

Designing a sustainable future: a new approach to influence design practice

Kirsty Cull, Julian Malins

Key words:

Sustainability, product design, design education, design brief, design practice

Abstract

This paper questions the basis of a sustainable approach to product design in an attempt to clarify the key issues which are liable to influence the outcome of the development of new products. The paper describes research undertaken to establish a set of sustainable characteristics for product design. It describes in detail how the characteristics can be used as a tool to influence the design process. The paper goes on to describe how the characteristics have been incorporated into an educational tool for assisting product design students to assimilate the inherent contradictions they face when addressing sustainability. Two case studies are reported: the first is based on the author's own design practice, illustrating how the characteristics could be incorporated into the design process; the second study reports the outcome of the application of the characteristics as an educational tool when applied to a group of product design students.

INTRODUCTION

With the implementation of legislation and directives forcing 'producer responsibility' through the entire lifecycle of a product, sustainability has become an increasingly prominent issue for design professionals. Many companies are now expressing the need for environmentally literate product designers, but are having difficulty recruiting as traditionally product designers have not been trained to deal with sustainability (Tischner & Charter, 2001: 122). The designer's ability to assimilate ideas, values and specifications within a single product provides them with an opportunity to influence design towards sustainable solutions. Incorporating sustainability into a design solution requires the integration of sustainable thinking as an intrinsic part of design practice. This represents an additional layer of complexity in the design process. Some of this complexity comes about because of the difficulty in defining the term 'sustainability' which is subject to a wide range of interpretations depending on the context and particular agenda of those using the term.

Sustainable product design (SPD) is complex in nature; it is a multi-faceted collection of problems that are amorphous, where the information is confusing, where there are conflicting values and where the ramifications of the whole system are unclear. This complexity is characterized by the difficulty of accessing information specific to the design process. If the designer wishes to incorporate sustainable values into their design solutions they

would be required to be familiar with a substantial body of literature. A time consuming and demanding task which design professionals working to a client deadline are liable to find difficult to achieve. Complicating design's adoption of sustainability further are the inherent contradictions faced by a designer when considering sustainability, conflicts exist between value judgments, societal norms, economic considerations and practical issues such as legislation. Sustainability also requires a designer to consider the design problems in context rather than in isolation.

The hypothesis underpinning this research states that design professionals are in a unique position to influence patterns of consumption by incorporating sustainability into new products. One way of achieving this outcome is by providing the design professional with an understanding of sustainability at the earliest phase in the design process. In order to test this hypothesis it has been necessary to formulate a set of core characteristics which represent SPD and to find ways in which these characteristics can be incorporated into design practice at an early stage. The result has been the development of an educational tool for use with product design students.

Two case studies are reported within the paper: the first is based on the author's own practice as a designer-researcher undertaking a Ph.D., utilizing design practice to inform the characteristics from the perspective of a product designer and illustrating how the characteristics could be incorporated into the design process; the second study reports the outcome of the application of the characteristics as an educational tool when applied to a group of product design students. The outcome of the research demonstrates how complex ideas can be incorporated into design practice and how concepts of sustainability can be instilled into the designer's lexicon so that they in turn can become sustainable designers. The objective of this paper is to not only report results from the case studies but to point to the challenges; the types of questions that have arisen; and to describe the use of the design process as a methodology.

DEFINING SUSTAINABILITY

SPD and eco-design are terms for strategies that aim to integrate environmental considerations into the design process, but confusion exists between the definitions of these terms. Life cycle thinking forms the basis of both these terms. Eco-design aims to minimize the consumption of energy and resources and the subsequent consequence on the environment, concentrating on reducing the impact of individual stages of a product's life span. SPD prioritizes the reduction of environmental impact in the whole system. This requires the designer to consider the design of a product in context of material extraction, production, distribution, need, societal issues, human factors, function and disposal.

The United Nations conference report *Our Common Future* provides a definition of sustainability in relation to development, as 'meet[ing] the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland, 1987: 48). This definition provides an aim that permeates all sectors of industry and society, however it does generate questions, such as what constitutes a need?

There have been a number of attempts to define criteria for sustainable product design (James, 1997; Design Museum, 2000; Dewberry & Fletcher, 2001; Fuad-Luke, 2002). Datschefski (2001) provides a comprehensive set of pragmatic criteria for SPD, addressing end of life strategies, efficiency, the prevention of hazardous emissions and doing more with less, formulated from a review of products for their environmental innovation. Whilst doing this Datschefski pays less attention to qualitative, human factors issues such as inclusive design, consumption, interaction and aesthetics. Stuart Walker (1998) offers a set of qualitative criteria for SPD developed from an exploration of abstract and theoretical ideas through design practice based on the notion of local production. These criteria do not address the pragmatic issues but do draw attention to the importance of the relationship between the individual with their material culture and the importance of aesthetics.

Initially this research involved the collection of criteria from an analysis of products that claim to be sustainable. Design is recognized as having its own distinct epistemological traditions; its own tacit knowledge and methods (Cross, 1999). A method used at the early stages of the design of a product, is the analysis of products informing the designer of existing design problems and competitors solutions. This method was adopted and adapted for the doctoral study allowing existing sustainable product solutions to inform the generation of the characteristics for SPD (figure 1.). This exploratory method illustrated the complexity of achieving SPD solutions, demonstrating that one product cannot embody all the characteristics of sustainability. The characteristics were derived from two sources of evidence, from the literature review which provided a range of definitions based on recognized authors and from information resulting from the product analysis which provided insight into the effective and ineffective use of aesthetics, ergonomics and product scripts.

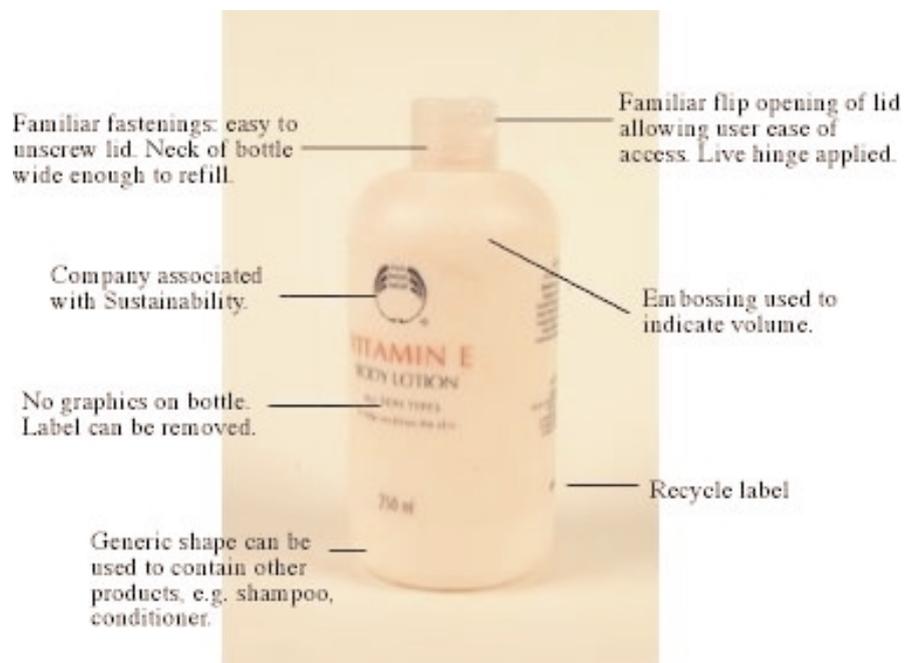


Figure 1. Example of Product Analysis. This bottle used by The Body Shop, a company well known for its sustainable agenda, has been evaluated for sustainable characteristics.

As a conscious effort to move away from checklist based criteria for SPD, which require the completion of the design before evaluation, the characteristics were explored through visual mapping. Framing the characteristics visually and adopting an appropriate language lead to the description of the characteristics that a product should possess to be sustainable. The characteristics were re-framed from a rules based set to a heuristic set forming a set of advisory statements for adoption by design professionals. This move represented an epistemological and creative shift in methods and theories of SPD.

DESIGN PRACTICE

The process of design involves the collection and conflation of needs, observations and values in the mind of the designer. 'This suspension of thought allows a pattern to evolve, providing designers with a picture, which depicts the inter-relationship(s) between different and often contrasting elements of a problem' (Valentine & Baxter, 2002: 238).

The intention is that by exploring the characteristics of SPD through the researchers' own design practice, the characteristics will be in a form which is more applicable to the needs of the designer. The researchers practice

focused on the problem solving, idea generation and concept stages. Problem solving was employed in two steps: step one identified the problems with existing products on the market and various solutions were generated; step two involved the generation of possible solutions to problems identified by the characteristics in relation to a specified design scenario. Solutions generated from both steps were conflated into a series of initial concepts, which were evaluated in relation to the design scenario. This iterative process resulted in the design of three sustainable product concepts (figure 2).

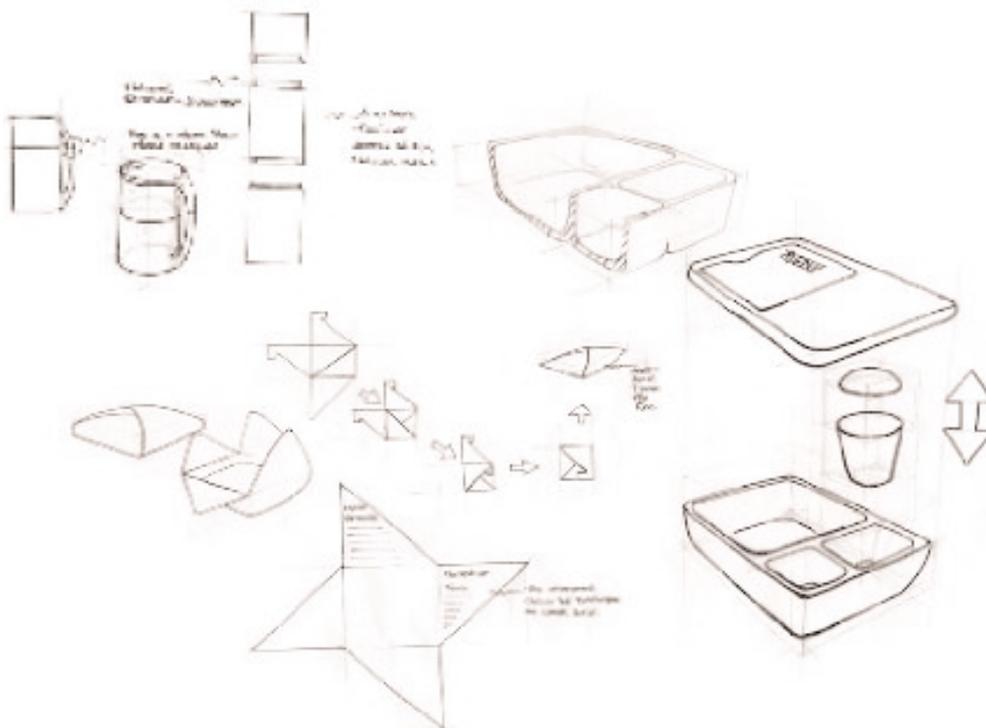


Figure 2. Concept designs for food packaging. Examples showing were produced from a two step problem solving approach incorporating the characteristics of sustainable product design.

Following an analysis of this design practice it became apparent that a useful division of the characteristics would be between those that are pragmatic and those that are qualitative in nature. As the process of designing unfolded it became clear that the pragmatic characteristics constrained the generation of ideas, due to pre-determined options. An example of a pragmatic characteristic with pre-determined options would be end of life strategies, options include recycle, reuse, repair, remanufacture, disposal or extending a products life. These pre-determined options make the pragmatic characteristics easier to address, arguably this is due to their nature or the designers' familiarity with them. The qualitative characteristics do not hinder idea generation, however these are maybe unfamiliar to the designer and how to address them presents more of a challenge. The conclusions of the exploration of the characteristics through design practice illustrate that the qualitative characteristics of SPD should be addressed at the problem solving and idea generation phases of the design process and the pragmatic characteristics as concepts are explored and developed.

THE CHARACTERISTICS OF SUSTAINABLE PRODUCT DESIGN

The formulation of the characteristics of SPD is an ongoing and iterative process. The characteristics aim to provide the designer with a framework of understanding of the problems and opportunities of SPD. The designer will be able to build upon this framework as advances within the field occur. Designing a sustainable product

requires the consideration of all stages of its life span: the function; manufacture; distribution; the consumers needs and desires; product performance and interaction; and appearance. Unlike other attempts these characteristics of SPD address all these aspects, describing problems with current practice and design opportunities in the framework of production and people: pragmatic and qualitative.

The characteristics of SPD have been divided into five taxonomies these are as follows:

- The product is designed with an ***end of life strategy***: An appropriate and safe method of disposal once the useful life of a product has expired is determined prior to production. Clear instructions, written or visual on appropriate disposal of a product are provided. This taxonomy address characteristics such as recycling and eco-labeling; reuse; familiar fastenings which allow the user to repair or remanufacture; the use of biodegradable materials e.g. in food packaging; and durability extending a products useful life.
- The product is design to ***do more with less***: Efficient use of resources and energy during production, distribution, use and disposal. This includes the use of local production and resources creating employment; applying renewable energy e.g. wind, water, solar or man-powered, and renewable resources; the creation of virtual products that provide services e.g. sharing of products; miniaturization; and multi-functional products e.g. the Black & Decker Quattro tool.
- The design of a product ***influences individuals to adopt sustainable and sufficient patterns of consumption***: this taxonomy maintains the need to develop alternative forms of the act of consumption in order to encourage consumers to adopt purchasing behaviour that serves their needs without having detrimental consequences on available resources, economies or the environment. This must be achieved through a period of transition that does not correspond with a scenario of giving up (Manzini, 1994). Characteristics include exploring alternative forms of products such as virtual products or services; questioning the needs the consumer is trying to achieve through the purchase of a product; and customization.
- Product scripts address ***real behvaiour, satisfy real needs and encourage users to be proactive***: The intended plan of use of a product should address real, rather than ideal behaviour patterns, satisfy real needs rather than transient fashionable or market-driven needs (Fuad-Luke, 2002). It should also encourage the adoption of sustainable behaviour through product scripts. Characteristics include constraining actions that result in use that is not sustainable; research and observation; inclusive design and considering the needs and wants of a consumer.
- The product displays ***seductive, simple and appropriate aesthetics***: The aesthetics of a product play a significant role in its adoption, aim to create the 'I like it, I want it, what is it?' (Seymour, 2002) element in a product. This taxonomy requires a move away from the transient styles and stereotypical aesthetics in order to design a competitive product. The characteristics ask: what type of consumer is the product trying to attract? And what lifestyle image does it offer the consumer?

EDUCATIONAL TOOL

Early investigations considered the design brief on the basis that this was in most cases the earliest point a designer is involved in the design of a new product. The conclusions from this initial inquiry were that the design brief is too late a phase in the design process to ensure that a sustainable product will result. This early conclusion might be interpreted as; the designer is powerless to influence the sustainability of a new product unless it is one of the specifically mentioned criteria for the new development. However subsequent research indicated that

provided the designer possesses an understanding of the characteristics involved in SPD it is possible for them to incorporate these concepts into design solutions whether specified by the brief or not. The most appropriate juncture to inform a product designer about SPD is as part of their training and education.

Based on the information and data gathered, an educational tool aiming to inform designers of the key issues liable to influence the outcome of sustainable products. The educational tools target audience is undergraduate design students. The aim being to provide them with an understanding of sustainability in relation to the product design process through interaction with the characteristics of SPD and subsequently carry this information onto their professional practice.

It was important to consider the most applicable manner to educate product design students in sustainability. Gray (1988) asserts that the intentions of teaching, the role of the lecturer and the teaching method need to be considered. The educational tool applies a constructivist approach to learning, requiring the participants to develop and negotiate the generation of concepts. The application of problem-centered learning provides a catalyst for generating new knowledge of how sustainable concepts can be incorporated into the design process. Critical thinking through interaction and reflection is beneficial for design students as it allows them to interpret the characteristics of SPD developing knowledge that can be transferred to a variety of design problems.

The educational tool provides a framework for a workshop. In this context the term workshop is used to describe an intense period of study focused on generating an understanding of the characteristics of SPD utilizing design methods and practice. The resulting tool is broken into three stages: stage one introduces the design students to sustainable product design through identification of their current level of understanding and the students development of this understanding using problem solving methods; stage two introduces the characteristics of sustainable product design in the form of an interactive seminar employing key phrases and product examples; stage three mediates the assimilation of the knowledge gained and applies it to design practice.

The workshop consists of a series of activities undertaken by small groups of design students instructed by a workshop facilitator. The activities were adapted from design practice as familiarity with the activity allows the design student to concentrate on the task in hand of the workshop rather than the context. The activities involved in the workshop (figure 3) are described under the three educational tool stages:

Stage One:

- Individually the design students create a mind map describing what they understand by the term SPD. This timed activity introduces the student to the problem and provides data on the level of understanding the design student already possess prior to an explanation of the characteristics of SPD.
- In small pre-designated groups, the design students generate as many as possible characteristics a sustainable product could possess using brainstorming. They answer *what are the various ways a designer can design an environmentally friendly product?* To aid this, the students are allowed to consider products.
- Evaluating the results from the brainstorming session, the students select and develop a set of sustainable design criteria that can be used to critically evaluate the sustainability of a variety of products.

Stage Two:

- Using the sustainable criteria for the evaluation of products created by the students, each group is provided with three pre-selected products to evaluate and determine the most and least sustainable. The pre-selected products possess both sustainable and un-sustainable aspects encouraging debate among the student groups. In this particular workshops products included a Nike running shoe, chopsticks, a bottle of water, a wind up radio, a plastic bag, and single use coffee filter.

- In the form of a seminar, the workshop facilitator explains to the students the characteristics of SPD, using keywords, product examples and questions. It is at this juncture clarification is gained by the students of the actions and considerations to be taken in design practice in order to design a sustainable product solution. Student preconceptions and misunderstandings are addressed.
- With an understanding of the characteristics of SPD, in their designated groups the students re-evaluated the three pre-selected products and decide which is the most and least sustainable.

Stage Three:

- Concentrating on the least sustainable product the students identify and list problems with the product. Problems involve interaction, function and un-sustainability for example, is the product harmful to the environment and people's well-being.
- Using the list of problems identified from the least sustainable product the student groups brainstorm possible design solutions.
- The student groups collectively re-design the least sustainable product to be sustainable. A sustainable concept is produced and presented describing the problems addressed and reasons are provided on why this concept is more sustainable than the original product.

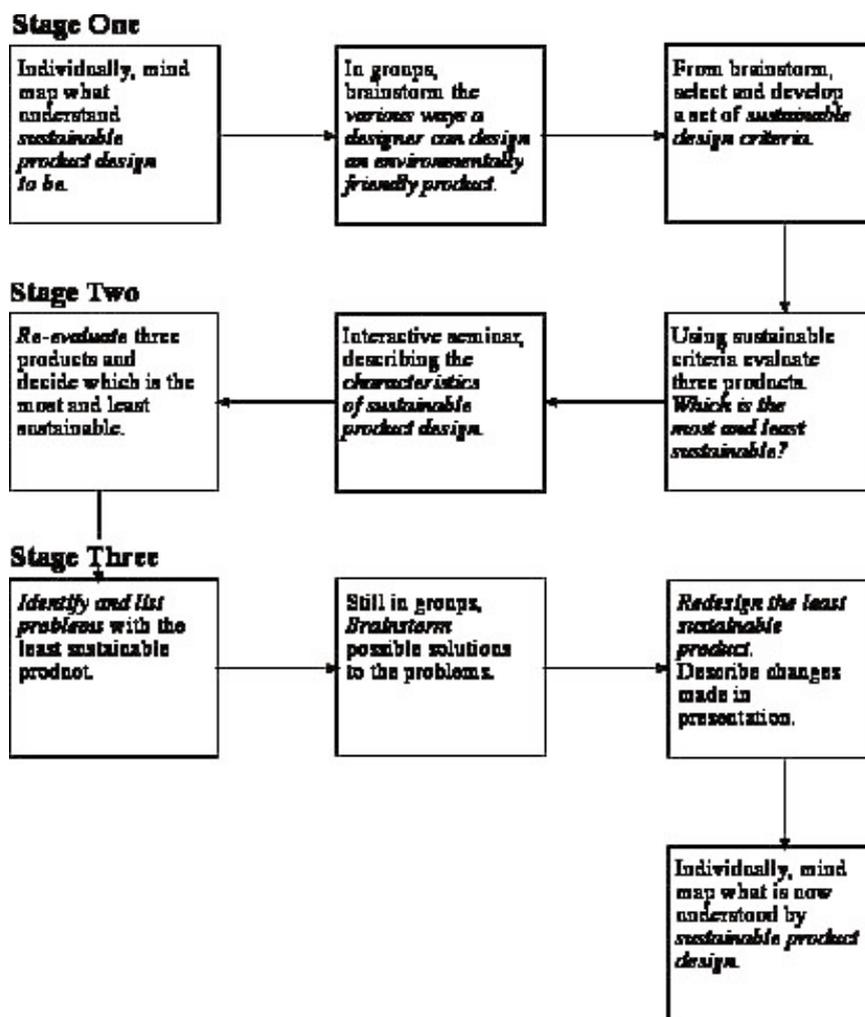


Figure 3. Flowchart proving an overview of the activities involved in the workshop for each stage of the educational tool.

- Individually the students create another mind map describing what they now understand by the term SPD. Again this is a timed task. This provides useful data for evaluating the success of the workshop.

The inclusion of designing in the workshop provides design students with an opportunity to assimilate and integrate the characteristics of SPD into their design practice. This practical activity focuses and encourages sustainable thinking as part of the design process.

Two workshops were carried out: workshop one involved second year undergraduate students from BSc(Hons) Design for Industry and BSc Engineering Design, product design and industrial design courses respectively; the second workshop involved third and fourth year undergraduate students from BSc(Hons) Design for Industry. All courses are based at the researchers host university.

Throughout the workshops 'reflection-in-action' (Schon, 1983) was applied providing provision for alterations to take place. The researcher took the role of the workshop facilitator. Participant observation recorded as field notes provide data on the students' interaction with the workshop activities, reflection on the workshop design and how it was conducted and provided notes on areas for change or improvement. Mind maps individually produced by students' prior to and on completion of the workshop provided immediate data for the evaluation of the workshop in terms of fulfilling the objective of raising student's awareness of sustainability.

WORKSHOP ONE

The mind maps individually produced by the students prior to and on completion of the workshop portrayed a refocusing of understanding. Initial mind maps focused on environmental problems and development of the word sustain, in terms of life extension or maintaining. Mind maps produced on completion of the workshop were design focused; first level branches described alternative power sources, safe production and end of life strategies, as well as design options such as multi-functional products. Design students concentrated on the pragmatic characteristics.

Analysis of the sustainable concepts produced by the student groups also showed the students were able to address the pragmatic characteristics, but generally were not able to assimilate the qualitative characteristics into the design of their concepts. This may be due to the level of understanding the students possess on human factors or difficulties in understanding the qualitative characteristics.

Concerned with this outcome, the researcher revisited the qualitative characteristics through her own design practice. As previously stated, the inquiry concentrated on the problem solving, idea generation and concept development phase. It was concluded from this that the qualitative characteristics are applicable to the design process although problem solving methods need not be restricted to brainstorming sessions.

WORKSHOP TWO

Informed by the initial workshop, changes were made to the structure of workshop two. Due to the students' difficulty brainstorming characteristics of SPD, student groups were asked to brainstorm characteristics that were not sustainable. Explanation of the characteristics of SPD was altered to increase student involvement. Each student was given a characteristic and description, which they presented to the other students and the workshop facilitator expanding upon when necessary. After the students description of the characteristics of SPD they created a wall chart by placing the characteristics under the taxonomies. This activity generated a substantial amount of debate amongst the students and the wall chart was continuously referred to during the design project.

Analysis of the mind maps produced individually by the students again portrayed a refocusing of their level of understanding of sustainability in relation to product design from development of the word sustain (for example product life expectancy, planned obsolescence, durability) and environmental concerns in the first mind map (figure 4), to descriptions of SPD in the second mind map (figure 5). Analysis of the mind maps produced on completion of the second workshop in relation to the first workshop showed that this group of students were able to understand the pragmatic and to a certain extent the qualitative characteristics. However the students had more difficulty addressing the qualitative characteristics in the generation of sustainable concepts, requiring assistance when including consumer/user actions.

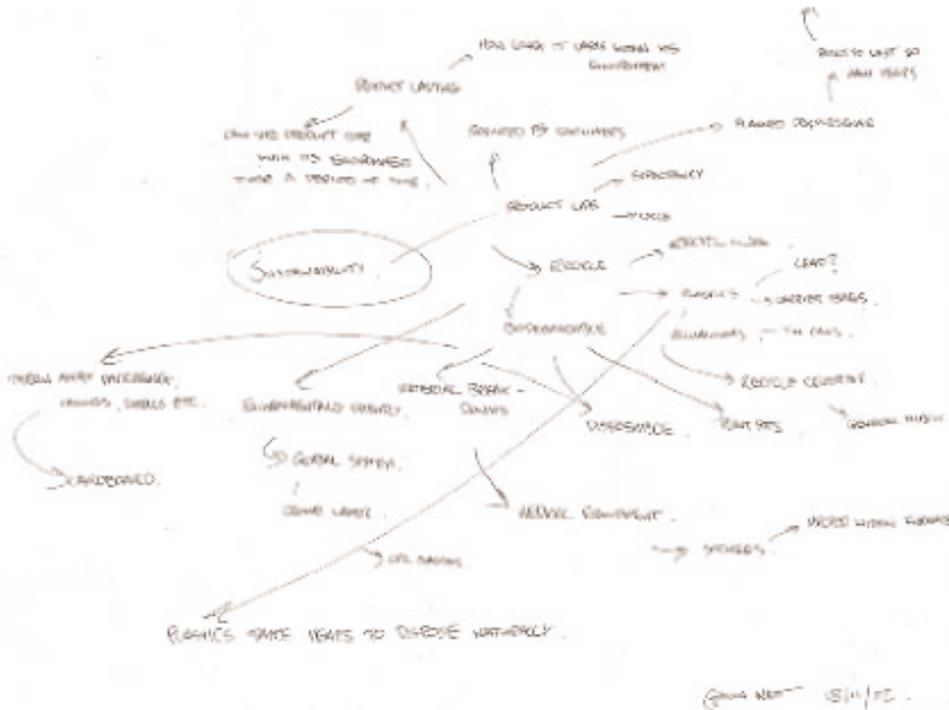


Figure 4. Example of students mind map generated prior to workshop.



Figure 5. Example of students mind map generated on completion of the workshop.

CONCLUSION

SPD is complex. In order for sustainable solutions to be generated, sustainable thinking needs to be integrated into the earliest possible phase of the design process. To influence the design and development of sustainable product solutions, designers must be informed of the characteristics of sustainability relevant to the problems they are tackling. Finding ways to inform designers similarly needs to be achieved at the earliest possible stage, the education and training of new designers.

The design and application of an educational tool aiming to provide designers with a framework of understanding of the problems of current design practice and the opportunities SPD offers has been described. Applying design practice the educational tool, in the form of a workshop, has altered product design students understanding of sustainable product design and aided the integration of sustainable thinking into their own design practice.

SPD is a moving target of increasing importance. Legislation and initiatives place new demands on manufacturers and designers to acquire these additional skills. Design has a unique contribution to make, this should be seen as an opportunity for designers to draw upon their skills to generate innovative solutions that make a difference.

REFERENCES

- Datschefski, E. 2001 *The Total Beauty of Sustainable Products*, East Sussex: Rotovision
- Design Museum. 2000 'assessment criteria', *Design Sense Awards*, London: Design Museum
- Dewberry, E. & Fletcher, K. 2001 *Design for the Environment Multimedia Implementation Project*, Goldsmith's College, University of London, [online] <http://www.demi.org.uk>
- Fuad-Luke, A. 2002 *The Eco-design Handbook: a complete sourcebook for the home and office*, London: Thames & Hudson
- Gray, C. 1988 *Teaching Styles in Higher Art Education*, Ph.D. Thesis, University of Aberdeen
- James, P. 1997 'The Sustainability Cycle: A New Tool for Product Development and Design', *The Journal of Sustainable Product Design*, issue 2, p.52-57
- Manzini, E. 1994 'Design, Environment and Social Quality: from "existenzminimum" to "quality maximum"', *Design Issues*, vol.10 p.37-43
- Schon, D. 1983 *The Reflective Practitioner: How Professionals Think in Action*, London: Area
- Seymour, D. 2002 *Making things Better for People*, Live lecture held at the National Museum of Scotland, 28th November 2002
- Tischner, U. & Charter, M. 2001 'Sustainable Product Design', *Sustainable Solutions: Developing Products and Services for the Future*, Greenleaf: Sheffield, p.118-138
- Valentine, L. & Baxter, S. 2002 'Understanding and Applying Visual Thinking in a Doctoral Context', In: *d3 Desire Designum, Design, 4th European Academy of Design, Conference Proceedings, Universidade de Averoio*, p.238-243
- Walker, S. 1998 'Experiments in Sustainable Product Design', *The Journal of Sustainable Product Design*, issue 7, p.41-50

BIOGRAPHY**Kirsty Cull**

Ph.D. Student

Gray's School of Art, The Robert Gordon University,

Garthdee Road, Aberdeen

Scotland AB10 7QD

Tel: +44(0)1224 263647

Email: k.cull@rgu.ac.uk

Kirsty Cull is currently undertaking a Ph.D. at Gray's School of Art, the Robert Gordon University. The Ph.D. is titled The Influence of Product Design on Sustainable Patterns of Consumption, due for completion submission September 2003.

Julian Malins

Reader in Design

Gray's School of Art, The Robert Gordon University,

Garthdee Road, Aberdeen

Scotland AB10 7QD

Tel: +44(0)1224 263690

Email: j.malins@rgu.ac.uk

Dr **Julian Malins** is Reader in Design and Senior Lecturer at Gray's School of Art. His responsibilities include computer assisted learning development. His design interests include the development of collaborative virtual learning environments for use in art and design education and the integration of new technologies into design practice.