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# SUSTAINABILITY FOR LEARNING ENVIRONMENTS

**EDITORS' PREAMBLE:** *Every brief and every client anticipates that building designs will be informed by sound environmental decision making. Quantitative research, particularly from the USA, has confirmed our commonsense notion that learning improves with good lighting, ventilation and water proofing as well as thermal comfort and acoustic control. In this paper, Dominique Hes provides an introduction to and critique of the relatively new Green Star rating tool for education buildings. One of the aims of the rating tool is to provide a road map for designers and clients to help them make good environmental decisions.*

*Dominique concludes with a critique of the current rating tool for education and a suggestion for how to move forward even if the tool is not yet ideal.*

Thornbury School
Architect: Luke Middleton from eme Design Pty Ltd
Image: Scott Haskins

## INTRODUCTION

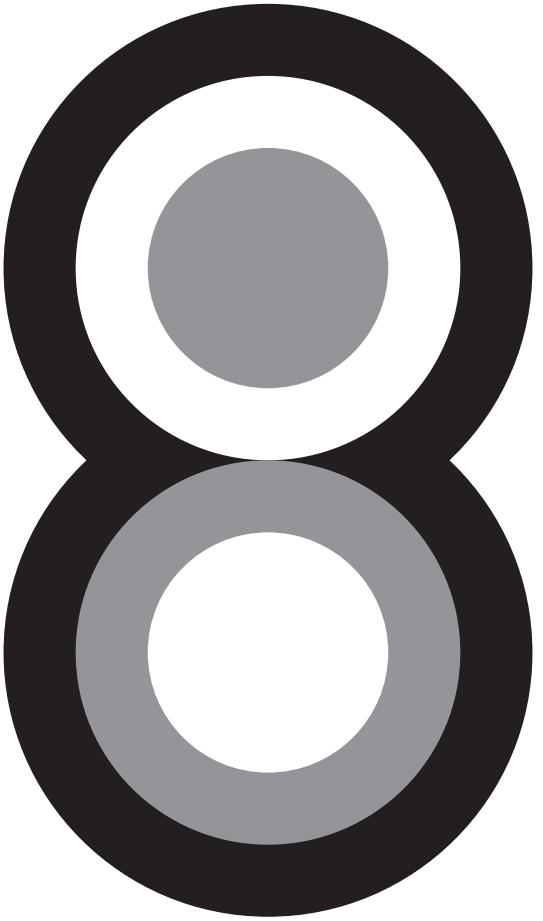
Schools have a significant impact on the environment through their embodied and operational use of resources and through their ability to shape young minds.

Further, school design has a significant impact on the ability of the teacher to teach and the learner to learn.[1] Currently, there is a large investment being made in the renewal of existing schools and the design of new ones[2] along Ecological Sustainable Design (ESD) or 'green' principles. But in the push to produce greener schools, it is important not to forget that that these spaces need to work well pedagogically as well as ecologically; the design of schools should provide effective healthy learning spaces that use energy, water and resources efficiently. This paper briefly introduces Green Star—Education v1 and how it is used, but its main focus is on those aspects of the rating tool that relate to the provision of effective learning environments. This will lead to a suggested definition of what it might mean to create effective, 'green' learning environments.

Effective Learning Environments (ELEs) support teaching and learning by providing the appropriate facilities and environments to carry out learning activities. That is supporting student centred, problem based learning through the ability to use multi communication methods, engagement with knowledge in active, flexible ways and the ability to work at different scales with different sized learning groups.

**1** See for example Brian W. Edwards, Environmental design and educational performance, with particular reference to 'green' schools in Hampshire and Essex. *Research in Education*, Issue 76, 2006, p. 27. Mark Schneider, *Do school facilities affect academic outcomes?* http://www.edfacilities.org/, Washington: National Clearing House for Educational Facilities, 2002. Susan Hallam, *Improving School Attendance*, Heinemann Educational, 1996. National Research Council, *Review and Assessment of the Health and Productivity Benefits of Green Schools: An Interim Report.* The National Academies Press, Washington, 2006. Clark, H. *Building Education: The Role of the Physical Environment in Enhancing Teaching and Research*, Institute of Education, University of London, London, 2002. **2** In the 2008 Australian National Government Budget $1.7 billion was committed over four years to maintain, upgrade and replace school infrastructure. An additional $481 million has been committed to the Solar Schools Program (Julia Gillard, Rebuilding Australia's Schools, Media Release dated 13 May, 2008 Available at http://mediacentre.dewr.gov.au/mediacentre/Gillard/Releases/RebuildingAustraliasschools.htm, accessed on May 19, 2008).

# TAKE



TAKE 8
LEARNING SPACES: The transformation of educational spaces for the 21st century.

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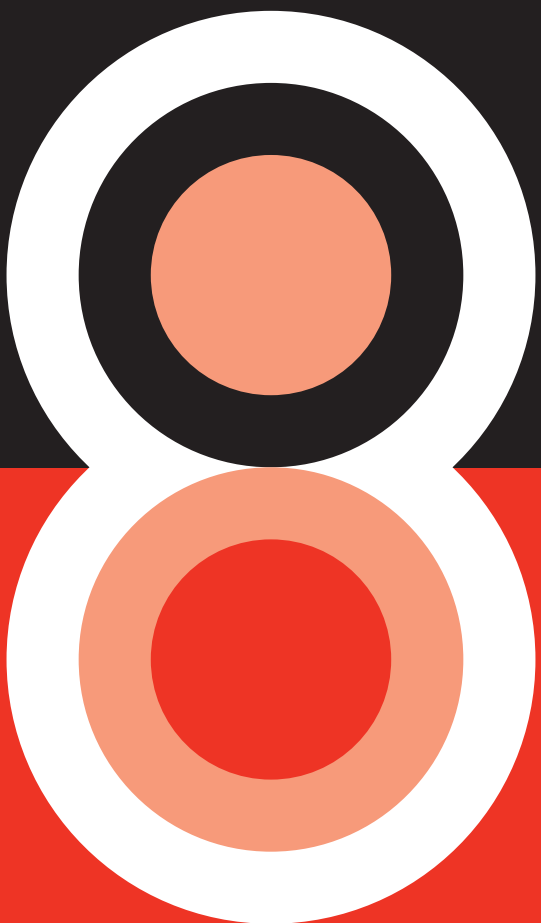

# LEARNING SPACES

The transformation of educational spaces for the 21st century

Clare Newton + Kenn Fisher (Eds)

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**SPACE IS IRREVOCABLY LINKED WITH PEDAGOGY. THE SHAPE AND SIZE OF THE SPACES, THE FURNITURE,AND THE FINISHES ARE SILENTINFLUENCES ON THE BEHAVIOUR OF EDUCATORS AND STUDENTS.**

# INTRODUCTION

*TAKE 8 explores the intersection between architecture and education with a focus on Australia. Under the title of* ***Learning Spaces****, the editors have asked researchers and practitioners from both education and architecture to contribute their reflections on the relationship between learning and physical space. TAKE 8* ***Learning Spaces*** *has grown out of an Australian Research Council Linkage Grant called* ***Smart Green Schools.*** *Both editors and many of the authors are contributors to that research as Chief Investigators, Industry Partners or PhD students.*[1]

TAKE 8 contains a mix of refereed journal articles, papers by practitioners, case studies and edited transcriptions of interviews and advice from professionals and academics working in the field. The papers and interviews will take you through the process from design conception of the educational philosophy to the implementation of new learning spaces.

An ambition for TAKE 8 is to support better communication between educators and designers. We have included two glossaries in recognition that we come from different disciplines with our own tribal languages and ways of knowing.

Space is irrevocably linked with pedagogy. The shape and size of the spaces, the furniture, and the finishes are silent influences on the behaviour of educators and students.

The interaction between space and learning is complex and the impact of the space on teaching can be invisible to its occupants. Not surprisingly, the most innovative spaces have evolved as design responses to strong pedagogical direction in schools.

TAKE 8 can be viewed as being organised largely into two categories. The first can be considered under the overall concept of *educational planning* which includes the first three chapters:

- *Educational transformation* (Lynne Sutton, Sue Wilks)
- *Linking pedagogy and space* (Mike Davies, Ty Goddard)
- *Learning environments*—formal and informal (Peter Stewart, Ken Woodman and Ben Cleveland, Peter Jamieson)

The second significant category of the TAKE 8 organisational model is that of *planning and design.* These themes include the following authors:

- *Civic connections* (design and community) (Max Chester, Stan Salagaras)
- *Design and architecture* (Mary Featherston, Geoffrey London and Jennifer Calzini)
- *Sustainability* (Dominique Hes)

The two categories are best understood as loose rather than defined. It is difficult to tease pedagogy and educational transformation away from planning and design. These close links between pedagogy and design are best illustrated in the case study interview on Dandenong High School.

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**1** Researchers at the Faculty of Architecture, Building and Planning at the University of Melbourne received ARC Linkage Grant funding to investigate the influence of innovative and sustainable school building designs on the education of middle-year school students. A teacher and architect were awarded APAI scholarships to work on the research topic in collaboration with the five Chief Investigators. The research is unusual in that it sits at the intersection of education and architecture. The Chief Investigators Clare Newton, Senior Lecturer in Architectural Design and Practice, Dr Dominique Hes, Dr Sue Wilks, Dr Kenn Fisher and Professor Kim Dovey respectively come from the diverse fields of architecture, sustainability, education, facility management, and urban design. Partners for the Smart Green Schools project are The Department of Education and Early Childhood Development (Victoria), the Office of the Government Architect (Victoria), Hayball, Mary Featherston Design, H2o Architects, McGauran Giannini Soon Pty Ltd, Sustainable Built Environments, Rubida Research, & McBride Charles Ryan. Loris Malaguzzi *The Hundred Languages of Children: Catalogue of the exhibition.* Reggio Children 1996 p.40

Educational planning is a concept that has been adapted from the health sector, where health planners are in great demand to work alongside doctors, nurses and administrators together with design teams of architects, engineers and quantity surveyors. They, and educational planners, develop and articulate an operational model that involves interpreting key discipline concepts and outlining these to architects. Conversely, they also work with architects to interpret their design language so that teachers can engage with the collaborative design process.

Editor Kenn Fisher has written extensively on this and likens the role of educational planners to that of advocating spatial literacy. This is an important concept in education, particularly as multiple literacies, as espoused by Gardner[2], reflect the significant array of literacies and competencies learners—and teachers—need.

Both Australia and New Zealand are recognised internationally for their innovative approaches to education curricula and learning spaces. Ty Goddard, Director of the British Council for School Environments, worked with the Smart Green Schools team during several months in late 2008 and early 2009. In an interview with the editors, Ty Goddard records his impressions of innovation in school design within Australia and notes the differences and similarities with the UK.

To an extent, the Australian state and federal governments have been following in the footsteps of the UK in terms of funding and processes. Both Australia and the UK have committed unprecedented funding to education infrastructure in recent years. The UK Building Schools for the Future, BSF, program was a strategic approach to capital investment announced in 2004. The UK government in partnership with local education authorities aimed to upgrade, rebuild or remodel schools so that every child would be educated in 21st-century environments which were 'flexible, inclusive and attractive' (see exctract right).[3]

Australian governments made a similar commitment to upgrade schools. In TAKE 8, initiatives developed within the Department of Education and Early Childhood Development, Victoria, are described in interviews with Lynne Sutton and Peter Stewart. Concurrently, other Australian states have developed programs for upgrading and rebuilding schools. Education departments in some states across Australia are developing schools through a procurement process called Private Public Partnerships, PPPs, similar to the UK Private Finance Initiative, PFI. In this process, developers build and manage the school environment for a lifespan such as 25 years.

### EXTRACT FROM A 2004 FACTSHEET FROM THE PRIME MINISTERS' OFFICE—UNITED KINGDOM

Prime Minister Tony Blair said:

> *"Over time this investment will see the entire secondary school building stock upgraded and refurbished in the greatest school renewal programme in British history.*

Capital funding available for investment in school buildings has risen sharply from £683 million in 1996-97 to £3.8 billion in 2003-4. It increases further to £4.5 billion in 2004-06 and to £5.1 billion in 2005-06.

BSF will include both conventional and Public Finance Initiative funding. Of the £2.2 billion for BSF, £1.2 billion (55.5%) will be covered by Public Finance Initiative credits.

[http://www.number10.gov.uk/Page5801]
Sourced: June 16, 2009

**2** Gardner, H. 1983, *Frames of Mind: The Theory of Multiple Intelligences,* New York: Basic. **3** [http://www.number10.gov.uk/Page5801] Accessed June 16, 2009

Spending on schools in Australia accelerated exponentially this year. In February 2009, in response to a world-wide economic downturn, the Australian federal government committed $16.2 billion over three years for the Building the Education Revolution, BER, program. Spending was focused on primary and secondary school infrastructure along with 500 new science laboratories and language learning centres in secondary schools. What was the catch? Spending had to happen quickly. The government's focus was primarily on job creation and protection to avoid a recession. State education departments quickly developed a range of template designs to facilitate schools getting proposals funded and ready for construction. It is too soon to capture the impact of this rapid spending. The template designs developed for the state of Victoria have operable walls which enable choice between a traditional classroom setting and a more fluid open-plan setting. Keeping options open has meant that the settings are not bespoke matches between pedagogy and space as seen in the Broadmeadows, Dandenong and Australian Science and Mathematics School case studies.

The question of why classrooms have persisted for so long cannot be ignored. There is a dark joke that has been around educational circles for some time, imagining Rip Van Winkle waking up after 100 years. He is bewildered as he visits airports, offices, shops and hospitals. Nothing is familiar until he finally sees a classroom and knows exactly what it is even though the blackboards are now white.

Many teachers at school and university levels remain committed to the classroom and lecture theatre as the best venues for teaching and learning. The open-plan schools from the seventies and eighties are still fresh in our collective memory and are often remembered as noisy and chaotic learning environments. There are lessons which can be learnt from that time but there are also new opportunities particularly because of the ease with which students can now access information and networks of people. The paper by educator Ben Cleveland and architect Ken Woodman tracks school design in the eighties against current thinking.

What is different for today's students? The access to information and learning within a virtual world is pervading and enriching student learning. This year, the Australian government has committed $43 billion over eight years to roll out a National Broadband Network which will reach 90 per cent of homes. We will be the first country in the world to have such an extensive network enabling information-rich content to be rapidly transmitted. Concepts such as 'cloud computing' will mean users can access infrastructure and programs via the internet without reliance on a particular computer. For students, the learning environment will more easily extend beyond the classroom walls. Global neighbourhoods will be enabled with students more able to work and play effectively within collaborate groups that are non-collocated.

Schools are gradually changing from classrooms into learning and information environments. Students play, communicate and learn in virtual as well as physical worlds. Schools are therefore shifting from teaching institutions to learning organisations through increased connectivity between students and their local and global environments. As teachers are released from being the knowledge providers, they can work with students as co-learners on authentic problems which draw on interdisciplinary knowledge. Physical space for learning environments is being rethought as interdisciplinary learning requires a range of settings.

Funding for both schools and higher education environments needs to be adjusted to recognise the importance of informal learning. Associate Professor, Peter Jamieson has written a paper which describes new campus based initiatives to support informal learning. Spaces for informal learning and collaboration need further consideration in the internal and external school settings. Editor, Clare Newton, is taking a travelling studio group of architecture design students from the University of Melbourne to the famous Thomas Jefferson campus at the University of Virginia. Their aim is to work with a group of University of Virginia students to develop propositions for informal learning environments. As the students work through the design process they are reflecting on their own learning and communication outside the timetable.[4]

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**4** The studio is part of a research project for a Master of Science (Information Systems) student, Kate Goodwin under the supervision of Dr Frank Vetere and Dr Gregor Kennedy at the University of Melbourne. Her topic of *"Slippery" Interactions: Exploring Informal Interaction and Co-Presence in Hybrid Spaces for the Support of Student Learning* aims to record how virtual and physical learning spaces converge to facilitate learning behaviour.

School environments embody our society's attitude to youth and education—they are a significant community asset with the potential to provide settings for lifelong learning as well as other community venues for recreation and services. The recent injection of funds into school and university infrastructure will help ensure that students are educated in facilities that are valued by the community as assets. Hopefully the new learning spaces will also be inspirational and support student engagement.

Papers by architect Max Chester and educator/developer Dr Stan Salagaras describe the benefits of schools sharing facilities with other schools and with the community.

Briefs to architects for school and higher education facilities increasingly require responses to issues such as embodied energy, environmental impacts, operating costs and life-cycle costs. The article by Dr Dominique Hes outlines the new Green Star rating system being used in education and argues for thinking of the building as a 3D text to support student learning about the environment.

Each of the schools described in the case studies is the result of a transformative design process in which educators have explored alternatives to the classroom model of pedagogy. The drawings and images of one case study school are expanded by a conversation between the designers and educators. In the conversation, the partnership of educators with designers is highlighted along with role of leadership and key moments in the transformative process.

*The process from educational brief, to architectural brief then into design, documentation, construction and occupation is a tangled path that needs to be negotiated. Pitfalls can occur which risk undermining the success of new spaces. Stories abound.*

### EXAMPLE ONE

A principal and a leadership group work hard to transform a traditional classroom setting into an open-plan, fluid team-teaching environment. The building is completed but the furniture seems to have been forgotten. A teacher is given a range of furniture brochures and has less than a week to select furniture. How does he decide? The importance of furniture in the success of a learning environment is not well understood by educators even when the educators are trying to develop new learning settings and pedagogies. Design advice is not often available to help with furniture selection.

### EXAMPLE TWO

A new open-plan learning environment is documented but the quantity surveyor's estimate of cost is over the budget. The acoustic treatment of the spaces is removed from the contract to bring the estimate back to within the budget. The contract is tendered to builders and the winning price is well below the budget but the department of education will not allow the acoustic treatment to be reinstated. The teachers and students occupying the new spaces are now struggling with poor acoustics.

### EXAMPLE THREE

One open-plan learning environment is included in a school which is otherwise classroom focused. The acoustics, the furniture and the ICT facilities are unsatisfactory. Teachers allocated to the space relocate their students whenever possible to the library or a computer laboratory. Even if the acoustics, furniture and ICT facilities were improved overnight, the editors suspect that this space will still not function in an optimal way unless the educational strategies, space ownership and timetabling are adjusted.

A literature review by Higgens et al (2005) suggests the success of any new school is largely determined by the extent to which, and the ways in which, stake holders such as teachers, students and the community are involved in the school design process. They suggest the message is clear:

*School designs cannot be imposed nor bought off-the-shelf. Success lies in users being able to articulate a distinctive vision for their school and then working with designers and architects to create integrated solutions. The open-plan classroom movement showed that purely physical design solutions that are not owned by their users or supported with effective systems and behaviour change will not work. (Higgens et al 2005: 3)*[5]

An early finding from the Smart Green Schools research has been the importance of good professional development and change management as new schools spaces are developed. Dr Sue Wilks and Mike Davies contribute papers on how best to support change within the teaching profession from the perspective of educators.

The change process ideally begins with the educators prior to the designers being appointed. Good leadership is a crucial ingredient. Teachers often speak of how a visit to an exemplar school is a changing point in their understanding of how space impacts on learning.

The chapters of TAKE 8 are structured to begin with the transformation of education. Later chapters deal more specifically with design issues and sustainability. A key understanding that readers will gain from the papers is that it is not enough to explore how space can support new pedagogies. The space needs to fit the philosophy and educational structure of the school.

## THE REFEREEING PROCESS

Selected papers were double blind refereed before being accepted for publication as a refereed paper, being those by:

- Dr Sue Wilks
- Ben Cleveland and Ken Woodman
- Associate Professor Peter Jamieson
- Dr Stan Salagaras
- Dr Dominique Hes

The refereeing was managed by the Chair of the Sisalation Steering Committee, A/Prof Julie Willis, without reference to the Editors.


## ACKNOWLEDGEMENTS

The editors thank Fletcher Group and the Australian Institute of Architects for the Sisalation Prize and facilitating the publication of this edition of TAKE. In addition, the editors thank the members of the Sisalation Steering Committee for managing the process. Particular thanks are given to Associate Professor Julie Willis who chairs the Sisalation Committee and managed the blind refereeing process. The editors and the refereed authors appreciate the referees' critical and useful feedback.

The editors appreciate the professional support provided by the AIA representatives on the Sisalation Committee, Melissa Medcalf and Martha Liew and copyediting by Della Thomas.

The editors thank both Meredyth Taylor and Ana Sala-Oviedo from Rubida Research for efficiently supporting the editorial process and helping with collecting and collating information.

Both the authors and the interviewees are thanked for their contributions on this important topic. The editors have appreciated the generous support by many who provided documents and images, transcriptions and case study notes. In particular, Dr Sue Wilks, Kate Marks and Ben Cleveland are thanked for help with transcriptions and case studies.

The editors appreciated the excellent graphic design service offered by Orbit Design.

Much of this publication has arisen out of research being undertaken within an Australian Research Council Linkage Grant funded project called Smart Green Schools.


**5** [1] Higgens, S., Hall, E., Wall, K., Woolner, P., & McCaughey, C., 'The Impact of School Environments: A literature review', The Design Council, http://www.design-council.org.uk/ London: 2005.

# EDITORS

## CLARE NEWTON

—

**Faculty of Architecture, Building and Planning, The University of Melbourne**

Prior to working at the University of Melbourne, Clare was a Director of the architectural firm, Newton Hutson Pty Ltd. In 1998, Clare received the Victorian NAWIC Award of Excellence for Innovation in Construction. Clare has been a Council Member of the Victorian Chapter of the Australian Institute of Architects, AIA, and Chair of the AIA State Education Committee. In 2003, Clare was one of 19 Melbourne architects asked to debate the best Victorian architecture from the past 75 years for the 2003 book titled *Judging Architecture*. She has been invited as a guest architecture critic at interstate universities and has been the AIA Competition Advisor on many architecture competitions including a new school and a campus building for neuroscience. She regularly sits on selection committees for architects and award juries. Clare was a jury member with the Government Architect and DE&T for the inaugural Minister's Awards for Innovation in Victorian School Buildings.

Clare's research is interdisciplinary. While her focus is on architectural practice and the translation gaps which occur between architectural ideas and their built form, she has other research strengths in pedagogy and the use of innovative IT suitable for communicating visually rich information. Clare is first named Chief Investigator on two Australian Research Council Linkage grants worth over $1 million in research funding. Since 1997, she has won several nationally competitive grants in multimedia. These multimedia projects developed web-based communication of visually complex information.

In 2005, Clare completed a Grad. Cert. in University Teaching and is currently undertaking a Doctorate of Education in order to better understand how learning spaces can better support 21st-century education.

## DR KENN FISHER

—

**Rubida Research, Woods Bagot and Associate Professor, Learning Environments, The Faculty of Architecture, Building and Planning, The University of Melbourne**

Kenn is recognised internationally as a leading educational facility specialist. Throughout his 30-year career he has worked in a range of disciplines in all education sectors as a teacher and academic, a structural engineer, a strategic planner, a campus planner, a project manager, a facility manager and, more recently, as an educational researcher. Now operating exclusively as a specialist in campus master planning and educational facility strategic consulting and architectural briefing, Kenn acts as the prime interface between designers, teachers and students to create environments for new teaching, learning and research trends. He has been engaged by more than 30 universities in Australia and overseas, numerous vocational training and community colleges, a number of state and national government ministries of education and many school organisations, and has directed numerous consulting and master-planning studies. Two of these projects include leading the winning design team of the United Arab Emirates University campus plan competition and serving as project director for one of the world's leading bioscience research campuses, the Waite Institute at the University of Adelaide. Kenn has served as a campus master planner for more than 20 institutions. He has also undertaken consulting for UNESCO in Laos and has been responsible for projects in Thailand, the United Arab Emirates and Europe.

Kenn wrote 'Linking Pedagogy and Space' guidelines for the DEECD for the Leading Schools Fund programme discussed in the next section.

Kenn has been invited as a member of several juries to determine winners of design competitions. From 1997 until 1998 Kenn was the head of an OECD Program on Educational Building in Paris and was responsible for overseeing 12 activities related to educational building planning, design and management for 25 countries in all sectors of education.

In addition to Kenn's PhD, he was awarded an honorary Doctor of Science (honoris causa), Deakin University *in recognition of his outstanding contribution to the fields of campus master planning and educational facility strategic planning, both within Australia and internationally.*

Kenn is a part-time A/Professor at the Faculty of Architecture, Building and Planning at the University of Melbourne.

## TOOLS

To support the design and construction of effective 'green' learning spaces, building rating tools, guidelines and checklists have been developed in many countries. However, caution needs to be applied in their use, for the tools may not cover: *'the social aspects of sustainability such as inclusion, participation and fair shares for all. Nor ... take account of what makes a good learning environment (for example... integration of external and internal space, flexibility of spaces for different uses, adaptability of building structure etc.)'*.[3] That is, they are only useful in as far as they facilitate the design of effective learning environments. If a 'green' school does not facilitate learning then the author would argue that it is not sustainable and the invested energy and resources have been wasted as the designed space is not fulfilling its function.

Yet rating tools can provide a road map that together with educator input can lead to buildings that are sustainable. The recently released Green Star—Education v1 rating tool is one such tool. It has been based on the Green Building Council of Australia's (GBCA) experience with office building tools which were developed using the UK's Building Research Establishment Environmental Assessment Method (BREEAM) system, and the North American Leadership in Energy and Environmental Design (LEED) system.

According to the GCBA[4] the Green Star rating system was created to:

- *define green building by establishing a common language and standard of measurement;*
- *promote integrated, whole-building design;*
- *identify building life-cycle impacts;*
- *raise awareness of green building benefits;*
- *recognise and reward environmental leadership; and*
- *transform the built environment to reduce the environmental impact of development.*

Green Star—Education v1 is a tool designed specifically for educational buildings because of their unique requirements and user profiles. Also, unlike the office tools, the Green Star—Education v1 tool incorporates a tailored energy calculator that assesses the designs based on their potential and predicted greenhouse gas emission in operation.[5] It is designed as a voluntary tool and aimed at the industry-leading project. The pop-out box over outlines the tool and describes the process of using the tool.

Woodleigh Grammar School
Strawbale walls
Architect: Luke Middleton from eme Design Pty Ltd
Image: Scott Haskins

**"RATING TOOLS CAN PROVIDE A ROAD MAP"**

**Dr Dominique Hes**

**3** Jane Wilkinson, *Leading Sustainable School Building Projects,* Nottingham: National College for School Leadership. Available at http://www.ncsl.org.uk/publications-index/publications-display.htm?id=29507, Accessed 25 February 2009. 2008, p. 20. **4** GBCA, Introduction page in Green Star—Education v1 rating tool (excel spreadsheet), Sydney: GBCA. Available at www.gbca.org.au accessed 25 February, 2009a. **5** Ibid

## GREEN STAR—EDUCATION V1—ELIGIBILITY, ASPECTS COVERED AND PROCEDURE

Specifically, the Green Star—Education v1 tool *'evaluates the environmental initiatives and/or the potential environmental impact of new education facilities, and additions to and major refurbishments of existing education facilities'*.[6]

### Eligibility criteria for Green Star—Education v1

*Buildings primarily used for educational purposes (e.g. primary or secondary schools and university buildings, including libraries) are eligible for Green Star—Education provided that they:*

1. *Have the following mix of GFA (measured to exclude internal car parks):*
   - *A minimum of 80% of BCA Class 9b, 8 and 5 space;*
   - *A minimum of 50% of BCA Class 9b space; and*
2. *Are not any of the following:*
   - *Buildings with over 20% of GFA dedicated to retail food service and/or indoor swimming pool(s);*
   - *Libraries that are not on education campuses; or*
   - *Facilities primarily dedicated to childcare.*[7]

As with other Green Star tools, a spreadsheet which is freely available online, guides the user through the assessment. It is only if a project wants to publicise its use of the tool and its assessment that an official assessment is required. Though, if it is the intention of the project to make the use of Green Star publicly it is advisable to begin the assessment process from day one. Many of the assessment credits align with that of the other Green Star tools those that are specific to educational buildings are:

- *[Buildings as a] Learning Resource;*
- *Maintainability;*
- *Unoccupied Areas;*
- *Stairs;*
- *Efficient External Lighting;*
- *Centralised Energy Systems;*
- *Transport Design and Planning;*
- *Potable Water Use in Laboratories;*
- *Recycled Content & Reused Products and Materials;*
- *Flooring;*
- *Joinery; and*
- *Loose Furniture.*[8]

To meet the conditional requirement: The project's predicted greenhouse gas emissions must meet the greenhouse gas emission benchmark. The Green Star—Education v1 Energy Calculator determines the benchmark for each project based on the composition of space types within each project. The conditional requirements are[9]:

| **Primary and High Schools Conditional Requirements** | **(kgCO2-e/ m²/annum)** |
|---|---|
| Classrooms | 61 |
| Computer and physics labs | 127 |
| Office and staff rooms | 85 |
| Library | 73 |
| Common space | 53 |
| Canteen | 65 |
| Workshops | 77 |
| Gymnasiums | 58 |
| Car parks | 58 |
| **Universities Conditional Requirements** | **(kgCO2-e/ m²/annum)** |
| Teaching/classroom spaces | 82 |
| Dry labs/speciality learning spaces and libraries | 88 |
| Office/administrative spaces | 79 |
| Common spaces | 57 |
| Wet labs | (varies based on density of fume cupboards) |
| Gymnasiums | 143 |
| Car parks | 52 |

**6** Ibid **7** GBCA, *Green Star Eligibility Criteria*, Sydney: GBCA. Available at http://www.gbca.org.au/uploads/192/960/Green%20Star%20Eligibility%20Criteria%20090209.pdf accessed 25 February 2009c, p.2. **8** GBCA, *Education Fact Sheet*, produced by the GBCA: Sydney. Available at http://www.gbca.org.au/uploads/226/1762/Education%20Fact%20Sheet_260808.pdf accessed 25 February 2009b, p.1. **9** GBCA, *Energy page in Green Star—Education v1 rating tool* (excel spreadsheet), Sydney: GBCA. Available at www.gbca.org.au accessed 25 February, 2009a.

The process for attaining a Green Star rating is, firstly to register with the GBCA. This incurs a cost depending on the size of the building. Next it is a matter of working through the spreadsheet to determine which criteria the project will aim for. Having a Green Star professional as part of the team will not only provide one credit, but will also ensure that the design team has someone to help them understand the level of commitment each credit will require. The documentation required is extensive and this needs to be both well understood and allowed for in the process from the beginning. Figure 1, shows the process of application. Once all the documentation has been collected it is submitted and sent to a third party panel of accredited assessors commissioned by the GCBA. It is usual for most projects to only get a fraction of the credit in the first round, thus there is a second round where they can address any feedback. Usually the reasons for this is a lack of documentation for the credits applied for, for example credits claimed for installing a large rainwater tank but it not being shown in the plans. Projects generally achieve most of the credits they have aimed for in the second round.

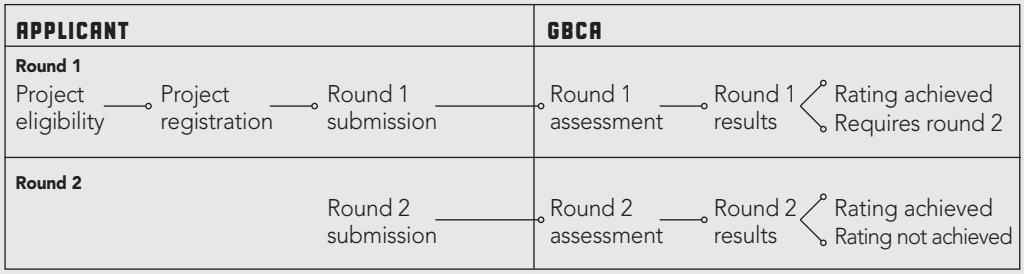


**Figure 1:** Application procedure for a Green Star certification[10]

Finally, a Green Star rating is only given for those buildings that achieve 4 or more stars, in line with the other Green Star tools:

- 4 Star Green Star Certified Rating receives a weighted score of 45–59, this signifies 'Best Practice'
- 5 Star Green Star Certified Rating receives a weighted score of 60–74, this signifies 'Australian Excellence'
- 6 Star Green Star Certified Rating receives a weighted score of 75–100, this signifies 'World Leadership'

Credits are divided over 9 categories of:

- Management—14 credits aiming to ensure a good foundation is set for the project, looks at issues of commissioning, the design and development process, documentation and future guidance;
- indoor environment quality—26 credits aiming to ensure that the indoor environment of the schools are performing optimally in relation to the air quality, lighting and pollutant;
- energy—29 points aimed at ensuring the building's design uses the minimum amount of energy while maintaining amenity and thus generates a minimum amount of greenhouse gases;
- transport—13 credits related to how people get to the school, specifically bicycle facilities, car parks, access to public transport etc.;
- water—16 credits related to design for water efficiency and recycling;
- materials—27 credits aiming to ensure that those materials chosen for the school are low in impact;
- land use and ecology—8 credits which aims are ensuring a minimal impacts is had on land use and the environment;
- emissions—14 credits aiming to deal with issues of Legionella prevention; refrigerant choice in relation to ozone depletion, greenhouse gas emissions and leaks; water course pollution and discharge to sewer and light pollution; and,
- innovation—5 credits aimed at supporting innovation through use of new technologies, ability to go beyond the Green Star bench marks and scope.

**10** GBCA, *Certification process, fact sheet produced by the GBCA:* Sydney. Available at http://www.gbca.org.au/uploads/192/960/Certification%20Process.pdf accessed 25th February 2009d, p.1.

McKinnon Primary School, VIC
Links to the outdoors
Architect: Kneeler Design Pty Ltd
Image: Silvi Glattauer

## "HOWEVER, USING A TOOL SUCH AS GREEN STAR DOES NOT GUARANTEE A MORE SUSTAINABLE BUILDING"

**Dr Dominique Hes**

## EFFECTIVENESS OF GREEN STAR TOOLS IN TRANSFORMING SPACES

There is only sporadic evidence of the capacity of the other Green Star tools to inform the design of better performing ESD buildings. This is due in part to the fact that there is no requirement for Green Star rated buildings to report on their performance publically. One of the main sources of information about Green Star rated buildings is the GBCA's own reports aimed at helping to argue the business case for adopting Green Star to achieve sustainable building outcomes[11]. While this report shows the resource and financial savings of Green Star rated buildings, it does not discuss the effectiveness of the spaces designed. Results from individual case studies, however, do highlight the impact Green Star has had on the design of effective spaces.

Council House 2, housing the City of Melbourne staff, includes natural ventilation, thermal mass and indoor air quality design strategies that have resulted in a low noise, open-plan environment filled with greenery and gentle diffuse light. Aside from reducing energy and water usage by over 70 percent, CSIRO research has also found productivity and occupant health improvements of almost 11 per cent over previous council accommodation[12]. 40 Albert Road, a building refurbishment, resulted in energy efficient spaces saving even more energy and water than CH2 while providing occupants with high air quality, using natural ventilation and daylighting where possible.

In reviewing these examples, what is evident is that the design of buildings using ESD rating tools is better considered. By employing the Green Star tool the design outcomes were occupant-sensitive resource-efficient buildings effectively integrating aspects of the local environment such natural ventilation, light, solar collection, etc.

However, using a tool such as Green Star does not guarantee a more sustainable building. Research done in Australia and internationally points to the operation of the facility and the behaviour of the occupants as central to determining the effectiveness of the design[13]. For schools this means how well the school is operated and maintained and the systems in place for training staff and students is as crucial as is the design of the space itself.

## ASPECTS OF GREEN STAR THAT SUPPORT DESIGN OF EFFECTIVE LEARNING SPACES

Many of the aspects covered by Green Star—Education v1 are related to potential building performance and not to the creation of effective learning spaces. From the

**11** GBCA, *The Dollars and Sense of Green Buildings* 2006. Green Building Council Australia, Sydney. GBCA, *The Dollars and Sense of Green Buildings* 2008. Green Building Council Australia, Sydney. **12** Phillip Paevere and Stephen Brown, Indoor Environment Quality and Occupant Productivity in the CH2 Building Post-Occupancy Summary Report No USP2007/23. CSIRO and the City of Melbourne, 2008, Melbourne. **13** Adam Hinge, Donald Winston, Byron Stigge, *Moving Toward Transparency and Disclosure in the Energy Performance of Green Buildings*. 2006 ACEEE Summer Study on Energy Efficiency in Buildings, pp. 3–128–138. Available at http://www.sallan.org/pdf-docs/Energy-Efficiency-HPB-SummerStudy06.pdf accessed 24th of May 2009.

research discussed below lighting, ventilation and water proofing have the highest impact on learning effectiveness, followed by providing adequate thermal comfort and minimising acoustic problems.
The remainder of this paper outlines these aspects of learning spaces design, citing why they are important outlining the relevant Green Star credits associated with them.

## LIGHTING

The Heschong Mahone Group[14] showed that the effects from the introduction of controlled natural daylight to classrooms, along with allowing views to the outdoors, resulted in an increase in student achievement of 26 per cent. In addition, Shum Miller[15] showed that daylight in classrooms can have an impact on reducing illness, absenteeism and an improvement in student behaviour. Daylighting strategies are most effective when the user can control heat gain and the amount of light and glare. If possible design should make use of indirect light either by allowing light in from the south (for the southern hemisphere, north for the northern hemisphere) or bouncing it in through light shelves. Light shelves will increase the distance natural light will travel into, and may illuminate a space by an extra 25 per cent.

In recognition of this Green Star—Education v1 provides six credits related to windows and daylight. 'IEQ 4—Daylight' provides the bulk of the credits and is related to providing a two per cent daylight factor over as much of the floor plate as possible, 'IEQ 11—Daylight Glare Control' provides one credit where it is demonstrated that glare has been adequately dealt with while 'IEQ 14—External Views' which provides one credit if 60 per cent of a nominated area has direct line of sight to views.

Significant savings on operational lighting costs can be achieved through effective natural and artificial lighting. For example, it is not necessary to have uniform lighting across an entire classroom, varying the lighting allows for the highlighting of spaces and the differentiation of activities and will lead to energy saving[16]. Long-term savings can be achieved through the future proofing of function through design for retrofitting by using different luminaries, diffusers or adaptive switching strategies. Green Star 'IEQ-12—High Frequency Ballasts' and 'IEQ-13—Electric Lighting Levels' provide one credit each in relation to artificial light levels and IEQ, under Energy 'Ene-4—Lighting Zoning' provides a further credit.

## AIR QUALITY AND VENTILATION

The link between respiratory illnesses such as asthma and mould has been thoroughly demonstrated in medical research.[17] Mould commonly occurs in poorly water proofed and ventilated buildings.
A significant percentage of absenteeism in schools is due to asthma-related illnesses. Cox-Ganser et al.[18] found that in the US between 1994 and 1996 asthma led to 14 million days of school loss—an average of 3.4 school days per child. Thus effective green learning spaces must be designed to ensure that areas where mould typically occurs are eliminated. According to Edwards:

> *... it appears evident that those green schools which give priority to daylight and natural ventilation generally outperform other schools.*[19]

Within Green Star—Education v1 air quality and ventilation is covered by three credits which includes appropriate Ventilation Rates (IEQ-1) and Air Change Effectiveness (IEQ-2) and specifically through ensuring relative humidity is controlled in mechanically ventilated buildings (60 per cent relative humidity in space and 80 per cent relative humidity in ductwork) or by specifying naturally ventilated buildings (IEQ-10—Mould Prevention). Limiting the ability for moisture to build up has the added benefit limiting that aspect in the degradation of buildings, leading to longer lasting facilities and therefore a better return on financial and environmental investments.

> *Moisture ranks as a leading cause of structural damage, and excess moisture in a building has been associated with a variety of health problems in children and adults.*[20]

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**14** Heschong Mahone Group, *Daylighting in Schools, An Investigation Into the Relationship Between Daylight and Performance*. 1999, detailed Report. Fair Oaks, CA. Heschong Mahone Group, *Windows and offices: a study of office workers performance and the indoor environment*. 2003, Prepared for California Energy Commission: Fair Oaks, CA. **15** Katrina Shum Miller, 'The A,B,C's of Sustainable Schools', SB08, *International Sustainable Building Conference*. September 21-25, 2008, Convention Centre Melbourne. **16** Prakash Nair and Randall Fielding, *The Language of School Design: Design Patterns for 21st Century Schools*, India: Designshare.com, 2005, p. 80. **17** IOM, *Clearing the Air: Asthma and Indoor Air Exposures*. Washington, DC: National Academy Press, 2000. IOM, *Damp Indoor Spaces and Health*. Washington, DC: The National Academies Press, 2004. **18** J M Cox-Ganser, S K White, R Jones, K Hilsbos, E Storey, P L Enright, C Y Rao and K Kreiss, Respiratory morbidity in office workers in a water damaged building. *Environ. Health Perspect.* 113 (2005): pp. 485–490. **19** Brian W. Edwards, Environmental design and educational performance, with particular reference to 'green' schools in Hampshire and Essex. *Research in Education*, Issue 76, 2006, p. 27. **20** BICE, *Review and Assessment of the Health and Productivity Benefits of Green Schools: An Interim Report*, Board on Infrastructure and the Constructed Environment (BICE), 2006. Available at http://books.nap.edu/openbook.php?record_id=11574&page=20 accessed on 28th of February 2009, p. 20.

Woodleigh Grammar School
Architect: Luke Middleton from eme Design Pty Ltd
Image: Luke Middleton

**"OFTEN, WITHIN THE DESIGN PROCESS, THE ACOUSTIC ANALYSIS IS CARRIED OUT TOO LATE"**

**Dr Dominique Hes**

### THERMAL COMFORT

Richard de Dear concluded that there are productivity benefits (through the perception of comfort by building users) if the indoor temperature reflects the outdoor temperature more closely, particularly if they have control over their environment.[21] From an operational energy perspective this means that the temperature bands do not need to be as narrow, for example 21.5+/–1°C, saving conditioning energy as well as reducing the size of plant and equipment needed. Green Star—Education v1 'IEQ-5—Thermal Comfort' provides the potential for three credits to improve thermal comfort: one credit is awarded if there is adequate user control for workstation areas (note not classrooms) and a further two credits are allotted if defined standards are met of either ASHRAE or ISO7730.

### ACOUSTICS

Many schools aiming to integrate ESD and a more flexible approach to the use of space have large open areas to allow multiple activities and though this offers good opportunities for daylighting and cross-ventilation it often results in poor acoustic performance.[22] Careful analysis of the potential internal and external noise levels when considering space design is crucial. Often, within the design process, the acoustic analysis is carried out too late requiring either a change in the design or expensive retrofitting. Bringing in the acoustic engineers earlier will help minimise this extra effort ensuring an integrated design minimising the chance that acoustic treatments are removed as a cost-cutting exercise. Green Star—Education v1 covers acoustics through 'IEQ-7—Internal Noise Levels' providing two credits.

### UNDERSTANDING THE SPACE AND LEARNING OPPORTUNITIES

All the design strategies outlined above require not only appropriate design consideration but also an understanding by the building

**21** Richard de Dear 'Sick building syndrome and appropriate design', in A. Auliciems (ed) *Advances in Bioclimatology* Berlin: Springer Verlag, 1998, pp.87–109. Richard de Dear 'The adaptive model of thermal comfort and energy conservation in the built environment.' *Institute for Building Environment and Energy Conservation*. V.22(6), 2002, pp. 31–35. **22** Brian W. Edwards, Environmental design and educational performance, with particular reference to 'green' schools in Hampshire and Essex. *Research in Education*, Issue 76, 2006.

occupants of when to open windows, close blinds and turn off lights, in order to maximise its ESD performance-green building perform best if they have green occupants.[23] Green Star—Education v1 approaches this through 'Man-5—Building Guides' which provides two credits for the development of building guides while 'Man-10—Learning Resources' provides one credit for fostering an understanding of the building by making it a learning resource. This mean that the resources invested into the efficient design of the building will be used by the occupants (students and teachers) for lived, tacit, learning, fulfilling one of the criteria of an ELE. Wilkinson agrees arguing that an educational space:

> *... should show the interconnections between natural systems and human needs where possible, making the building itself a positive factor and tool in learning about sustainability rather than just a neutral backdrop.*[24]

## GREEN STAR—EDUCATION V1 AND EFFECTIVE LEARNING ENVIRONMENTS

The Green Star—Education v1 rating tool supports the design of 'green' schools by providing guidance on what is considered best practice for adequately lit, ventilated, comfortable, acoustically effective and resource efficient ESD buildings. However, as Green Star is primarily an ESD tool it only provides limited guidance on the design of Effective Learning Environments. Further research on how to achieve both educational and green objectives and create Effective Green Learning Environments (EGLEs) is necessary. A tentative definition of an Effective Green Learning Environment is:

> *... an environment that supports teaching and learning through the provision of adequately lit, ventilated, thermally comfortable and acoustically effective spaces that are resource efficient in construction and operation. Further, EGLEs provide opportunities for tacit learning through interaction, understanding and engagement with the building, systems and space.*

The design of EGLEs requires the use of established strategies for the 'green' design of schools but also the inclusion of expertise on current pedagogical requirements from project inception. A current Australian Research Council project called 'Smart Green Schools' has brought together a multidisciplinary team of educators, architects and ESD experts to explore these issues.

## CONCLUSION

The aim of this paper was not to provide an overview of the whole Green Star—Education v1 rating tool, but to reflect on those credits that support both more environmentally friendly building and effective learning outcomes. It is interesting to note that those credits related to more effective learning outcomes, as discussed here, only make up a small percentage of the total credits available[25]. This raises the question: should a tool such as Green Star just focus on environmental performance and ignore the less quantitative issues of comfort and student performance, or is a more complex tool that includes learning effectiveness, pedagogical and curriculum aspects required? For now, ensuring the educators and students have a voice in the design alongside the use of Green Star seems to be the best way forward.


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**23** Stephen Browne and Ian Frame. *Green buildings need Green Occupants*. Eco-Management and Auditing, 6(2), 1999, pp. 80–85. **24** Jane Wilkinson, *Leading Sustainable School Building Projects*, Nottingham: National College for School Leadership. Available at http://www.ncsl.org.uk/publications-index/publications-display.htm?id=29507 Accessed 25th February 2009.(2008), p.27. **25** Note that these are the credits directly related to light, ventilation, thermal comfort and acoustics. All elements of the project can in some way affect the spaces, for example the 20 credits for 'Ene-1—Greenhouse Gas Emissions' do influence how the spaces are designed.