

Tania Humphries-Smith

## **ABSTRACT**

This paper reports on the development of a web-based learning and teaching resource specifically aimed at the socio-centric dimension of sustainable design which can be found at [www.sociocentricdesign.com](http://www.sociocentricdesign.com). A literature review focusing on the socially related aspects of sustainable design is presented, culminating in identification of the components required to understand this aspect of sustainable design, along with the understanding that its incorporation requires that the final design is left as late as possible, while considering the design's purpose and its effects on the user, the community and society as a whole.

An evaluation of existing web based resources on sustainable design is also presented. However, the focus is on the outcomes learned from the collection of primary data informing both the development of the resource and an evaluation of the outcome.

The paper sets out in some detail the content, arrangement and web interfaces for the new learning and teaching web based resource, focused on the socio-centric dimension. This includes the need for a high level of interactivity in the web interface.

## **INTRODUCTION**

This paper reports on the development of a learning and teaching resource aimed at undergraduate designers and engineers to assist them in understanding the third of the three dimensions of sustainable design, namely the socio-centric dimension. The socio-centric dimension is defined as “Human expectations and aspirations – the needs of human beings to live worthwhile lives” (Dodds and Venables, 2005).

Sustainable design, as opposed to eco-design or green design, is considered to include all three aspects (technological, ecological and sociological), whereas eco-design generally considers only the technological and ecological aspects. A more detailed definition is provided in the literature review section which focuses on the social and psychological aspects of sustainable design. This is similarly the focus of the outcomes of primary data that was collected, firstly to inform the development of a learning and teaching resource and secondly to evaluate that resource. The paper sets out in some detail the content, arrangement and web interfaces of a new learning resource that has been developed as part of a Mini-Project funded by the Higher Education Academy Engineering Subject Centre. The resource can be found at [www.sociocentricdesign.com](http://www.sociocentricdesign.com). This research develops an earlier study reported by Humphries-Smith (2008b) which considered how sustainable design is or should be integrated into the design and engineering curriculum.

## **Aims and objectives**

The aim of the study was to provide a resource which can be used by engineering and product design students to enable them to form a better understanding of human expectations and aspirations, namely the socio-centric dimension, with respect to solutions to sustainable design problems.

The objectives of the study were determined as:

- define the socio-centric dimensions in detail
- evaluate the existing learning and teaching resources for sustainable design with a focus on web based tools
- develop a web based teaching tool that is focused towards the socio-centric dimension of sustainability
- evaluate the learning and teaching resource developed.

## LITERATURE REVIEW

### Sustainability

Sustainable design needs to be seen in the wider context of sustainability and sustainable development. These are concepts which date back to at least 1972 and the United Nations Environment Program (UNEP) Stockholm conference. The Brundtland Report of 1987 (WCED), the Rio Earth Summit of 1992 (UN) and the Kyoto Protocol of 1997 (UN), which came into force in February 2007, are also significant points in the development of thinking on sustainable development. Madge (1997) and Dewberry and Goggin (1994) provide comprehensive histories and definitions of sustainable design. The definition provided by Dewberry and Goggin, where they discuss the transition from eco-design to sustainable design, is particularly relevant here: 'The concept of sustainable design, however, is much more complex and moves the interface of design outwards toward societal conditions, development and ethics [...] and involves a general shift from physiological to psychological needs' (p.49).

Madge (1997) states that sustainable design is 'also the study of needs and ethics, of current and future technologies, of sociologies, consumer behaviours and environmental impacts and improvements' (p.53).

The Royal Academy of Engineering's report introduced the requirement to have three dimensions (eco, techno and socio-centric) in order to achieve true sustainability (Dodds and Venables, 2005), although Timothy O'Riordan had classified the techno and eco-centric approaches in 1976. The socio-centric approach, which covers social and ethical issues, was then added to create the *Triple Bottom Line* (Elkington, 1997) or three dimensions that transform eco-design into sustainable design. Interestingly, Webster (2004) suggests that this view is false and can lead to unchecked economic growth, instead proposing a concentric image, with economy in the centre and society and the outer ring being an "ecosphere" (p.40). Meanwhile, Sherwin and Bhamra (2001) make the critical point that eco-design must be incorporated very early in the design process.

It is reported that the common approach to eco-design adopted by industry, as opposed

to sustainable design, is eco-efficiency. This is a linear “cradle to grave” approach (DeSimone and Popoff, 2000). However, McDonough and Braungart claim that eco-efficiency as a strategy only makes people “less bad” (2002).

### **Sustainable design approaches**

Clearly there is a range of approaches, tools and techniques that have been developed within each of the three dimensions. Of interest here is the range of approaches to the socio-centric dimension:

- *emotionally durable design* – Chapman (2005) focuses on the problem with the current methods and techniques which tend to lead directly to the third of the three Rs of sustainable design – reduce, reuse, recycle – when what is required for true sustainability is reducing and reusing. To do this will require people to be more emotionally connected to their belongings, thus not wishing to dispose of them
- *cradle to cradle* – McDonough and Braungart (2002) are also critical of the focus on recycling, pointing out this is a one way process – cradle to grave – when what is required is a cycle of reuse. They look at an analogy with nature where “waste” is simply a nutrient for something else
- *biomimicry* – Benyus (2002) also looks to nature, pointing out that nature produces everything without producing toxic waste etc and suggesting that we need to copy/emulate nature’s processes
- *product attachment* – Mugge (2004), Desmet and Hekkert (2007) and Schifferstein (2004) explore how designers can design products in such a way as to encourage their consumers to become attached to them and thus not wish to dispose of them
- *behavioural design* – Lilley and Lofthouse (2008) look at how designers can design products so that they consciously change the way people behave, with the aim in mind of reducing carbon footprints
- *slow consumption* – Cooper (2005) also considers product attachment so that people reduce their desire to acquire more and thus slow down the cycle of consumption.

All of these authors criticise the limited scope of sustainable design tools, techniques and approaches currently in common use and stress the need for designers to take an interdisciplinary approach when working in the socio-centric dimension, working with psychologists, biologists, chemists, ecologists and sociologists so that solutions are found that are not only beneficial to the user but also to the wider community and environment.

### **Sustainable design and higher education**

The need to embed sustainable development in all HE curricula was established by HEFCE in 2005, and the Engineering Council UK (2005) now requires all professionally recognised engineers to “undertake engineering activities in a way that contributes to sustainable development” (p11). There has also been a raft of legislation introduced concerning sustainable design issues which, of course, directly affect engineers and designers and which employers expect graduates of these disciplines to incorporate into their work.

Thus, those educating engineers and designers must address sustainable design in the

curriculum. The difficulties of doing this should not be underestimated and are reported upon elsewhere by Humphries-Smith (2008b) and Ramirez (2006, 2007), although Pitt and Lubben (2009) report on how the social aspects of sustainable design are being addressed with some success in the A level Design and Technology curriculum through the Sustainable Design Award. They report that two out of three teachers in their sample included the social dimension in their understanding of sustainable design.

There are a number of web based resources explaining the principles and tools of sustainability which can assist designers and engineers. These range from the government backed Envirowise organisation ([www.envirowise.gov.uk](http://www.envirowise.gov.uk)) to the multinational O2 Global Network ([www.o2.org/index.php](http://www.o2.org/index.php)). Included are resources such as the InformationInspiration website ([www.informationinspiration.org.uk](http://www.informationinspiration.org.uk)) and the Sustainable Design Portal ([www.ecobarkingcrickets.org](http://www.ecobarkingcrickets.org)), both of which were evaluated in this study.

It is concluded that true sustainable design requires the final design to be left as late as possible as, first and foremost, sustainable design requires consideration of the design's purpose and its effects on the user, the community and society as a whole. Therefore, a resource to teach true sustainable design has to contain more than tools (typically in the form of simple checklists and spreadsheets) to apply during the design process. The resource will also need to engage the user to think holistically not so much about the design of the product/item but more about the best solution to the problem identified.

It is reasonable to conclude that, unless all three aspects of sustainable design are considered, "we are not as sustainable as we might like to think we are" (Chapman, 2005). Currently the focus is on eco-design, addressing the techno and eco-centric dimensions, and this has produced some movement towards more sustainable products, albeit in McDonough and Braungart's opinion only 'less bad'. Clearly the socio-dimension requires behavioural change and is the most challenging dimension to embrace. However, without it our ability to design truly sustainable products is severely limited.

## **METHODOLOGY**

A qualitative research methodology was used to collect a rich data set that included opinions, feelings and preferences. As such the data set is inevitably focused on a small sample, in this case one institution (Bournemouth University). However, as previous studies (Humphries-Smith, 2008b) have already shown, the difficulties of addressing sustainable design within the design and engineering curriculum are common and widespread. As would be anticipated there are exceptions, such as the work undertaken over the last ten years at Loughborough University (Lofthouse, 2009) where ecodesign is embedded into the design and engineering curriculum. Therefore the findings of this study should be transferable to higher education institutions with design and engineering courses similar in nature to Bournemouth University.

The data collection took place in two stages. Stage 1 was designed to determine the existing knowledge level of undergraduates of sustainable design and also to gain feedback on existing web-based resources on sustainable design. Stage 2 was designed

to gain feedback on the new web based resource developed as a result of this research. All data collection took place at Bournemouth University with respondents being third or final year undergraduate students on design/engineering courses. Students on these courses are exposed to aspects of sustainable design, mainly through units covering materials and manufacturing and projects. Sustainable design also features in the programme learning outcomes however, in common with many higher education courses, sustainable design is far from embedded or covered in its full breadth.

### **Stage 1**

A survey method of data collection was chosen due to the fact that the data had to be collected over a short period of time and the completion could be organised electronically, allowing the respondents to complete the survey at their own convenience. Thus a small, but representative, sample group was used. The members of the sample group were all undergraduate third (industrial placement) or final year students on a range of design/engineering courses at Bournemouth University. The rationale for this was that the web based resource was to be designed to be used by undergraduate design and engineering students, clearly represented by the sample group. Additionally, the nature and extent of educational input on sustainability received by these students was a known quantity.

The survey was a two part process. Initially respondents were asked to answer the following three questions:

1. what is your understanding of sustainable design?
2. what would you be looking for in a design tool that is meant to help you integrate sustainability into your design process?
3. sustainability is generally considered to be based on three dimensions: the ECO-centric, TECHNO-centric and SOCIO-centric dimensions. What do each of these mean to you?

The respondents were then asked to look at two websites: an eco-design resource at [www.informationinspiration.org.uk](http://www.informationinspiration.org.uk) and [www.ecobarkingcrickets.org](http://www.ecobarkingcrickets.org) (otherwise known as the Sustainable Design Portal). They were then asked to complete five further questions (via two separate discussion groups, one each for third and final year students, set up on Facebook.com):

- i) is the *InformationInspiration* website a helpful tool for designers interested in the integration of sustainability into the design process? Please explain your findings.
- ii) how accessible are the design tools provided by the website?
- iii) would you be able to use/incorporate these tools into your design work?
- iv) if you could add more information to this site what would it be?
- v) how does the Sustainable Design Portal compare to the *InformationInspiration* website? Please consider content as well as website design.

There were a number of limitations to this study. As an unsupervised survey there was a lack of control over who from the sample group responded - the questionnaire had to stand alone, along with an assumed level of computer literacy required to answer an online survey. As with all questionnaires the time required of participants was a potential

barrier at 30-45 minutes to compare the two websites.

## **Stage 2**

Once the [www.sociocentricdesign.com](http://www.sociocentricdesign.com) website became live, final year students on BA/BSc Product Design were invited to evaluate it via a blog set up on the myBU virtual learning environment. It should be noted that these students were students that, as second years, had been respondents to an early study reported in Humphries-Smith (2008a). They were not the students who had responded in stage 1, however they had had exposure to the same two websites previously. These students were chosen because they had previous exposure to the relevant websites and also a higher level of understanding of sustainable design than the stage 1 respondents. The use of a blog tool as a data collection method was chosen because, historically, students have been found to respond well to this type of technology and because it encourages the expression of opinions and prompts discussion, thus producing the type of data required by this study.

The students were specifically asked to comment upon the following aspects of the website:

1. is the website a helpful tool for designers interested in the integration of sustainability into the design process? Please explain your findings.
2. how accessible is the information provided by the website?
3. would you be able to use/incorporate these theories/ideas into your design work using the information provided on the website?
4. if you could add more information to this site what would it be?
5. is there sufficient interactivity to make the site engaging? If not, what else would improve it?

## **RESULTS**

### **Stage 1**

#### **Responses from students**

The detailed results of stage 1 have been published elsewhere (Conrad and Humphries-Smith, 2009) thus only a summary will be provided here.

The initial questionnaire comprising three questions was completed by 40 third year students and 15 final year students at their end of year Design Show, with the researcher being present all day to answer questions and the questionnaires being collected at the end of the day. The evaluation of web based resources (which required considerably more input in terms of time and effort) was completed by eight students.

Generally, third year students demonstrated a much better level of understanding than final year students. Most of the responses suggested that eco-design orientated content (such as suppliers, material and manufacturing information and current/future technologies) was what was generally being sought. In terms of interactivity there was general agreement that the resource should be thought-provoking and encouraging.

A clear divide between the two groups of students was seen with respect to question 3, with third year students having a much better idea of the three dimensions of sustainable design than final year students, of whom two thirds could not answer the question.

Student feedback on the two websites was very different. The *InformationInspiration* website was considered to be “a very good foundation to improve sustainable design knowledge” (final year student), With the examples, description of tools and fact based information being highlighted as useful. However, much concern was raised regarding the likelihood of designers actually using a number of the tools, although there was general agreement that having been introduced to some sustainable design tools they would try to use them in their future design work. The Sustainable Design Portal did not gain favourable feedback due to the fact it is essentially a database of links to other resources, is less structured and, to operate effectively, requires more knowledge of the subject area than undergraduates generally have. With respect to the design of the website, comments indicated the need for more downloads and case studies, less text and more inspiration.

This study has shown that existing resources do not address the socio-centric aspects of sustainable design, although the *InformationInspiration* resource has a section entitled ‘New ways of doing things’ which begins to consider the socio-centric aspect. Most resources, while generally clear and easy to navigate, encompass many of the tools and ideas related to eco-design but not sustainable design as defined in section 2 of this paper. Thus, the web based resource developed as an output of this study complements existing resources and contributes to education in this field.

### **Web resource design**

The results of the research suggested that in order to engage the target audience it is necessary to offer a high level of interactivity in the web interface. The following requirements listed were considered to be essential organisational elements for the creation of the web resource: easily accessible; intuitive; inspiring; engaging; guiding; open-minded; visual; up to date; allow for real discussions; involve real people and be more than a textbook.

Based on the literature analysis, the content of the web resource is arranged into the following navigation sections with sub-sections (Conrad and Humphries-Smith, 2009):

- past and future – addressing the question: is sustainability the end of design?
- time – emphasizing how time is vital for good solutions, how it needs to be spent upon evaluation and interaction with the future user and community it will impact upon
- people issues - how designers can be an active part of society, how our designs affect the developing world, how our designs affect the developed world, design that considers peoples’ wellbeing
- consumption - consumption is natural, filling gaps – too much free time, slow consumption, living with less
- design – focusing on visualising design choices and the resulting impact on the individual, the local community, society in general and the natural environment

- theories – each of these is briefly explained, in some cases with podcast interviews with the originators, and linked to original web-based sources.

The home page of the new web resource, known as *Socio-Centric Sustainable Design – a resource for designers and engineers*, features a diagram of the three dimensions with 'pop-out' explanations of each dimension. The intention of this is to ensure that the full breadth covered by sustainable design, as opposed to green design or eco-design, is understood. There is also a podcast which provides a brief history of sustainable design to help the user understand how the three dimensions have come about.

Figure 1 is a screen shot of the home page, showing the diagram which illustrates the three dimensions and demonstrating the intuitive navigation of the sub-sections on the right hand side. The navigation tabs at the top give latest information on legislation, conferences, exhibitions and publications.



*Figure 1. Homepage from [www.sociocentricdesign.com](http://www.sociocentricdesign.com)*

Figure 2 shows a page from the theories section of the website which gives the user links to external podcasts, enabling the views of significant individuals in this field to be heard. This is very important, as respondents indicate that engagement is achieved by using: important groups and individuals; blogs; wikispace; podcasts; talks, conferences and exhibitions; publications; downloads and webinars. The website features a blog facility which will automatically collate data into a wiki. It is anticipated that this feature will be a strength of the site, keeping it up to date with the latest thinking.





Figure 2. Example of page from [www.sociocentricdesign.com](http://www.sociocentricdesign.com)

## Stage 2

Eight students posted comments on the myBU blogsite. Many more viewed the information provided. Generally, the comments were considered and provided constructive criticism.

### Evaluation by students

Much of the feedback from students was positive, for example:

*Navigation of the website is simple and the overall layout of the website is easy to use. The content on the website is mainly clear and concise and the tabs are a good source for locating information.*

*Information on the website is very useful, especially the theories section. The links to external articles and sites are also interesting as they present several different perspectives, it makes the resource more topical and varied. It means I am more likely to return and check for new articles/links.*

*I found the website useful on the whole, it explains sustainability in "bitesize" chunks that are easy to digest and understand. I didn't feel bombarded by masses of text or get bored.*

However, there were a number of criticisms:

*The only page with content that can be a bit difficult to view is the Publications tab which has a lot of text clumped together that possibly could be better defined.*

*Examples of the theories put into practice could be a useful tool. Real life products/examples and how the sustainability issues were incorporated or tackled could be an interesting way to demonstrate the points the website puts across.*

*It would be useful to know how many and what sort of companies actually design in a truly sustainable fashion in Industry. Many claim to design sustainably but actually only use a handful of "green" methods to boost their corporate standing without actually making much environmental impact.*

*Although the conciseness of the information is great the site still needs to have a lot more graphical information and content such as diagrams, charts, images, graphics, animation, video, etc. to really make the site engaging. Simple activities and exercises can also be incorporated to make the site more interactive.*

The criticisms are addressed in the next section.

### **Final web resource design**

Figure 3 shows the modified publications page in response to student feedback. Instead of a long list of publications it is now divided into sections, currently: history of sustainable design; theories; methods/techniques and latest publications.



*Figure 3. Revised publications page from [www.sociocentricdesign.com](http://www.sociocentricdesign.com)*

Two links to case studies have been added, namely the Aeron chair by Herman Millar and the Kodak Disposable Camera. These will be added to as further case studies are developed.

The last two student points need further consideration. Firstly, there may be ethical concerns with regard to making claims about companies being sustainable or otherwise.

Secondly, the addition of activities and exercises would move the site in the direction of becoming a learning method rather than a resource, which may have the effect of limiting the scope of its use and would need careful consideration. It may be that it would be better to develop separate material, making use of this resource, which could be tailored to specific courses and learners.

## CONCLUSIONS

The intention of this new web based resource is to focus on the socio-centric dimension and therefore not to replicate information that is already available. Thus it links to existing resources, such as the *InformationInspiration* website, but concentrates on providing material unavailable elsewhere, presented in an inspirational and engaging format for aspiring designers and engineers.

This resource is unique in focusing on the socio-centric aspect of sustainable design and in pulling together the disparate elements of this aspect into one resource. It provides the opportunity for aspiring designers and engineers to engage with and learn about this vital aspect of sustainable design. Without this aspect it is impossible to design truly sustainable products. Although developed for and with students of one institution, the outcomes should be transferable to similar design and engineering courses in other higher education institutions.

It is the intention that the web-based resource, which has been developed as an outcome of this research, will continue to be updated and added to by both the author and, through the wiki facility, by users of the site. This will be particularly important as, in its current form, it is primarily a tool to help users' understanding of the issues, hence the 'bite-size' chunk approach. However, as this understanding develops there will be a requirement for more in-depth material which provides solutions, although it is questionable whether definitive solutions are possible. Some attempts towards solutions will come via the continuous addition of publications on academic research (under the publications tab) which should also prompt additional wiki threads to develop the debates. It would also be possible to add value to this resource by adding activities and exercises, although this may change the nature of the resource and may not, therefore, be appropriate.

The website is publicly available and through dissemination, such as this paper, it is intended that a wider audience of undergraduate designers and engineers will make use of the site. Although primarily set up with product and engineering undergraduates in mind, the site would be applicable to a wider audience in terms of subject area (e.g. interior design or building services, particularly if the examples were to be adapted). It is the intention to bring the web resource to a much larger general readership, that of practicing designers/engineers. The structure of the website is deliberately flexible, enabling feedback from these sources to be used to adapt and modify the current resource as required by other users. It would even be possible to add authors to the website so that they could adapt their own specific sections.

## ACKNOWLEDGEMENTS

The author gratefully acknowledges the participation of students on BA/BSc Product Design, BSc Design Engineering and BSc Computer Aided Product Design courses at Bournemouth University.

## REFERENCES

- Benyus, J.M. (2002) *Biomimicry – innovations inspired by nature*. New York: Harper Collins/Perennial.
- Chapman, J. (2005) *Emotionally durable design – objects, experiences and empathy*. London: Earthscan Publications Ltd.
- Conrad, F. and Humphries-Smith, T. (2009) The development of an on-line learning and teaching resource for socio-centric aspects of sustainable design. Creating a Better World, *Proceedings of 11th Engineering and Design Education International Conference*, 10-11 September 2009, Brighton, UK.
- Cooper, T. (2005) Slower consumption – reflection on product life spans and the “throwaway society”. *Journal of Industrial Ecology*, **9** (1-2), 51-67.
- DeSimone, L. D. and Popoff, F. (2000) *Eco-efficiency – the business link to sustainable development*. Massachusetts: MIT Press.
- Desmet, P. and Hekkert, P. (2007) Framework of product experience. *International Journal of Design*, **1** (1), 55-66.
- Dodds, R. and Venables, R. (Eds) (2005) *Engineering for sustainable development – guiding principles*. London: RAEng.
- Elkington, J. (1997) *Cannibals with forks – the triple bottom line of 21st century business*. Oxford: Capstone Publishing Ltd.
- Engineering Council UK. (2005) *Standards for professional engineering competence (UK-SPEC)*. London: ECUK.
- HEFCE. (2005) *Sustainable development in higher education – consultation on a support strategy and action plan*. Higher Education Funding Council for England.
- Humphries-Smith, T. (2008a) An evaluation of existing online learning and teaching resources for the socio-centric aspects of sustainable design: new perspectives in design education. *Proceedings of 10th Engineering and Product Design Education International Conference*, September 2008, Barcelona, Spain.
- Humphries-Smith, T. (2008b) Sustainable design and the design curriculum. *Journal of Design Research, Futures of Design Education Special Edition*, **7** (3), 259-274.

Lilley, D. and Lofthouse, V. (2008) *Behavioural design*. Available from: <http://www-staff.lboro.ac.uk/~cddl/> [accessed 11 February 2010].

Lofthouse, V. (2009) Ecodesign tools in design education. *Proceedings of 11th Engineering and Product Design Education International Conference*, September 2008, Brighton, UK.

Madge, P. (1997) Ecological design : a new critique. *Design Issues*, **13** (2), 44-54.

McDonough, W. and Braungart, M. (2002) *Cradle to cradle – remaking the way we make things*. New York: North Point Press.

Meadows, D., Randers, J. and Meadows, D. (2004) *Limits to growth – the 30 year update*. London: Earthscan Publications Ltd.

Mugge, R., Schifferstein, H. and Schoormans, J. (2004) Personalizing product appearance: the effect on product attachment. *Proceedings of 4th International Conference on Design and Emotion*, 12-14 July 2004, Ankara, Turkey.

O’Riordan, T. (1976) *Environmentalism*. London: Pion Ltd.

Pitt, J. and Lubben, F. (2009) The social agenda of education for sustainable development within design and technology: the case of the Sustainable Design Award. *International Journal of Design Education*, **19** (2), 167-186.

Ramirez, M. (2006) Sustainability in the education of industrial designers: the case for Australia. *International Journal of Sustainability in Higher Education*, **7** (2), 189-202.

Ramirez, M. (2007) Sustainability integration in industrial design education: a world wide survey. *ConnectED 2007 International Conference on Design Education*, 9-12 July 2007, Sydney, Australia.

Schifferstein, H., Mugge, R., Hekkert, P. (2004) Designing consumer-product attachment. In McDonagh, D., Hekkert, P., Van Erp, J. and Gyi, D. (eds) *Design and emotion: the experience of everyday things*. London: Taylor and Francis, 327-331

Sherwin, C. and Bhamra, T. (2001) Early eco-design integration: experiences from a single case. *Journal of Design Research*, **1** (2), 40-48.

United Nations (UN). (1992) *Agenda 21 – report on the United Nations Conference on Environment and Development, Annex I*. 3-14 June 1992, Rio de Janeiro, Brazil.

United Nations (UN). (1998) *Kyoto protocol to the United Nations framework convention on climate change*. Kyoto, Japan: UN.

Webster, K. (2004) *Rethink, refuse, reduce: education for sustainability in a changing*

*world*. Preston Montford: FSC Publications.

World Commission on Environment and Development (WCED) (1987) *Brundtland report – our common future*. 13th impression. Oxford: Oxford Press.

**Contact details**

**Dr Tania Humphries-Smith BSc, MPhil, EdD, MIED, CEng, FHEA**

Associate Dean (Technology and Design), School of Design, Engineering and Computing, Bournemouth University, Talbot Campus, Fern Barrow, Poole, Dorset, BH12 5BB, UK

Tel: 01202 961402, email: [thumphri@bournemouth.ac.uk](mailto:thumphri@bournemouth.ac.uk)