond the group because they are capable of further development and learning.

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Canterbury Girls' High School, Sydney, Australia

Scenarios for the future

Among the various scenarios constructed for the future of schooling are those proposed by the OECD and by the Australians K. Suter and B. Caldwell.

The six scenarios presented in the OECD publication *What Schools for the Future?* are:

1. Strong bureaucratic systems would resist radical change while performing fundamental tasks that would not always be well recognised.

2. Market approaches to school would expand significantly, stimulating widespread innovation but creating difficult transitions and widening inequalities.

3. Schools would enjoy a high status as community institutions and provide bulwark against social fragmentation.

4. Schools and teachers would network widely in "learning organisations" which would have high levels of public trust and strong equity features.

5. Institutions and systems would be dismantled and replaced by diverse learning networks as part of a "network society".

6. The teacher supply problems would reach crisis proportions threatening a "meltdown" despite concerted policy measures.

K. Suter poses three scenarios for future schooling. In his first, schools would continue to operate basically as they do at present. This is premised on the fact that people do not like change, that most of the teachers who will be around in ten years are in the service now, and that since the infrastructure is already in place, the conservative forces will act to preserve the status quo. This is not an attractive scenario and is not sustainable. The second scenario is that students would be educated at home via cyber schooling. This would free up a lot of real estate and promote individually tailored learning but would neglect socialisation. The third scenario is represented by the community learning centre; keeping the school facilities but expanding and changing their role, and adding forms of learning for all ages, food at all times and other community services such as health and sport.

B. Caldwell also offers three scenarios. The first supposes that the divide between public and private schools would increase and that public schools would only act as safety nets in the public domain. Government would support the private school networks. In the second scenario, there would be a greater commitment to the public good. This would be evidenced by the government vacating the ownership and delivery of education but actively supporting all schools through increased revenue. Community support would be high. Curriculum and learning technologies would be varied and state-of-the-art. The third scenario is that schools would decline as institutions and their place would be taken by community learning centres and home based learning. With an eye to adhering to core values, Caldwell constructs a matrix for the three scenarios based on liberty, equality, fraternity, efficiency and economic growth. On this basis his second scenario is the preferred option.

Suter virtually leads us to adopt his third scenario, of the community learning centre, as the most acceptable. One can imagine further consolidating school real estate and extensively upgrading the remaining stock. Caldwell bundles this option in with the growth of home based learning.

Suter's scenarios are clearly linked to the building fabric of schools whereas Caldwell's are not. But we can imagine that if all schools are in the private domain and have strong community support, they would be free to design and create their own physical environments within the funding available to suit their purposes and integrate with their communities.

Synthesising Suter's third and Caldwell's second scenarios results in a community learning centre which is operational all hours, accessible to all people, privately operated but government resourced, and is well equipped with state-of-the-art facilities and learning materials appropriate to the specialisations on offer.

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Article by:
Andrew Bunting
Director
Architectus Melbourne
Abbotsford, Australia
Fax: 00 61 (03)94 29 84 80
E-mail: andrew.bunting@architectus.com.au