Australian approach to sustainable design professional development education

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ABSTRACT: Through a parallel process of regulatory change and growing consumer demand, the Australian building industry is rapidly accepting its responsibility to reduce its environmental impact. However, there is a large gap between excellence in sustainable design and the average industry participant's ability to implement it.
In 2005, the Australian Government and the University of Technology Sydney partnered with the local building industry to create the *Building Industry Training in Sustainability*, a world-class professional development programme for builders, designers and architects on sustainable residential buildings.
This paper identifies the policy drivers that lead to the creation of the training programme, the partnership approach between government, academia and industry, the intellectual basis underpinning the development of training courses, and the unique delivery arrangement that provides high quality training opportunities to practitioners to all regions of Australia. In particular, the paper explores the role of education design in shifting practice.

Keywords: sustainable housing, continuing professional development, effective learning theory, thermal performance, water management, materials and waste, energy services

1 INTRODUCTION

In 2003 the building regulatory environment changed substantially with the introduction of the first minimum energy performance standards for residential buildings. Standards for other classes of buildings were added in 2004 and 2005, and by May 2006 all building classes were subject to energy standards. While these new standards don't represent world's highest stringency, their introduction has suddenly raised awareness of the environmental impact of buildings. At the same time water shortages plus domestic and international discussions on climate change have raised consumer interest in sustainability and increased demand for environmentally sustainable homes.

Regulatory and market changes are good drivers of change, and have increased the profitability of those working that market niche, but across the board change can only be created by an industry armed with knowledge and skills for solving more complex climate and building system issues. Due to the fact that these issues were relatively new to the Australian industry, the existing professional development system did not have a large programme of sustainability education and training, nor did it contain large numbers of trainers with the necessary expertise. This gap is needed to be filled in a hurry and the Australian Government sought a partnership with the building industry and academia to fast track change by creating the initiative called *Building Industry Training in Sustainability (BITS)*.

The aim of the *BITS* is to facilitate the adoption of sustainability by the 'mainstream' of the residential building industry. Participant evaluations of existing sustainability-related educational programs for the Australian building industry indicated that although the programs were increasing participant awareness, they were not necessarily resulting in a mainstream change in practice.

To address this issue, the key was seen as a new approach to training development based on greater attention to learning process. The *Building Industry Training in Sustainability* has been based on a learning theory framework. It moves away from traditional, more passive forms of delivery towards a problem-based, interactive approach that is conducive to effective learning and skills development.

This paper will explain how the application of a learning theory framework informed both the content and the delivery processes for the *Building Industry Training in Sustainability* continuing professional development program.

2. POLICY DRIVERS

2.1 Energy, Water and Greenhouse Impacts

Australian buildings have a significant impact on the natural environment, particularly the production of greenhouse gas emissions and the consumption of potable water. Research conducted for the Australian Government has found that the share of greenhouse gas emissions from the building sector

represents some 20 percent of the total Australian emissions and is increasing at a rate faster than almost all other energy related emissions. Studies published by the Australian Greenhouse Office established that emissions from residential buildings are expected to increase by at least 17% between 1990 and 2010 while commercial buildings are expected to double from 32 to 63 Mt between 1990 and 2010, this rate of growth is far in excess of Australia's target of only 7 percent growth in emissions between 1990 and 2010 [1] & [2]. More recent evidence has suggested that emission growth rates are much higher than predicted.

Not only is the growth in annual energy consumption of concern, but the increase in climate sensitive peak energy demand is also growing strongly, and putting a strain on the available electricity generation capacity.

Increasing demand for electricity due to the use of air conditioners is a problem identified in many nations with hot dry or hot humid climates. Australia is no exception, as air conditioner prices have fallen and comfort expectations increase, the number of businesses and households with air conditioners has dramatically increased. Since the early 1990s the sales of air conditioners to the domestic market has more than doubled from less than 400,000 units in 1993 to around 1,200,000 units in 2003 (Figure 1). This trend is expected to continue with sales approaching 1,500,000 units in 2006.

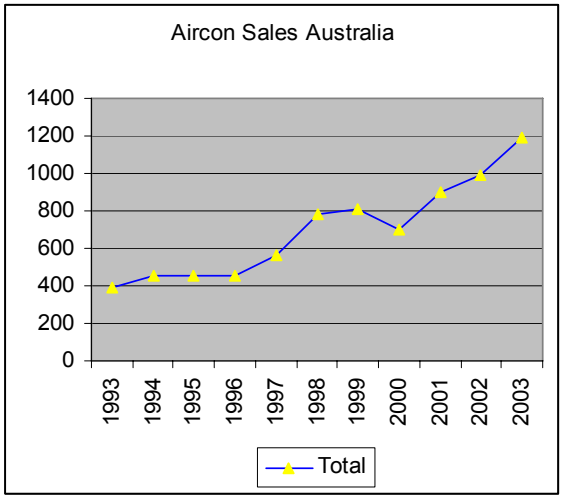

Figure 1: Product Sales, Air Conditioners, Australia

One of the key drivers for this phenomenon in Australia has been the impact of relatively poor thermal performance of buildings, linked in no small way to relatively cheap electricity and a mild climate where no major city suffers from extreme climatic conditions such as annual snow falls. Australian residential electricity prices are cheaper than those in the UK, Spain, France, Ireland, Germany, Italy and most of the European Community [3]. As the availability of cooling technologies increases and the price has fallen, developers have become even less likely to construct buildings to naturally maintain thermal comfort during periods of higher temperatures. Technology solutions to the comfort problem have focussed on appliance rather than building design solutions.

In recent years, many parts of Australia have more frequently experienced periods during summer when the demand for electricity is close to or exceeds the available supply. In the past two decades electricity demand has more than doubled.

The additional demand for energy is directly related to the inherent performance of a building to maintain human thermal comfort. While commercial air conditioning energy consumption and greenhouse emissions is some four times that of the residential sector, the relatively constant business load, though dependent on climate and weather extremes, it is not as large a contributor to summer peak loads as residential buildings.

Volatile demand patterns can lead to electricity market problems that tend to put upwards pressure on the wholesale cost of supplying electricity, including: (a) high spot market prices for electricity more than 100 times the average price; (b) inefficient investment in network and generation infrastructure; and (c) network failures and supply disruptions.

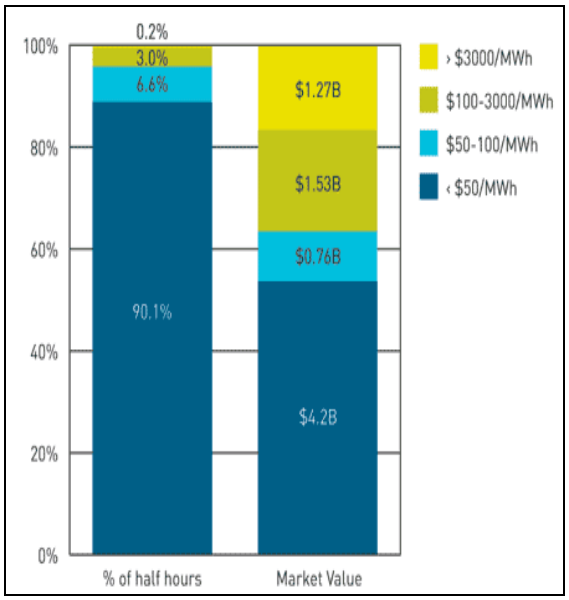

Figure 2: Value of spot market - National Electricity Market, 2002

Meeting peak load is very costly, as electricity generation and transmission infrastructure is designed to cope with peaks that happen quite rarely, and the cost of electricity is increased to cover extremely high market prices that occur on those occasions when demand gets close to supply. Figure 2 shows that peaks lasting for only 3.2 per cent of the annual duration of the market accounted for 36 per cent of total spot market costs [4]. Reducing the magnitude and costs of these peaks will reduce overall system costs.

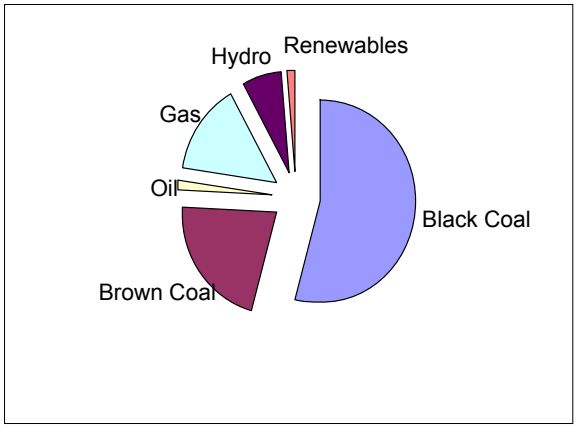

Figure 3: Electricity Generation by Fuel 2004-05

The generation of electricity is also the single largest source of greenhouse gas emissions in Australia, with 77% electricity from coal-fired power stations, giving electricity a carbon intensity of 0.8 tonnes CO_2 per MWh [3] & [5]. Australia 's energy needs continue to grow rapidly, with the Australian Bureau of Agricultural and Resource Economics estimating that net electricity demand will rise by around 50 per cent by 2020 [6].

Growth of building sector CO_2 emissions has been driven overall by economic growth increasing the need for new buildings, compounded by ever increasing use of air conditioning, increases in lighting levels, and rising standby loads.

Australia is the driest habitable continent on Earth, and the most populated areas are subject to extended periods of drought. Water catchment areas supplying the major cities are limited due to the lack of suitable topography and low rainfall volumes, and cities have grown much faster than the available water supply infrastructure. Global climate change predictions point to greater variability in rainfall for most of the populated areas placing greater stress on the availability of rainwater.

2.2 Australian Government Policy Perspective

The Australian Government recognises climate change as a real and serious global challenge. Australia is already experiencing the impacts of climate change, although it is difficult to discern these precisely in a climate that is subject to extreme variability [7].

In 1997, the Prime Minister, Mr John Howard committed the Australian Government to a program of action to address global climate issues. An important part of Australia's commitment was the formation of the Australian Greenhouse Office (AGO) as the lead national agency on greenhouse matters.

Energy efficiency is, and will remain a central element of a cost-effective greenhouse abatement strategy, and improving our energy efficiency performance is a priority for the Australian Government [7].

Following extensive consultation with the building and construction industry, the Australian Government agreed on a dual approach of mandating energy performance requirements through existing building regulatory mechanisms, complemented by voluntary industry driven best practice initiatives, and market instruments.

Because of the large number of environmental problems (energy, water, resource depletion, bio-diversity reduction, etc) directly or indirectly related to climate change, the Australian Government chose to address the issues collectively as environmental sustainability rather than single issue actions.

Central to the broader scale sustainability approach has been the development of the Your Home project, a suite of technical and consumer guide materials describing holistic sustainability best practice solutions across a range of climate and urban situations [8]. Your Home branded publications have become the core resource materials for communication with building practitioners, government policy makers and the Australian community on environmentally sustainable housing solutions.

The Your Home project extends from technical manuals for building industry practitioners, to consumer magazines and DVDs, to professional development training courses and consumer workshops. The focus of this paper is the approach taken for the second level of the professional develop training programme commonly known as *Building Industry Training in Sustainability*.

3. PARTNERSHIP APPROACH AND MAINSTREAMING ENVIRONMENT ISSUES

Environment issues have not been at the forefront of building industry policy until recently and as a result the majority of current practitioners do not have formal training in environmentally sustainable building solutions.

The Australian Government recognised early in the Your Home project that solutions beyond that delivered through minimum regulations can only be affected by a building industry skilled and knowledgeable on both the problems and solutions.

In 1999 at the start of the Your Home project the Australian Government built a partnership with the major building industry representative organisations and professional bodies focussed on jointly developing materials determined by their members. The result is a suite of materials and related training courses developed by practitioners for fellow practitioners, and delivered through the existing mainstream professional development programmes.

By using existing training delivery structures where available, environment issues have been presented to a larger number of practitioners, particularly in regions that require mandatory annual professional development for certain licence holders. And by using the industry's own training system and trainers, industry organisations have established a level of ownership of the issues and promoted the courses more widely than budgets would otherwise have allowed.

This approach works particularly well for introducing environment issues to practitioners, but

more sophisticated technical training needs presenters with both skills as an educationalist as well as building technical and sustainability knowledge. It is at this point that the *Building Industry Training in Sustainability* initiative departs the approach used for the introducing environment issues. This second level of training requires knowledge and skills uncommon throughout the existing network of trainers, therefore a separate group of specialists has been established with their own professional development structure and are scheduled for training on behalf of the major industry organisations. In other words, a central pool of experts is available for conducting industry training across many organisations and professions rather than from within the employ of industry organisations, thus providing greater flexibility and technical capacity.

This approach will still not deliver the quality of training necessary to establish significant change across the building industry without the right educational strategy. *Building Industry Training in Sustainability* is an outstanding success because of the marriage of unique delivery mechanisms and the application of appropriate learning theory.

4. LEARNING THEORY

4.1 Background to the application of learning theory

A useful framework for conceptualising the current state of the Australian building industry in relation to sustainability is the theory of diffusion of innovations [9]. This theory describes the various stages in the process of innovation becoming mainstream.

The first stage in the diffusion of innovations is characterised by awareness. Information starts to become available and as a result more and more people begin to 'know about' the innovation. The Australian building industry has reached this stage, with the increasing prominence of sustainability as a concept. Most practitioners are aware of the concept's existence, and a significant proportion agree that it is important and want to know more about how to implement it. Information on the sustainable design and construction of housing is increasingly available, however it has not yet become a mainstream practice. This is mirrored by current research on Your Home, a multi-award winning national Australian technical guide to sustainable design, which indicates that whilst practitioners are aware of Your Home, most are not yet using it as an integral part of their everyday practice [10].

The second stage in the diffusion of innovation is characterised by change in practice. The Australian building industry is on the cusp of this stage, presenting the opportunity to use the *Building Industry Training in Sustainability* as a catalyst for change. To enable a widespread change in practice, the program developers identified the need for greater attention to learning process. Whilst much of the necessary information already exists, the key is arranging it into useful and innovative learning processes that engender skills development and lead to a widespread change in practice.

4.2 The effective education principles and their application

The past two decades have seen a significant shift in teaching approach and emphasis in the Australian and international tertiary and technical education sectors. This shift has redefined 'effective education' and resulted in a move away from the traditional 'input' strategy (aimed at transferring facts and knowledge from the lecturer to the student), and towards an 'output' strategy, focused on the quality of student comprehension resulting from teaching and learning activities [11]. In this section we explain two important principles of effective education: learner centred teaching and linking principles and practice, and illustrate how these principles are embodied in the *Building Industry Training in Sustainability*.

4.3 Learner centred teaching

A learner-centred approach aims to develop and change the way learners think about, understand and apply the subject matter and has as its goal learning for genuine, personalised knowledge and action. Teaching strategies typical of a learner-centred approach are problem-solving activities that encourage learners to personally engage and actively participate in their learning. The key elements of a learner centred approach are:

- ⇒ Start where the learner is
- ⇒ Use learning outcomes to guide development
- ⇒ Ensure relevance to daily practice

Starting where the learner is involves knowing your audience, and was done in this project by mapping the profile of potential participants and by involving a selection of participant groups in the development of the program. Because the *Building Industry Training in Sustainability* aims to facilitate adoption of sustainability by the 'mainstream' of the Australian building industry we focused particularly on the group described as the 'late majority' in the diffusion of innovations framework [9].

We mapped the profile of the intended audience in terms of building industry sector/ profession, predominant attitudes to sustainability, current levels of knowledge of sustainability, issues within participant's control to change and common barriers and drivers for each participant group in relation to the implementation of sustainability. This analysis generated our approach to content, which included an explicit coverage of rationale and drivers, from both a global perspective (the 'big picture') and an individual perspective (What's in it for me? What's in it for my client?). It also informed the approach to structure, by ordering the presentation of issues to mirror the design and construction sequence (and therefore the thinking process that participants typically go through in their daily practice).

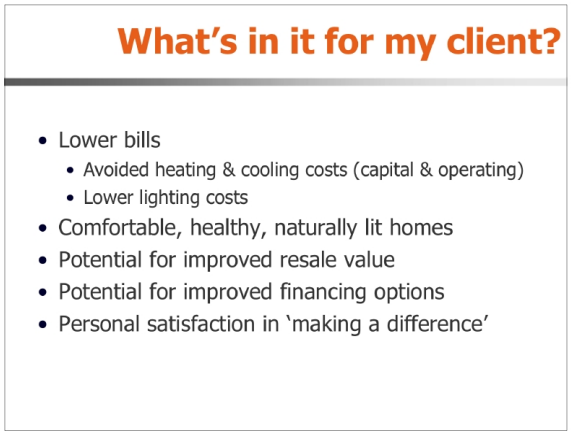

Figure 4: introductory slide from the 'thermal performance' module illustrating a learner centred approach

Explicit and precise learning outcomes were set up at the commencement of the program to define the outcomes to be delivered to participants. This provides three distinct advantages. Firstly, it requires us to retain a focus on the learner. Secondly, the learner focus results in viewing the information and action needs from the learner's perspective rather than the teacher's or the training developers. Thirdly, this perspective ensures information (content) is structured in ways that are meaningful for the learner, and activities (processes) focus on developing changes in learner practice. Learning outcomes are made explicit to participants in the presentation and in the various activity instructions.

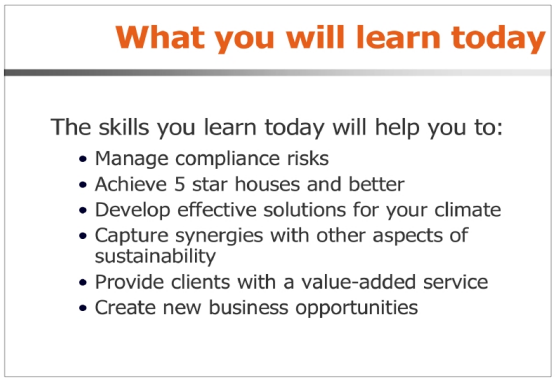

Figure 5: Learning outcomes presented to participants in the 'thermal performance' module

The learner focus helped to optimise the relevance of the program to the daily practice of participants. In particular, it allowed us to structure material to reflect participants' typical decision making processes and to develop activities that mirrored 'real life' situations. These aspects of the program are described in more detail in the following section.

4.4 Linking principles and practice

In developing professionally useful knowledge of principles, it is vital that learners do not merely 'learn the example' but see the fundamental principles at work in the example. This is what enables the learner to adapt and apply the knowledge to context. This is particularly relevant when dealing with a complex issue like sustainability, which manifests in different ways in different contexts. The key elements of the link between principles and practice embodied in the program are:

- ⇒ Practice in applying the principles to different contexts
- ⇒ Problem-based activities that mirror 'real life' situations of participants
- ⇒ A decision-making framework that can be applied to different contexts
- ⇒ Tools with applications beyond the classroom

A range of sustainability principles is presented at the beginning of each module, including principles for reducing environmental impact and principles for successfully managing and implementing projects. Then, the focus of the rest of the day is on application of principles to context. This is delivered through a comprehensive range of case studies and through the activities. This approach aims to make principles clear and explicit (and easy to remember) and to provide participants with the skills to apply the principles to practice.

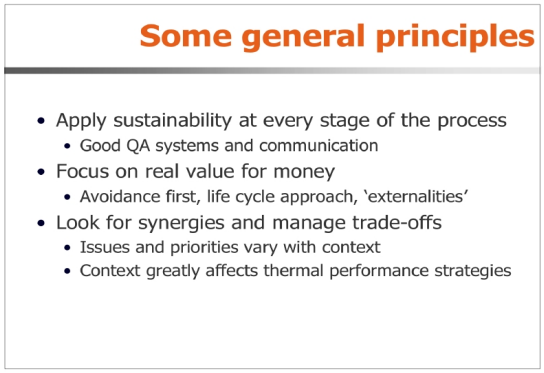

Figure 6: Example of general principles for project management in thermal performance module

For each module, problem based activities have been developed based on a typical real life scenario. This scenario is set up at the beginning of the module in the form of client brief, drawings and specifications, and forms the basis of three progressive activities. In all modules, the scenario begins with an analysis of risks and opportunities and goes on to focus on detailed strategy development such as design/ construction strategies and strategies for effective project management/ client relations. Relationships to other aspects of sustainability (outside the module topic) are explicitly drawn in to reinforce the importance of a holistic approach and the need to manage synergies and conflicts. The scenario is the same for the two key audience groups, designers and builders, but where appropriate the outputs are different, to mirror the

respective roles and responsibilities. For example, in some activities builders may be asked to develop a tendering strategy and designers a concept design.

A decision-making framework that maps the scale of impact against cost/ implementation effort is introduced to participants and reinforced through the activities, where participants are asked to prioritise their strategies and justify them to clients. This framework provides participants with the skills to manage one of the key barriers to the implementation of sustainable housing, a perceived lack of cost effectiveness.

Finally, tools with applications beyond the 'classroom' have been developed to encourage participants to apply their new skills to practice. This takes the form of a succinct and carefully designed checklist, which is structured to mirror the stages of the design and construction process. The checklist encourages critical thinking by grouping suggested actions under goals so the rationale for implementing them is clear and arranging actions in a hierarchy that reflects environmental benefit and implementation effort. It is also designed to be simple to use, and has applications as a quality assurance tool on projects as well as a tool for discussing the project goals with clients.

5. CONCLUSION

Building Industry Training in Sustainability has been successful at bringing disparate parts of the building industry together to establish a programme to significantly improve the environmental performance of the wider industry. By mainstreaming environment issues into existing training systems and programmes, by building a career path for expert presenters, and by utilising the most appropriate learning theories, *Building Industry Training in Sustainability* has the potential to foster a knowledgeable and skilled industry ready to create building solutions well in advance of any regulatory standards.

The program was piloted with industry groups in early 2006 and released to the market in April 2006. Therefore, an extensive evaluation of the program's effectiveness, and in particular the impact of the learning theory framework on industry uptake of sustainable housing, is not available at the time of writing. However, there is evidence from the pilot phase to suggest that the program is engaging the interest of participants, providing them with the needed skills and creating change. Table 1 shows the percentages of pilot program participants who rated the following aspects of the program highly. The range in each category reflects the spread of responses across the various modules.

Aspect of training	**% of participants who rated as 'high'**
Level of interaction/ participation	80-89%
Clarity of theory and principles	86-91%
Application of theory to practice	83%
Relevance to your work	83-86%
Clarity of learning outcomes	89-100%
Learning outcomes achieved	89-100%
Overall quality of course	100%
Would you attend another of these modules?	100%

Table 1: Participant feedback from the *Building Industry Training in Sustainability* industry pilot

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