

**Author:** Nicola L. Bould, Senior Teaching Fellow, BA(Hons) (UK),

**Title:** Sustainable Design Education:  
Students take charge of creating a clean, green university

Design Studies | University of Otago | PO Box 56 | Dunedin | New Zealand  
64 3 472 8947 | nicola@design.otago.ac.nz

**Presenter:** Nicola Bould

**Paper Stream:** Education for Sustainability

### **Abstract**

According to Moggridge (2007), the terms ‘sustainable design’ and ‘product design’ appear to be polar opposites. One is concerned with the consequence of a consumerist society, whilst the other is responsible for inflating it. Thus it is a “challenging subject for designers to come to grips with” (2007 p.656). Unfortunately this has meant that the word sustainable has been frequently misused or tagged onto products as an afterthought. With today’s cogent research supporting the argument that expanding landfills, depleting oil reserves and massive carbon outputs are irreversibly changing global ecosystems, it is necessary to design responsibly to ensure the future of our planet.

For the last few years these sustainable beliefs have been used to provoke design students at the University of Otago, to question their response to their environment. However, in the academic year of 2006, the students were given the challenging task to analyse, interpret and design solutions to improve their own and their university’s behaviour.

This paper considers the design process these students experienced, the success of the outcomes and whether this project has had a positive affect on their awareness of environmental issues. The student project, itself, is part of a deeper multi-disciplinary thesis research to understand and improve sustainable product design education. It has been inspired by the work of Charter and Tischner (2001), McDonough and Braungart (2002), Rothstein (Arizona State University, 2004), Datschefski (2001) and Szenasy (Heller & Vienne, 2003), who have proved that creative solutions to sustainable design education are viable. The goal of this research is to critique current methodologies for facilitating environmental and social responsibility within product design education. It aims to demonstrate links between considered educational practices and an increased appreciation for issues of sustainability amongst practicing product designers.

### **1. Introduction**

The complexity of product design education generally begins with the history of design and moves on to the practicalities of form and function. Then, in no particular order, there are the intricacies of human factors, from ergonomics and anthropometrics to biomechanics. Somewhere has to come the comprehension of the vast scope of materials and the appreciation of simple or elaborate manufacturing processes. There is also the interaction between user and product, where

terminologies such as cognitive ergonomics, experience, interaction, inclusive and emotional or user-centred design have become popular. Then there is sustainable design; where does this fit in the complex web of creative thinking? All of these facets are integral to the product design process. However, in Design Studies at the University of Otago, it is environmentally [and socially] sustainable design that is at the heart of the product-design structure.

In March 2006, 27 third-year students were given the task to investigate environmental issues, analyse the results and take charge of designing their own clean, green university. The objectives were [a] to ascertain if student's world-views changed over the course of the year and [b] to obtain a number of creative, well-designed products purchasable by the university to start 2007 with a clean, green philosophy.

This paper investigates the pedagogy of education for sustainability and lifelong learning through the integration of sustainable philosophies, a tangible project and tertiary student education. The research engaged with students to enable them to learn about environmentally and socially responsible design. The paper explores the success of design solutions from the students and seeks to understand the level of affect on individuals. It takes a critical look at current attitudes towards sustainability and introduces strategies of research towards successful future design education.

## **2. Overview of the Student Project**

### **2.1 The Brief**

27 third-year product design students at the University of Otago, researched, conceptualised and prototyped designs based on waste minimisation at their University. Their brief was simply to create a product, system or service to reduce waste (paper, trash, recyclables, organic, energy or water) that is useful, useable, desirable and sustainable. Throughout the whole project it was understood that to ensure the feasibility of the University of Otago implementing any of the prototypes, manufacturing and economics must be realistic. Whilst providing students with a practical project and interaction with users, manufacturers and local authorities, it has integrated design theory and practice with pertinent issues in psychology, social responsibility, sustainability and ethnography.

### **2.2 The Methodologies**

The research commenced with free exploration [student + digital camera]. The following images show some of the student's concerns:



From the lack of recycling facilities for students [a] and staff [b]; confusion about what recycling goes where [c]; concerns about paper [d], cardboard [e] and energy waste [f] to the amount of take away coffee cup used [g].

Inspired by one item of waste, the students were encouraged to do a bibliographic search then present their findings. They answered the questions: what material is the waste product made from? Where do the materials come from? How far has the product travelled? What process has the product been through? What happens to the product upon reaching its end-of-life? In the author's interpretation the findings from this research seemed to produce a negative atmosphere within the group of students.

The students were then encouraged to choose a product, designer or company that embodies sustainable design to study and discuss. Fortunately there are exciting and inspirational product designers and companies who do focus on 'green' issues. In the author's interpretation this discussion returned the tenor of the group to a positive one.

Next the students rummaged through their own bins to produce an audit of waste, they visited recycling centres and met experts in waste minimisation. All of these activities enabled them to understand the problems and achievements of recycling and the variety, quality and quantity of waste generated.

The students interviewed peers, academic staff, general staff and cleaners to learn of present perceptions of waste. They conducted user observations by watching their fellow scholars and staff members to understand how waste is managed. Concurrently the students began brainstorming and creating. From this research they made design recommendations. Eight of the most innovative and exciting individual concepts were selected for development to a professional level. Therefore eight groups ranging from 1-4 students were formed to complete the task of conceptual prototyping, development and refinement.

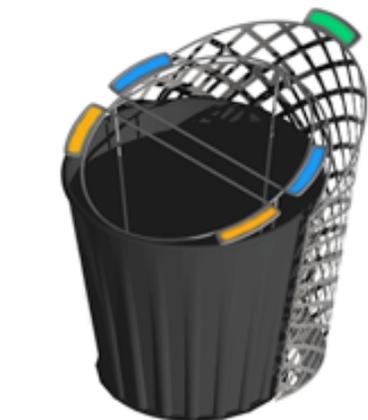
### 2.3 The Outcomes

The following are six of the final designs from the eight groups.



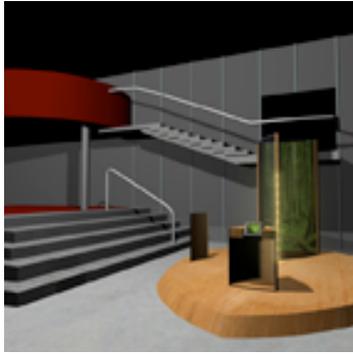
#### *Retrocycle*

This design aims to retrofit the majority of existing bins on campus. An aluminium construction clips onto the current bin frames. Three bin bags securely attach to the legs. The graphic labels on the top and sides indicate which segment is for what rubbish.



#### *Tri-cycle*

Again this is a retrofit however, this time the aim is the small bins frequently found in staff offices. The paper recycling basket clips onto the back and the bin itself is divided into two: recyclables and trash.



### *Paper tower*

This product is aimed at creating awareness of the reams of white paper the university wastes in any given month. The idea is a tower of paper, collected at the end of each week. LED lights represent the amount of paper saved. The aim is to reduce the tower of paper to show the image of the trees and increase the amounts of LED's lit. An information centre next to the tower will provide paper saving advice.



A poster campaign to compliment the retro fit bins will help solidify the idea.



### *Hydro power*

A micro hydropower station is proposed to be located in the local stream, which is situated centrally on campus, to generate electricity and promote awareness. There will be enough energy to light the surrounding area and to power the information station. This station will provide information about the amount of energy currently used on campus, how hydropower stations work and simple ways of reducing energy use.



### *LED White light*

Energy consumption in computer labs is extremely high. Lights burn for 24hrs a day. The LED white light plugs directly into each computer and allows main lights to be turned off. When the computer is in use it burns brightly yet when the computer sleeps or switches off the LED light goes blue. Therefore providing enough light to move around furniture but with no energy wastage.



### *Lowtech furniture*

Cardboard furniture could be seen as a necessity at the University considering the trend to burn couches. This solution not only addresses the issue of cheap, desirable furniture for student accommodation but also the environmental impacts of throw-away furniture. If this is burnt it will not be as toxic for the environment as your everyday couch and once the students have finished with it, it can be thrown back into the cardboard skip for recycling. Made from cardboard, water and flour there is no process required for dismantling.

### 3. Sustainable Design Discussion

#### 3.1 Product Design

“Some individuals evolve insights into people’s lives, with the results that they design radically new solutions to problems that might seem obvious once manifested in tangible form - in other words, giving users what they never knew they wanted - one of the most innovative roles designers can play”(Heskett, 2002, p62).

As Heskett states designers can provide new solutions to complex problems. However, there have been thousands of complex problems created because of the irresponsible attitudes of some designers. Historically little or no regard has been given to the consequences of producing new ‘super’ materials for innovative designer masterpieces, or to the creation of our throw away society. However, the paradigm is shifting. People are beginning to realise that our existence on this planet may not be so permanent.

According to Datschefski (1997 - 2004) “designers are purveyors of elegance, style and functionality. But much of this elegance is only skin deep. A few designers and discerning consumers are starting to look beyond pure surface.” How often do we judge designer objects on superficial values? How do designers believe they are progressive when they are producing consumer products that are made using un-renewable resources, polluting processes, exploiting workers or encourage un-sustainable behaviour? He proposes the need for a product protocol where “sustainable products are products that are fully compatible with nature throughout their entire life.” This takes into account “the materials they are made from form part of a continuous cycle and the energy used to make them does not release persistent poisons into the air or water” (Datschefski, 2001 p.29).

#### 3.2 Climate Change

American politician and environmentalist, Al Gore (2006), Australian biologist and writer, Tim Flannery (2005) and the British economist, Sir Nicholas Stern (2006) have all recently declared that we are balanced on a pinnacle of change where we face only two possible futures. One is too frightening to imagine and the other is so remote that it seems impossible to accomplish: “where we continue to thrive and prosper, but *within* the ecological limits of the natural world we inhabit” (Purves, 2005 p.xvii). If we are to believe this ‘inconvenient truth’, the scientists and the economists then a new role for designers is going to materialise: re-thinking, re-structuring and re-designing our entire existence *on* and use *of* our planet.

#### 3.3 Sustainable Product Design

Norman (2004) insists that the key to successful product design is through the user. Cagan and Vogel (2002 p.87) assert that one of the solutions to creating breakthrough products is to ensure products have an appearance and characteristics that consumers recognise as useful, useable and desirable. *Useful* takes into consideration the point of view of the user and queries if the product does its job. *Useable* questions whether the product fits the hand and mind of the human being. *Desirable* determines how appealing and engaging the product is to consumers. For one product to be successful it must meet these criteria, however, if we acknowledge that climate change is happening then for new products to continue to prosper a fourth dimension must be added: *sustainable*. This will establish how environmentally acceptable a product is and whether it can continue indefinitely.

McDonough and Braungart’s (2001, p.144) proposal of a ‘cradle-to-cradle’ approach to product design instead of the old ‘cradle-to-grave’ attitude has been widely debated. Cradle-to-grave can be seen by visiting any landfill today where we can currently distinguish the remnants of our material assets being wasted. It will be overflowing with computers, furniture, televisions,

telephones, clothing, organic waste, washing machines, paper cups, babies' nappies, etc. The majority of these items are made from valuable resources and require millions of dollars to extract and process, only to be tossed out at the end of its life. The cradle-to-cradle approach proposes that the company takes responsibility for the products they manufacture. They must consider the whole life-cycle from beginning (cradle), through use and end-of-life back to the beginning. Therefore minimal resources are wasted and the terms reduce, reuse, recycle and regulate are commonly found in any company, whatever product they are producing (2002, p.48).

### **3.4 Sustainable Economy**

Sustainable philosophies are not merely debated by designers, but by those who deal with the finances. Sir Nicholas Stern is not the only economist concerned with the state of global well being but green business guru, John Elkington, the co-founder of SustainAbility (1987 - 2007), a website which offers advice, networks and a think-tank to clients about the risks and opportunities associated with corporate responsibility and sustainable development. Elkington (1998 p.2) coined the phrase 'triple bottom-line', which considers economic prosperity, environmental quality and social justice. For businesses he believes that to decline the challenge of triple bottom line reporting will be economic suicide. He identifies seven elements or 'revolutions' that are feasible to lead us towards a sustainable future.

Charter and Tischner (2001, p.121) state that sustainable product design is directly connected to economic, environmental and social factors when creating products and services. "Sustainable product design is more than eco-design, as it integrates social and ethical aspects of the product's life-cycle alongside environmental and economic considerations – aiming for the so-called 'triple bottom line'." Methodologies and tools have been developed by this duo to reach the goal of a more environmentally and socially sustainable economy.

### **3.5 Better by Design?**

So is this the opportunity designers are waiting for? Can we create sustainable business through better design? Better by Design, is a government-funded organization whose objectives are to assist New Zealand companies increase their exports and profits through the better use of design in their products and services (New Zealand Trade and Enterprise, 2005). Better by Design, however, seems to be timidly promoting sustainable design through the *Masterclass on Design*, [scheduled 1-2 August, 2006] where the foremost topic to be taught is "Creating a sustainable design vision and culture" (Taylor, 2005). As one of the partners of the initiative, Professor Roy Fleetwood [Head of the School of Design, Victoria University, Wellington] comments, "building a sustainable design-led company is an ongoing challenge" (Fleetwood, 2006). Therefore the word sustainable is used in the online material most commonly in phrases such as "sustainable edge" (Hawkins and Hendry, 2005), "sustainable profitability" (Heskett, 2005) or "innovation process to create sustainable value" (Bley, 2005).

An interesting comparison is the innovation guide 'Better by Design' developed in Minnesota, USA, which advocates Design for the Environment (DfE). Co-founders, Kurk and McNamara's (2006) belief is that "design is key to the function, meaning and appeal of products used by people every day throughout the world. It has long been recognized as a critical stage for determining costs and profitability. The National Research Council estimates that 70 percent or more of the costs of product development, manufacture and use are determined during initial design stages. For those who bring shape to our physical world by designing products, it is also an unparalleled window of opportunity to distinguish products, while championing the environment through innovation." So why is our own 'Better by Design' not fostering similar philosophies? Surely it is not through lack of knowledge or economics?

Maybe the reason sustainability is not ubiquitous is due to scepticism? When we look at examples such as the Y2K bug, it is not difficult to appreciate why. However, with the success of the reduction in the size of the hole in the ozone layer, due to the Montreal Protocol (Flannery, 2005 p.220), we can acknowledge this achievement and consider how the world can unite once again to avert disaster.

### **3.6 Sustainable Design Education**

Dr Mario Tabucanon from the United Nations University (UNU) told young adults attending the Asean Environment Forum on the 6<sup>th</sup> January 2007, “changes in educational systems are needed to provide young people more life-long opportunities to learn how best to care for the environment” (Han, 2007).

This sustainable perspective is already being employed worldwide within some product design programmes. Australia’s RMIT in Melbourne have a Centre for Design actively promoting sustainability through research and consulting. In Europe, primarily Delft University of Technology in the Netherlands, which teaches a Design for Sustainability (DfS) programme. The UK has Loughborough University with their ‘Tool-box’ for sustainable design education, the University College for the Creative Arts with their BA Hons in Product Design Sustainable Futures. Furthermore the Surrey Institute for Art and Design publishes the Journal of Sustainable Product Design from the Centre for Sustainable Design. America’s leading sustainable educators are the Green Design Institute at Carnegie Mellon, Pennsylvania and the Innovation Space at Arizona State University. The latter is teaching students “how to develop products that create market value while serving real societal needs and minimizing impacts on the environment” (Arizona State University, 2006).

In New Zealand there is minimal product design education available, therefore the opportunities for sustainable product design are few and far between. The closest is the University of Auckland, which offers a paper entitled ‘Sustainable Engineering Design’ where students are “expected to provide input into effective, efficient and sustainable product design” (University of Auckland, 2007).

### **3.7 Sustainable Design Education in New Zealand**

So what is the reason sustainable design education is so slow to be implemented into New Zealand’s tertiary education? Do our product designers not care about the consequences of their actions or decisions? Does it amount to social awareness and those designers who are socially conscientious in their personal lives are the individuals who are socially conscious in their professional ones? If this is true it is imperative that sustainable design education catches students as they commence on their career path. The project detailed in this paper showed success from a number of perspectives. The students gained an abundance of knowledge relating to the theoretical design process; they experienced a project with a real context, very specific boundaries and gained an understanding of sustainable and socially responsible design.

However, questions still remain regarding the process itself. Has the year provided the students with enough knowledge to ensure they practise sustainable solutions themselves? The student design recommendations were innovative and potentially appealing to the University, but has this sustainable philosophy ingrained itself into each person?

The students were asked their views through an anonymous questionnaire (Appendix A) on what

they had learnt throughout the course of the year, [70% response rate]. A particular student comment was “this course has made me understand the importance of taking a step back and having a look at the big picture. Not just in terms of the environment, but also in terms of a design itself and the wide reaching impacts it can have. I have learnt that it is important to immerse yourself in what you are doing and to develop a total understanding, but I have also realised that it is important to be able to distance yourself and critique your motives, your designs and yourself, to get the best possible result.” (Anonymous, Student Questionnaire, University of Otago, 2006).

Another student, from the Lowtech Furniture project, has gone on to start his own business designing, manufacturing and selling cardboard furniture. In an interview with Organic NZ: Soil and Health Association, he commented “The reason this all started was because one of our lecturers, Nicola Bould, got us to write a submission for the Dunedin City Council waste strategy. Envirowaste are collecting all of our waste resources throughout Dunedin and on-selling them, shipping them straight overseas. I asked them why they don’t create facilities to recycle here, turn them into new products and then export them. They said that they don’t have the resources. I guess until then I wasn’t aware of the issues we face, not only as a community and a country, but globally. People ignore environmental problems or they just don’t know. It’s really scary. And that is where Lowtech furniture has a place - it’s functional, but it also raises awareness.” (Evans in prep, 2007)

A sustainable philosophy has indeed become ingrained in a number of the students. When asked to rank themselves (1-5) on the level of environmental awareness they held prior to and subsequent to the project, 95% had increased by at least one rank. Therefore sustainable education can make a difference; it can educate our future designers, and this gives us hope that modified educational strategies can influence future manufacturers, planners, economists, leaders... (the list goes on) to make a difference. The question is now, how do we prioritise sustainable design education in New Zealand’s tertiary design curriculum?

#### **4. Conclusions and Future Research**

This paper has made visible the notion that sustainability plays an important role in the design process. The project was successful because it exposed students to issues concerning people and planet. The students who participated in the project gained a new understanding of the relationship between bibliographical, field and user observational research and the considerations that must be given to creating sustainable design.

Through this project the author gained valuable insight and comprehension of how students deal with a topic that most were unaware or uncaring of. The project promoted social responsibility and challenged student’s ideas about both the design process and their own ethical considerations. This project is by no means complete. Ongoing evaluation through further research, testing and refinement will provide valuable information to ensure future designers graduate with a real understanding of the issues of sustainability. The project will continue as PhD research, gaining new knowledge and developing planning methodologies for environmentally and socially sustainable design education. Design recommendations could then be made to institutions to ensure we are providing our future designers with the tools (knowledge) towards a sustainable community/country/world. These proposals could also connect with existing resources such as practising designers, product manufacture companies and even government bodies (like Better by Design) to ensure New Zealand is making a difference. This country has the potential to be a world leader in the field of sustainability, through the commitment and vision of our leaders and through the desire of our 4.1 million people to create a clean, green New Zealand.

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## Appendix A

October 26, 2006

Questions sent to 27 third year design students:

1. Can you categorise yourself *prior* to DESI 301 / DEFE 321 in terms of environmental awareness, (please tick the closest one/s):

Never thought about it;

Thought about it but consciously didn't act (didn't even attempt to kerbside recycle);

Thought about it and acted minimally (like putting kerbside recycling out);

Conscious and careful about what you do (recycle, careful of what you bought/ate/acted etc.);

Extremely aware and actively doing something (activism / promotion of environmental issues).

2. Can you categorise yourself *subsequent* to DESI 301 / DEFE 321 in terms of environmental awareness, (please tick the closest one/s):

Still don't care;

Think about it but consciously don't act (don't even put kerbside recycling out);

Think about it and act minimally (like putting kerbside recycling out);

Conscious and careful about what you do (recycle, careful of what you buy/eat/do etc.);

Extremely aware and actively doing something (activism / promotion of environmental issues).

3. Are you inspired to learn more about environmental issues?

- a. If the answer is yes, would you like to practise using sustainable solutions in your career?

- b. If the answer is no, is there anything that could persuade you that the environment is as important as economics/politics/the user/form and function?

4. What stands out as being the greatest issue/factor you learnt from the course?

5. If you could change or add anything to the structure of the paper what would you change/add?

6. Do you have anything else you would like to comment on?