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The Dilemma of using Real-scale Modelling as a means of Fabricating Sustainability in the Design Studio

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ABSTRACT: This paper contributes to research in learning about sustainability in the design studio using real-scale modelling based on an ethnographic study of a second year design studio at Deakin University in Australia. Through a digital design project followed by a real-scale modelling project, architecture students designed and then constructed small-scale ‘EcoPods’. Once constructed, student works were placed on public display at the Sustainable Living Festival at Federation Square in February 2005.

The paper examines the design, delivery and student outcomes for these projects. Issues raised include second year architecture students’ approaches to conceptual development in relation to sustainability, the importance of transparency of concept, deep and surface learning approaches, translation of concepts to real-scale and material and resource usage in real-scale modelling. The ‘dilemma’ relates to the inherent contradiction in using material and human resources to relate sustainability on both conceptual and constructed levels to student architects. The paper is founded on a central question: ‘In using resources for design education now, may resources be potentially saved in the future through students’ application of this knowledge in practice?’ The project, although very successful in terms of student learning in design, tectonics and real-scale modelling, served to highlight the issues of integrating sustainability within the construction process.

Conference theme: Education
Keywords: Design Studio, Sustainability, Real-Scale Modelling

1. INTRODUCTION

The research is based on the study of a second year design studio involving two architectural design projects undertaken at Deakin University in semester 2, 2005. This research is an extension of an ethnographic study of the studio undertaken in 2002-2003, which focused on the issues inherent in media use on the design studio and comparisons to real-scale modelling. This research uses the ethnographic framework characterized by the study of a culture, engagement of the researcher into the culture and the use of diverse forms of data to address the issue of integration of issues of sustainability into a real-scale modelling project (Massey 1998). The research methodology included the analysis of student design projects, observation of students, examination of student ‘digital reflective folios’, informal interviews with students and the analysis of assessment. Through this ethnographic framework, the issue of the dilemma of using real-scale modelling as a means of fabricating sustainability in the design studio is examined.

The two projects under examination are the ‘EcoPod Architecture’ project and the ‘EcoPod Architecture @1:1’ project. Arising from an opportunity to work with a non-profit sustainability organization, these projects were a vehicle for students to engage in issues of sustainability on both a conceptual and tectonic level. The project was conceived when a student, Heide Lee, introduced the author to the Sustainable Living Foundation (SLF), a community based not-for-profit organisation committed to ‘promoting, celebrating and practicing the principles of sustainable living’. The SLF brings together values, expertise and resources to inform and inspire the wider community about sustainable living and operates an annual Sustainable Living Festival every February at Melbourne’s Federation Square, attracting over 120,000 people. ‘The festival showcases and celebrates leading examples of sustainable living in Australia, drawing together a wide variety of displays, exhibits, artworks, performances and demonstrations to inspire its audience’ (Sustainable Living Foundation, 2004). The festival operates under six themes:

- Think
- Feel
- Design
- Create
- Feast
- Play

Each of these themes is addressed within the Federation Square site in the form of installations, exhibitions, talks, activities and displays by sponsors. Themes are designed to address issues of sustainability in ways that engage a broad spectrum of the community. By reaching out in this manner, the foundation aims to create a popular awareness of sustainability in order to bring about the necessary changes in lifestyle and consumption. Deakin University’s School of Architecture and Building viewed working with the festival as an opportunity for both students and the school and supported the integration of the EcoPods projects into the curriculum. By working with this non-profit organisation,
students of architecture were provided opportunities for a sense of connection with the community and engagement in issues of sustainability. The opportunity to have works on display at Federation Square was also seen as a major incentive for students to perform well, beyond that of traditional design projects.

2. THE SECOND YEAR DESIGN STUDIO

This design studio is based on the model of problem based learning (PBL). Here, a design problem that acts as a catalyst for students to acquire knowledge and skills. The aim of PBL is to encourage open-minded, reflective, critical and active learning (Margetson 1997). PBL generally uses stimulus material (an architectural brief) and resources to facilitate the discussion of a problem within a real-life scenario or ‘reflective practicum’ (Schon 1985, p. 89).

The Architecture 2b unit is a second year, second semester unit in architectural design synthesis that engages students in specific issues. The unit operates from July 22nd to October 22nd, generally has 90 – 100 students enrolled every year and is worth 1 credit point, or 1/4 of the semester load for the Bachelor of Arts (Architecture) degree. Three main projects are undertaken in this unit. The first is generally the design of a medium-scale building (a community radio station in 2004), followed by the design of a small-scaled structure that is then built to real-scale at the end of semester. The intention of this programme is to allow students to address a diverse range of issues inherent in each project within a problem-based-learning context. The issues addressed in this unit are outlined in the unit website:

SRD 264 Architecture 2b is a studio-based unit in architectural design that focuses on the relationship between architecture and the technology used to realise architectural ideas. The unit will enable the exploration of a diverse range of issues, including tectonics, form-making, innovation, ESD, ecology, ‘wicked’ problems, compositional processes and actual construction.

This unit is the only dedicated ‘digital design studio’ within the architectural curriculum at Deakin University, and is paperless in delivery, submission and assessment of projects. Unit materials are delivered through a website on the University’s learning management system (Deakin Studies Online or DSO). Students are encouraged to utilise hybrid media techniques including drawings, physical models and 3D CAD in their project development. The term hybrid, borrowed from the field of biology, meaning ‘something of mixed origin or composition’ (AHD 2000), has been used by Bermudez and King (2000) to describe multiple iterations between representational media within a design process. The outcome of hybrid media use in the design process is translated into a digital presentation (webpage, digital images, movie and PowerPoint files) and submitted to DSO for review, assessment and placement on an online Virtual Gallery. This unit has been the focus of much research by the author in relation to representational media use in the form of postgraduate research and academic papers (see Ham 2003 and Ham 2003a). This research has been utilised to develop the unit based on real understandings of students’ design processes.

3. THE ECOPOD ARCHITECTURE PROJECT

Since 2001, real-scale modelling (1:1 construction, actual construction or design build) has been integrated into the Architecture 2b unit in the form of a Music Room, a small-scaled space specifically designed for the contemplation and composition of music (See Ham 2005). The Music Room project engages students in musical composition as the formative basis for the design of a small-scaled ‘masterpiece’. In introducing the new project, the unit chair was required to depart from a well-established curriculum whilst retaining the basic format and staging of the projects. The integration of the project required an adaptation of the structure of the existing unit, a change in the focus of the lecture series and the inclusion of guest lectures and seminars. The programme for the Architecture 2b unit in 2004 is outlined in Figure 1, below:

<table>
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Source: (Ham 2005)

**Figure 1**: Architecture 2b 2004 Programme

Design

The EcoPod Architecture project was designed to replace the Music Room project as a conceptual basis for the real-scale modeling project. The project was designed to engage students in issues of sustainability on a conceptual level, and did not seek to address issues of landscape, solar orientation and sustainable systems integration inherent in traditional design projects. Students at this stage of the course had not covered the mechanics of sustainable design in associated technology units, thus lacked the technical ability to apply these to a design on a deep level. The EcoPod Architecture project referred to the festival themes for inspiration for the design of structures specifically designed to communicate a message about sustainability. This brief did not place conceptual limits on how students could communicate their message of sustainability and allowed high degrees of creativity in relating small-scale structure design to the festival themes.

The project website outlines the tasks for the EcoPod Architecture project:

This project requires you to design an ‘EcoPod’ to be used in the Sustainable Living Festival at Federation Square. The main purpose of the EcoPod is to provide a structure within which participants in the festival can participate in one of the festival themes. Six themes have been chosen for the 2005 festival:
The outcome of this design project needs to be contextualised within its placement in the second year, second semester of the architecture programme. Students undertaking this project had generally previously completed three design units, each with a different focus. The first year of the course is very much an introduction into the craft of architecture through a series of short, small-scale design projects. The second year, first semester course addresses the issue of housing within the environment through three design project of varying complexity. Thus, these students have only had limited experience in addressing complex issues of design, and had no experience in addressing environmentally sustainable design. Students undertaking this project were observed to have some difficulty in understanding how to address issues of sustainability on a conceptual level. Although the higher-performing students were more able to address the complexities of addressing a theme through a building design, lower-performing students struggled with the concept of the project. The design of this small-scaled structure had no purpose other than for use within the festival as a means of demonstrating the validity of the concept. This was, in a sense, a conceptual design project that required tangible demonstrations of the validity of the concept. Some students adopted surface learning approaches as a way out, concentrating their efforts on digital imagery. Marton and Saljo (1976) have shown that students can be very strategic in their approach to learning and will adopt deep or surface learning for particular tasks. The choice is not a psychological disposition, but one dictated by a number of variables, including perceptions of lecturers’ signals and where learning goals are not stated or articulated. Students may shift from a deep approach to a shallow approach from subject to subject and project to project, depending on how the demands of each learning task are perceived.

### Theme | Statement | Ideas
--- | --- | ---
**Think** | The vision of sustainable living | The Think-EcoPod is designed as a place to open your mind and stimulate new thoughts about our place on the planet.
**Feel** | The passion of sustainable living | The Feel-EcoPod will activate your senses, soothe your soul, help you move towards a more sustainable lifestyle and leave you feeling healthy, cleansed and positive.
**Create** | The art of sustainable living | The Create-EcoPod encourages you to explore the role of creativity in the change process towards sustainability.
**Design** | The function of sustainable living | The Design-EcoPod stimulates thoughts and actions regarding the functions of sustainable living, how you plan and arrange your environment into sustainable formats.
**Feast** | The taste of sustainable living | The Feast-EcoPod engages you in the taste of vitality and sustenance and exposes the role of human consumption in a sustainable food chain.
**Play** | The thrill of sustainable living | The Play-EcoPod lets you experience the fun of sustainable travel, sport and other recreations.

Source: (Ham 2005)

**Figure 2: Architecture 2b EcoPod Architecture Project brief**

The project was worth 30% of unit marks and operated over a four-week period (see figure 1). Project aims included:
- To design a small-scale building that actively engages people in exploring concepts of sustainability
- To increase the consciousness of students towards issues of sustainability
- To explore the design of exquisitely detailed, demountable tectonically-driven architecture
- To explore materiality of construction in terms of ecological impact
- To resolve a small-scaled building design to a ‘masterpiece’ level.

Students were provided with physical limitations to their design, in recognition for the need to actually construct a selection of the projects in the weeks to follow. Designs were required to be around 3x3x3m, completely dismountable into packages of 1.2 x 1.2 x 2.4m with 20kg mass, able to be set up on irregular terrain and able to withstand prevailing weather conditions. This requirement for weatherproof structures ended up being redundant, as the built projects were eventually displayed indoors, however the exhibition location was unknown at the time of writing the project. Tectonic design formed an integral element of the brief, and close consideration was required of detailing and connections. Sustainably harvested materials of low embodied energy were encouraged in the designs. To facilitate this, the SLF’s Eco-ID was provided as a resource for students to use in material selection, supported by seminars and involvement by practitioners in studio sessions. Although a conceptually complex project for the year level and time allocation, this was offset by the minimal building programme, where time not spent on consideration of planning arrangements was intended to be used for conceptual and tectonic resolution.

**Outcome**

The outcome of this design project needs to be contextualised within its placement in the second year, second semester of the architecture programme. Students undertaking this project had generally previously completed three design units, each with a different focus. The first year of the course is very much an introduction into the craft of architecture through a series of short, small-scale design projects. The second year, first semester course addresses the issue of housing within the environment through three design project of varying complexity. Thus, these students have only had limited experience in addressing complex issues of design, and had no experience in addressing environmentally sustainable design. Students undertaking this project were observed to have some difficulty in understanding how to address issues of sustainability on a conceptual level. Although the higher-performing students were more able to address the complexities of addressing a theme through a building design, lower-performing students struggled with the concept of the project. The design of this small-scaled structure had no purpose other than for use within the festival as a means of communicating a message about sustainability and architecture through the development of a theme (eg. Think, Feel, Design, Create, Feast, Play). The authenticity of the brief and the client, along with the potential for projects to be selected for construction increased the risk for students and the need to address the fundamentals of the brief, beyond that of traditional design projects. This was found to be the most difficult element of the project, where students used to operating in low-risk environments where conceptual issues could be ‘talked through’ in reviews were challenged to demonstrate real connections to the brief. This was, in a sense, a conceptual design project that required tangible demonstrations of the validity of the concept.

Some students adopted surface learning approaches as a way out, concentrating their efforts on digital imagery. Marton and Saljo (1976) have shown that students can be very strategic in their approach to learning and will adopt deep or surface learning for particular tasks. The choice is not a psychological disposition, but one dictated by a number of variables, including perceptions of lecturers’ signals and where learning goals are not stated or articulated. Students may shift from a deep approach to a shallow approach from subject to subject and project to project, depending on how the demands of each learning task are perceived.

Very few students successfully addressed the critical connection between the theme and the design, even though explicit recognition of the importance of this was given in the project brief and in lectures and studio sessions. The project operated within a new typology, with very few precedents to draw upon. Students were found to disconnect the conceptual design with the issue of constructability. As is indicative of students in this year level, they tended to revert to known construction principles (eg. house framing) taught in construction units, and not consider construction fully as a design issue. Limited knowledge of detailing resulted in a number of projects being over-designed, with inappropriate materials and connections. Operation within the representational media of drawings, physical models and 3D CAD reinforced limited understandings of the physicality of construction. For example, the ‘Think’ and ‘Design’ EcoPods (see...
figures 3a and 3e), both negated serious issues of overturning and stability, issues that are not brought to the young designers' attention through the 3D CAD model. Students have demonstrated an exceptional ability to utilise digital media in the development and representation of their projects. 3D CAD programmes are widely used to build and render models, from which images are taken, manipulated and inserted into web-based submissions. The images in Figure 3, below, are of projects selected for actual construction and are indicative of the upper level of the class, in terms of conceptual development and response to the brief. Closer examination of these projects gives us an understanding of the 'dilemma' inherent in delivering a design project for a major festival where members of the public are provided the opportunity to interact with and try to interpret the intentions of student work. Students, in undertaking the project in this year of their course, had limited understanding of the reality of the brief and the need for transparency of connections between their design and a festival theme.

No one project fully adequately addressed the connection between a festival theme and architecture. From the cohort, 4 students received a High Distinction, 16 students received Distinctions, 38 students received Credits, 15 students received Passes and 6 students failed. This distribution is about average for design projects in this unit. Although many projects delivered digital imagery of very high quality, they operated on very weak assumptions and failed to explore connections to sustainability in depth. All EcoPods selected for construction required varying degrees of conceptual and tectonic re-working in order for them to be considered suitable for inclusion in the festival.

The 'Think' EcoPod served as a transitory space for people to think about sustainability by examining quotes from famous people etched into the finger-like fins. Two 'Feel' EcoPods were selected, both designed as furniture pieces rather than an architectural space. One 'Feel' EcoPod utilised the heat of the sun through plastic piping to reinforce notions of solar gain, with a north-facing 'warm' seat and a south-facing 'cold' seat. The second 'Feel' EcoPod comprised a series of contoured seats based on metaphorical ideas of ripples of water in the 'forest' of the city. Although a beautiful piece of furniture, this concept was found to be quite abstract and hard to interpret in relation to the festival theme, requiring adjustment during the construction process. The Create 'EcoPod' responded to the forms of Federation Square and provided a space for creative activities. Although an excellent idea, this project lacked the follow through, in terms of further ways to address the creative theme, leaving it as an empty sculpture for participants to be creative within. The Design 'EcoPod' operated on a very abstract conceptual basis, as an expression of ESD principles of sunshading and cross-flow ventilation. Like the 'Feel' EcoPod, above, this design intention was not explicit within the structure itself, but relied heavily on the designer's justification in her web-page submission. The most transparent design was one for the 'Feast' EcoPod, as a place for the pedal-powered orange juice stall to make and sell their products. Designed in the form of a peeled apple (mysteriously, not as an orange), this EcoPod had real purpose and responded best to the chosen theme. The two 'Play' EcoPods relied on interaction with the structures to relate to the theme. One of these relied on loose conceptual connections with the Butterfly Effect, whilst the second was based on a mythical battle between steel stairs and a plywood slide.
4. THE ECOPOD ARCHITECTURE@1:1 PROJECT

Design
This project operated over a period of three weeks at the end of the semester, worth 30% of unit marks. From the 90 EcoPod Architecture submissions, eight projects were developed to full-scale over a period of eighteen days. No budget was provided for this construction task, requiring students to seek sponsorship from local businesses in the form of material or monetary donations. A workshop with woodwork, welding and other equipment as well as two technicians were provided to support the project. Due to tight timelines, students were required to work on the project for 3-4 days a week.

The unit website stated the aims of this project:
- To actually construct a small-scale building that actively engages people in exploring concepts of sustainability
- To develop deep understandings of issues of tectonics within a real-world context
- To construct a small-scaled structure to a 'masterpiece' level
- To develop true understandings of the role and importance of teamwork

The project required to form teams, elect a team member, maintain a project programme and document individual participation. Regular meetings were held with unit staff in the early stages of the project in order to ensure appropriate detail development. Well renowned Geelong-based engineer, Peter Yttrup, consulted to teams to provide structural solutions and confirm sizes and fixing details. A dedicated website developed by students was intended to recorded construction progress, meeting minutes, provide recognition of sponsors and to demonstrate the final product.

Outcome
Real-scale modelling has been demonstrated to enhance students learning in design and tectonics in the design studio. It has formed an element of architecture curricula in Australia (Nolan 1997; Green and Parnell 2001), Singapore (Lim 2001), Vietnam (Tran 1994) and Europe (eg. Martens 1996; Nelson 1999). It is apparent that, although there seem to be many positive outcomes reported from the integration of 1:1 construction into the design studio, the model is used by a relatively small number of schools internationally. Issues of infrastructure, cost, legal liability and organisation limit the integration of this method of design teaching for most schools.

Assessment for this project was generally higher, but more polarized than previous projects, with an average mark of 72%. Marking was allocated to teams, then distributed to individuals by team members based on attendance, innovation, and general performance, then moderated by the unit chair. 24 students received a High Distinction, with 39 receiving a Distinction and only eight Credits and no Pass grades. The highest mark was 96, however 6 students failed, one with a low mark of 0 for one student who failed to contribute anything to his team. Assessment was undertaken in consideration of the difficulty of the task, the short duration of the project and the resource limitations.

Real-scale modelling was evaluated in the Architecture 2b unit by Challis (2002) ‘against the attributes of authenticity in the environment of education as delineated by Martin-Kniep (2000)’ as an ‘illustration of curriculum design, including assessment, to explore how it met the aims of creating learning experiences that were purposeful, rich in their complexity, and mirrored the demands of the profession in a supportive environment that fostered development’. This
environment provides opportunities for students to develop deep understandings of tectonic design that are more difficult to achieve in traditional design projects.

Since 2001, the author has witnessed the ability of second year students to construct small-scale structures of extremely high quality, despite the limitations of time, budget and resources. The tight timeline required constructor teams to work well together, managing individual team tasks, material supply, sponsorship and website development, as well as leading the construction process. Involvement in the physical activity of 1:1 construction also brings forward realisations for students of the limitations of representational media as a tectonic design tool. In actually constructing a project, students realise the limitations of 2D representation, the lack of physicality of 3D CAD and the issues of materiality and scale in a physical model. It is contended that reflection on these limitations helps students reach maturity of representational media use in the design studio.

A critical factor in 1:1 construction is the substantial risk inherent in the activity. Student constructor teams are placed in an environment that simulates the high-pressure conditions of construction, complete with the real risk of structural failure or non-completion of the project. With the increased risk of 1:1 construction come the rewards of learning tectonic design in a fun, and challenging environment. The fun in this type of project is an outcome of the intense and dynamic collaborative environment and in the excitement of constructing a structure to be proud of. Learning is, however, limited by the 'tectonic learning potential' of each project. Each project, whether constructed of plywood, material or steel, has variable potential in terms of enabling students learning about tectonic design.

For the EcoPod Architecture@1:1 project, the relationship between the EcoPod and the festival themes required continuous reinforcement by staff during the design development and construction process. Every project selected for construction required further development for exhibition at the Sustainable Living Festival. Fundamental conceptual connections between the design and sustainability were, in some cases not transparent in the original design and required the intervention of staff members. Student constructor teams were faced with two competing issues during the construction process: the need to complete projects on time within their limited budget and the need to use sustainably sourced materials and methods wherever possible. The planar nature of many design elements were ideal for the use of 12-19mm plywood, which proved to meet performance requirements and limit environmental impact. Recycled materials were used wherever possible, derived from local suppliers and previous years projects. These included re-used plastic bags, steel sheet, copper pipes and other materials.

As the deadline loomed for completion of the construction, student teams made strategic decisions in order to facilitate completion. For one group, a lack of knowledge of sustainable materials, ready availability and the tight timeline resulted in them using a small amount of rainforest veneers for their ‘Think’ EcoPod. Issues of embodied energy and sustainability were sometimes relegated behind availability and cost. In the current situation where there is little immediate visible impact of individual material selection decisions on the environment, it is easy to see how sustainability can be progressively left out behind during construction. The has strong parallels with the industry, where demands of clients, budgets and timelines compete with environmental concerns, provided learning opportunities for students. One hopes that reflection on this will impact on students’ future practice.

The demonstrable beneficial learning outcomes of the EcoPod Architecture @1:1 project came at an environmental cost, in terms of material usage. Collectively, construction teams consumed approximately 50 sheets of plywood, 100 linear metres of 9x45 Pinus Radiata, 50 linear metres of fabric, 10 linear metres of steel section and plates, dozens of bolts, hundreds of nails and hours of energy supply for lighting and welding (see figure 4). Herein lies the dilemma of framing a real-scale modelling project within the context of sustainability. Construction is an inherently resource intensive process that uses vast quantities of real materials to achieve authentic learning outcomes for architectural design.

In considering this dilemma, a number of questions are posed: ‘In using resources for design education now, may resources be potentially saved in the future through students’ application of this knowledge in practice?’ That is, will the learning outcomes from this project result the potential for reduced material usage for one or more projects when students graduate? For example, will the team who inadvertently used rainforest veneers learn from this and be more selective in the future? Will the ‘Design’ EcoPod designer and construction team, who operated on very loose ideas of cross-flow ventilation, sunshading and PV panels, recognise the limitations of operation purely in the conceptual realm? One would hope so. Reflection on the activity of real-scale modelling is seen as a very important element of this project. Reflective digital folios were required as the final submission for the unit, where students were encouraged to consider their own learning in relation to the design projects and the activity of real-scale modelling for the final project. Further reflection, as these students progress throughout the course and into the industry, is seen as the intrinsic final element of
the project that will help resolve the dilemma of using real-scale modelling as a means of fabricating sustainability in the design studio.

Following an initial exhibition in the new a+b studio at Deakin University, EcoPods were dismounted, transported by truck and installed as an exhibition at the BMW Edge space at Federation Square in February 2005. This exhibition realised the intention of the design project, as an installation of EcoPods that relate to the festival themes. For the student cohort, the opportunity to have their work on display at such a high-profile location justified the many hours of hard work they put into building the project.

Because of their high-profile location, there was a high degree of public interaction with the EcoPods. Over the three day duration of the festival, thousands of people, young and old and from all walks of life, interacted with the installations. To bridge the conceptual gap between the original design intention, the final built artefact and the festival themes, an explanatory poster was made. This significantly impacted on the readability and perceived relevance of the EcoPods for the general public. A sense of curiosity pervaded the exhibition audience and people were interested in the concept, process and products on display. The participant group who appeared most able to interpret and interact with the EcoPods was school-aged children. Class groups of children spontaneously interacted with EcoPods. The most successful EcoPods in this regard, unsurprisingly, were the ‘Play’ Ecopods which had children touching, feeling and shaking the structures in a playful and inquisitive manner. Other EcoPods were interacted actively and passively. People wrote thoughts about sustainability on panels of the ‘Create’ EcoPod, sat in the ‘Feast’ EcoPod and on the ‘Feel’ EcoPod, read quotes from the ‘Think’ EcoPod and walked through the ‘Design’ EcoPod.


Source: (Prof. Des Smith)

Figure 4: EcoPods at Federation Square

The success of the EcoPod projects can be measured in terms of these public interactions. Ultimately, they formed an integral part of the Sustainable Living Festival and were enjoyed by thousands of people. Compared to structures built in previous years, this public interaction increased the sustainability of the project simply because they were used by more people and were exhibited outside of the University. The aim of the exhibition was to have EcoPods sold so that they could be useful for the longer term. This was only partly successful, as only the ‘Think’ EcoPod sold and is now on display in a shop in Brisbane. The size of the EcoPods, requirements to dismantle them as part of the sale and transportation acted as disincentives for potential bidders. Unsold EcoPods are placed in storage at the University for use in later years.

Generally speaking, the more playful EcoPods received the most attention. Here, the issue of transparency of concept was highlighted. Students, in participating in the exhibition, observed levels of interaction and, hopefully, realised that design concepts need to be transparent to the general public. This reinforced the criticism levelled in reviews of design projects in previous reviews and served as an important lesson. Public interaction with the EcoPods appeared to generate an awareness of the issue that sustainability is an issue in architectural design. Although the meaning of each EcoPod was sometimes not transparent, this was circumvented by the presence of student volunteers to provide an explanation. The experience in having work exhibited at Federation Square was a rewarding one for students providing them with a great source of pride that justified their considerable efforts.

5. CONCLUSIONS

Although not without its challenges and problems, the integration of the design studio and the Sustainable Living Festival proved successful for students, and was received well by the festival organisers and the public. Two primary issues are
inherent in the project that bring forward the dilemma of using real-scale modeling as a means of ‘fabricating sustainability’. A principal problem that undermines the success of the project is the ability for second year students to operate on a highly conceptual level in regards to sustainability. Students generally had trouble connecting a theme about sustainability to the design of a small-scale structure. This conceptual development formed the foundation of the real-scale modeling thus is of primary importance.

The second issue is the dilemma inherent in consuming resources in a project that served to address issues of sustainability. Large quantities of building materials were used in the construction of the eight EcoPods, although this was offset by paperless submissions for previous projects. In comparison to previous real-scale modelling projects, which consumed similar resources, the exhibition of EcoPods at the festival offset the environmental impact by extending the life of the project. In exhibiting projects at Federation Square, meaning was given to the design project, with members of the public interacting with EcoPods. During these interactions, messages about sustainability and architecture were imparted, thus justifying the original design brief. Students, in observing these interactions, learn about the need for transparency of design concept in ways that are unavailable in traditional design projects. Reflective activity thus serves to conclude the learning inherent in the project.

The real-scale modelling project consumed a large amount of resources, but served as a vehicle for authentic learning about architectural design. This learning serves the purposes of informing students’ future design practice. In consuming resources now, it is contended that future resources may well be saved in much larger building projects as an outcome of the learning inherent in this project. However it may be that using real-scale modelling as a means of ‘fabricating sustainability’ in the design studio is a fabrication in itself.

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REFERENCES