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Title: How to effectively engage students' with environmentally sustainable product design?

Category: Embedding Sustainability

Abstract

It has become increasingly evident that the impacts of human development and production/consumption over the last half of the twentieth century and into the twenty-first century are unsustainable in the long term. The response to this is an increased focus on identifying opportunities to support and enhance sustainability. This transition not only presents a huge challenge for product designers but also provides opportunity for designers to reframe their practices and processes.

It is therefore imperative that the teaching of sustainable design is embedded deeply into the curriculum of product design programmes. Responding to the need for a focus on sustainability in higher education, many programmes have developed projects centred on design for social responsibility. Furthermore, despite the plethora of sustainable design frameworks attempting to provide solutions to the world's ecological crisis, many designers oversimplify such systems in order to attain suitable design outcomes. These may result in superficial design responses when it comes to issues of sustainability. Due to the complex nature of ecology and ecosystems, developing student projects that go beyond "eco-design" will help them to better cope with the complexity of the relationships between the environment, society and the economy

We propose that a new approach is required to engage students more deeply in environmentally sustainable product design. This approach will assist students to develop greater ecological literacy and develop new modes of design process thinking that is required to help negotiate future environmental and social challenges. In effect, the proposed approach reflects the need for collaboration between scientists (ecologists) and designers to build new capacity in this area.

Introduction
One of the most commonly used definitions of sustainability states "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED. 1987, p. 47). It is clear that humanity is using the planet's resources faster than they can be renewed. Since the industrial era, humanity has witnessed advanced negative impacts on climate change, ecological degradation and pervasive poverty in developed and developing nations (Doppelt 2003). The ecological footprint of people now exceeds the world's ability to regenerate it by about 25% (Leape 2006). Over the next few decades humanity will be progressively confronted by increasing negative environmental and social impacts of human development. This transition towards sustainability, in its everyday dimension, requires billions of people to quickly redefine their life projects (Manzini & Jegou 2006).

Sustainable design has emerged as a response to these environmental and social imperatives. Design for sustainability can be defined as a strategic design activity which aims to conceive and develop sustainable products services and solutions (Manzini 2006). The notion of a more ecologically and socially responsible approach to design is not new. In the early 1970s Papanek (1971) challenged the existing attitudes and practices of designers and outlined a design approach that emphasised social and ecological responsibility. Papanek (1971) argued that design aims must show greater social and ecological sensitivity, and consider the genuine needs of people. In 2001 industrial designers from around the world declared that industrial design will no longer regard the environment as a separate entity and industrial designers need to pursue the path of sustainable development by coordinating various aspects that influence its attainment, including politics, economy, culture, technology and environment (ICSID 2001).

Sustainability and sustainable design in higher education

"Higher education institutions bear a profound, moral responsibility to increase the awareness, knowledge, skills, and values needed to create a just and sustainable future'' (Cortese 2003, p.17). Cortese (2003) also states that the change in mind-set necessary to achieve this vision is a sustained, long-term effort to transform education at all levels. A new educational agenda has been established with entirely new ways of thinking and new intellectual priorities to rescue the environment and the human prospect, such that ''those now being educated will have to do what we, the present generation, have been unable or unwilling to do'' (Ramirez 2006, p.191). In addition, Wals and Jickling (2002) argue that sustainability provides colleges and universities an opportunity to confront their core values, their practices and the way they program for student learning.

"Design education for sustainability can help usher a promising future by transforming the designers of tomorrow" (Ramirez 2006, p.191). While design educators have responded to sustainable imperatives in various ways, it appears that approaches are mixed and often appear to be ad hoc. For example, a recent survey of Australian industrial design programmes illustrated that aspects of environmentally sensitive design are currently being incorporated in most Australian industrial design degree programs, albeit only to a minor extent (Ramirez 2006).

Product Design at Auckland University of Technology

The three-year undergraduate product design programme at AUT University was developed in 2007 and launched with the first intake of students in 2008. In 2010, the programme will have 75 students across the three years as well as five studying at postgraduate level. The student profile indicates that the undergraduate students in the programme have predominantly transitioned directly from secondary school with a small percentage of students in the 20 to 30 year age bracket.

While the development of a new academic programme provides many organisational and operational challenges, it also presents a unique opportunity to develop new approaches to teaching and learning and without the constraints of institutional history and tradition. An innovative pedagogical approach to product design is currently being developed in the product design programme at AUT that expands the definition of a 'product' to become a range of outcomes i.e. 'the product of' a creative design process. The emphasis on learning

becomes 'design thinking' as an outcome rather than necessarily on the tangible, physical 3D product outcomes. Further to this, and as a response to emerging world sustainability issues, sustainable design is currently being deeply embedded in the curriculum, pedagogy and focus for the entire programme. A number of initiatives are seen by the department as a catalyst to assist in building knowledge and capability in the area of sustainable design and to start to gauge student, interest awareness and understanding of sustainably issues.

'Everyday Interventions' Project

In 2009 the programme undertook the first student project focused on sustainable design. 'Everyday Interventions' was a seven week studio project undertaken by twenty three second year students at the beginning of semester two. The project was lead by a team of two lecturers, one academic and one guest lecturer from industry. The key aim of the project was to introduce and begin to engage students with some of the fundamental concepts of sustainability and sustainable design, leading to practical, tangible outcomes through a creative design process. It was also hoped that the project would also assist students to become engaged with broader issues around the role of design in creating a better future. For the purposes of the project the focus was limited to environmental dimension rather than social dimension of sustainability.

Given the complex and often 'negative impact', focus of environmental sustainability i.e., impending climate crisis, a more optimistic approach to the project was developed to inspire and motivate students. As Ramirez (2006) argues, environmental (sustainability) education should thus have a more optimistic focus and be empowering for students. Rather than focusing on just trying to reduce the negative environmental impacts of products through design (eco efficiency), the project focused on a human-centred approach to sustainable design with potentially more positive, practical human behavioural change outcomes. Further to this, Orr (1992) states 'the study of environmental problems is an exercise in despair unless it is regarded as only a preface to the study, design, and implementation of solutions'. Students were encouraged to see themselves as possible agents of change.

A number of key lectures and discussions were used to engage students in discourse around the broader issues of sustainability and to launch and underpin the project. Students were first asked to consider how they personally envisioned the 'future' and this was used to unpack a number of key world environmental and social issues. From this the history of environmental and social sustainability was discussed leading to philosophical and 'values' based perspectives. Much of this discussion focused on the notion that while design has contributed to 'unsustainable' development through production/consumption models, design can potentially play a more positive role in starting to move towards a more sustainable future. Initial feedback that emerged through discussions at the beginning of the introduction suggested that while the majority of students seemed to have some understanding of the issues i.e. climate change, social issues, it was a clear that many students did not appear to grasp the breadth, depth, scale and complexity of the issues, and the implications that these issues would be likely to have on them personally and in their lifetimes.

From this point a number of sustainable design frameworks and approaches were presented and then used to explore and 'define' sustainability and approaches to sustainable design, as well as to drive the research and creative design process. The frameworks were seen as a 'way in' and start point to the project, and something that students could draw upon during

the process. Students were also encouraged to also to begin their own investigations and background research.

The term 'Everyday Interventions' was selected to deliberately remove the word 'product' from the title reflecting the broader approach to product design at AUT, and to encourage students to research and explore more laterally and to go beyond products such as service and system based approaches and solutions. The project was divided into three key phases: 1. Research, 2. Exploration, 3. Design.

The Design Process
Given the relatively short period of the project and complex nature of the topic the students were provided with a carefully structured design process and with a set of design tools and techniques.

1. Research.
Given the human-centered approach to the project, a participant observation study (Bharma and Lofthouse, 2007) was used to drive the research phase of the design process. The goal was to identify 'actual' user practices, habits and behaviors in relation to clearly defined negative impacts on the environment. Students were asked to select an adult who they knew very well and who with agreement they were able to 'shadow' for an extended period of time (no less than two hours) and over a number of days while they went about normal activities. For confidentiality and ethical reasons students were also asked to not disclose any aspects of the identity of the person to other members of the class or to lecturers.

The process of observation was discussed in studio sessions with most students agreeing that after a period of time the participants forgot that they were being observed and therefore were generally not moderated by the observation process. Overall the feedback from students indicated that they enjoyed the observation process and were able to look deeply at activities and behaviours with 'fresh' eyes.

From this process, and using definitions developed, three key clearly 'unsustainable' practices, habits and behaviors were identified, documented and presented to small groups for evaluation. A matrix of criteria was developed to assess and evaluate each of these for 'design potential'. From this students were able to select a particular design opportunity to explore. At this point students were also asked to further reflect of the frameworks that they were presented with.
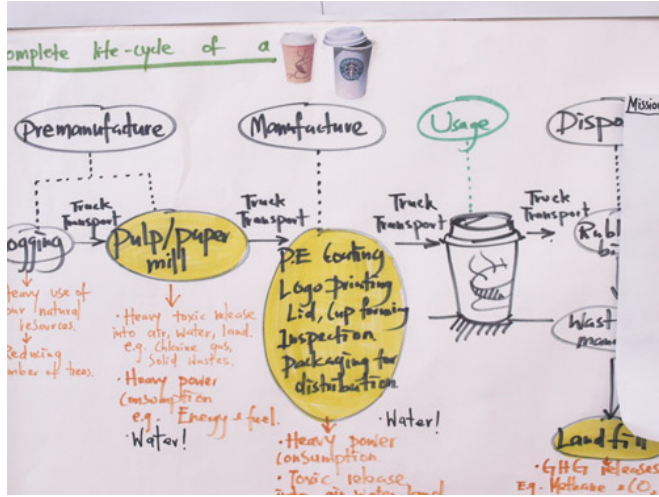
2. Exploration.
Students were then encouraged to further research and unpack the specific selected activity/behavior as a 'system' of interrelated steps, issues and/or factors. A number of techniques were utilised including further specific interviews with participants, photographic documentation and analysis using role playing, system diagrams and mind mapping. This resulted in the development of a set of design parameters i.e., a clearly defined opportunity to explore and 'solve.'

A number of creative tools were then used to drive a divergent and convergent a creative design process. Students were encouraged to think laterally about the problem, and without necessarily exploring and relying on physical product outcomes. Students were reminded of

the word 'intervention' to assist people to begin to change behaviours as a creative trigger. Further more specific research was also encouraged at this point in the process to underpin and inform the creative process including life-cycle analysis if appropriate.

Figure 1.   Example of student Life-Cycle diagram

3. Design.

Informed by critique and analysis of the exploration phase, possible design solutions were then identified.   These were interegated by students in class session and small group situations.   Students were encouraged to quickly and effectively further explore ideas in drawings, quick 3D models and prototypes if appropriate, system diagrams, models and virtual mock-ups for testing and evaluation. From this a final design proposal was developed and presented to class in a formal critique session.   Students were encouraged to engage their participants with their design proposals and to report feedback.

Student Design Outcomes

The following represents an example of three approaches and design outcomes to the project.

1. Clingfilm Replacement

This project explored a replacement for disposable Clingfilm food wrap. Based on principle of the vacuum freezer bag, this solution offers the user a reusable, food storage and transportation (Lunchbox) solution.

Figure 2.   Model of 'Lunchbox' design proposal

2. Paper Coffee Cups

In this project the student has explored the opportunities to help consumers to 'consider' opportunities for reusing non-recyclable coffee cups of which billions are placed in landfills each year. The proposed solutions engage consumers with a series of humorous and thought provoking 'second life' creative opportunities for coffee cups through the use of innovative product graphics and branding.
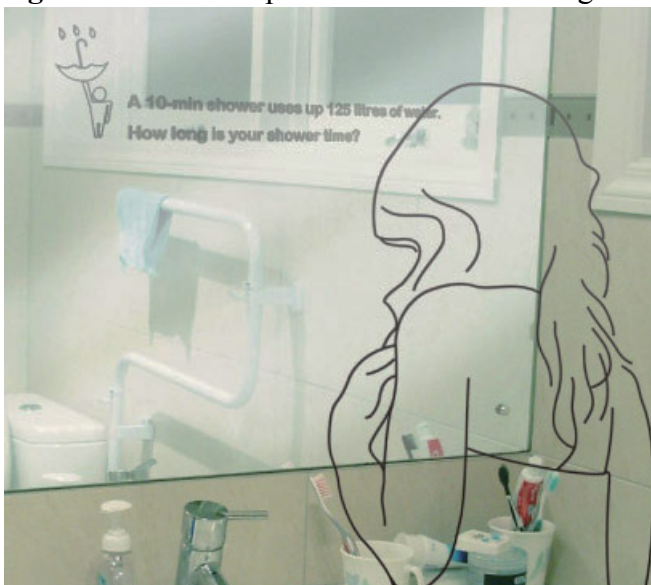
Figure 3. *Model of 'Coffee Cups' design proposal*

3. Hidden Messages

This project moves beyond a product solution to provide domestic bathroom users with hidden messages, which appear when activated by water use. The messages remind the users of the impacts of excessive water usage.

Figure 4. Example from 'Hidden Messages' design proposal.

Discussion

The student responses for this project are generally in line with what is commonly presented in international eco design books (i.e. Fuad-Luke 2009, Proctor 2009) and student design competitions, where design responses are often centered identifying issues of toxicity and lowering material impacts, while minimising the impacts of human consumption/activity. The majority of student responses fell into these categories. Anecdotal evidence indicated that, while initially the majority of students seemed to have some understanding of sustainability and did not seem to grasp the breadth, depth, scale and complexity of the issues. However, it appears that students became much more interested, motivated and engaged by sustainability throughout this project. Further to this, class discussions have indicated that students have also become much more aware of their own 'unsustainable' behaviors and of those of their friends and families. Many have also indicated that they have now begun to engage and debate sustainability issues with them as well. The design outcomes produced by students have also demonstrated the use of 'design thinking' to push beyond physical 3D products to higher level services and system based solutions.

While this project has provided a good platform for the programme to begin to engage students with issues around sustainability and sustainable design, it is believed that there is a need to engage students more deeply around ecology to underpin a more effective approach to sustainable design. Vezzolo and Manzini (2008) suggest that the dependence of society (present and future) on the long term functioning of complex ecosystems is often forgotten. One approach may entail engaging students in real environmental design problems by working alongside biologists and ecologists. This approach to collaboration will help ensure design students are able develop a deeper understanding of ecological systems and processes. From this, they will develop a level of ecological literacy that will help them to engage in eco-design projects in a genuinely more meaningful way. It will help provide them the tools to challenge their design actions and impart them with the knowledge of what questions they should be asking, and what specialists may be able to help them answer these questions. It is anticipated that an important outcome of this approach is that design students learn to acknowledge the complexity of ecological systems.

Traditionally designers often oversimplify such systems in order to attain suitable design outcomes, which may result in superficial design responses to issues of sustainability. These are probably due to a failure of designers to understand the complexity of ecological systems. For example, Bhamra and Lofthouse (2007) describe a compostable mobile phone case that releases a seed on disintegration. Similarly, Braungart et al. (2007) describe a potential Cradle to Cradle design solution where a biodegradable ice cream wrapper may be designed to contain seeds to be thrown away to supporting plant life. While the growing of plants appears to be a worthwhile ideal, in New Zealand many "garden plants" have escaped to become invasive weeds resulting in considerable ecological destruction (DOC 2002). The potential negative impact of this eco-approach is likely to be further exaggerated in a global economy where products are shipped and consumed worldwide. The spread of alien invasive species has had considerable impacts on indigenous species worldwide and is a continued threat to global biodiversity (Bright 1998, Mooney & Hobbs 2000, Myers 2002, Younge 2002).

In the context of ecological design challenges, understanding that systems are complex and may not be easily simplified is an important insight when dealing with issues of sustainability. Such projects will help students to better appreciate this. In addition, by being able to understand and manage the complexity of ecological systems will help them to better cope with exploring the complexity of the relationships between the environment, society and the economy.

A greater involvement in design projects that are ecological in nature (i.e. products for conservation) is way for students to access knowledge regarding the serious consequence of people's impacts on the environment. However, unlike confronting doom scenarios, such projects will demonstrate the positive power of design to facilitate positive change for the future. Such an approach might help students better understand the necessity for people to demonstrate a greater engagement with nature. In doing so, they might develop a greater appreciation of the role of biodiversity and the benefits of it for people.

Conclusion

This paper has presented an approach to sustainable design currently under development in the new product design programme at AUT University. It has included an overview of a second year product design project that has begun to engage students with the complex issues of sustainability and sustainable design. It illustrates some of the challenges when attempting to engage students with sustainable design. Furthermore, it is important to continue to challenge students to move beyond simple eco design strategies and responses. In order to achieve this requires that design educators help find projects that challenge students and require that they engage with environmental issues at a deeper level.

It is essential that universities and institutions of higher learning engage students with sustainability and it is also essential that teaching of sustainable design is embedded deeply into the curriculum of design programmes. In addition, is important to develop sustainable product design capacity in New Zealand. By educating a new breed of environmentally aware designers will ultimately help to demonstrate the value of design to external stakeholders involved in the environmental, agricultural and conservation sciences.

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