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FACULTY OF SOCIAL SCIENCE AND HUMANITIES

DEPARTMENT OF DESIGN AND TECHNOLOGY

EXPLORING WEBSITE EFFECTIVENESS AND THE INFLUENCE OF THE
SUSTAINABLE DESIGN AWARD WEBSITE ON
DECISION-MAKING CONCERNING SUSTAINABILITY WITHIN AS/A2
DESIGN AND TECHNOLOGY

by

PETER CLARK SIMMONS

A Doctorial Thesis

Submitted in partial fulfilment of the requirements for the award of

Doctor of Philosophy
of Loughborough University

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CERTIFICATE OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this thesis, that the original work is my own except as specified in acknowledgements or in footnotes, and that neither the thesis nor the original work contained therein has been submitted to this or any other institution for a degree.

_____ (Printed name)

_____ (Signed)

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Abstract

This PhD thesis looks at the meaning of website effectiveness and their influence on design decision-making. The research is focused within the context of designing by 16+ students and concerning sustainability. Design practice is explored within Advanced level General Certificate of Education (commonly referred to as AS/A2) Design and Technology, in order to define its particular characteristics.

The study uses a theoretical position developed from the Assessment of Performance Unit's (APU) discussion document from 1982 as a framework to explore information retrieval within designing. The position of the study within designing and its place within research related to the use of knowledge, skills and values in designing is clarified. A literature review conducted conceived information retrieval as a characteristic of skill in the APU model.

This study has established a consensus position on what is good practice in website development and design, and illustrates the structure of selected sustainable design websites, as well as assessing their navigation. The study indicates which types of information AS/A2 level student designers are seeking and how they use websites within their design work. The drivers behind sustainable design decision-making are identified.

The understood consensus of sustainable development and sustainable design as an emerging area in designing is defined. The research is situated within the Sustainable Design Award (SDA) scheme that aimed to implement sustainable development into Design and Technology education and also outlines the content embodied in selected sustainable design websites. AS/A2 level Design and Technology education is used as the context for the main study.

Action research was used to help develop the SDA website which was created as a primary assessment tool for the research study, concentrating on students aged 16 to 18. The usability of the selected websites was assessed by undergraduate designers from Loughborough University. A framework was developed and the effectiveness of the SDA website was measured 'before use', 'during use' and 'after use'. Quantitative and qualitative research methods were used to gather data from the students such as questionnaires, folio assessments and interviews.

The results indicate a prominence of website use and sustainable design within AS/A2 level design work, however sustainable design is taught as a separate entity and is not fully integrated into design practice. Sustainable design websites were accessed by half of the 72 students questioned, but only 28% had used the SDA website. The information that the student designers sought fell into two categories: specific information and inspiration, supporting Lofthouse (2001a). The use of these decreased dramatically as projects progressed in AS/A2 level and undergraduate level design education, this pattern was consistent in website use, sustainable design and sustainable design website use.

Cluster analysis was carried out on the sustainable design websites with the informative cluster identified as representing the appropriate strategy for effective higher level website design. This cluster included characteristics such as comprehensive content information on sustainability, inspirational images and product examples. Appropriate approaches to the detailed design and development of the SDA website are reported.

Future recommended work includes a focus on 'before use', to investigate the affects of increasing awareness of the website. Relating wider sustainability issues to AS/A2 Design and Technology education is discussed, investigating further the use of eco-design tools as the discussion highlights conflicting opinions. An expansion to the cluster analysis to help define further the four website cluster groups. The development of a website that correlates the emerging patterns of website, sustainable design and sustainable design website use, with work on value judgements completed by Trimmingham (2007).

Peter Clark Simmons

List of Publications

Simmons, P. and Badni, K. (2006) 'Developing a framework for analysing the effectiveness of sustainable design websites in influencing design decisions', In *Designing the Future, The D&T Association International Research Conference 2006*, Norman, E., Spendlove, D. and Owen-Jackson, G. (Eds). Wellesbourne, UK, The Design and Technology Association: 121-133.
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Simmons, P. and Badni, K. (2007) 'The use of sustainable design websites within design and technology education at AS/A2 level', In *Linking Learning: The Design and Technology Association Education and International Research Conference 2007*, Norman, E. and Spendlove, D. (Eds), University of Wolverhampton, Telford, The Design and Technology Association: 77-84.
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Simmons, P. and Trimmingham, R. (2008) 'Decision-making for Design and Technology education: the use of sustainable design websites', In *Designing The Curriculum – Making It Work: The Design and Technology Association Education and International Research Conference 2008*, Norman, E. and Spendlove, D. (Eds), Loughborough University, The Design and Technology Association.
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List of abbreviations

APU – Assessment of Performance Unit

CAT – Centre for Alternative Technology

COID – Council of Industrial Design

DEMI – Design for the Environment Multimedia Implementation

ITDG – Intermediate Technology Development Group, now Practical Action

SDA – Sustainable Design Award

SIR – Schools Information Retrieval

STEP – Sustainable Technology Education Project

CHAPTER 1 INTRODUCTION

This chapter gives my personal motivations for undertaking the study and reports the background to the PhD research. It summarises its context and outlines the research agenda. The aims and objectives of the study and an outline of the research questions are also included.

1.1 Personal motivations

The author (practitioner) graduated with a BA (Hons) in Industrial Design and Technology from Loughborough University. As an undergraduate, the author designed and made a wind-up shaver for his final major project work, this involved considering many aspects of sustainable design. The project illustrated a need for a greater prominence of sustainable design thinking within design practice.

Since attaining a degree, the practitioner has also been involved with the Sustainable Design Award (SDA) as a researcher, teacher and also website designer. The practitioner is the managing director of a design consultancy that specialises in website design, graphic design and sustainable practice. Given this background and education as an industrial designer, it was felt that it would be appropriate to research within this field.

1.2 Background to research programme

The response by businesses and designers to sustainable development and sustainable design, more specifically, has evolved over the past two decades. In the 1980s industry sought to reduce environmental impact through 'end of pipe' techniques. The emphasis later shifted to look at cleaner manufacturing processes

that address issues of less waste and pollution. Currently the focus resides in a 'cradle to grave' approach looking at environmental, social and economic aspects throughout a product's lifecycle (Bhamra 2004). The design of products and the education of designers have therefore become integral to the progress in this area. Bhamra (2004) identified the current position of sustainable development as combining technology, culture and nature, the success of which relies on the effectiveness, innovation and creativity of its implementation. Furthermore, Bhamra (2004) identified five significant features that aid the progression to sustainable design:

'...initial and sustained motivation; communication / information flow; whole-life thinking; hands-on environmentally conscious design; positioning in the world.' (Bhamra 2004:564)

The success of sustainable design websites relate directly to the effectiveness, innovation and creativity aspects identified by Bhamra (2004). In Design and Technology education, sustainable design websites are often used as key information sources for students to refer to.

It is their effectiveness in this role that will be focused on in this research. Around 16.5 million UK households, 65%, had access to the internet in 2008 (UK Government 2008). The internet could be seen as an appropriate tool for educating young people in general as they represent a fairly large proportion of the population of internet users (Wu 1999, UK Government 2007b). Over nine out of ten young people (93%) aged 16 to 24 in the UK had used the internet in the last three months in 2008. 77% of the same group (around 5 million users) had accessed the internet every day (UK Government 2009).

The Office for National Statistics reported that, in 2009, 91% of these users were accessing their emails, 77% were finding information, 55% downloading software, and 54% were reading the news. 70% had reported to have purchased items using the internet (UK Government 2009).

Therefore well-designed, effective sustainable design websites for AS/A2 level Design and Technology could have a major role to play in improving educational practice and in forwarding a broader ethos relating to sustainability.

1.2.1 Sustainable design websites

This study explores prominent websites that are related to sustainable development. The content of these websites could be used by designers to inform their design decision-making and are therefore referred to as 'sustainable design websites' for the purposes of this research.

The focus of this study concentrates on sustainable design websites which are used by sustainable design initiatives as a tool to inform and inspire various aged students. Sustainable design websites and their success may be determined by analysing how effective they are at communicating the information. Communication is a key factor 'before' use, 'during' use, and 'after' use. In this context, the sustainable design education websites all aim to inform young designers of the issues and to help influence their design decisions by giving them access to information on sustainable development, material technologies, values and systems for example. Effectiveness therefore relates to the impact on design decisions.

Effectiveness, in this instance, could be deemed to be when a student uses one of these more sustainable resolutions, acting from the website information available. Perhaps effectiveness could be defined as thinking about the issues in a different way after being inspired by sustainable development i.e. considering sustainable development issues in their design work without necessarily employing suggested sustainable design methods (Capewell 2003, Capewell et al. 2002).

Website effectiveness may be better assessed in the context of people changing their behaviour rather than taking an action. The websites may not have an immediate effect on the user but trigger the issues at a future point in their work or everyday lives. It is this influence that is difficult to pinpoint. The effectiveness of sustainable design websites in conveying and communicating information is therefore an important focus area. It takes a greater priority when you consider sustainable design as an evolving area that designers struggle to prioritise.

Generally, website assessments fail to consider all of these areas of website effectiveness and consequently there is little prior art on which this research can be based. Most website assessments are focussed on usability or aesthetic value but there appears to be little focus on whether the websites are effective at

communicating and influencing subsequent behaviour. Defining website effectiveness is a key factor for the study to progress.

How can effectiveness be judged? Is it judged by a designer gaining an understanding of the relevant issues or an attempt by the designer to resolve these issues? Or is it that a demonstration of effective sustainable design practice is the criterion for success? The word 'effectiveness' can be interpreted extremely broadly. For example a website may be considered effective by simply getting a user to access the site, or return to it. The understanding of effectiveness could also be judged in terms of how much influence it has on the user. The discussion of the meaning of effectiveness forms a major part of the literature review.

1.3 Research agenda

An outline of the research study is shown in Figure 1-1. The start of the research agenda is shown at the top of the hour glass diagram, and becomes more focussed as the shape narrows. Figure 1-1 also illustrates the following broad aspects of the agenda:

- background research of designing;
- context for the chosen area;
- detailed main study;
- outlining the general principles within the researched context.

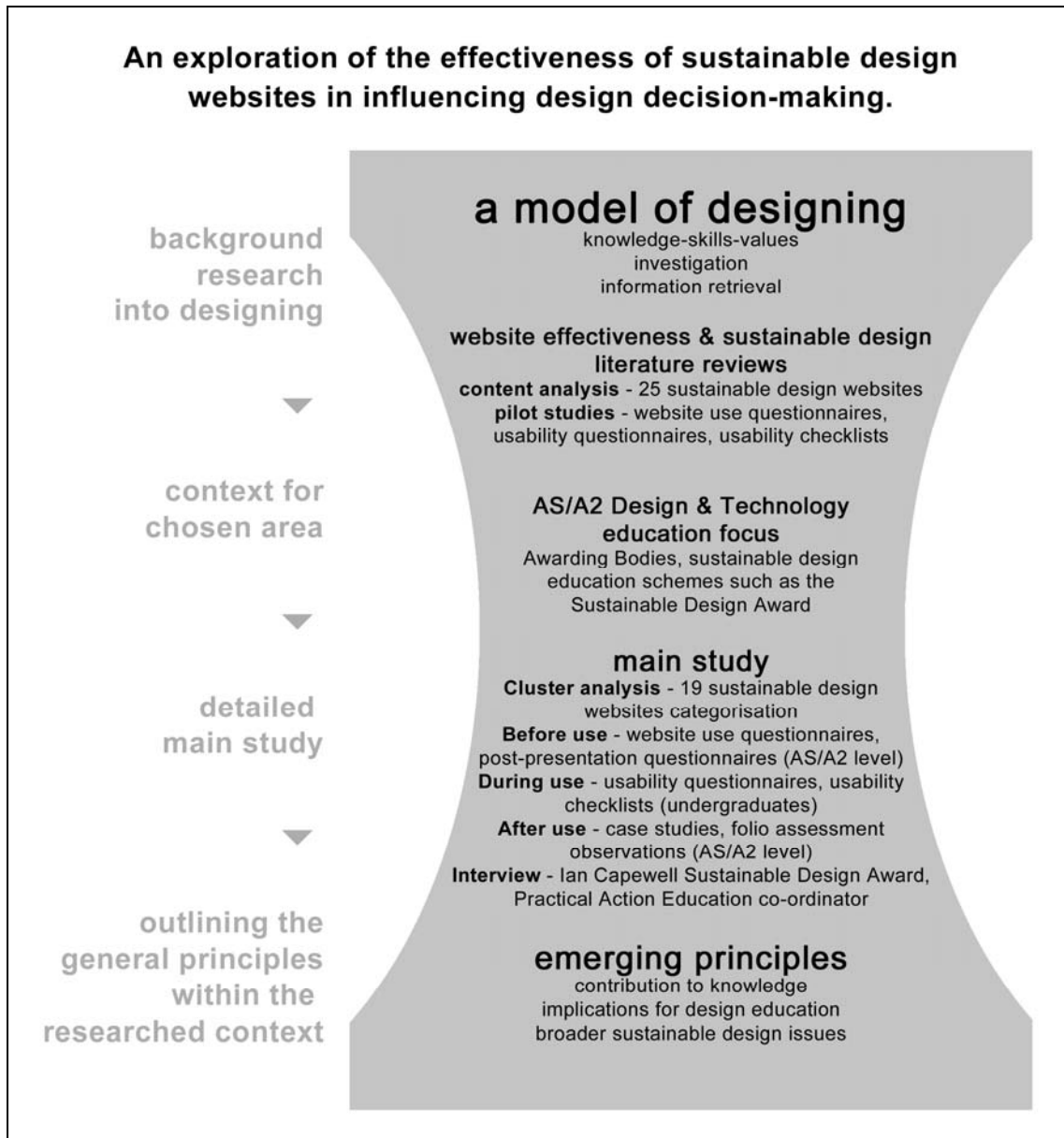


Figure 1-1: A model of the research programme

After the main study the hour-glass then opens out again representing the explanation of the findings from the research to wider contexts and the possible implications of the study as a whole.

This research focuses on Design and Technology education at AS and A2 level. AS and A2 level combine to give an Advanced level qualification for predominantly 16-18 year old students offered by schools within England. AS level (Advanced Subsidiary level) is assessed at the end of year one and is a standalone qualification, with A2 level students assessed at the end of a second year of study.

1.4 Aim

The overall aim of this research is to gain an understanding of how effective websites are in influencing decision-making concerning sustainability within AS/A2 level Design and Technology education. The outcome of this research will give a greater understanding of how websites dedicated to the understanding of sustainable design are being used to raise awareness with this age group. The thesis will report the potential implications derived from the findings.

1.5 Objectives

This research sets out:

- to establish whether there is a current consensus on sustainable development and sustainable design within AS/A2 level Design and Technology education;
- to classify the characteristics of leading sustainable design websites;
- to establish a meaning for effectiveness in the context of the use of sustainable design websites;
- to establish a process for investigating effectiveness through quantitative and qualitative research methods;
- to establish the key principles for improving effectiveness of the Sustainable Design Award website;
- to consider the extent to which the emerging principles might apply to other websites used by students at this level, and beyond.

These issues combine to give a broad research agenda based on a need to improve sustainable design education and measure how effective websites are in influencing design decisions. The use of websites within AS/A2 level education is to be analysed with the aim of improving schemes such as the Sustainable Design Award (SDA) (Capewell and Norman 2003) through its findings.

As the practitioner was to be the designer of the SDA website, it could prove an invaluable and accessible evaluation tool for the research work. Practical Action aimed to have a website that can be used as a sustainable development information resource for students and teachers alike and its success in achieving that is dependant on how effective the website is and how it relates to design decisions.

Pilot studies will be used to assess appropriate research methodology as well as developing a foundation for the main research study.

1.6 Research questions

The research aims to answer the following chief research questions:

- What is sustainable design within AS/A2 Design and Technology education?
 - What is the understood consensus concerning approaches to sustainable development?
 - What are the principles followed by sustainable design in AS/A2 Design and Technology education?
- Can leading sustainable design websites be classified according to their characteristics?
 - Which sustainable design websites are prominent?
 - What content is present on current sustainable design websites?
 - What is recommended as good website design practice?
 - Can the sustainable design websites be placed into categories?
 - What are the characteristics of leading sustainable design websites?
- What is effectiveness in this context?
 - Which areas of sustainable design websites do designers find useful?
 - Do sustainable design websites influence design decision-making within AS/A2 Design and Technology education?
- How do you measure the effectiveness of websites?
 - Can quantitative research methods help to measure effectiveness?
 - Can qualitative research methods help to measure effectiveness?
- What are the key principles governing the effectiveness of the Sustainable Design Award website?
 - Is the SDA website effective in influencing design decisions by AS/A2 Design and Technology education students?
 - Do supporting inputs make the SDA website more effective?
 - At what stages in designing does the SDA website influence student design decisions?

- Do the effective features of the SDA website parallel those of other leading sustainable design websites?
 - How could the effectiveness of the sustainable design websites be improved?
- Are the findings more widely applicable?
 - Are the effectiveness principles established for the SDA website applicable to sustainable design websites or websites in general?

1.7 Research strategy

The research strategy had two essential components; analysis relating to existing sustainable design websites and the design, development and analysis of a new website. These were based on a detailed literature review of website effectiveness. 25 existing sustainable design websites were analysed and clustered to categorise them for later research. An initial website (mach I) was created for the Sustainable Design Award by the practitioner to be used as a tool for the research study. After consultation from the SDA steering committee and feedback from students and teachers, a second website (mach II) was developed to meet their needs.

The mach II website was then tested and analysed for its usability by undergraduate students. Inputs were given to raise awareness of the website and to help consider factors relating to its effectiveness 'before use', 'during use' and 'after use'. 72 questionnaires were completed and 18 case studies were assessed, analysing the student folio work to see the mach II websites' influence on sustainable design students. An interview was also carried out with the co-ordinator of the SDA to help confirm or refute the findings.

These empirical results were then analysed in the context of emerging practice for website design and means for improving effectiveness identified.

CHAPTER 2 LITERATURE REVIEW: DESIGNING AND INFORMATION RETRIEVAL

In order to help further define the context for this thesis, this chapter outlines a model of designing. An Assessment of Performance Unit discussion document is discussed. It proposed a model of designing in the 1980s which has since been developed. This research study uses the document to establish a theoretical position on which this thesis can be based. This chapter reports a particular aspect of the model of designing, namely the area of investigation focusing on information retrieval.



2.1 Designing

2.1.1 A model of designing

There have been various attempts to frame a model of designing. This thesis aims to consider a model that is fit for purpose and uses a framework offered by a discussion document (Hicks 1982) entitled *'Understanding Design and Technology'* published in 1982 by the Assessment of Performance Unit (APU) to establish its theoretical position. The document concerned Design and Technology education at primary and secondary level within the United Kingdom. It had a number of contributions by notable practitioners from Design and Technology education, such as the late Professor John Eggleston of Keele University and the late Professor Bruce Archer of the Royal College of Arts. The discussion group outlined the aspects of Design and Technology that most likely reflected this education within schools. The discussion group also discussed 'when and where abilities in Design and Technology' (Hicks 1982:1) are prominent within the school curriculum. It also looked at the assessment of student development within Design and Technology.

In 1982 'Design' and 'Technology' were separate areas, but have been discussed together since using 'Design and Technology' as a composite noun (Hicks 1982). As recognised in the APU document (Hicks 1982), activities in Design and Technology often overlap. Barlex (2007b) discusses the origins of Design and Technology, the intimate connection between each word and its goal for inclusion in the National Curriculum described as 'increased competence'.

The APU document has since been used as a framework for Design and Technology education research, and as a model for understanding design issues. The document considers the knowledge, skills and values of design students as they look to 'come to grips with the problems of living in, and exerting their influence upon, the man-made world' (Hicks 1982:2). Archer, Roberts and Baynes refer to knowledge, skills and values (Archer et al. 1992) this was taken further by Norman. Norman (1998a, 2000) illustrates effective design as being bound by the three categories, and that research and education should see these as prominent issues in design.

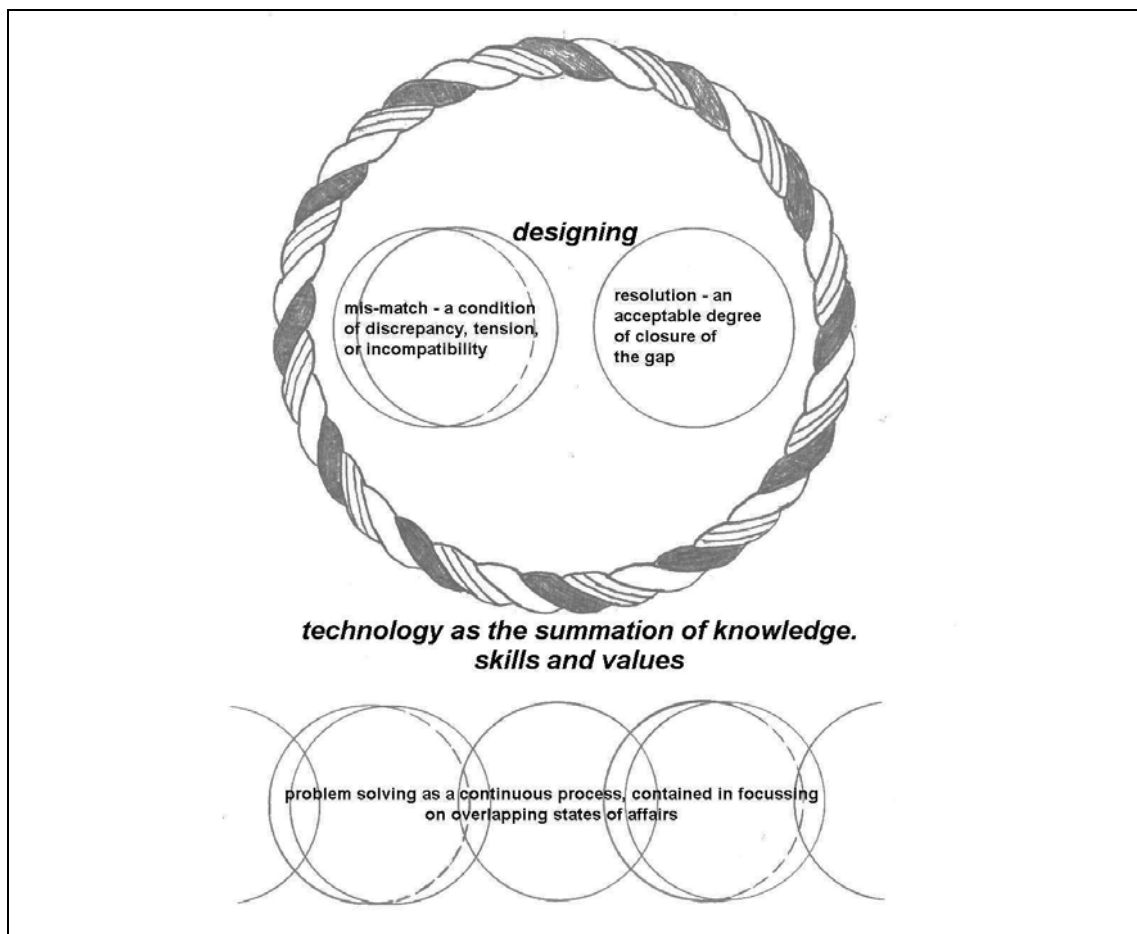


Figure 2-1: Technology as the summation of knowledge, skills and values
(Norman 2000:129)

An alternative model of which demonstrates the kind of design decision-making embodied in the school curricula was explored by Barlex (2007a). The diagram (Figure 2-2) shows the five points of the pentagon representing conceptual, technical, marketing, constructional and aesthetic aspects of design.

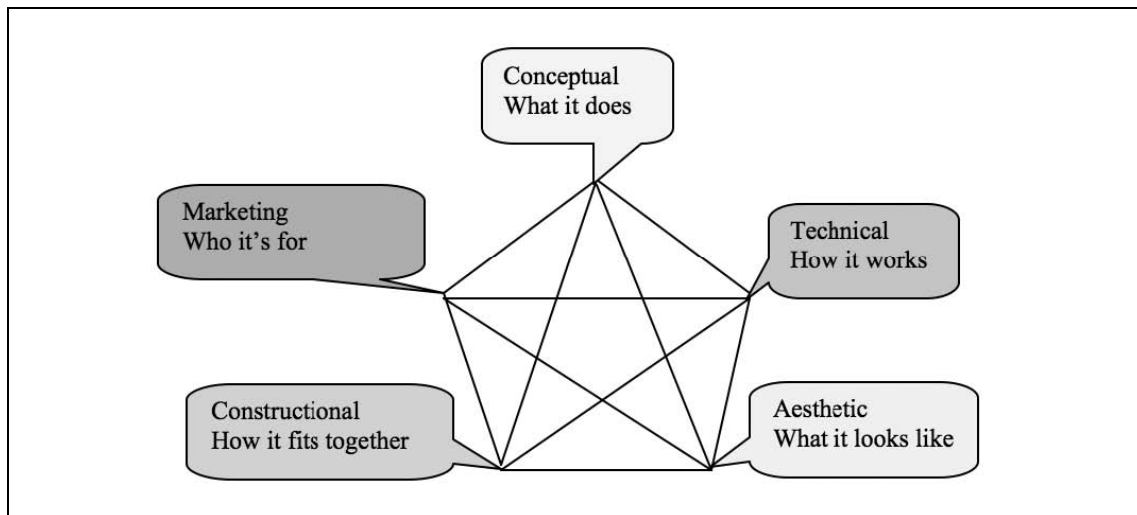


Figure 2-2: The design decision pentagon (Barlex 2007a:50)

This model was developed to include food technology in education (Rutland and Barlex 2006), and later additions were made by Trebell (2009) to include safety, constructional and material aspects (Figure 2-3). These models suggest some of the critical areas in which decisions need to be made. The Sustainable Design Award initiative would be emerging within these kinds of models of current practice.

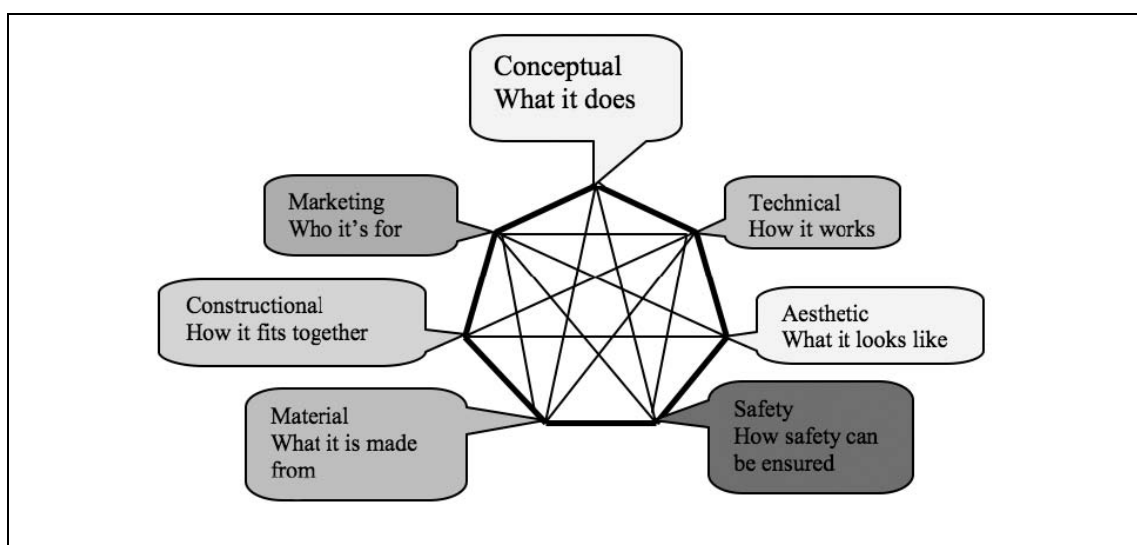


Figure 2-3: The design decision heptagon (Trebell 2009:61)

2.1.1.1 Knowledge, skills and values

The APU document (1982), related to the assessment of Design and Technology in general education, has three categories for knowledge, four for skills and four for values.

Knowledge contributes to the design resolution, and was discussed in terms of three categories:

- **control** concerns the factors in a man-made environment, a decision of materials for example, to perform a certain way in correlation to their attributes;
- **energy**, a knowledge of energy to power products and systems will enable suitable resolutions to be selected by the designer;
- **materials** selection by the practitioner can be assisted by a knowledge of the materials' properties.

Skills are described as a key aspect of designing by the APU document, consisting of the following categories:

- **investigation** which incorporates an ability to identify design problems, and through designerly activity, produce a resolution, system or product through experimentation;
- **invention** 'includes the ability to initiate and develop ideas' (Hicks 1982:4), illustrating those ideas through drawing and making, creating alternative resolutions;
- **implementation** of design decisions taken across a range of designerly activity, and the most appropriate resolution is selected;
- **evaluation** demonstrates an ability to create a system or design a method for testing, coupled with an ability to see which of the proposed resolutions to the design task are judged the most successful.

'As design involves the selection and use of appropriate materials, knowledge is also required of their sources and costs; of their useful properties and limitations; and of the appropriate methods by which they may be processed, manipulated and concerned.' (Hicks 1982:5)

The 1982 report considers **values** in four areas:

- **technical** values involve the practitioners application and understanding of the approach designers or design students take to concepts like efficiency, flexibility, precision and confidence;
- **economic** values, understanding the differences between value, price and cost, economics considers the value of the product or system in use, its intrinsic value and its worth in terms of exchange;
- **aesthetic** values concerns the individual perception of forms and colours that help to communicate an idea, a meaning, or an expression;
- **moral** judgements within legislation and learning, for example an awareness of the 'natural environment and his responsibility for its and his own future survival' (Hicks 1982:7).

The effectiveness of a sustainable design website relates to the skill of investigation. This skill is exercised in the complex arena of knowledge, skills and values for design decision-making. For example, Pedgley (1999:30) describes design decisions in the context of product functions: 'those providing utility (i.e. usefulness; included for practical gain)' and 'those providing expression (i.e. bringing character and meaning to a product with no enhancement of utility)'.

'Participation in activities relating to Design and Technology can rarely be entirely free from the exercise of value judgement.' (Hicks 1982:6)

As Layton (1992:9) explains 'it is always difficult to isolate the material artefact from the network of human activities in which it is inextricably enmeshed'. Layton also suggests that often products can induce a reaction from humans, reshaping peoples' values and possibly being introduced to new values. Advancements in technology can drive a change of perception, changing the circumstances within which choices are made.

'What we encounter today is the result of decisions which reflect the value judgements of those who shaped a development which was in no sense inevitable.' (Layton 1992:10)

2.1.2 Design research

One focus for the Design Education Research Group in Design and Technology at Loughborough University has been the role of knowledge, skills and values in human judgements. In exploring research agendas associated with design decision-making, Norman investigated a model based on the intersection of knowledge, skills and values (Norman 1988a, see Figure 2-4 below). Pedgley pursued the knowledge component of the model as part of a PhD research project, particularly relating to materials. Pedgley conducted a diary study of his own designing and conducted interviews with professional designers. Pedgley (1999) illustrated how designers often make judgements with incomplete information. Trimingham (née Coles) looked at the area of values in her PhD thesis (Trimingham 2008), investigating how values impacted upon design decision-making. Trimingham developed a new taxonomy and showed how values influenced decisions throughout a design project (Trimingham 2008).

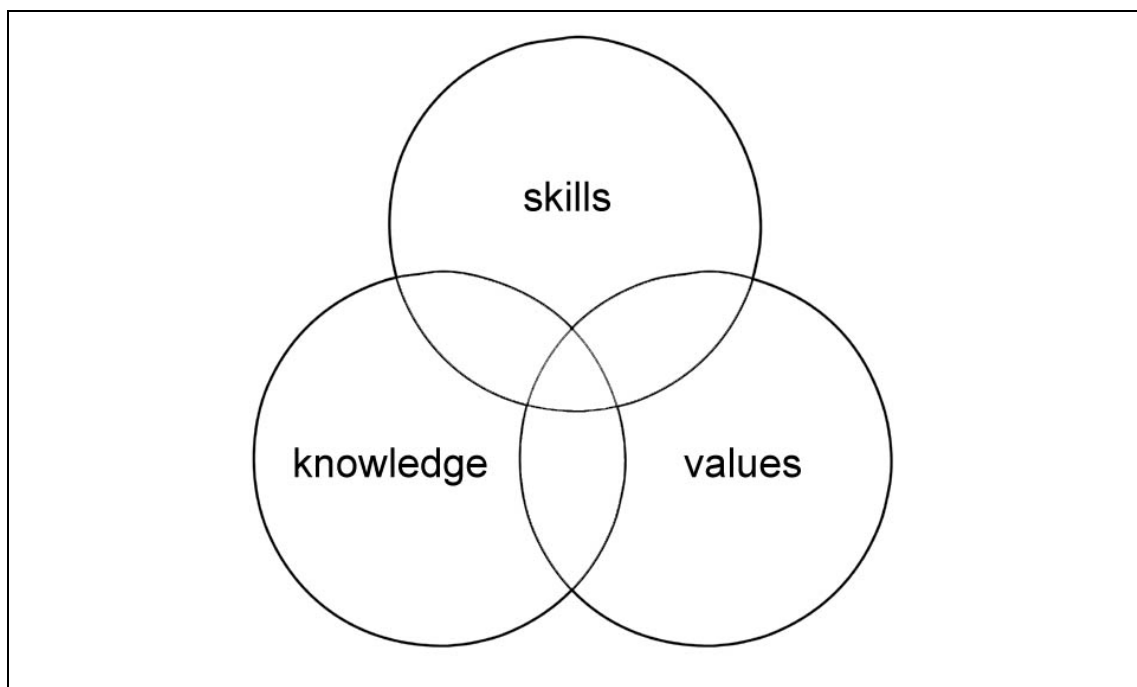


Figure 2-4: Knowledge, skills and values based upon the Assessment of Performance Unit report (Hicks 1982, Pedgley 1999)

In reflecting on this work, Norman concluded that the 'information requirements will increase as the designers' roles widen, and it is inevitable that the Internet will play an increasing role in helping to meet designers' information requirements' (Norman 2006:28). Rather than scouring through books and journals, designers now use

interactive resources such as the internet to find information. Once this information has been gathered, or not gathered as the case may be, the designer makes decisions based upon the information they have, the skills they possess and the values which they hold (Lillis and Clark 2008:2). This study investigates the effectiveness of websites in influencing design decisions. These design decisions involve knowledge, skills and values and hence can be seen to be related to the research carried out by Pedgley and Trimmingham.

A growing emphasis on sustainable development in society has put a greater responsibility on the designer to consider sustainable design issues throughout their design work, sometimes to the detriment of other more conventional influencing factors. For example, designers may have to choose a material used for a component based upon design factors such as cost, aesthetic properties or weight, but also balance this against sustainable design factors. Design decisions taken throughout designing can be influenced by a designer's personal values, knowledge and skills.

2.2 Information retrieval

This study relates to the skills section of the diagram shown in Figure 2-4. Investigation within the skills category is the essential focus of the research specifically looking at information retrieval and communication design.

2.2.1 Traditional approaches to information retrieval

Information retrieval is 'finding material (usually documents) of unstructured nature (usually text) that satisfies an information need from within large collections (usually stored on computers)' (Manning et al. 2009:1). As suggested it has become usual for this information to be stored on computers but the need for information within design has been there long before the advances in technology.

Norman (1988b) reported the first specific study on information use in designing undertaken by a panel of information experts from the Council of Industrial Design (C.O.I.D) in 1979. The findings of this study focused on paper submissions from research communities, the industrial design industry and the technical press (1988b:137). Norman goes on to report a second and third symposium concerning information for designers.

In the third symposium on information retrieval, Kingsmill (1977) describes the installation of new 'minicomputer and communications equipment' (DIALTECH) at the Technology Reports Centre of the Department of Industry. Norman (1988b:137) describes the system as allowing 'designers to carry out literature searches by using ordinary telephone lines at their own computer terminals'.

Alongside this facilitation of new technologies in the late 1970s, GCSE Design and Technology education started to provide information to design students with modular resource books which focused on energy, materials, electronics, mechanisms and instrumentation. Undergraduate education followed suit with one particular study by Rhodes and Smith (1987) highlighting the process of information retrieval.

Norman credits the drive towards the use of information technology in the late 1970s and 1980s to the Microelectronics Education Programme (1988b). This programme helped integrate microcomputers into schools, but it was in 1979, when practitioners, policy makers and designers were brought together by the British Library to discuss the programme's use within schools, that proved a facilitator for the Microelectronics Education Programme. The British Library set-up grants to assist the programmes integration and use of a special database called Schools Information Retrieval (SIR).

The thirst for better design outcomes through informed design decisions exists in both professional design practice and design education. Professional designers would generally carry out research in the form of expert advice, user-centred questionnaires, or experimental tests (Norman 1988b). In modern times you only have to look at the development of design consultancies to realise the importance of information to aid design decision-making, as illustrated in the results section. In fact due to the availability of technology, information retrieval has become an activity that happens regularly in every day life (Manning et al. 2009).

However there appear to be some stark differences between professional design and design education. Norman (1988b) suggests that for professionals the priority is the end product and its success in the market, a success that can be very finely balanced. Properties of materials, costs and specification can all have a significant affect on this success. A designer needs to carry out or have to hand the latest research, whilst conceiving the product and its market in order to make informed choices about both technical and aesthetic issues in design.

In design education many of the Awarding Bodies focus on the process rather than just the design conclusion. In professional design practice much of the focus is on the outcome, and time can often have a bearing on the process. Up until the Norman paper (1988b), the information provided was largely through written communication. Practical examples of materials, technological outcomes and the information provided was largely down to the school that the student attended. At the time of writing Norman suggests that 'it is possible to imagine this wealth of information contained on a computer database, but not with currently available technology' (1988b:139).

Prestel, The Times Network, and the National Educational Resources and Information Services were all national databases which collated information of general interest. Norman (1988b) reported that the take-up and use of these databases along, with local facilities, and any new forms of information technology that incorporates audio and video, would be dependant on the cost to each school or college. Norman also predicts that these databases would act as information tools for undergraduate education. Just as computer-aided learning was a dream in the 1960s, a fully interactive teaching package with the capability of integrating both audio and video was a realistic dream held in the 1980s (Williams et al. 2007). With an exciting new age on the horizon, practical worries about its capabilities and limitations surfaced. Could this interactive technology be locally relevant to design students, in a format appropriate for that age range?

The large burden of cost in advancing technologies would soon decrease as the information technology revolution would take hold. In 1988, professional designers were in a better position than design educators to access this developing hardware and software and put into practice these exciting advances in technology.

The Google generation

Norman's predictions have largely come to fruition. Today's generation still have the same information requirements as those described in 1988, a thirst for specific information about material properties and manufacturing technologies, but the technology and its availability has surpassed expectations. Far from relying on databases to inform design students, we now have a generation that are being educated with emerging internet technologies and readily accessible information at

the click of a button (Manning et al. 2009). The restrictions on the methods of finding that information within professional practice are driven by cost and time (Lillis and Clark 2008).

In everyday activities the influence of the development of the internet is immeasurable, and the prominence of computers is now widespread (Hallam 2009). Advancements in capabilities have led to the global age where students can collaborate with people worldwide to help inform their projects with the latest information from within their own classrooms (Williams et al. 2007).

The emergence of websites as an interactive tool has led to a wave of internet icons such as *Twitter*, *Facebook*, *Google*, and *YouTube* (Hallam 2009). Due to the development of blogs, tweets, wikis and RSS feeds, an ability to interact and contribute to the knowledge base has raised issues of validity and trust. No longer is the only information available validated by the British Library or such authoritative bodies. The same information resource that provides a platform for education research is also widely used for other activities such as social networking, for online retail and business marketing.

Greater emphasis is perhaps placed on designers to reach their own judgements through their own experience. Professional designers are similar to student designers at undergraduate level education where the students are guided but ultimately make their own design decisions. The indications from the professional designers in a private communication (Lillis and Clark 2008) are that they use websites regularly to source information during research and idea generation, and the design team for each project is split up and given specific tasks. The designers commented that they have 5-10 trusted websites each that they use regularly and use the Google search engine as a starting point if they need to. The professional designers also felt that they were able to dismiss using certain websites fairly quickly based on their appearance and content.

Pedgley (1999:48) categorises information in two forms, 'that which is received but not sought' and 'that which is actively consulted'. This concerns the method by which information is acquired, for example, information found by a person using the internet may have been searched for, or happened upon. 'Information use can be regarded as a key step in designers' acquisition of new knowledge' (Pedgley 1999:48).

This study looks at the use of websites in the context of information retrieval within designing, and its effectiveness in influencing design decision-making.

2.3 Designerly activity

In design, Cross (2007:22) discusses that there are 'things to know, ways of knowing them and ways of finding out about them'. Cross (2007:22) describes a 'designerly way of knowing' as distinct when compared to forms of knowledge from more popular scientific and scholarly research. Cross (2007:23) also writes that 'scientists problem-solve by analysis, whereas designers problem-solve by synthesis' indicating the difference between the two and that analysing designerly activity can be less defined.

Lawson suggests that 'no one technique and indeed no one piece of research can give us all the answers' (2004:5) but it could give an overall picture. Lawson describes possible methods which could contribute to this understanding.

Information may be gathered by the designers themselves this could allow access to 'information designers are given and the information they produce' (Lawson 2004:3), because designing is a creative activity and is often difficult to measure. Hidden knowledge held by the designer would be difficult to decipher.

Information could be collected through placing empirical conditions on a designer although realism would be difficult to replicate when considering recreating the knowledge relied upon in design decision-making. Observation of designers in practice may reveal resources of information but would be difficult to assess.

Asking the designers what they know directly can cause issues as they are not professional writers and the presentation of information may prove more logical than in reality. Pedgley (2007) discusses that, by its nature, collecting information from designers has a presence in design activity, the very thing the practitioner is trying to assess. 'Interviewing designers privately and confidentially not about individual projects but about their process in general and the knowledge they rely upon can alleviate some of these problems' (Lawson 2004:5). Pedgley (2007:470) continues to suggest that four types of analysis are best suited to analyse design activity:

participant observation, action research, diary method, and project reporting. Aspects of each of these can be seen in the research methodology of this study.

2.4 Designing and information retrieval chapter conclusions

The APU document model of designing was used to put the study into context, the information retrieval aspect of skill was identified (Hicks 1982). Chapter 2 reviewed information retrieval, the information designers seek and how they seek information.

The chapter reviews current information retrieval techniques and describes the Google generation. It also suggested that the research methods discussed in isolation would give limited information but a combination of several methods could help to build up an overall picture (Lawson 2004). Pedgley (2007) highlighted several key components of analysing design activity that were used to gather information in this study.

CHAPTER 3 LITERATURE REVIEW: WEBSITE EFFECTIVENESS

This chapter establishes a consensus on what constitutes 'website effectiveness' through a literature review of the subject. It describes the three distinct areas of effectiveness in greater depth: 'before use', 'during use' and 'after use'. The chapter concludes by summarising the findings of the literature through a mind map diagram of website effectiveness.



3.1 Website effectiveness

In order to establish a consensus to define website effectiveness, an extensive literature review was carried out to draw together a wide range of perspectives. In the past 'practitioners and researchers have proposed different criteria for effective website design based on common sense, intuition, and rules-of-thumb, effective website design focusing on the quality of the information it provides has rarely been studied' (Katerattanakul and Siau 1999:279).

How can effectiveness be judged? Is it judged by a designer gaining an understanding of the relevant issues or an attempt by the designer to resolve these issues? Or is it that a demonstration of effective sustainable design practice is the criterion for success? The word 'effectiveness' is subject to a considerable range of interpretation, for example a website may be considered effective by simply getting a user to access the website, or return to it. It may also be judged on how much influence it has on the user.

The brainstorm in Figure 3-1 shows the key areas of effectiveness as loosely based on texts by Durham (1999), Nielsen (1993), Mayhew (1999) and Preece (1993). It illustrates the wide-ranging areas that make up effectiveness in this context.

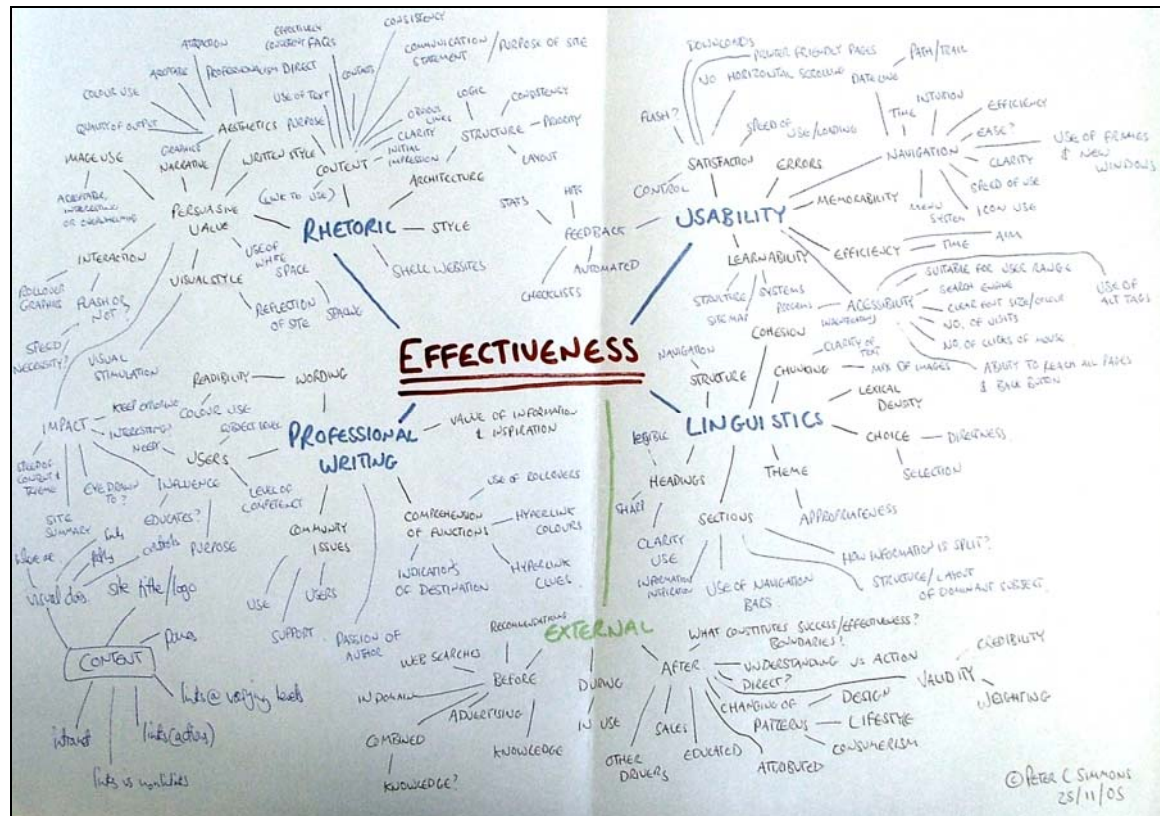


Figure 3-1: A mind map of effectiveness based on work by various authors (Durham 1999, Nielsen 1993, Mayhew 1999 and Preece 1993)

In this instance, website effectiveness covers a range of areas from content to usability. Initial research studies into effectiveness have proved useful in establishing a firm understanding of the key areas by the author. Theoretical studies of the effectiveness of the internet websites appear sparse for two main reasons; it is a relatively new research area and people are still finding their way, secondly the nature of internet research means that people at the forefront are unlikely to sit back and reflect on developments (Day 1997).

Most users fall into the category of surfer or information retriever (Preece 1993). According to Preece (1993) 'surfers' simply browse websites not looking for anything specific just clicking on items of interest. 'Information retrievers' tend to look for specific information and therefore it is difficult for websites to meet the needs of both user groups. For website designers, they have to make a decision whether to design

the website looking to attract surfers or to design the website to guide information retrievers to the specific information they need. The person or organisation funding the website may also want to convey a message. Such decisions contribute to the approach taken to a website's design. Organisations have little control over which users visit their website, unless it is password protected, it could be assumed that both types of user have access to the information. Some retail websites will use their marketing to target one of these groups of users that would be most likely to purchase their product.

Websites can be seen as a communication tool and therefore their composition can be viewed in the same manner. Day (1997) argues that websites, like other communication tools, possess an explicit purpose, coherent structure, and a relevant conclusion (relevant conclusion implying an achievement or outcome). Website effectiveness, placed in this context, would seem reliant on the judgements of the website user. According to Day (1997), websites are judged not on how they work, more on if they work.

'A website works because the people it serves like it.' (Day 1997:109)

The qualities that make a website likeable may be considered as part of website effectiveness. Likeability is part of both 'during use' and the 'after use' phases. Can a website be effective without it being likeable? Does an effective website focus on each of the areas of 'before use', 'during use' and 'after use' equally? When considering a website's entire design, Day (1997) argued that it is down to the views of the individual user.

'In the context of learning about websites, it is not sufficient to just read the literature about website design and effectiveness; in addition, students must actively form their own informed attitudes about website quality.' (Rathswohl 2002:1312)

Websites require a level of user interactivity. If you also consider their varying formats, for an informed assessment of a website's effectiveness, the website would need to be used. Conclusions can then be gathered from set assessment tools or a more subjective assessment made of the website's effectiveness 'during use'.

‘...when the web pages are meant to teach or provide information, the task of effective web page design can be considered from an instructional design point of view, an aesthetic point of view, or a psychological point of view...’
(Katerattanakul and Siau 1999:280)

Katerattanakul and Siau (1999) identify three areas that educational websites can be classified into; instructional, aesthetic and psychological. These judgements need to be considered when deciding what makes a website effective. Instructional would imply a website that informs the user of specific information. Aesthetic would mean a website that has graphical appeal to the user. Appearance may be an influence on the user, and aesthetics can also add to the websites’ likeability. Psychological would look more to the ease of use and how things are displayed structurally to help the user find the information they require. It could be argued that websites become effective when they meet the goal of what the website is trying to achieve. It could be said that sustainable design schemes aim to inform, inspire and motivate, and so their corresponding websites could be considered effective if they achieve these aims.

3.2 The phases of effectiveness

The review went further than just concentrating on criteria that ‘...typically relate to a website’s design and layout, content and navigation features’ (Rathswohl 2002:1313). The review intended to expand these areas, to allow for a wider spectrum of criteria that relate to different phases of a website use: ‘before use’, ‘during use’ and ‘after use’.

The categories under each section were gathered from the literature, and from the researchers own experience as a professional designer. Sometimes these areas were mentioned by an author in the literature but not expanded upon. All the areas were summarised at the end of the chapter in Table 3-2.

3.2.1 Before use

‘Before use’ takes into account the time before reaching the website and the possible paths that may have led to the website. This section outlines the main contributory factors to reaching a website. Often the approach to finding a website is not a major

consideration for website designers, concentrating on when the users actually use the website rather than how they got there.

The areas of 'before use' include:

- revisiting a website;
- recommendations from colleagues or leaders in the field;
- advertising;
- website searches;
- chance, the appropriateness of a domain name.

A return visit to a website may indicate that the website has been successful in communicating information the first time it was used. Although a revisit may also be viewed as a failure, as the user may not have been successful when using the website the first time.

Recommendations from other users may be considered as a measurement of success, especially colleagues, teachers or SDA promotion by Practical Action, as one would presume the website had been of some value to the recommender.

3.2.1.1 Website marketing

Advertising and marketing may lead you to a particular website, but it could be argued that this is effectiveness of the advertising rather than the website itself. The same conclusion could be drawn from website searches. It could be argued that website searches show popularity but the position of a website on a list of search results can also be bought. Many websites pay companies to promote their website by placing their website listing at the top of the page in search results specific to that search engine rather than relying on their own knowledge of website marketing.

Companies invest money in search engine optimisation. Google is the most popular website search engine in the United Kingdom (Hallam 2009). For other countries other search engines are the most popular for example in the United States of America it is *Yahoo!*. Depending which target audience the website is aiming at it can be optimised to appear high on the website listings. As this study is based within the United Kingdom, Google is the focus for this section.

The other possibility is that the website was discovered by pure chance by guessing an appropriate domain name. It is important to recognise that on a basic level websites cannot be effective unless the user finds and accesses the website. Companies employ different methods to achieve a ranking on Google. To start with Google ranks higher websites containing plain text in html code, as it is able to trawl through this text for its searches. Any words used as a title, with bold, underline or italic used, it recognises as important, this includes the words used in the top-bar. These words can all be considered as 'key words', for a high ranking in Google it is important that these words reflect the words that you would like people to search for in Google to find your website.

Trust and reliability of information is often an issue with websites for its users, Google itself also reflects this. Incoming links from what Google sees as reliable sources will improve your Google ranking, any links from academic servers or well established organisations such as the BBC will improve its position. It is possible to buy a position within the top screen within Google through 'pay per click' advertising. Google have recently made the first three links on Google appear as well optimised websites however they tend to be paid for links (Hallam 2009). This enables website tools such as Google Insight which can show users what people are looking for, which key words they are searching, when they are searching for them and where in the world. With this information marketing departments can pinpoint these advertisements to people who are specifically searching for their product.

3.2.1.2 User retention

A key part for businesses using websites is to retain clients and have presence on the internet (Hallam 2009). One way of achieving this is through social networking. An effective way for businesses to do this is through blogging. Blogging allows users to inform their audience instantly of developments and news in their business, through updating their blog. Each blog entry is stored chronologically and can be accessed by anyone on the internet. The creator of the blog can allow users permissions to update or comment or simply just view the blog entries. Blogging is search engine friendly and can be used to communicate with clients and let those clients respond. Twitter and Facebook are popular social networking websites that can be used to inform and interact with clients.

User retention is important as it helps activate a client base and also helps users to return to the website. This makes it a prominent consideration 'before use'.

3.2.2 During use

'During use' has been a major focus of literature concerning website effectiveness. The key areas identified under 'during use' are identified below although many aspects are also applicable to 'before' and 'after' use:

- cognitive psychology (visual perception, information processing, attention, memory, learning, models);
- human-computer interaction (physical, experience, psychological, socio-cultural and user interaction);
- usability (navigation, accessibility, feedback, errors, learnability, memorability, satisfaction, throughput, flexibility and attitude);
- linguistics (sections, chunking, structure, theme, headings);
- rhetoric (persuasive value (interaction, style, aesthetics), architecture, shell sites, content (obvious links)).

3.2.2.1 Cognitive psychology

Cognitive psychology 'is the study of human perception and cognition' (Mayhew 1999:2), it relates to how a task is carried out and the capabilities of the user involved to process/interpret the information needed to complete this task. Preece (1993) outlined two main ways of improving the design from this perspective; providing knowledge about expectations of what to do and what not to do, and identifying potential problems.

Preece (1993), Day (1997), Grudin (1992), Rosen and Purinton (2004), and Mayhew (1999) believe cognitive psychology comprises of the following key factors discussed in detail below: *visual perception, information processing, attention, memory, learning and mental models*.

3.2.2.1.1 Visual perception

People's visual perception of flat objects can help to give a greater three dimensional appearance to the website design; text, graphics, animation and video (Day 1997). Many design aspects relating to computer interface design relate directly to website design, for example considering whether it is: legible, distinguishable, comprehensible, uncluttered, and of meaningful structure to assist the visual appearance of the website (Grudin 1992). Even the organisation and presentation of tables can influence people's decisions as to the time spent on a specific website page. First impressions can often influence users and help users decide on the validity of the information they are viewing (Rosen and Purinton 2004).

3.2.2.1.2 Information processing

Information processing means a response to looking at a certain part of the screen, or performing an action as a direct result. Stages outlined by Preece (1993) relate to the encoding of the information, comparing this to other representations in the brain, deciding upon a response and then carrying out an action.

'Our ability to remember things, therefore, is closely linked to the way in which they are initially encoded.' (Preece 1993:26)

Verbal and visual information processing preferences can determine how a user perceives a product, in this case, the website. Its structure and use are also important as these help a user to navigate and remember where certain information is held. This ability to remember things has become a theoretical foundation on which cognitive psychology is often based (Mayhew 1999).

3.2.2.1.3 Attracting attention

Grabbing people's attention is a vital, yet often overlooked, quality needed by a website. The user has many distractions from using the website so keeping the attention of the user is a difficult task. This is referred to as selective attention (Day 1997). How a website is going to attract this attention needs to be addressed, with the correct information given to the user at a specific time. Important information needs to be prominent on the website, the structure therefore plays crucial role in the success of the design of the website (Rosen and Purinton 2004). The ability to allow users to multi-task but ultimately come back to the website flexibly is important and is often determined by links and structuring (Preece 1993). Determining factors of

successful attention grabbing relate to the presentation of information, various visual and auditory cues, and partitioning of pages and their flow.

3.2.2.1.4 Memory

Memory is an integral part of all our actions in everyday life but the level of memory varies considerably. Some tasks on computer systems are more complex than others and take longer to learn. Preece (1993) believes determining factors such as names and icons that are meaningful and reflective can often improve this memory level. Improved menu structures with clever design names could be seen as an area where this is beginning to be exploited. Browsers themselves hold a memory of website addresses, an ability to save the page as a bookmark also helps navigate the user (Hallam 2009).

3.2.2.1.5 Learning

Learning to use a computer requires active involvement (Rosen and Purinton 2004). Preece (1993) also identified five key aspects of learning:

- learning through doing;
- learning by active thinking – understanding the system;
- learning through goal and plan knowledge – having an aim to the use;
- learning through analogy – familiar concepts;
- learning from errors – feedback from making mistakes.

3.2.2.1.6 Mental models

Often mental models of ourselves interacting with products are formed and can provide a basis for predicting or explaining our interactions. This mental model tends to reflect previous experience, interactions and behaviour patterns. It is therefore important to create a design that enables the 'user to develop a suitable mental model' (Preece 1993:31).

3.2.2.2 Human-computer interaction

The way that users interact with their computers whilst using computer programs or websites can indicate factors that lead to improvements. The successfulness in conveying information, or areas that are easy to use, indicate an effective human-computer interaction (Rosen and Purinton 2004). There are many parallels between computer programs and websites in relation to their effectiveness. Both are a computer based output which aim to safely, effectively, efficiently and communicate a

certain subject area. Well-designed computer outputs with good usability (Preece 1993) can be seen to improve performance of a workforce, improve quality of life and make the world a safer more enjoyable place to live in.

A focus on the efficiency of users when accessing the specific information required will help to improve the design of product's exterior and interior. Effective use of sustainable design websites will help to improve knowledge of sustainable design principles, and in turn contribute to a better world for current and future generations (Bhamra and Lofthouse 2007). Designing for successful human-computer Interaction can be helped by a knowledge of the users, a knowledge of the purpose, an understanding of when and where it will be used, and also what is actually technically feasible (Preece 1993).

Preece (1993) also goes on to outline four key factors relating to users which it is key to bear in mind during this study:

- physical – height, weight, left/right handed, dexterity, visual acuity, health and fitness;
- experience – knowledge of the task they want to do and computer use;
- psychological – adventurous or timid state of mind, ability to learn, memory;
- socio-cultural – background, upbringing, educational attainment, age, race, gender, ethnicity.

These four factors are important when assessing the users of the sustainable design websites.

3.2.2.3 Task analysis

Tasks performed by website users are an important aspect in understanding the effectiveness of websites. The world-wide-web is a rapidly expanding communication tool and is used in many ways across a spectrum of communities and networks.

Table 3-1 illustrates factors that Preece (1993) considers as part of human-computer interaction. The table shows the 'task factors' as part of wider considerations.

ORGANISATIONAL FACTORS: training, job design, politics, roles, work organisation		ENVIRONMENTAL FACTORS: noise, heating, lighting, ventilation	
HEALTH & SAFETY FACTORS: stress, headaches, musculo-skeletal, disorders	Cognitive process & capabilities THE USER: Motivation, enjoyment, satisfaction, personality, experience level		COMFORT FACTORS: seating, equipment, layout
USER INTERFACE: input devices, output displays, dialogue structures, use of colour, icons, commands, graphics, natural language, 3D, user support materials, multimedia			
TASK FACTORS: easy, complex, novel, task allocation, repetitive, monitoring, skills, components			
CONSTRAINTS: costs, timescales, budgets, staff, equipment, building structure			
SYSTEM FUNCTIONALITY: hardware, software, application			
PRODUCTIVITY FACTORS: increase output, increase quality, decrease costs, decrease errors, decrease labour requirements, decrease production time, increase creative and innovative ideas leading to new products			

Table 3-1: Factors to be considered in Human-Computer Interaction
(Preece 1993:19)

Mayhew (1999) describes requirement analysis as a key area of task analysis to consider. It relates to the patterns of use highlighting user competency, frequency of use, and experience of the user.

Preece (1993) takes this a step further in assessing computer interaction and specific variables to consider when setting a task:

- is the task repetitive?;
- how do the tasks vary?;
- how regularly is the task carried out?;
- is time critical?;
- what skills and knowledge are required to perform the task?;

- are warnings appropriate for flash sites or sites which need upgraded software?;
- how many are using the site to complete the task?;
- will the user be switching between tasks?;
- personal policies of use, accessibility, job content, power and influence within the business – may all contribute to a communication tool and its layout.

Analysing user interaction in performing tasks can help with the design of a website. The design development of websites can consider issues such as work flow, conceptual modelling, mock-up designs, and iterative designs to help eradicate usability flaws with their design. Other areas that are critical in this phase relate to conventions and standards in screen design, user interface functionality, an evaluation of usability bugs, and aesthetic value of the concepts of the screen design.

3.2.2.4 Usability

Usability concerns how a product meets the needs of the user. According to Dumas (1993) the time it takes to complete a task and how easy it was to complete, are the determining factors. Usability considers what task the user is trying to complete; e.g. researching, purchasing a product, downloading software, and also what the aim of the website is. Web guru Jacob Nielsen outlines five attributes of usability (Nielsen 1993:26):

- learnability: how easy it is for the user to learn?;
- efficiency: how productive will the user become?;
- memorability: how easy is it for the user to remember?;
- errors: how many errors does the user commit? Can they recover?;
- satisfaction: how pleasant is it for the user to use?.

Preece (1993) discusses three other aspects alongside learnability as being essential to usability testing, these are:

- throughput: tasks accomplished, speed of tasks and errors made;
- flexibility: ability of the user to adapt to a new system;
- attitude: positive attitude given to the users as they grow in confidence using the system.

These usability issues outlined by Nielsen (1993, 2006) and Preece (1993) can be seen as decisive when assessing the effectiveness of a website. It is imperative however that usability remains a part of a bigger picture. This study does not just include a website's usability but also its overall effectiveness.

‘...when designing websites or applications, ease-of-learning goals are often more important than ease-of-use goals...’ (Mayhew 1999:139)

Mayhew (1999) points out that many users will not visit a website daily and that ease of navigation and updated content must be considered as ‘very important qualitative goals’ for websites.

3.2.2.4.1 Key conclusions from a usability study by Spool

Spool (1999) assessed nine websites in depth, testing usability through usability checklists and automated computer systems. As a result of the feedback the following conclusions were made:

- be aware of ‘shell’ websites, information is inserted by a different department after the main structure has been designed;
- two types of users recognised; information retrieval and surfing (described earlier by Preece (1993));
- some adverts aim to attract but have the opposite effect, pop-ups and splash screens can often detract from the website;
- experience matters;
- users expectations & knowledge presumptions;
- links – how well it was able to predict/differentiate a link, often more links made a page more difficult to navigate;
- white space – there is no indication of benefits in commercial sites;
- scrolling / the fold – first clicks often not negative below the fold (the fold is a term used for the cut off screen);
- download time – not an issue, animation a distraction;
- content - more interesting equals more time spent.

According to the study, the most successful websites had content and navigation inextricably linked. The Spool (1999) study also outlined the following usability problems that they found to be common practice:

- users do not understand the whole product and do not use it correctly;
- users can't find information;
- users can't understand the information;
- users can't recover from errors.

3.2.2.5 Assessing readability

Various tests have been developed in order to assess usability in specific areas such as website readability:

- Gunning Fog - score determined by number of words, sentences and longer words;
- Flesch Ready Ease - determined by the average number of syllables per words or sentence, the higher the result the easier the readability;
- Flesch-Kincaid Grade level - determined by the average number of syllables per words or sentence, score gives the grade level needed to read the website.

Gunning Fog is the most common of these tests and has been widely used in various usability studies in the past including a website usability assessment carried out by Spool (1999). The tests allow practitioners to assess sections of their websites to help refine readability issues, helping to add clarity to their website content.

3.2.2.6 User interface

'The user interface to an interactive product such as software can be defined as the languages through which the user and the product communicate with one another.' (Mayhew 1999:1)

Wu (1999) concludes that this interaction can be classified in three forms: between user and messages, between humans and machines, and between senders and receivers. Interaction can be seen as a key consideration of effectiveness. The user interface to an interactive product such as software can be defined as the languages through which the user and the product communicate with one another (Mayhew 1999).

Mayhew (1999) outlines several key factors that determine the outcome of user interface success:

- cognitive, perceptual and constraints of people;
- special and unique characteristics of the intended user population in particular;
- unique characteristics of the users' physical and social work environment;
- unique characteristics and requirements of the users' tasks, which are being supported by the product;
- unique capabilities and constraints of the chosen software and/or hardware and platform for the product.

Mayhew (1999) outlines the benefits of more usable interface designs to users and in some cases the benefits to a business:

- increased profitability;
- decreased user training time and cost;
- decreased user errors;
- increased accuracy of data input and data interpretation;
- decreased need for ongoing technical support;
- greater profits due to more competitive products/services;
- decreased overall development and maintenance costs;
- decreased customer support costs;
- more follow-on business due to satisfied customers.

In the classroom, greater usability in websites could help to decrease time finding information needed for projects, decrease assistance from teachers and increase support from online experts. Use of controls, colour, fonts, format, terminology, interaction pointers, and wording of messages online are all vital to successful interface design.

‘...too large a volume of information may make it difficult for consumers to access...’ (Katerattanakul and Siau 1999:281)

The layout of the material can also determine how easy the information is to access. Information presented to target a certain audience can be more effective than large quantities of information.

3.2.2.7 Likeability factors

Likeability is an important aspect of website effectiveness. Day's (1997) assertions into website effectiveness are based on an idea that all effective websites are likeable and that non-effective websites are not. This would appear to be more dependent on the particular aim of each website individually. Surely websites can be effective in conveying information without a need necessarily to be liked by their user. If the aim was to create a website that was likeable, perhaps then it could be considered as an 'effectiveness' consideration.

Attitude towards a website is important. Attitude is formed upon cognitive information, emotional information, and aims to address behavioural intentions (Day 1997, Yang 2009). It is important to highlight that the majority of users do not wish to understand the technology behind a website, but simply to know if the website works. When you consider likeability in this context it holds greater significance to the user.

Day (1997) identified the following contributory factors as key parts of what makes a website likeable:

- quality - dynamic quality (refers to websites acting in response to an action) and static quality (quality is not interactivity dependant);
- customer focus - specific to user;
- purpose - creator/audience driven, not based on sales or hits;
- content - responsive to expectations and behaviours;
- structure - logical and customer-based;
- house-style - integrity (consistency) and clarity (layout, assists and comprehension);
- action - communication of purpose and result.

3.2.3 After use

Another phase of website effectiveness can be seen as 'after use', this concerns how a website affects a user after they have visited the website. The key areas identified under 'after use' are:

- change in patterns (designing, lifestyle or consumption);
- review of usability (validity, credibility and weighting);
- website sales;
- direct or indirect influence.

3.2.3.1 Change in patterns

How to measure the effects of using a website can be or difficult to do? To start with it is difficult to know which areas to measure the effectiveness of websites by (Spiliopoulou 2000). A *change in patterns* can indicate that the website has had an influence, for example, a website giving information about materials and then those materials being present in the final product design. A change in patterns could also be seen in being influenced by issues and changing a view on a subject, it could also affect which product people purchase and consume (Spiliopoulou 2000, Ivory 2005).

3.2.3.2 Review of usability

'After use' could also consider a *review* of the websites previously used for usability assessment, looking at the websites' usability in retrospect, and whether the user found what they were looking for. 'After use' would consider whether the user was able to access what they wanted, when they needed it (Bauer and Scharl 2000, Brajnik 2000, Olsina et al. 1999, Spool 1999).

3.2.3.3 Website sales

Several websites which aim to sell products from their websites, ecommerce based websites, could measure the effectiveness of their website by looking at the amount of traffic and sales that they have had through the website (Schubert and Selz 2001). Whether it has been successful in meeting their targets for *website sales* could be a way of looking at its effectiveness 'after use' (Spool 1999). Much like sales, educational value added by the website maybe considered 'after use', for example the user accessing educational tools to be used in their design work may help to indicate the impact the websites effectiveness.

3.2.3.4 Direct and indirect influence

Direct and indirect influence were both mentioned within the literature as being important areas of website effectiveness but neither area was developed. The authors' own personal experience of using websites enabled an insight into this area of website effectiveness (Simmons and Badni 2007). The following outline of direct and indirect influence was then reported in a 'review of the literature concerning

website effectiveness: before, during and after use' in the E-learning in Science and Design and Technology: Proceedings of IDATER 2007 online conference.

Direct and *indirect influence* could be considered as part of website effectiveness after using the website (Simmons and Badni 2007). *Direct influence* is clearer to define as these decisions are easier to track or correlate. An example of direct use would be finding materials property information and then that information appearing in a folio and the material being used in the final product design, another example could be the use of a tool downloaded from a website to help in their project. *Indirect influence* is much more difficult to define as this is often not documented, but just had an influence on how the practitioner acts. It could also be influencing the practitioner on what they do not use, for example if the information on materials properties were not suitable for the design, the material would be ruled out and therefore not seen in the final product or outcome.

Signs of website use within design decision-making, lifestyle choices or consumption could indicate that a website has been effective in conveying information. The success of this implementation of information gathered on the website maybe considered as 'after use'. This may include a review of the statistics generated whilst the website is being accessed. A reflection of success could also relate to website sales and a users education. Is an action needed to demonstrate a success; is effectiveness more related to an understanding of the issues? If the website has conveyed information then that is one measure of success. This issue would hinge on whether that was the aim of the website. If money had been invested with an aim to change people's perceptions then the investment may be deemed a failure. With an issue such as sustainable development, the issue of success becomes more significant if schemes are reliant on the website as a tool to motivate change. For the sustainable design schemes included in this study they aim to educate and re-educate people and the onus would then be on the user to act.

3.3 Website effectiveness chapter conclusions

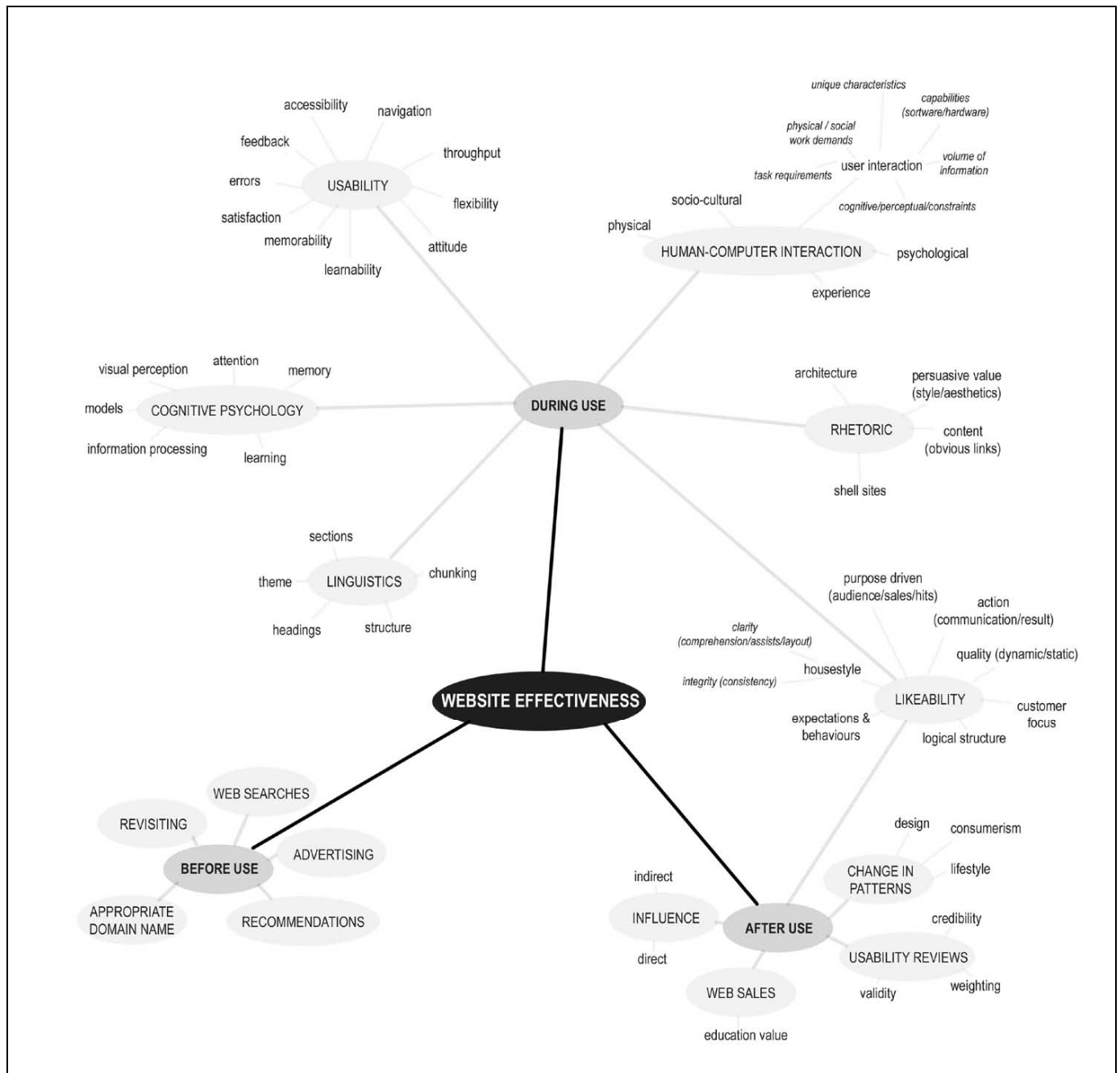


Figure 3-2: A diagram of the issues relating to website effectiveness

The literature has illustrated that the word 'effectiveness' encompasses a broad array of detailed areas. The three phases in which effectiveness could be judged in this study emerged as 'before', 'during' and 'after' use, shown in Figure 3-2. The figure shows the various aspects of website effectiveness research which has been previously identified. This chapter has also identified methods of task analysis that have been used by researchers to investigate aspects of website effectiveness.

Table 3-2 highlights the phases of use and the specific authors in the literature review that address a particular area. Under each of these phases the topics are split into distinct 'effectiveness' sub-headings. 'Before use' for example can be broken down into five: revisits to a website, recommendations to the website, advertising to attract you to the website, website searches and appropriateness of the domain name. Under each of the categories references have been cited to different authors. The authors were identified by keyword searches and cited references from conference papers found online. The initial literature review took place to help shape the direction of the study, this was updated to cover current literature after the study was completed. The updated literature is indicated by *italics*.

BEFORE WEBSITE USE					
Revisiting	Recommendations	Advertising	Searches	Domain name	
	Rathswohl 2002 Boyd and Ellison 2007	Dahlén et al. 2003 McMillan et al. 2007	Bauer and Scharl 2000 Spink and Jansen 2004		
DURING WEBSITE USE					
Cognitive psychology	HCI	Usability	Linguistics	Rhetoric	Likeability
Day 1997 Durham 1999 Grudin 1992 Mayhew 1999 Preece 1993 Spool 1999 Rosen and Purinton 2004	Durham 1999 Grudin 1992 Katerattanakul and Siau 1999 Mayhew 1999 Preece 1993 Spool 1999 Wu 1999 Ivory 2005 Petre 2006 Yang 2009	Bauer and Scharl 2000 Brajnik 2000 Dumas and Redish 1993 Durham 1999 Grudin 1992 Katerattanakul and Siau 1999 Nielsen 1993 Olsina et al. 1999 Preece 1993 Spiliopoulou 2000 Spool 1999 Nantel and Glaser 2008 Nielsen 2006	Bauer and Scharl 2000 Durham 1999	Bauer and Scharl 2000 Durham 1999 Olsina et al. 1999	Day 1997 Yang 2009
AFTER WEBSITE USE					
Patterns	Usability reviews	Web sales	Influence	Likeability	
Spiliopoulou 2000 Ivory 2005	Bauer and Scharl 2000 Brajnik 2000 Olsina et al. 1999 Spool 1999 Nielsen 2006	Schubert and Selz 2001 Spool 1999		Day 1997 Yang 2009	

Table 3-2: Classification of literature found in relation to website effectiveness

The literature found has been outlined in Table 3-2. The table illustrates a need for greater investigation into some aspects of website effectiveness. This will be referred

to in the design of the main study and the methodology used in helping to answer the research questions posed.

Table 3-2 helps to show the amount of literature on each subject under each of the subheadings, for example the table shows a lot of literature on the 'during use' phase, more specifically usability. Table 3-2 is particularly useful in indicating areas of research and for illustrating gaps in the research. These gaps are highlighted with shading. The table shows that there is little literature into 'before use' areas; revisiting and the domain names of websites. This study does not focus on these areas. This study focuses on whether students use websites and what they are looking at, and the impact they have rather than how they use a website a second time. Domain names were not focused on as the study involved websites currently available that already have domain names, and teachers would normally supply these recommended websites to the students.

It could be assumed that most research into website effectiveness focuses on when the user has actually reached the website rather than focusing on issues of finding the website. It also shows that 'after use' there is little information on the influence or impact of these websites. This would further support the notion that website effectiveness is rarely assessed in terms of having some impact or outcome. It is this area that is integral to a website's success and could be used to justify money being spent on websites such as those developed by Sustainable Design Award (SDA) (Capewell 2004), Sustainable Technology Education Project (STEP) (Capewell 2003) and Design for the Environmental Multimedia Implementation (DEMI) (Fletcher and Dewberry 2002).

This study could have also considered how students from various age groups interact with websites and how they revisit websites or not. To make the study feasible in the timescale just AS/A2 student website effectiveness within design activity was focused on.

It is apparent that a greater knowledge of how such websites influence users is needed to determine the success of websites and the worth of the investment into them. With a topic such as sustainable development, awareness of the issues and access to information is essential to make progress.

Most of the literature looks at usability analysis, which although informative does not give a rounded picture of effectiveness. The methodology will look to include the identified areas of website effectiveness: 'before use', 'during use' and 'after use'.

The literature review reveals little literature 'before use'. Gaps were also present in the literature about 'after use', case studies and folio assessment looking at instances of website use in AS/A2 design folio work would help to see how websites influenced the student users. The methodology for 'after use' involved both folio tracking and semi structured interviews with the students talking through their folios in order to show evidence of key events.

Much of the literature focuses on the websites in use, usability questionnaires will be used to help categorise the websites and to assess the usability of the SDA website. The Sustainable Design Award website will be developed to reflect the literature found in Chapter 3 on best practice. Usability is a key part of establishing a new SDA website that was fit for purpose as a research tool and that also reflected current understanding of good practice in website design.

CHAPTER 4 LITERATURE REVIEW: SUSTAINABLE DEVELOPMENT

This section reports key literature concerning the understood consensus of approaches to sustainable development as recommended by experts. It also looks at the integration of sustainable development into design, and the main internal and external drivers behind this integration. As a key and emerging area of designing, the exploration of sustainable development within this chapter gives an overview for the topic that will be used within the research studies.



4.1 Establishing a consensus position concerning sustainable development

This chapter reflected the current understanding of sustainable development. It also served to enhance the knowledge of the practitioner on the subject used in the study. The knowledge gained helped: inform the development the SDA website in relating to the stakeholders; to classify the sustainable design websites; and consider best practice in the discussion.

4.1.1 The Brundtland report

The Brundtland report 'Our Common Future' is referenced in much of the literature surrounding this area, and is often used as a foundation on which issues around sustainable development can be based. The report (Brundtland 1987) called for a strategy to combine environmental, economic and social issues with development. The term 'Sustainable Development' was coined. It would seem appropriate therefore, to start this chapter with the definition in the Brundtland report formed by the World Commission on the Environment and Development.

‘...sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs’
(Brundtland 1987: 24)

In other words, the 1987 Brundtland report presented an idea of ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ (ibid:24). These principles have guided people’s understanding of sustainable development, placing a focus on policies, designs and services in the short and long term.

4.1.1.1 The North and South

The terms North and South are used by the Brundtland Report as a way of distinguishing between developed and developing world countries. The report concludes that many of the problems faced are due to extreme poverty in the South and unsustainable measures relating to production and consumption in the North. The report can be viewed differently depending on personal standings. Spangenberg (2001) argues that the North see the report as a new environmental concept while the South regard it as a commission to alleviate poverty and economic development. Brundtland aimed to focus on updating the strategy to address the environmental dimension of systems and interdependencies of both North and South (Brundtland 1987).

4.1.1.2 Short and long-term aims of the Brundtland report

The report goes further to highlight a shared responsibility which takes into account inequalities of power and influence.

‘Sustainable Development requires meeting the basic needs of all and extending the opportunity to all to fulfil their aspirations for a better life.’
(Brundtland 1987:24)

Figure 4-1 illustrates the Spangenberg (2001) interpretation of the Brundtland Report’s main goals of sustainable development (Brundtland 1987). It shows the

objective to distribute wealth between short term aims, today, and long term aims, tomorrow.

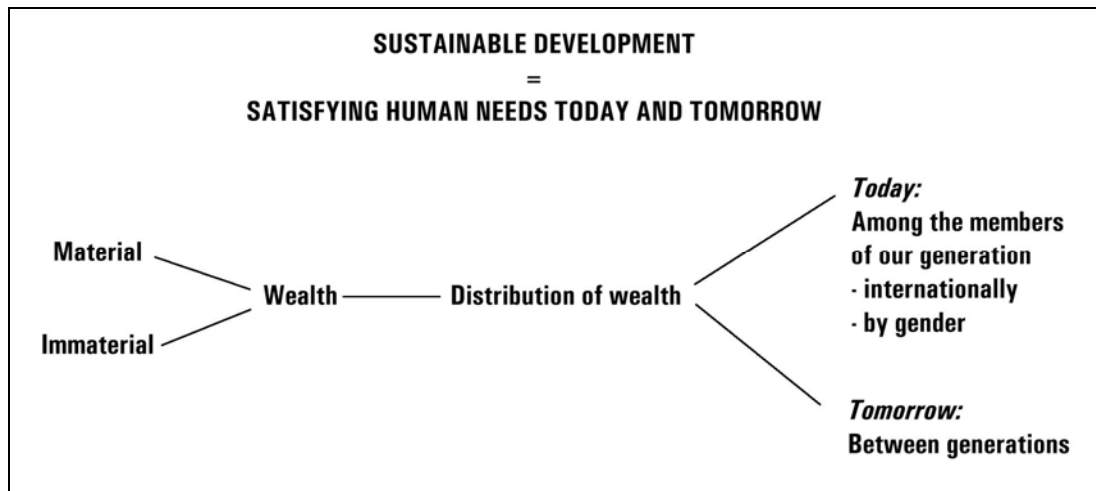


Figure 4-1: Spangenberg's interpretation of the sustainable development goal
(Spangenberg 2001:27)

Improving the lifestyles of people in the short and long term is seen as the 'driving idea behind sustainable development' (Capewell et al. 2003:21). The concept itself is a fairly simple one but the implementation is much more complex. Organisations such as Practical Action have pushed this ideal by promoting what they see as the three dimensions to sustainable development: environmental, social and economic considerations. To this end, a further sustainable development definition, based around Brundtland, has been developed that incorporates this:

'... ensuring a better quality of life for everyone, now and in the future. It involves the bringing together of social, environmental and economic issues into one over-arching objective.' (Capewell et al. 2002:2)

The concept of sustainable development was not novel, but a combination of social injustice and environmental degradation had pushed the issue to the fore (Capewell et al. 2002). These problems led to a realisation that to tackle the bigger problem of sustainable development other areas surrounding social, ethical and economic issues must be addressed.

'It is generally agreed that we need to move towards Sustainable Development, but that to do so will require a massive social, ethical, economic and environmental shift in the way we currently live.'

(Lofthouse 2001a:7)'

4.1.1.3 Progression from the Brundtland debate

The recommendations for progress from the Brundtland report (Brundtland 1989) are generally agreed upon. Some authors (e.g. Jacobs 1991, Gower 1992, Williamson et al. 2002) have suggested that we should be addressing short-term immediate matters, such as poverty, rather than longer term aims. Jacobs (1991) and Gower (1992) feel the Brundtland report fails to address the burning issues and falls short, raising some interesting arguments about whether the report is as comprehensive as initially assumed.

Without doubt, the overall aim of helping these 'future generations' is worthy but is the method? Are there not more pressing matters that need dealing with first such as poverty or illness?

Although Jacobs (1991) agrees in principle with the Brundtland report's definitions, Jacobs notes that it fails to place a timescale, or indeed time limit, on sustainable development. How far into the future should we be looking to support, especially with a far from solid foundation to build on. Jacobs suggests that a system that would look after ourselves alongside the immediate next generation, would secure the future of every subsequent one (Jacobs 1991) arguing that there is no need for a longer term plan.

Gower (1992) is in favour of prioritising our objectives but warns that as we gain more power our control will be far reaching into the future. There is a need to improve the quality of life for future generations, and this should be a priority. Morally, this stance is agreed upon (Williamson et al. 2002), however we cannot be certain of the needs of distant future generations, and that 'jumping the gun' may not be the best method.

4.1.2 Environmental ethics

It is not just the overall ideals of Brundtland that have come in for criticism, the specific areas seem a lot more complex than Brundtland would imply, for example the question of environmental ethics.

It is argued (Spash 1993, Sylvan and Bennett 1994, Light and Rolston 2003) that current environmental considerations are based around profit and successful business, suggesting that Brundtland is wrong to decide on the moral debate of 'ecocentrism' and 'anthropocentrism' on behalf of the people. Brundtland leans towards preserving humanity but not at the expense of an ecological community. This contrasts to the view that the people are in some way the authority over nature, and hold no responsibility for individual actions and their consequences.

In the United Kingdom, it could be argued that ultimately a democratically elected government is in place to represent the people. World Commissions, including Brundtland, should make these decisions on behalf of the people, and for the good of the world in which we live. The Brundtland Report appears to favour ecocentrism the idea of looking after the world for our future children rather than inheriting the world from our elders (Wilkinson 1999).

4.1.3 Intergenerational equity

Intergenerational equity is another area and cause for debate. Light and Rolston (2003) describe intergenerational equity as concerning four areas: equal rights, responsibility, vital interests and, mutual advantage. Not all agree that we should be sharing resources with the past, present and future. There is an idea that we have a responsibility to hand over the planet improved, or at least in the same condition as when we found it. Williamson (2002) argues that we have no responsibility to deliver those ideals. We are bringing the future generations into the world therefore we should determine how we live our lives.

Another stance is that each generation should treat the next generation as it would wish to be treated (Jacobs 1991). Above all Jacobs argues that the issue of intergenerational equity needs addressing as this could well obstruct the progress of any proposals put forward.

In the immediate years after the Brundtland Report, it was heavily criticised by both Court (1990) and Jacobs (1991) who suggested that it failed to address key issues, for example poverty as a major cause of environmental damage but did not relate this to intergenerational equity. It is argued (Court 1990) that a failure to truly embrace sustainable development keeps the rich getting richer and the poor getting poorer. However it is important to keep this in context, recent years have seen a distinct upturn in both internal government activity and also in the United Nation's input. It is easy to criticise reports on their own but their effects are not instant and that must be remembered.

The G8 summit in Scotland in 2005 saw the major governments pledging money to help address the problem of poverty in developing countries. Most recently in 2008, the world leaders and their energy ministers established the International Partnership for Energy Efficiency Cooperation (IPEEC). The IPEEC outlined a focus on global co-operation in energy efficiency which aims to address energy security, climate change and economic growth. It could be argued that without the Brundtland Report this would not have been achieved.

4.1.4 International and UK government policies

The idea of sustainable development was taken a step further when 108 world leaders met at the United Nations Earth Summit in Rio de Janeiro in 1992. The world leaders agreed on three major target areas: Agenda 21, the Rio Declaration on Environment and Development, and the Statement of Forest Principles (Zwetsloot and Bos 1998:4). Agenda 21 is a comprehensive programme that called for action in all areas of sustainable development.

The management of sustainable development in business requires a global understanding of detrimental effects of current actions, and also policies that minimised these effects. Sometimes sustainable development issues were overlooked, as companies are often governed by regulations that address health and safety, and the environment, and not sustainable development as a whole (Zwetsloot and Bos 1998).

In response to Agenda 21, the UK government issued a national and regional focus. They identified four key objectives that portrayed their understanding of sustainable

development and what it means on a practical level (Williamson 2002). These objectives related to issues of an environmental, social and economic nature.

The four objectives (UK Government 1999) included are:

- social progress which recognises the needs of everyone;
- effective protection of the environment;
- prudent use of natural resources;
- maintenance of high and stable levels of economic growth and employment.

These objectives are ideals. In 1999, Kofi Annan urged companies to apply principles that recognised human rights, good standards for labour and also environmental protection. This step towards sustainable development has been most effective at a company level when regional and national policies have been in line (Annan 1999).

In 2005, the UK Government issued a new sustainable development strategy. It stated a hope to deliver new products and services with lower environmental impacts throughout their life-cycles. Through better education and rewards, the UK Government hoped to implement a new 'changing patterns' policy. It focused on the whole life-cycle of goods and services and materials, and included social and economic impacts, and those made outside of the United Kingdom. The three areas (UK Government 2005) that they wished to address are:

- better products and services (reduction in environmental impacts from use of energy, resources and hazardous substances);
- cleaner and more efficient production processes;
- shifting consumption to have a lower impact.

They hoped to integrate an environmental policy into trade and industry that would take a leading role in European Union (EU) action plans. It would build a market for new products and services, and identify emerging trends and indicators.

4.1.5 Sustainable development models

Sustainable development considers a vast array of issues which several authors have attempted to summarise through models of sustainable development. These models are reported in this section.

4.1.5.1 The dimensions: environment - society - economy

Spangenberg discussed the need to maintain functioning systems whilst avoiding irreversible damages and leaving choices to future generations. As Spangenberg (2001) reported the United Nations Commission on Sustainable Development (UNCSD) states that sustainable development can be viewed in the four dimensions shown in Figure 4-2; environmental, social, institutional and economic. Other commentators on the subject referred to three dimensions: environmental, economic and social.

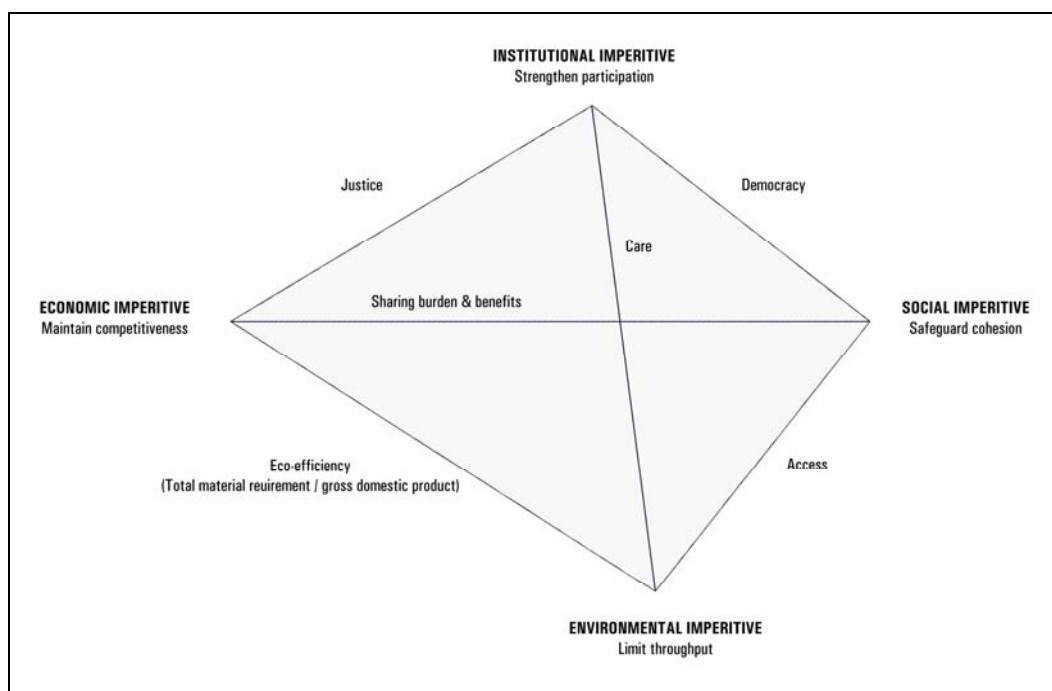


Figure 4-2: Spangenberg's model of sustainable development
(Spangenberg 2001:31)

Spangenberg proposed a fourth, often overlooked dimension, institutions. Spangenberg felt institutions were important in order to integrate sustainable development principles into political groups, the legal system, and traditional practices. Institutions relate to all of the other three and would seem more of a method of applying the other dimensions than an entity itself, as Spangenberg (2001) suggests. More often than not it is regulations from the institutions that act as a driver for change in these dimensions.

The environmental dimension largely relates to preserving ecological systems as 'the natural base sustaining human civilisation' (Spangenberg 2001:30). Environmental

issues are often addressed singularly and perhaps only within obvious products and services that have natural resources at the core. 'Remarkable' for example, produce stationary from recycled materials such as car tyres or plastic cups, and their company ethos could be perceived as addressing the environmental dimension.

The social dimension addresses the area of human development and the need to improve health, skills and working conditions. The overall objective is to strive for an absence of poverty and working against discrimination, whilst making these improvements.

The economic dimension relates to efficiency through maximising profit from the products and services. It serves to meet the needs of the customer and maintains a commitment to creating/providing enough jobs.

Some authors (e.g. Light and Rolston 2003, Sylvan and Bennett 1994) imply an equal sharing of each entity: society, environment, and economy, but this is often far from reality. It is important to remember that there is no standard model for this. Although these areas are seemingly largely agreed upon within the literature, the focus is now turning to how much weighting should be put on each dimension. Balancing the importance of one area over another may have a direct influence on the outcome of a product or service (Rodgers 2002).

Sustainable development is a multifaceted concept with a range of stakeholders. The argument over intergenerational equity (4.1.3) being an example of this. A person's own values or knowledge are likely to determine the area of concentration on which the sustainable emphasis may be placed.

4.1.5.2 The five capitals model

Forum for the Future are a respected sustainable development charity in the United Kingdom. They aim to promote sustainability and educate people about more sustainable ways of living. Forum for the Future believe (Bland 2005) that the main drivers behind sustainable development are the adverse effects of extremes. These extremes relate to wider issues such as shortages of food and water, global temperatures rising and the material consumption rate increasing. They act as the

main drivers behind national and local policy change, and championing sustainability issues.

‘Sustainable development is a dynamic process which enables all people to realise their potential and improve their quality of life in ways which simultaneously protect and enhance the earth’s life support systems.’

(Bland 2005:para.2)

Forum for the Future also support what they call the ‘triple-bottom line’ of environmental, social, and economic responsibility. All three areas relate to sustainable development issues within design practice. Practical Action also champion these issues. Social responsibility includes issues surrounding quality of life and human rights (Light and Rolston 2003). Environmental responsibility emphasises the need to ensure that actions or lifestyles do not have a negative impact on the planet. Economic responsibility looks to promote designs that are beneficial to the region from which the product came or was marketed (Capewell et al. 2007).

Forum for the Future also publish a five capitals structure for business and believe that the best way of managing capital assets in the long term is through sustainable development (Bland 2005):

- natural capital - addresses energy and material use in goods & services (resources, waste and processes);
- human capital - health, knowledge, skills and motivation areas (relates to education and training);
- social capital - institutions that control the human capital (e.g. families, communities and business);
- manufactured capital - any material goods, fixed assets and the production process (tools, machines, buildings);
- financial capital - economy, owned and traded.

Forum for the Future applied ‘The Natural Step’ framework that helped to integrate these capitals into companies such as BP, Carillon Construction and Sainsburys. This was achieved through training, consultancy, research and development to undertake sustainable development methods (Bland 2005).

4.1.5.3 The twelve features model

The twelve features model gives a more detailed overview of sustainable development and formed a suitable framework for the evaluation of the sustainable design websites in this PhD research study.

The twelve features model was developed through an Economic and Social Research Council (ESRC) funded project at Keele University. It engaged over 60 academics and practitioners who aimed to produce an outline of a sustainable society. Since 2000 it has been adopted by Forum for the Future for the Higher Education Partnership (HEPS) project. The twelve features of a sustainable society model is a useful tool in providing a comprehensive basis for considering the areas of sustainability. It goes into more detail than models that cover just the headings of social, environmental and economic issues generally. The model in Figure 4-3 gives the twelve features of a sustainable society.

Twelve features model

- 1) In their extraction and use, substances taken from the earth do not exceed the environment's capacity to disperse, absorb, recycle or otherwise neutralise their harmful effects (to humans and/or the environment)
- 2) In their manufacture and use, artificial substances do not exceed the environment's capacity to disperse, absorb, recycle or otherwise neutralise their harmful effects (to humans and/or the environment)
- 3) The capacity of the environment to provide ecological system integrity, biological diversity and productivity is protected or enhanced
- 4) At all ages, individuals enjoy a high standard of health
- 5) Individuals are adept at relationships and social participation, and throughout life set and achieve high personal standards of their development and learning
- 6) There is access to varied and satisfying opportunities for work, personal creativity, and recreation
- 7) There are trusted and accessible systems of governance and justice
- 8) Communities and society at large share key positive values and a sense of purpose
- 9) The structures and institutions of society promote stewardship of natural resources and development of people
- 10) Homes, communities and society at large provide safe, supportive living and working environments
- 11) All infrastructure, technologies and processes make minimum use of natural resources and maximum use of human innovation and skills
- 12) Financial capital accurately represents the value of natural, human, social and manufactured capital

Figure 4-3: The twelve features of sustainable society model
(Johnston 2007: 20-21)

4.1.6 Sustainable development summary

On the whole, Brundtland's assessment that sustainable development needs addressing for both current and future generations is generally agreed upon. When development is linked to sustainable development it suggests that 'advancements be achieved in ways which are consistent with continuous improvement' (Walker 1998:8). This would be hard to argue against.

It has also been established that the meaning of sustainable development has been amplified since the Brundtland definition. Sustainable development comprises of three main focus areas; economic, environment and social aspects (institutional integration appears applicable across all three). All three areas need attention if the goal of sustainable development is to be achieved. The issues now revolve around how much weighting to give each area, and there is no correct balance or timescale. It is fresh thinking and inspirational outcomes that should set a new agenda for sustainable development (Walker 1998).

4.2 Development of sustainable design

This section reports how sustainable development relates to design, referring to both sustainable design and eco-design. For the purposes of this study sustainable design refers to environmental, economic and social issues, eco-design just concerns one aspect of that, environmental.

4.2.1 Sustainable design

Sustainable design is the integration of environmental, social and economic considerations into design decisions. The aim is to give these areas the same amount of attention as the more traditional design values such as aesthetics, ergonomics and functionality (Brezet and van Hemel 1997).

Sustainable design has derived from the realisation that some products have had a negative impact on the environment. It is 'widely recognised that a more fundamental, systematic shift in our approaches to product design, manufacturing and our material expectations will be required if sustainability is to be fully embraced' (Walker 1998:7).

'A key challenge is how to infuse sustainability issues at the front of the new product development process where ideas and concepts are generated and the issues are often poorly understood.' (Charter et al 1997a:5)

Although most texts agree with the notion of sustainable design, the challenge of how to integrate these issues and which to focus on is still disputed.

'...sustainability work entails an inseparable and crucial political dynamic which requires discussion, debate and mediation between competing stakeholder groups, ultimately requiring compromise on goals and values...' (Elshof 2008:141)

4.2.2 Eco-design

Eco-design is a term often used in sustainable development discussions. It relates specifically to the environmental part of sustainable design.

‘Eco-design means that ‘the environment’ helps to define the direction of design decisions.’ (Brezet and van Hemel 1997:37)

It is commonly used as a way of explaining design practice that takes into account environmental issues. Brezet and van Hemel (1997) use the term *eco-design* when they outline internal and external drivers. Although they focus on environmental issues, the internal and external drivers are applicable to the other recognised areas of sustainable design such as economic and social issues.

4.2.2.1 Eco-design internal drivers

Brezet and van Hemel (1997) outline some of the internal drivers behind integration of eco-design principles that are conversant with the principles of sustainable development (Figure 4-4). These drivers vary from decisions of conscience to the demands of business. These factors will ultimately determine the extent businesses implant more environmental methods. It will also determine the amount of time and focus placed on eco-design generally in comparison to other key factors such as aesthetics or ergonomics.

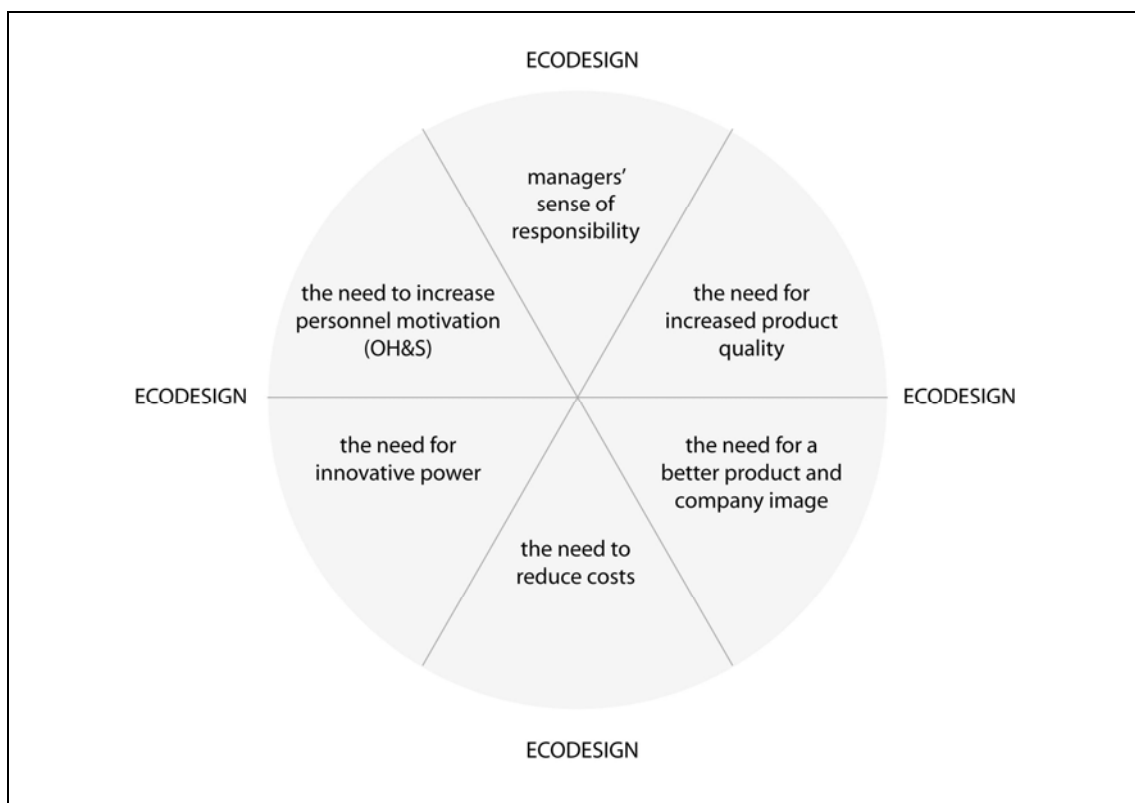


Figure 4-4: Internal drivers for eco-design – adapted diagram (Brezet and van Hemel 1997:79)

Business-led drivers are factors like reducing costs, increasing innovative power within the industry and improving the company or product image. Conscientious designers can make decisions that increase the quality of a product. These decisions based on personal values can act to influence a 'more sustainable product'. There are also other external factors that play an important role in influencing this (Brezet and van Hemel 1997).

4.2.2.2 Eco-design external drivers

External drivers have been outlined by Brezet and Hemel (Figure 4-5), many of these overlap with the internal drivers already presented. Market demands play an important role in the success of a product. Some designers consider this demand and analyse whether there is an actual need for the product in the first place. A more suitable eco-design solution may be a system rather than a product, or perhaps there is no need for the product at all (Coles 2006, Brezet and van Hemel 1997).

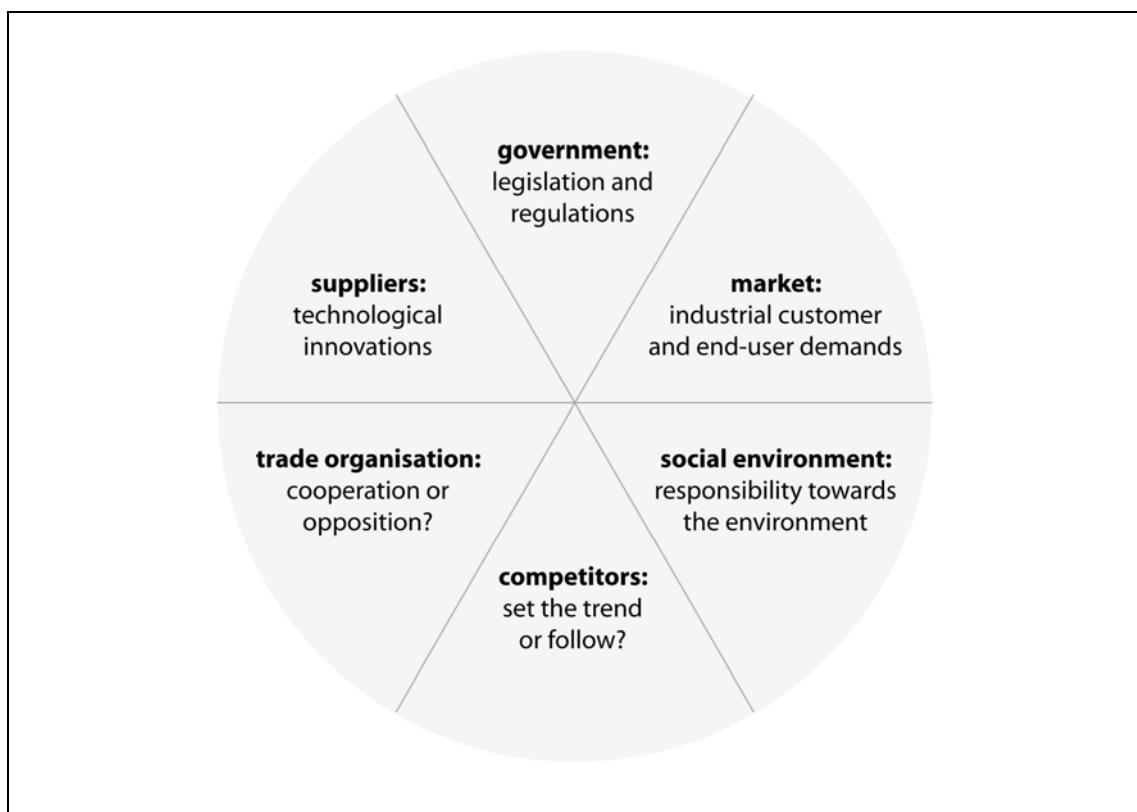


Figure 4-5: External drivers for eco-design - adapted diagram (Brezet and van Hemel 1997:80)

The other main external drivers relate to legislation and regulation, both compulsory and advisory. It could be argued that this has been one of the main drivers behind a move towards more sustainable resolutions.

4.2.3 Cyclic, solar and safe

Edwin Datschefski promotes the biothinking ideal of cyclic, solar and safe policies (Datschefski 1999:42).

- Cyclic: requires no use of landfill at all with only closed loop products promoted i.e. recycling, compostable or edible;
- solar: covers products that are powered by themselves i.e. muscle power, solar-panels, wind energy, and other renewable energy sources;
- safe: are products that are efficient and don't produce unnecessary waste in production or use i.e. not release toxic gases.

It is believed (Datschefski 1999) that these steps would lead to a much improved environmental performance in designing towards a sustainable future as discussed in the previous section.

4.2.4 Drivers for implementing environmental methods into businesses

Martin Charter (1997a) outlines the following drivers behind why business should focus on environmental performance of products:

- customers;
- environmental regulations;
- product stewardship;
- risk management;
- sustainable development;
- eco-labelling;
- voluntary standards such as ISO 14001;
- shift to cleaner technologies;
- competitive advantage;
- increased profitability.

Access to current standards and regulations such as ISO 14001 and WEEE is essential. It is also important that the background and reasoning behind the

legislation is understood (van Nes and Cramer 2006) with regards to eliminating toxic materials, increasing recyclability, increased ability to dismantle.

The financial arguments are still largely unclear and these can often lead to a lack of commitment. Initially, sustainable design largely concentrated on environmental and financial aspects but has since started to develop social and ethical agendas further.

4.2.4.1 Legislation

Since the 1970s, legislation on environmental matters has become more demanding, influenced by civil rights and peace movements, combined with environmental pressures from organisations such as Greenpeace. Most of the legislation aims to place responsibility on the producer in order to hold people accountable for their actions. In turn, pressure and responsibility is increased, with the onus being on designers, businesses and manufacturers to improve their own practices (van Nes and Cramer 2006). Legislation has become an important and effective method of progressing sustainable development.

In 1990, the Environmental Protection Act implemented a push towards responsible waste management. It holds anyone accountable who: produces, imports, carries, treats or disposes of wastes in any scenario. In 1996, the Landfill Tax Regulations and Finance Act placed a charge of £15 per tonne of waste in tax. That figure has changed to two rates:

- £2.50 per tonne for waste such as rocks and soil;
- £32 per tonne for 2008/09, increasing by £8 per tonne each year until 2010/11.

This is collected from companies in a bid to deter waste in landfill sites (UK Government 2007a).

In 1997, the Producer Responsibility Obligations Regulations were introduced. The UK Government opting to implement a European Commission Directive which placed responsibility onto producers and users of packaging (UK Government 2005a). The policy charges larger businesses that do not achieve the recovery and recycling packaging targets set out. These regulations were again reviewed and updated in 2005 (UK Government 2005a). For example, Nike have reduced their shoe box designs from over ten down to just two fully recyclable packages (Allaway 2006).

Waste Electronic and Electrical Equipment (WEEE) legislation focuses on products with a plug or battery and aims to improve disposal methods of these products. It addresses financing for disposal, banning the use of materials that cannot be disposed of, disassembly and recycling of products, and the encouragement to use recycled materials to help close the loop (Allaway 2006). The 2000 Directive was implemented from January 2008.

End of Vehicle Life is another area that is being addressed. EU directives are currently looking to address disassembly problems by placing a responsibility on the car manufacturer so that 95% of the car is recyclable. The emphasis on recycling would increase the output of recycled material such as steel and plastics that could be used in other products.

Since the United Nations Environment Programme's (UNEP) Global Environmental Outlook in 2000 (the first global environmental forum), UNEP have proved a catalyst behind cleaner production and sustainable consumption (Charter and Chick 2001).

UNEP placed an emphasis on minimising negative impacts whilst maximising positive impacts of products throughout and beyond their lifecycle. Thus making sustainable development less of a business problem and more of a technical one for the design world to address (Charter and Chick 2001).

The internal drivers (Figure 4-4) and external drivers (Figure 4-5) behind eco-design illustrate reasons why businesses should integrate eco-design throughout their design work. To feel real benefits, businesses should fully embrace eco-design practice throughout the process. In turn this means that designers have to embrace the concept wholeheartedly. In order to achieve this, integration strategies (Brezet and van Hemel 1997) have been established for; sustainable development, cleaner production, and the life cycle approach (the latter two can be seen as steps to achieving the first).

Cleaner production stemmed from the Rio Conference and has since been seen as an important step to achieving sustainable development (Brezet and van Hemel 1997). This involves the improvement of production processes to conserve raw materials and energy, eliminating toxic materials, and reduce the quantity and toxicity of all emissions and wastes. Manufacturing techniques, material extraction,

disassembly and disposal are all areas that emphasise cleaner production which the Rio Conference sought to improve (Brezet and van Hemel 1997).

4.2.4.2 The life-cycle approach

Often restricted to production, the life-cycle approach aims to tackle the issues throughout the product's lifetime. The emphasis is placed on prevention rather than cure, with sustainable development issues being addressed earlier. Van Nes and Cramer (2006) suggest that the life-cycle approach is underexposed, but an important area for companies to look at.

Lofthouse (2001a) has outlined five main benefits to businesses that implement sustainable design policies throughout product development:

- preparation for legislation rather than reacting to it;
- new business opportunities through innovative resolutions;
- cost savings due to the rethinking of business approaches;
- an edge on competition as the first to market products with significant sustainable improvements;
- portrayal of a responsible and caring image.

The main focus of sustainable design initially concerned the use of life-cycle analysis tools, whilst others focussed on disassembly, recycling and remanufacturing. Lofthouse (2001a) comments that the effective integration of sustainable design arrives when the process is at its most flexible in the early stages of design decisions. It is argued that sustainable design should be implemented at the same time that other specification issues are taken.

‘...early stages of the product development process (i.e. design) are recognised as being critical to the success of eco-design’ (Lofthouse 2001a:7)

Lofthouse (2001a) also concludes that the success of sustainable design is dependant on it being integrated into the process and not considered as a separate entity. Datschefski (1999) also agrees that sustainable design must take place throughout the product's lifecycle. Indicating that middle or end of pipe scenarios are steps forward, but to fully embrace sustainable development, people must apply these principles throughout the whole of design projects.

Cramer (1997) suggests that methods focussing on cleaner production at the end of pipe help a slow 'incremental environmental improvement' at operational level, but believes that more comprehensive measures are needed, supporting the effective integration of sustainable methods throughout product development.

'...more far-reaching innovative improvements of current production techniques are required' (Cramer 1997:7)

Figure 4-6 (Brezet and van Hemel 1997) gives an overview of various stages of implementation for sustainable design. The top of the ladder is where the companies should strive to be, most companies are situated more towards the middle of the ladder. Businesses that consider themselves to be at the bottom of the ladder should be striving to move towards the top part of the ladder. This indicates more integration of sustainable practices.

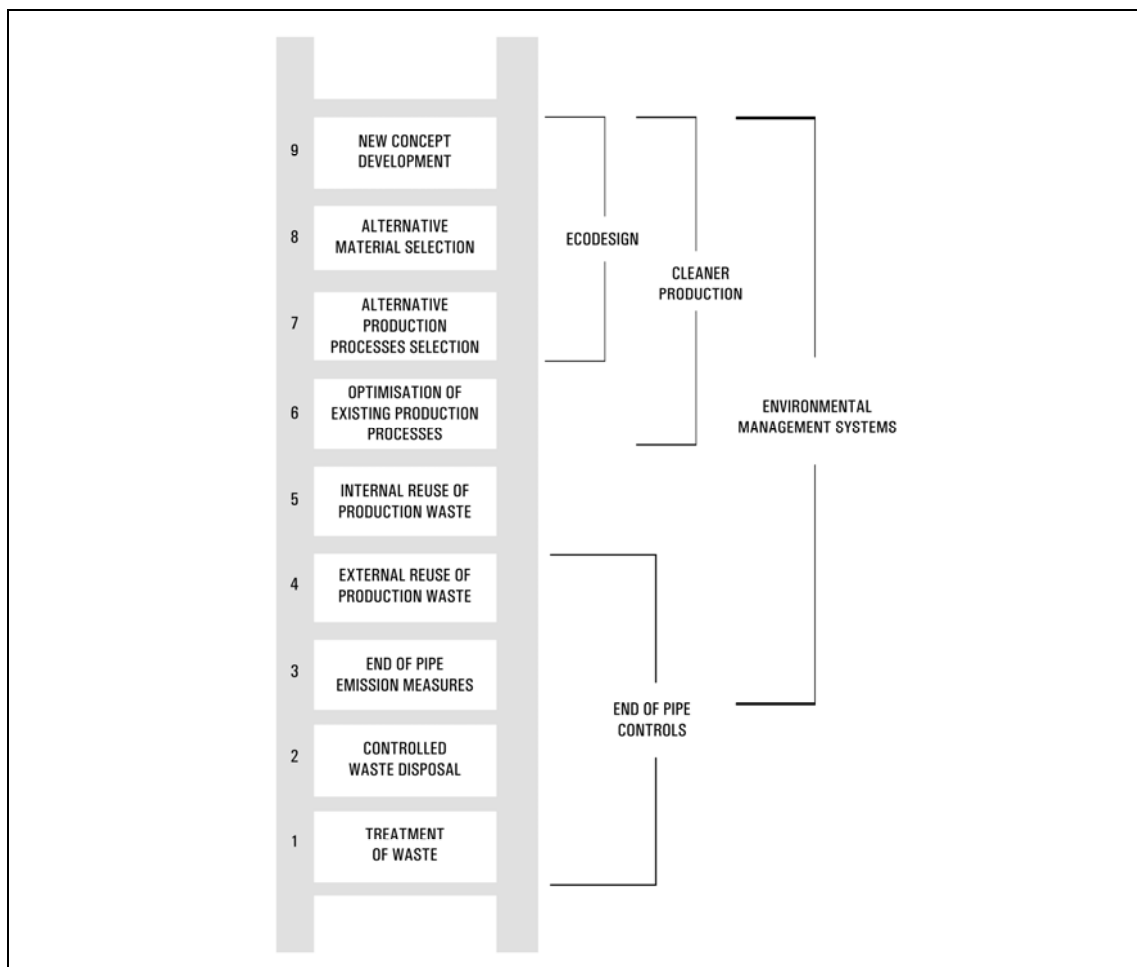


Figure 4-6: Environmental awareness in business 'the prevention ladder' (Brezet and van Hemel 1997:40)

Environmental Management Systems (EMS) are also shown on the ladder diagram (Figure 4-6). They aim to identify and deal with waste produced in all the departments of the company (Melnik et al. 2003). Guidelines such as ISO14001, largely apply end-of-life controls, internal and external reuse of materials, and improved alternative production methods. Melnik (2003:329) argues 'experience with these systems over time has a greater impact on the selection and use of environmental options'. Sometimes these EMS can produce few innovative solutions and only really serve to update a company on its progress (Datschewski 1999, Melnik et al. 2003). Eco-design is placed at the top end of this ladder with the treatment of waste at the bottom perhaps an indication of progress towards sustainable development, from evolution at steps 6-8 and aiming for revolution at the highest step, 9.

'An economic infrastructure needs to be created to collect and keep existing 'value' in 'the economic cycle' through upgrading, dismantling, remanufacturing, reconditioning, recycling and other strategies. Therefore it means managing both 'front of pipe' and 'end of pipe', and not either/or.' (Charter and Chick 1997:5)

To illustrate the need for creativity and innovation, to integrate eco-design at the concept development stage, Charter and Chick (1997) propose the four step model seen in Figure 4-7. The areas covered are rethink, redesign, refine and repair, with the focus very much centred on the first two. Rethink and redesign would indicate an overhaul of the whole product but one that focuses on the initial stages of the design when initial ideas are flowing (Bhamra and Evans 2002). Charter believes this integration has to be introduced project by project with legislation as its initial creditable driver (Charter and Chick 1997).

In 1997, most companies were situated at the repair phase (Charter and Chick 1997), dealing with products at their end of life. In recent years, slowly production methods and services are introducing new structures with cleaner, less impact, processes through sustainable design. The business world would seem to have developed since Charter's assessment to more of the middle ground, 'middle of pipe', by minimising waste and using cleaner production processes. Few companies are employing front of pipe techniques.

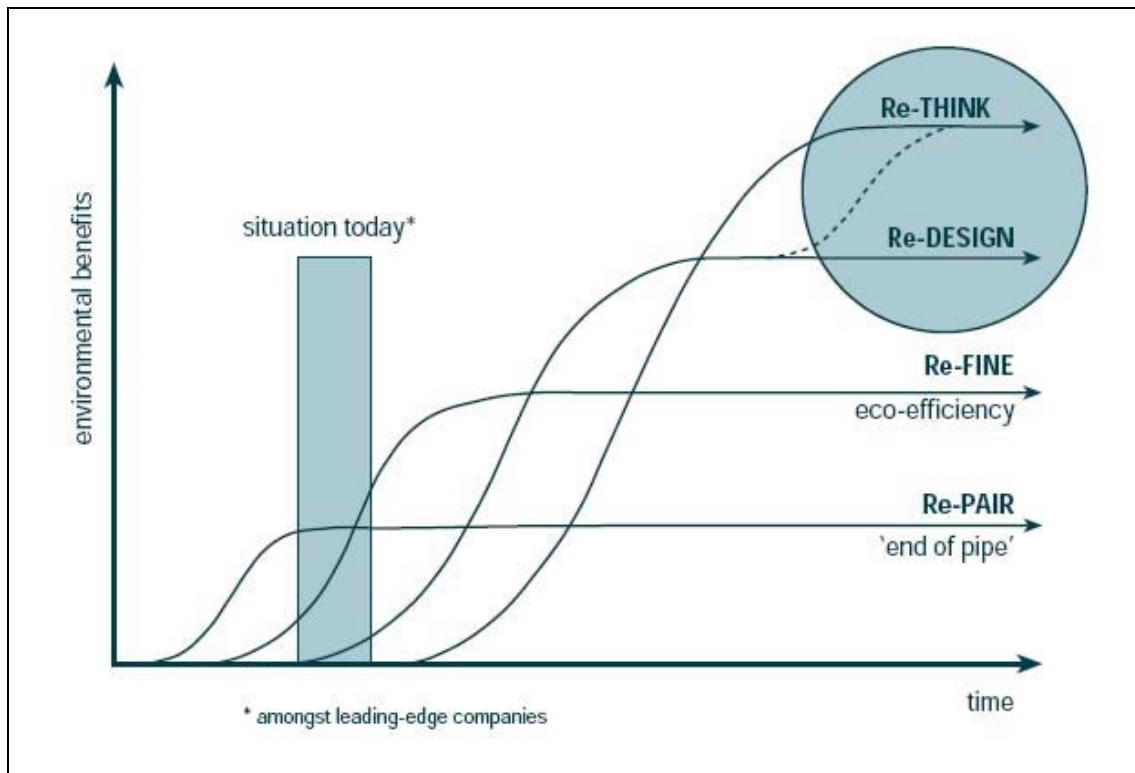


Figure 4-7: Four step model of eco-design innovation
(Charter and Chick 1997:4)

In order to move forward it is argued that the design world should incorporate a mixture of strategies (Bhamra and Evans 2002, Charter and Chick 1997). Local production and consumption coupled with a 'low-tec' solution. Information technology led dematerialisation as a 'high-tec' solution, and a 'more from less' attitude which has implications on working hours.

For sustainable design to be fully embraced, new concept development and revolution, not evolution, must take precedent. This is agreed with by Bhamra (2004:567) 'new strategies will need to be employed in design that creates outcomes that are environmentally acceptable, socially desirable and economically appropriate'. Bhamra (2004) recognises that the early stages of designing are important in implementing new strategies and that this may need to be an incremental innovative process. The focus for designers will ultimately remain on meeting consumer needs and improving products, innovative sustainable design could play a part in that.

‘An innovative approach is more likely to achieve sustainability targets but is little understood or practised’ (Bhamra 2004:567)

The drivers and business case for implementing new innovative methods is growing stronger as more and more examples of success stories emerge. Lifestyle choices are integral to design, with a need for sustainable products, businesses and designers will consider sustainable issues. The aim of achieving ‘profitable products which are both environmentally and socially responsible’ (Bhamra and Lofthouse 2007:39), has becoming a very real possibility for some companies who see the benefits of a sustainable reputation and innovative ethos.

4.2.5 Sustainable production, social and ethical issues

Understanding the benefits of sustainable design may help businesses to implement sustainable practice, and focus more on social and ethical issues. The business case for sustainable design is getting stronger. Many businesses have taken strides towards sustainable practice but have not yet implemented it during product development (Bhamra 2004).

The legislation (Charter and Chick 1997) states that the UK government aims to reduce unsustainable and environmentally damaging methods in agriculture, and promote trade liberalisation. The UK Government sees the development of sustainable products through better design as the crucial part of the integration of sustainable development.

Their product policy aims to achieve:

- a reduction of environmental impacts of everyday products (lifecycle);
- an enhancement of measures to close loops in resources (recycling, reuse, remanufacture);
- a promotion of radical design solutions (environment & economy benefit);
- knowledge and capacity for improvements.

Above all they aim to raise product standards to low impact solutions, promoting integrated eco-design. The UK government (1999) also issued their own aims of greater efficiency and value with less resource use, pollution and waste in production. Environmental legislation was also introduced, the objectives were to:

- promote energy efficiency: climate change agreements / emissions trading;
- encourage waste minimisation and recycling;
- prevent pollution and control waste;
- support the mainstreaming of sustainable production.

4.2.6 Global consumption

A global policy on consumption became a priority, because as Robins and Leeuw stated if seven billion people lived in the way of the West 'we would need 10 worlds to satisfy the needs' (Robins and de Leeuw 2001:48). The economic value of a product is important, if it is a rare item, the price increases. This value needs to be created in sustainability. Charter and Chick (1997) argue that people keep products that are broken as they seem to have value. Perhaps one solution therefore is to use parts of broken products rather than use new materials, and energy, time and time again.

According to authors like Charter (1997) and Walker (1998), a shift is needed towards products with a real value but reduced environmental impact. This shift needs to incorporate both individual and shared consumption e.g. car hire. Many people use cars to drive to work everyday and carry out the same journey as the person next to them. The emissions could be halved by car-sharing.

In 1999, an Oxford Commission on changing consumption patterns set a seven point agenda. It included minimising consumption requirements, developing eco-efficient goods and services, strengthening public action and the mechanisms internationally, building stronger alliances and institutional links. Sustainable consumption has two main issues:

- eco-efficiency - the same goods out of less materials;
- eco-sufficiency - the same welfare out of fewer goods and services.

The UK government issued a framework to address a growing need to consider consumption balanced against the quality of life (Robins and de Leeuw 2001). It also aimed to address a growing concern to improve the deeper sustainable development issues behind products. The focus of this framework relates to goods and services directly: meeting basic needs, improving the quality of life, raising efficiency and regenerating the environment. The framework also calls for: a reform of underlying

patterns, an enabling of long term social, economic and environmental benefits, an influence in purchase, use and disposal choices, and an identification of innovative political, cultural market approaches.

In order for these reforms to work, and less consumption to be achieved, key issues such as education, demand management and less choice all need to be addressed.

4.3 Sustainable development and its integration into design education

4.3.1 AS/A2 level Design and Technology

Approximately 3,300,000 pupils attend secondary education in England, with the subject Design & Technology (D&T) being compulsory until they have completed Key Stage 3 (Pitt and Lubben 2007:6). Pitt and Lubben found that around 55% of the pupils choose to continue D&T into Key Stage 4 choosing between: resistant materials, electronics, food technology, textiles, graphic products, and systems and control. The element of designing and making products is a common thread throughout these Key Stage 4 subject choices. At the end of Key Stage 4 students take examinations called GCSEs (General Certificate in Secondary Education). Once they have completed their GCSEs the pupils have an option to continue their studies for a further two years. These two years are called Advanced (A) levels. The first year is known as Advanced Supplementary (AS) and the second year A2. Of the 214,000 who were studying A levels in England in 2005, 17,900 (8.4%) did D&T. 23,700 pupils took AS level that same year (Pitt and Lubben 2007:7).

The A level course comprises of 6 modules, 3 in AS and 3 in A2, which include design and make projects (Lewis 2001). The Qualifications and Curriculum Authority (QCA) are the UK government examination regulator. The QCA regulates four Awarding Bodies: the Assessment and Qualifications Alliance (AQA), Edexcel, the Welsh Joint Education Committee (WJEC) and the Oxford Cambridge and RSA Examinations (OCR). Each school can choose which Awarding Body specification they would like to follow. Figure 4-8 illustrates the outline structure set out by each Awarding Body showing which Design and Technology courses they offer.

Examination Board	Edexcel	AOA	OCR	WJEC
D&T Courses Offered	DT: Food Tech. DT: Product Des - Res. Mat Tech - Graphics with Mats - Textiles Tech. DT: Systems & Control Tech	DT: Food Tech. DT: Product Des - Textiles Tech. - 3 D* DT: Systems & Control Tech	DT: Product Des DT: Systems & Control Tech	DT: Product Des DT: Systems & Control Tech DT: Food Tech
Unit 1	Industrial & Commercial Practices 11/2hr paper. (E A) 30%	Materials Paper 11/2hr paper (E A) 30%	System Case study – 20 hrs. Investigate a system set by OCR – examples given. Students choose specific context. (E A) 30%	Written Paper – 21/2 hrs Designing and innovation. Product analysis, materials and components. Industrial and commercial practices. (E A) 30%
Unit 2	Product Dev (IA) 40%	Project Coursework. Approx 50hr. Either Project/s (IA) 40%	Product Study - analysis and development. 50% product analysis and 50% testing for modification. (IA) 40%	Design and Make task – one product (25hrs) plus folder (15hrs) (IA) 40%
Unit 3	Materials components and systems 11/2hr paper (E A) 30%	Design Paper (2Hrs). Theme sent to centres. Students not allowed to use research in exam. (E A) 30%	Written Examination (E A) 30%	Case Study – 5-10 day work placement – (E A) 30%
A2 Assessment Units (50% overall)				
Unit 4	Further study of Materials, Comps and systems. 11/2 hr paper. (E A) 30%	Product Study. Approx 25hr In-depth study of designing and making product. Can combine with work experience. (IA) 30%	Designing – 40hrs. Topic selected by candidate. (IA) 30%	Written paper (3hr) themes human responsibility, processes, public interaction, production systems and control. (E A) 40%
Unit 5	Product Development Coursework (IA) 40%	Project. 50hr. Using any materials. Assessed by D&M criteria (same as for AS level – but top band only for A2) Exemplar tasks. (IA) 30%	Making and Evaluating – 40hrs (IA) 30%	
Unit 6	Design and Technology Capability. 3hr Exam. (E A) 30%	Examination Paper (3 hrs). 3 sections, Materials classification, Design and market influences, processes and manufacture. (E A) 40%	Written Examination – 21/2hrs 5 Design problems. (E A) 40%	

Figure 4-8: Outline structures of Design & Technology AS/A2 level for Awarding Bodies (Hellier 2004)

Figure 4-8 shows the outline structures for the AS/A2 level Design and Technology programmes offered by the Awarding Bodies. Sustainable design is applicable to the majority of coursework projects and many of the examination paper topics illustrated in Figure 4-8.

4.3.2 The integration of sustainable design in education

The Brundtland report in 1987 highlighted the need for the development of more sustainable ways of living (Brundtland 1987). Legislation, a conscious push towards more environmental, social and economic policies, and clever design resolutions have all begun to lead to a change in the way we design and consume products. To this end, a further sustainable development definition, based around Brundtland, has been developed that incorporates this idea of sustainable progression:

‘... ensuring a better quality of life for everyone, now and in the future. It involves the bringing together of social, environmental and economic issues into one over-arching objective.’ (Capewell et al. 2002:2)

Education concerning these sustainable development issues within Design and Technology is seen as being imperative to its overall success. Second Nature are an American based organisation that believe that education can be a major player in the integration of sustainable development into everyday life.

‘... in order for society to move in a sustainable direction, higher education must develop a new framework in which the sector and individual institutions operate as fully integrated communities that teach, research, and model social and ecological sustainability’ (Clare 2001:para.3)

This education, or re-education, can be used to promote more sustainable products and make designers aware of the bigger picture of sustainable development.

Sustainable development is a key issue for all educators, designers and students; its rising prominence is largely due to government legislation and an increasingly environmentally conscious society (Capewell et al. 2002). In general terms, sustainability has become a major user consideration in products. People now choose products based on environmental and ethical responsibility as much as they do on form, function, price and aesthetics (Elshof 2008). Sustainability within Design and Technology shifted the focus from ‘end of pipe’ techniques to look at the whole product’s life-cycle, a ‘cradle to grave’ approach (Bhamra 2004).

Legislation and environmental concerns have proved key motivators in the growth of sustainable design. Sustainable design has established itself as a central aspect of good design practice for both companies and designers, and therefore has an influencing role in design decision-making, as designers try to balance multiple design issues and judgements (Trimingham et al. 2008). The integration of sustainable development into AS level Design and Technology would vary depending on the Awarding Body (Pitt and Lubben 2007).

4.3.3 Sustainable design education initiatives

Since the Brundtland Report, the prominence of sustainable development within Design and Technology education has grown. ‘There are signs that the international technology education community has begun to move toward more sustainable practices’ (Elshof 2008:134). Several groups and organisations have taken significant

steps to tackle this often testing area. Notably work by the PRé Consultancy in the Netherlands who developed design assessment tools (e.g. *the EcoIndicator Manuals for Designers*) in the late 90s (Goedkoop 1995), the UNEP Eco-design manual '*Eco-design: a promising approach to sustainable design and production*' (Brezet and van Hemel 1997), the Royal Melbourne Institute of Technology's research work and subsequent publication *A Guide to EcoReDesign: improving the environmental performance of manufactured products* (Gerstakis et al. 1997).

The necessity to integrate sustainable development into Design and Technology education has led to the development of several sustainable design based education schemes such as Practical Action's Sustainable Design Award (SDA) (Capewell and Norman 2003), Sustainable Technology Education Project (STEP) and Design for the Environment Multimedia Implementation (DEMI) (Clare 2001, Fletcher and Dewberry 2002) championing the movement. The Information:Inspiration website was designed as part of a research study by Lofthouse (2001a, 2001b), the website was aimed at undergraduate and professional designers. All of the schemes set-up websites with an aim to give students access to sustainable design information and resources but as yet there is little subsequent research to assess their effectiveness. These sustainable design initiatives are all aimed at different age groups as shown in Table 4-1.

Sustainable design websites	Target audience age group
Sustainable Technology Education Project (STEP) www.step.org	11- 14 years old
Sustainable Design Award (SDA) www.sda-uk.org	16-18 years old
Design for the Environment Multimedia Implementation (DEMI)	Undergraduate students
Information:Inspiration	Undergraduate students and professional designers

Table 4-1: Sustainable design in education and their target audience age group

The *Sustainable Design Award* (SDA) was led by a charitable organisation Practical Action (formerly the Intermediate Technology Development Group) and it operated from 2002-2007 in partnership with Loughborough University in England, the Centre for Alternative Technology in Wales and Twente University in the Netherlands (Capewell and Norman 2003, Pitt and Lubben 2007). As ITDG they coined the phrase 'technology with a human face'. Practical Action introduced the SDA to

increase awareness of sustainable development and place it firmly on the education agenda in Design and Technology at AS/A2 level (Capewell and Norman 2003).

The SDA offered two strategies to support AS/A2 level Design and Technology. Firstly, students were introduced to the environmental, social and economic dimensions of sustainable development through product analysis. The SDA also sought to show how these principles could be applied to the student design projects. Secondly, the SDA intended to generate ideas for students' own project work, providing students with access to further sustainable design information and resources, and offer support to their projects (Capewell and Norman 2003, Hellier 2007).

Communication has proved a vital component in the development of the scheme to both teachers and students through different forms of media, from handbooks to teaching sessions and a dedicated website. From training days to key one-to-one inputs in schools, the SDA scheme aims to raise the profile of sustainable development for the designers of the future. The website has become an integral part of the SDA.

As the PhD research area overlaps with the SDA agenda, and given the practitioner's input as a website designer, it would seem suitable that the SDA website be used as the fundamental research instrument. The findings of the proposed research would be beneficial to both parties.

The SDA website (www.sda-uk.org) averages around 13,700 visits a week (MediaHouse 2006), the majority from academic servers and so the SDA website has potentially become a practical way of communicating sustainable design information directly to students. This website, and others like it, could be seen as being a key information resource tool for Design and Technology education, and for supporting educational initiatives like the SDA.

DEMI has also been a notable scheme from 1998 to 2001, that responded 'to the need for sustainable development curriculum within and throughout undergraduate design programmes' (Clare 2001:4). *DEMI* was developed by a consortium of several academic institutions including Goldsmiths College, Falmouth College of Arts, Surrey Institute of Art and Design, the University of Brighton and the Design Council. They

aimed to bring together sustainable development issues and debate, whilst providing key information for students (Fletcher and Dewberry 2002). As with the nature of websites with a growing subject the website needed continuing updates, it is currently offline. The DEMI project was UK government funded, this funding ended in 2001. DEMI had similar aims to the SDA but was developed as a website resource aimed at older students, predominantly undergraduates.

The DEMI website was structured into six areas: principles, materials and properties, gallery, design for sustainability, environmental issues, and sustainability concepts. The layout and links were structured into a map to allow you to navigate through different areas which are inter-linked. There was also a search facility and links to external websites.

The *Sustainable Technology Education Project* (STEP) is a sustainable design scheme aimed at students aged 11 to 14 years old. STEP was produced by Practical Action and was funded by the Department for International Development (DFID) and the European Commission. STEP is aimed at increasing the awareness of sustainable technology amongst young people, focusing on the impact of economic and environmental decisions in design (Capewell 2003).

A PhD study by Lofthouse resulted in the development of the *Information:Inspiration* website (Lofthouse 2001b) which sought to help designers address sustainable design issues. The website was split into detailed information which included links to other websites, and inspirational product examples. The Information:Inspiration website is aimed at professional designers and undergraduate students.

Bhamra and Lofthouse (2008) developed a *tool box for sustainable design education* to guide and support the integration of sustainable design into learning. Trimmingham reports the 10 learning objectives involved in the toolbox (Trimingham et al. 2008). These objectives can be seen in Table 4-2.

	Learning Objective
1	Understand the historical context of sustainable development
2	Understand different definitions of Sustainability (e.g. Brundtland, Natural Step, Triple Bottom Line)
3	Understand key concepts of sustainable development (e.g. Limits to Growth, Carrying capacity, Ecological footprints, Sustainable Consumption, Needs and Rights, Diversity).
4	Understand the idea of systems thinking in relation to Sustainability.
5	Have an appreciation of the commercial, institutional, legislative and social motivations for implementing Sustainable Development.
6	Demonstrate knowledge and understanding of the concept of Sustainable Design and how it exists within an industrial context.
7	Have a practical understanding of the pressures facing industry in terms of integrating Sustainable Design into an established product development process (e.g. internal drivers, legislation...).
8	Have an appreciation of the current range of tools and resources available for Sustainable Design and understand how to use some of the most common (e.g. LCA, MET Matrix, Environmental checklists).
9	Understand future directions for Sustainable Design (e.g. system innovation and function fulfilment).
10	Understand how to analyse the environmental profile of a product, and generate appropriate improvement options.

Table 4-2: Sustainable design key learning objectives
(Trimingham et al. 2008)

4.3.4 Sustainable design tools

Potentially sustainable development may present insurmountable barriers to design and its practitioners. The 'challenge for designers is to find meaningful tools which engage with the design process and help them to tackle design for sustainability' (Bhamra and Lofthouse 2007:65). Quick, easy-to-use tools that focus on detailed information e.g. how a material is manufactured or the weight of a material when considering transportation issues. Eco-design tools may provide the information needed to help designers make quick but decisive judgements, rather than relying on searching through vast amounts of information that covers sustainable design more generally.

Sustainable design tools have been developed to help designers make design decisions when sustainable design issues are at the fore. There are various tools available for designers to use. Bhamra and Lofthouse (2007) split these into five sections:

- environmental assessment;
- strategic design;
- idea generation;
- user centred design;

- information provision.

Three of the sustainable design tools that were developed by the SDA for use within AS/A2 level work are; the design abacus (Figure 4-9), the eco-design web (Figure 4-10), and eco-indicators (Figure 4-11). The design abacus was adapted by Lofthouse and Bhamra and then used by the SDA. The Ecodesign web was developed by Lofthouse as an adaptation of the LiDS wheel (Brezet and van Hemel 1997) and the Eco-Indicator method was created by the PRé Consultants (Goedkoop 1995).

Each tool has a basic framework which designers can apply to their own projects and considerations. The design abacus and eco-design web are reliant on the designer making their own judgements; using their own knowledge and values. In contrast, the eco-indicator relies on the knowledge, and to some extent values, of 'experts' who have given each material/process grades relating to its sustainability (Capewell 2004). This reduces the judgements that a designer has to make or at least the knowledge base that he/she has to have, and thus markedly reduces the time required for each decision.

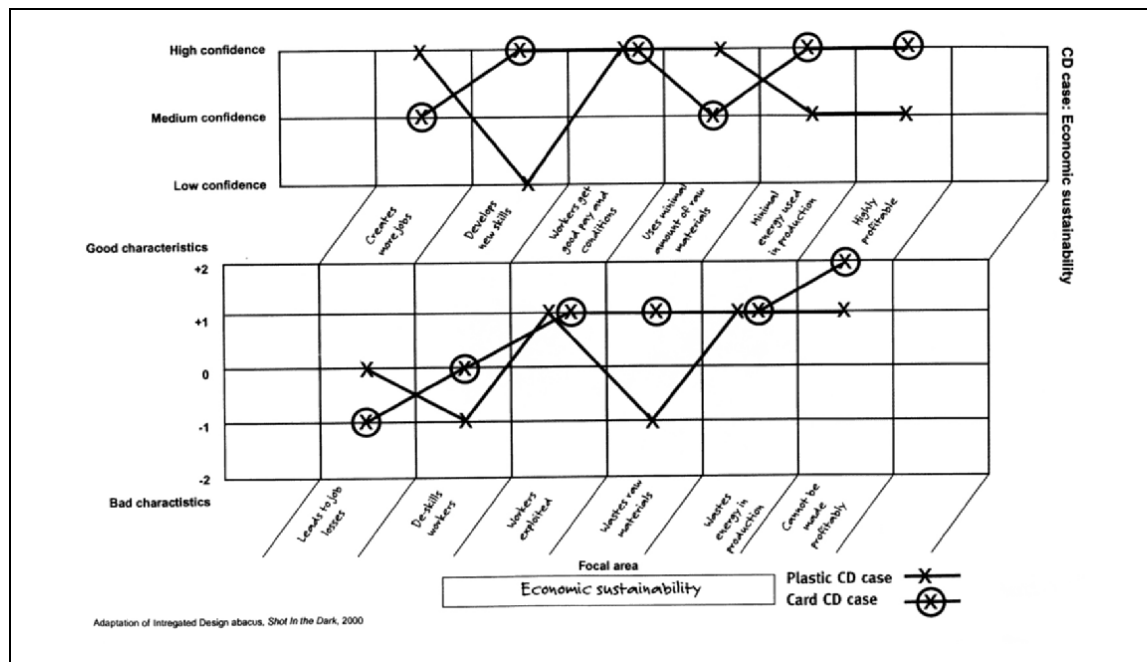


Figure 4-9: Design abacus, example from www.sda-uk.org (Capewell 2004)

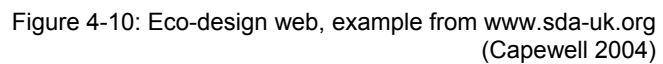


Figure 4-11: Eco-indicator, example from www.sda-uk.org
(Capewell 2004)

4.3.5 The evaluation of the Sustainable Design Award

As the first phase of the Sustainable Design Award launch reached its conclusion, a report of the project, which the SDA had committed to as a requirement of European Union funding, was drawn up by Pitt and Lubben (2007). Pitt had been involved with the Sustainable Design Award from its beginning.

The relevant conclusions from the report (Pitt and Lubben 2007) noted that the SDA showed how sustainable design could be integrated into the existing structure of AS/A2 Design and Technology as defined by the Awarding Bodies. However, the existence of the award alone is not a motivating factor for teachers to adopt a sustainable design mindset. Pitt and Lubben (2007:2) highlighted three notions of sustainability: ‘...a focus on the reuse and durability of materials, on the environmental, social, moral and economic implications of products, and on stewardship of the world for future generations.’

It is important to note that these ‘notions of sustainability’ may have been perceived ethos of the partnership delivering the SDA project. It was highlighted that the main factor in understanding sustainable design and developing confidence in implementing these notions was the availability of high-quality project resources. The promotion of these resources and their application to all projects could be a key factor in its integration.

‘...vigorous promotion of these resources, widening the provision of access, collecting users’ feedback and continuous updating of these resources will increase the impact of the SDA project.’ (Pitt and Lubben 2007:3)

Up-to-date design contexts and exemplar portfolios were mainly used during the first two years of the SDA by teachers, and so could be seen as recruitment tools rather than learning resources.

The report notes that start activities (such as product pairs and the line-ups) and the eco-design tools were widely used, and that further support by teachers is needed to support positive learning outcomes using these tools. It is also noted that within England the SDA had a considerable impact on sustainable thinking by key professionals.

4.4 Sustainable design chapter conclusions

In conclusion, it is generally agreed (Capewell 2004, Charter and Chick 1997, Walker 1998, Spangenberg 2001) that sustainable design should be integrated throughout designing, from design education to professional design. Educating, and re-educating, designers, communicating the key issues of sustainability and providing access to detailed information is essential to its success. This becomes increasingly important when designers have to make key design decisions when weighting a sustainability consideration over another area such as ergonomics for example.

Ultimately designers make value judgements which determine the overall outcome of a design, and it will be up to these designers to decide how much weighting to give sustainable design over other factors. There are also issues within sustainable design to weigh up that will be unique to each design, deciding between environmental issues or social responsibility for example. These judgements rely on an informed decision based on knowledge, skills and values (Pedgley 1999, Coles 2006).

Eco-design drivers in terms of legislation and from clients are also important to drive the growth of the area. This needs to go further than using eco-design as an attractive marketing tool, but addressing the issues in every decision. There are difficulties that need to be overcome such as a lack of information and limitations on time. To address these issues, resources are being produced to support designers and industry to implement sustainable design into practice.

As a key communication tool, websites play a key role in helping to support design students and designers through effective resources and presentation of the three notions of sustainability highlighted by Pitt and Lubben (2007) in their report of the SDA. The effectiveness of websites in conveying this information could have an effect on positive outcomes suggested in the report.

The review helps to give an overview of the many facets of sustainable development and the drivers behind the area's growth. Various models of sustainable development were looked at with the 12 features model being highlighted as a model that could be used to assess the content present on sustainable design websites.

CHAPTER 5 RESEARCH METHODS

Chapter 5 describes the data collection methods undertaken throughout the research project. It explains the role played by action research and introduces the Sustainable Design Award and its website. The chapter outlines the research methodology which correlates to the research questions, reporting the data collection methods used in the pilot studies and the main study. It records the results of the pilot studies and how these influenced the design of the main study.



The literature review covered three broad areas establishing:

- a context for this study within designing, information retrieval and designerly activity (2.4);
- the meaning of website effectiveness (3.3);
- a consensus position concerning sustainable design (4.4).

These areas reflected the research strategy requirements, the conclusions section for each are indicated in brackets.

5.1 Methodology

5.1.1 Triangulation and research principles

The literature review provided a useful consensus position from which this study could build upon. The research methodology is used to address the research questions where greater exploration was needed. The pilot studies were used to trial research methods and to help maximise their usefulness, improving the methods for the main study. The main study is designed to answer the research questions specifically with a triangulation of data used to confirm the validity of the findings.

‘Triangulation: collecting information from a diverse range of individuals and settings, using a variety of methods.’ (Clare 2001:75)

According to Robson (1993:383), triangulation of data collection sources is an ‘indispensable tool in real world enquiry’ and is ‘particularly valuable in the analysis of qualitative data’. When establishing the prospective research methods for this study triangulation of data collection has been a large consideration. It is hoped that a cross-validation of data will lead to an improvement of quality and accuracy of the findings.

Triangulation perhaps adds greater value when there are many interrelated factors influencing the research outcome, this can add greater complexity to the analysis. Blalock highlights the complexity of understanding results when often the variable factors to consider when designing appropriate research methods ‘in the real world a large number of variables are found to be highly interrelated. This means their causes and effects are hard to disentangle’ (Blalock 1970:6).

Blalock (1970) describes a need for the researcher to follow standardised principles and conventional methods when designing a methodology for a research study. Three main methodological concerns are described:

‘The first is to collect data in such a way that all respondents are confronted with nearly identical situations: similar interviewer relationships and the same set of questions. The second is a concern with sampling and the question of the generalizability of results. The third is with specifying standard criteria for data analysis procedures, so that different analysts will reach similar conclusions when confronted with the same set of data.’ (Blalock 1970:47)

5.1.2 Data collection activities

The study will be evidence-based with hypotheses emerging from grounded theories. For the research to have meaning, the data collection methods employed need to be focussed on a purpose. This means solving a problem rather than just gaining knowledge.

Robson outlines three traditional research strategies (Robson 1993:40):

- experiment - measuring the effects of manipulating one variable on another variable;
- survey - collection of information in standardized form from groups of people;
- case study - development of detailed, intensive knowledge about a single 'case', or of a small number of related 'cases'.

Approaches to assessing website design using usability assessment are discussed by Nielsen (1993:223). The approaches are wide-ranging and some of them will be employed in this study. Nielsen went on to outline their advantages and disadvantages:

- heuristic evaluation (early design): finds individual problems, does not involve real users;
- performance measures (final testing): good statistics, does not find individual problems;
- thinking aloud (iterative design): pinpoints misconceptions, unnatural;
- observations: reveals real tasks, no control of experiment;
- questionnaires: subjective user preferences, pilot studies needed;
- interviews: flexible & probing, time consuming;
- focus groups: spontaneous reactions, low validity & difficult to analyse;
- logging use: commonly used features & ongoing, mass of data;
- user feedback: tracks changes in requirements & views, handling replies.

A mixture of purpose driven methods suggested by both Robson (1993) and Nielsen (1993) that are best suited to attaining answers to the research questions will be used within this study. The literature categorises research methods as either quantitative or qualitative. Quantitative methods are measured values relating to a quantity or amount. The results from these can often be difficult to interpret in real-life scenarios with variables that cannot often be controlled. Qualitative methods look to address this issue by acting in real-time and assessing the relationship between practitioner and the subject. These methods address questions of what people did and what they say they did (Blalock 1970, Robson 1993).

5.2 Data gathering

To gather information within designerly activity several methods were used to give an overall picture as discussed by Lawson (2004) (2.3). The methods used in this chapter and the focus findings (chapter 7) are presented to reflect the categories of 'before use', 'during use' and 'after use' as emerged from the literature review of website effectiveness (chapter 3). During the research: questionnaires; checklists; folio assessments; case studies; and an interview, were all used.

This study used both quantitative and qualitative research methods to help answer the research questions. The qualitative assessment of the case studies, questionnaires and interview identified important topics with detailed examples being linked to the folio work. The quantitative technique in some of the pilot studies enabled a refinement of quantitative measures for the main study. The quantitative choice of predetermined responses would help in analysing the findings.

The *questionnaires* allowed for information from a number of subjects to be collected simultaneously. It included open questions about the types of websites the users were accessing and the information sought, it also asked about the users background. The questionnaire also included specific closed questions looking at when and how often the users accessed websites in general, sustainable design websites and the SDA. The questionnaires were refined in response to the pilot study to reduce the chance of ambiguous answers and to confirm the appropriateness of the methodology. The findings from the main study were collated with 73 students questioned, and due to its statistical significance, conclusions could be made about website use.

The questionnaires were given to the AS/A2 level Design and Technology students who were given time to complete them during their classes. The questionnaires contained both defined quantitative questions and qualitative open questions. The quantitative feedback was collated into Microsoft Excel spreadsheet with the results reported in a table format. The qualitative answers were collated together with the areas reported.

The literature looking at the usability of websites suggested usability *checklists* to help measure a website's usability (Gaffney 1998, Nielsen 1993). These were adapted to bring in other areas discovered in the literature including likeability. The

results from these were collated and reviewed to help assess the various sustainable design websites and help develop the SDA website.

The semi-structured interview during the folio assessment with the student allowed the researcher to speak with the subject face to face and ask open questions around the SDA project and the initial findings of the study. Although interviews can be time-consuming, the specific information gathered added value to the study. It also enabled the researcher to clarify points that the subject made in response to the questions. The interview was recorded with the answers noted down and the main points emphasised highlighted. These were then reported as the main areas in the focus findings.

A detailed *folio assessment* of the design work allowed for a recording of the key instances to be made with photographs or copies of the instances taken. The folio assessment allowed the subjects to talk through their design folios to highlight to the researcher any key aspects of website use and sustainability references within their work. It also allowed for examples that were not recorded or evident in their folios to be highlighted by the subject. The case study information was gathered relating to each subject. This allowed the reader to view detailed information and responses as a whole, building up a profile of each subject individually and their contribution to the overall picture.

The *interview* with the SDA co-ordinator was structured and targeted at reviewing the research evidence. A set of questions were used to guide the interview across three areas: sustainable design, websites, and sustainable design websites. The main points emphasised by the subject were noted down. The structured interview acted as a tool to help confirm the findings from the main study by helping to triangulate the data. The interview was recorded on a dictaphone and later transcribed with the key points collated as areas for discussion.

5.2.1 The role of the practitioner

The term 'practitioner' is referred to in this study and is used to describe the author's several roles as: researcher, website designer, professional consultant, author, and lecturer (teaching inputs and study weekends).

5.2.2 Sampling

There are many types of sampling used in research studies such as simple random sampling, systematic sampling, stratified sampling, cluster sampling, quota sampling, stage sampling, convenience sampling, purposive sampling, and dimensional sampling (Allison et al. 1996, Cohen and Manion 1989).

A unique opportunity arose to create and test a website for the Sustainable Design Award which had a captive audience of students. Due to the nature of this, the sample type used in this study was convenience sampling as the subjects were immediately to hand. This was true for each of the methods employed, with the participants from the Design & Technology Department at Loughborough University, linked through the SDA scheme or personal contacts of the practitioner. The students selected from each class were random.

5.2.3 Participants

AS/A2 level Design and Technology was central to the study. It was felt that including undergraduate students in the study would not enable conclusive judgements to be made but would help to indicate potential broader issues.

Three levels of expertise were selected for this study:

- AS/A2 level Design and Technology students;
- undergraduate Industrial Design and Technology students.

The pilot studies tested both AS/A2 and undergraduate level students.

5.2.3.1 AS/A2 level Design and Technology

Four schools took part in the study with 73 students taking part in the study. All of these students completed website use questionnaires and 18 of the students took part in the folio assessment questionnaire and observational study. Three of the schools had volunteered to take part at a study weekend, whilst the other school was contacted to take part in the study. The 18 students were chosen at random, so the students had varying knowledge of sustainable development, and efforts to integrate it into mainstream design education.

5.2.3.2 Undergraduate Design and Technology

41 undergraduate students completed usability checklist and questionnaires in the main study. The undergraduate students were studying industrial design at the Design and Technology Department at Loughborough University.

5.2.4 Overview of the research study

Figure 5-1 shows an overview of the research study with the number of participants shown, the diagram should be read from top to bottom.

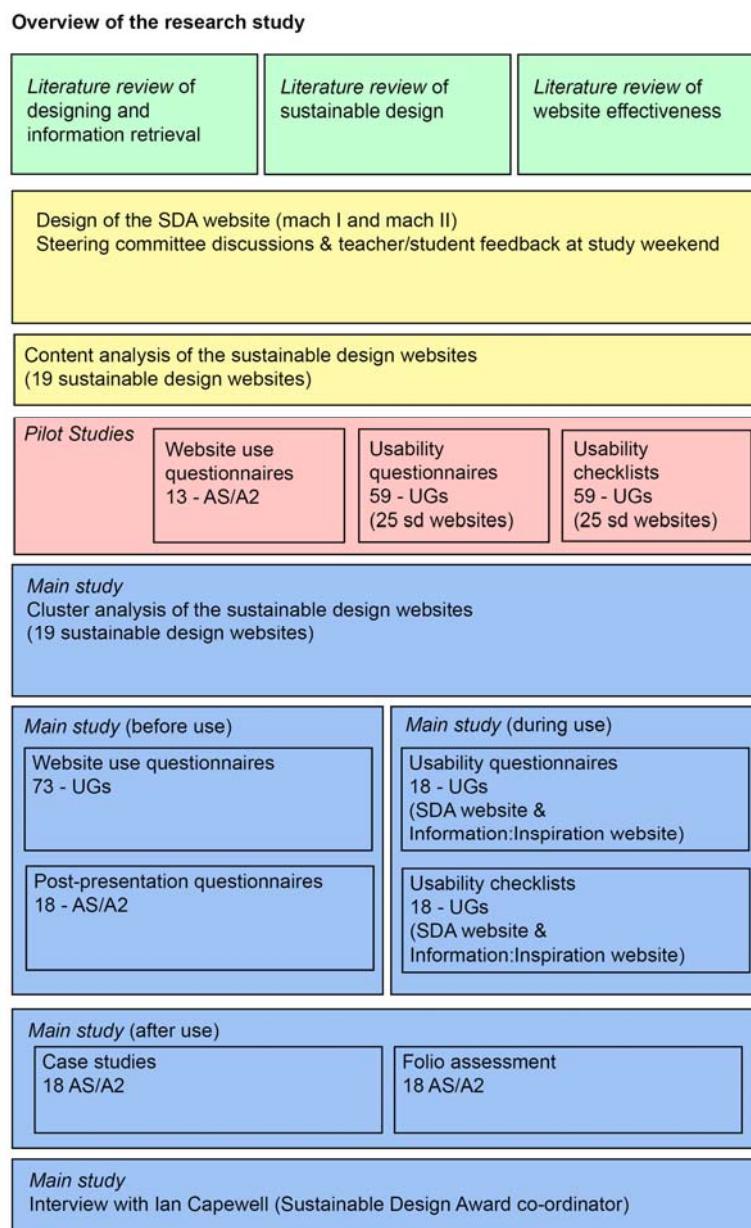


Figure 5-1: Overview of the research study

5.2.5 Research questions and their associated methodology

Table 5-1 outlines the research questions alongside the research conducted.

<i>Research questions</i>	<i>Research conducted:</i>
<p>1a) What is sustainable design within AS/A2 Design and Technology education?</p> <p>1b) What is the understood consensus of sustainable development?</p> <p>1c) What are the principles followed by sustainable design in AS/A2 Design and Technology education?</p>	<p><i>Literature review:</i></p> <ul style="list-style-type: none"> • consensus on sustainable design and sustainable development gathered; • principles outlined by sustainable design education schemes in England and Wales. <p><i>Main study:</i></p> <ul style="list-style-type: none"> • interview with an expert in sustainable design education schemes.
<p>2) Can leading sustainable design websites be classified according to their characteristics?</p> <p>2a) Which sustainable design websites are prominent?</p> <p>2b) What content is present on current sustainable design websites?</p> <p>2c) What is recommended as good website design practice?</p> <p>2d) Can the sustainable design websites be placed into categories?</p> <p>2e) What are the characteristics of leading sustainable design websites?</p>	<p><i>Literature review:</i></p> <ul style="list-style-type: none"> • reviews of sustainable design websites; • observational studies of the sustainable design websites, looking at content and categorisation; • website searches and recommendations; <p><i>Pilot study:</i></p> <ul style="list-style-type: none"> • usability checklist of the sustainable design websites by 59 design undergraduates; • website effectiveness questionnaires focussing on the sustainable design websites by 59 design undergraduates; • automated usability checklists of the sustainable design websites. <p><i>Main study:</i></p> <ul style="list-style-type: none"> • cluster analysis used to determine website types amongst the sustainable design websites, analysing the characteristics of successful cluster; • sustainable design websites placed on the 12 features web; • usability checklist of chosen sustainable design websites by 41 design undergraduates; • website effectiveness questionnaire focussing on the chosen sustainable design websites by 41 design undergraduates; • an interview with a sustainable design expert involved in the SDA educational scheme.
<p>3) What is effectiveness in this context?</p> <p>3a) Which areas of sustainable design websites do designers find useful?</p> <p>3b) Do sustainable design websites influence design decision-making within AS/A2 Design and Technology education?</p>	<p><i>Literature review:</i></p> <ul style="list-style-type: none"> • effectiveness, identifying its meaning in this context; • communication and information retrieval for designing. <p><i>Main study:</i></p> <ul style="list-style-type: none"> • 73 website use questionnaires; • 18 folio assessment questionnaires; • 18 folio assessment observations (sheets, copies, photographs), identifying areas of website use within student design project work (when used and what); • 41 usability checklists; • 41 usability questionnaires.

<p>4) How do you measure the effectiveness of websites?</p> <p>4a) Can quantitative research methods help to measure effectiveness?</p> <p>4b) Can qualitative research methods help to measure effectiveness?</p>	<p><i>Literature review:</i></p> <ul style="list-style-type: none"> • website effectiveness. <p><i>Pilot study:</i></p> <ul style="list-style-type: none"> • 13 website use questionnaires; • website effectiveness questionnaire focussing on the sustainable design websites by 59 design undergraduates. <p><i>Main study:</i></p> <ul style="list-style-type: none"> • cluster analysis used to determine website types amongst the sustainable design websites, analysing the characteristics of successful cluster; • 73 website use questionnaires; • 18 folio assessment questionnaires; • 18 folio assessment observations (sheets, copies, photographs); • 41 usability questionnaires.
<p>5) What are the key principles governing the effectiveness of the Sustainable Design Award website?</p> <p>5a) Is the SDA website effective in influencing design decisions by AS/A2 Design and Technology education students?</p> <p>5b) Do supporting inputs make the SDA website more effective?</p> <p>5c) At what stages in designing does the SDA website influence student design decisions?</p> <p>5d) Do the effective features of the SDA website parallel those of other leading sustainable design websites?</p>	<p><i>Main study:</i></p> <ul style="list-style-type: none"> • cluster analysis used to determine website types amongst the sustainable design websites, analysing the characteristics of successful cluster; • 73 website use questionnaires; • 18 folio assessment questionnaires; • 18 folio assessment observations (sheets, copies, photographs); • 41 usability checklists; • 41 usability questionnaires; • identify areas of website use, sustainable design, and sustainable design websites within student design project work (when used and for what); • an interview with a sustainable design education scheme expert.
<p>6) Are the findings more widely applicable?</p> <p>6a) Are the effectiveness principles established for the SDA website applicable to sustainable design websites or websites in general?</p>	<p><i>Main study:</i></p> <ul style="list-style-type: none"> • cluster analysis used to determine website types amongst the sustainable design websites, analysing the characteristics of successful cluster; • an interview with a sustainable design education scheme expert.

Table 5-1: Research questions with related data collection activities

The relationship between the practitioner and the subjects varied with each research method. Interaction between the practitioner and the subjects featured in the presentations, interview and folio assessment. The students described their design folio pages, observations were recorded with any key parts highlighted. A record of the work was also taken through photographs or photocopies of the highlighted work. An interview was held with direct questions being asked and a questionnaire to guide the interview, noting down answers. There was limited interaction between the practitioner and the subject in the other research methods, where questionnaires were handed to each subject and these subjects were left to complete them.

5.3 Creating the Sustainable Design Award website

Given the consensus position on sustainable development, and emergence of sustainable design initiatives, discussed in Chapter 4, tools to implement the new practice into education were needed. For the Sustainable Design Award, a Steering Committee of which the practitioner conducting this research was a member, developed the Sustainable Design Award website, aimed to help integrate sustainable design in AS/A2 level Design and Technology. The development of the website would provide a unique opportunity to develop and assess the website's effectiveness in influencing design decisions for this research study. It is this ability to develop and be involved in the testing that lends itself to action research.

5.3.1 Action research

With no datum for which inputs could be measured and no control group as a realistic possibility, action research was used in this study. An action was taken with direct data relating to its impact measured. *Action research* is widely recognised as one of the most productive and valid forms of research by some of the leaders in the field (Archer et al. 1992, Norman 1999, Roberts 2000, Green 1998).

‘A designerly approach, rather than a scholarly or scientific approach, can with advantage be made towards educational research and curriculum development’ (Archer et al. 1992:12).

Action research applies ‘all the normal rules governing research practice’ (Archer 2004:29) but it also generates immediately applicable new knowledge. The methodology used in this thesis demonstrates a cyclic method of working within the research process, as championed by several leading researchers (Elliott 1991, and Kemmis and McTaggart 1988). The labels *action research* and *qualitative modes of inquiry* have overlapping agendas, highlighted by Smith (2004:190): ‘Teacher research, classroom research, illuminative evaluation, clinical research, teacher autobiography, classroom process studies, diachronic inquiry, etc., are all tapping into much the same territory’. Overall the action research strategy involves a range of practical activities that are suitable for several common research methods (including interviews, questionnaires, and focus groups).

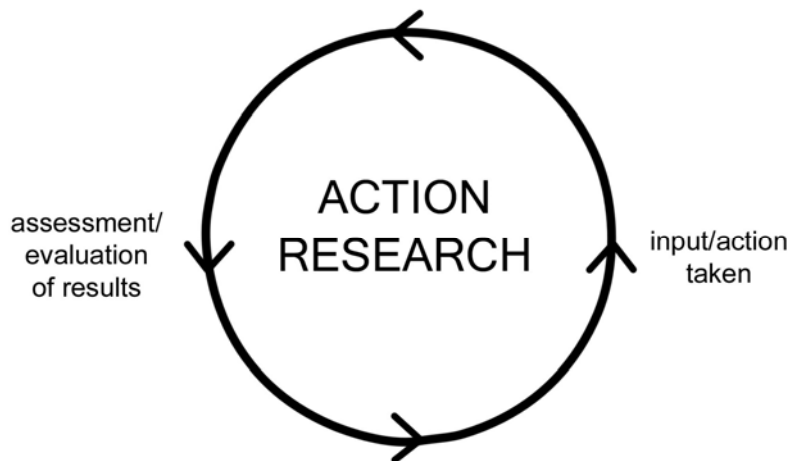


Figure 5-2: Action research method diagram

Action research projects are structured to contribute to, test and/or refute existing knowledge systematically through a series of classroom based activities.

‘...the fundamentals of action research involve: the questioning of assumptions; the clarification of values; the discovery of the mismatches between espoused values and practice; the understanding of the wider social context in which I work.’ (Green 1998:2)

Despite its flexibility, action research, in terms of this research project, takes its traditional form of consciously taking an action to gain a result. It is not the result of that action that is necessarily applicable to other areas, but the deeper understanding of the context gained (Green 1999). Action research is described as ‘a total process in which a ‘problem situation’ is diagnosed, remedial action planned and implemented, and its effects monitored if improvements are to get underway’ (Burns 2000:443). It is the instigation of change which makes action research very applicable to research projects such as this.

5.3.2 Introduction of the Sustainable Design Award initiative

The cyclic nature of the research enabled minor alterations to be made throughout this process. Interim conclusions could be made in the pilot studies and they could be acted upon in the main study. As the author (practitioner), and colleagues from Loughborough University, have been involved in the SDA project from its beginning, this thesis has focused on this scheme and its integration into Design and

Technology education. An overview of the scheme's development is shown in Table 5-2.

Year	Sustainable Design Award Description
2002	DFID supported projects in the UK and the Netherlands to help to raise awareness and understanding in young people of sustainable development.
2003	The Sustainable Design Award was introduced by Practical Action to support the sustainable design principles needed within Design & Technology education (Figure 4-8). Resources were provided such as the teachers handbook and SDA website.
2006	Evaluation of the Sustainable Design Project by James Pitt and Fred Lubben (2007) of the University of York. This report evaluated the project through educational resources are key (4.3.5).
2007 +	Project on-going but now driven through resources and teacher training rather than 'direct input' based.

Table 5-2: An overview of the Sustainable Design Award

The scheme can be seen as an action (Table 5-2) taken to impact upon the education of students at the 16+ level. Each part of the scheme in terms of inputs and resources could also be seen as actions taken by the SDA to have a specific purpose within classrooms. After the SDA project's pilot studies were completed in 2002-03, 150 schools were enrolled in the 2003-04 and up to 241 schools in 2005-06. The SDA was awarded to 882 students from 2002-06 studying Design and Technology at AS/A2 level (Pitt and Lubben 2007).

The results or success of the SDA scheme, and the actions taken, would perhaps best be measured by the design outcomes of the students who undertook the award and their design work. It could also be measured in terms of awareness and the educational push towards sustainable development within design, at an educator and legislative level.

5.3.3 Developing the Sustainable Design Award website

The Sustainable Design Award website was initially set-up after discussions by the SDA Steering Committee. This committee consisted of the practitioner conducting this research, representatives from Practical Action, representatives from Loughborough University and the Centre for Alternative Technology. Several meetings took place between the steering committee to discuss the development of the website and the content of the website. The aim of the website was to inform its

users about sustainable design and the SDA. The main users of the SDA website were identified as Design and Technology AS/A2 level teachers and students. The Steering Committee would then take responsibility for areas of the website where they were most qualified to contribute to the website for example the materials section was written largely by Pitt. The website's design was undertaken by the practitioner of this research.

After an initial website was developed, feedback was gathered through the SDA study days held at Loughborough University. Both students and teachers were asked to give feedback via group PowerPoint presentations. The feedback proved useful in refining the website, and as a result key changes were made. These are reported in chapter 6.

5.3.4 Assessing the effectiveness of the Sustainable Design Award website

The SDA is the first scheme in the United Kingdom to focus specifically on post-16 students and, as outlined by Capewell and Norman (2003), the scheme took several actions to support classroom education in terms of:

- teacher information days;
- a sustainability pack;
- student study weekends and school visits;
- electronic communication via email and the website.

The scheme has also developed as a result of these initial actions. The *Sustainability Handbook* (Capewell et al. 2007) has now been written and sent out to schools free of charge as a support to teachers and students. It refers to specific sections of the SDA website in appropriate places. This progression towards a greater reliance on communication tools such as the website and the handbook is a result of an iterative process undertaken within the SDA development team in assessing the scheme after a particular action was taken.

ACTION RESEARCH

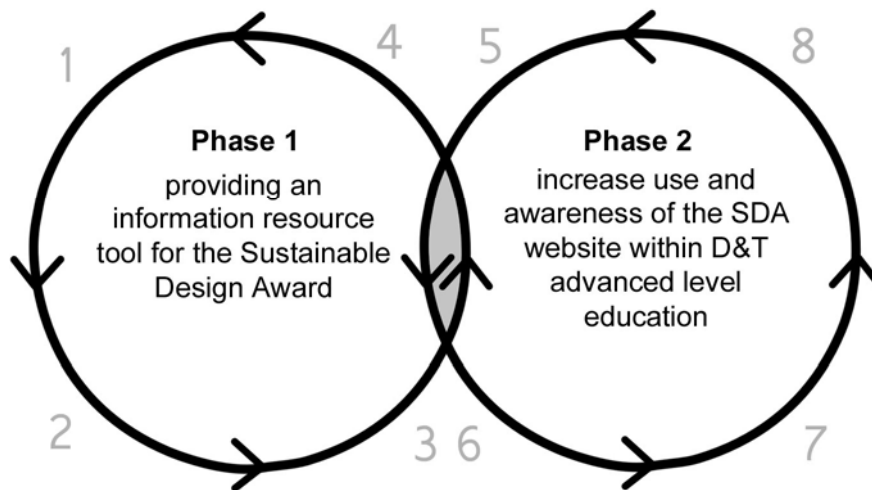


Figure 5-3: An overview diagram of SDA action research

Judgements were made on the success of the SDA website, and as a result, recommendations for further developments to have a greater impact and appeal to teachers and students were made. Figure 5-3 shows both phases 1 and 2. It is an overview of the process of the SDA introducing information resource tools (phase 1: 1 to 4), and then looking at the use of the SDA website specifically (phase 2: 5 to 8). These are given in more detail in Figure 5-4 and Figure 5-5.



Figure 5-4: SDA action research method diagram (**phase 1**)

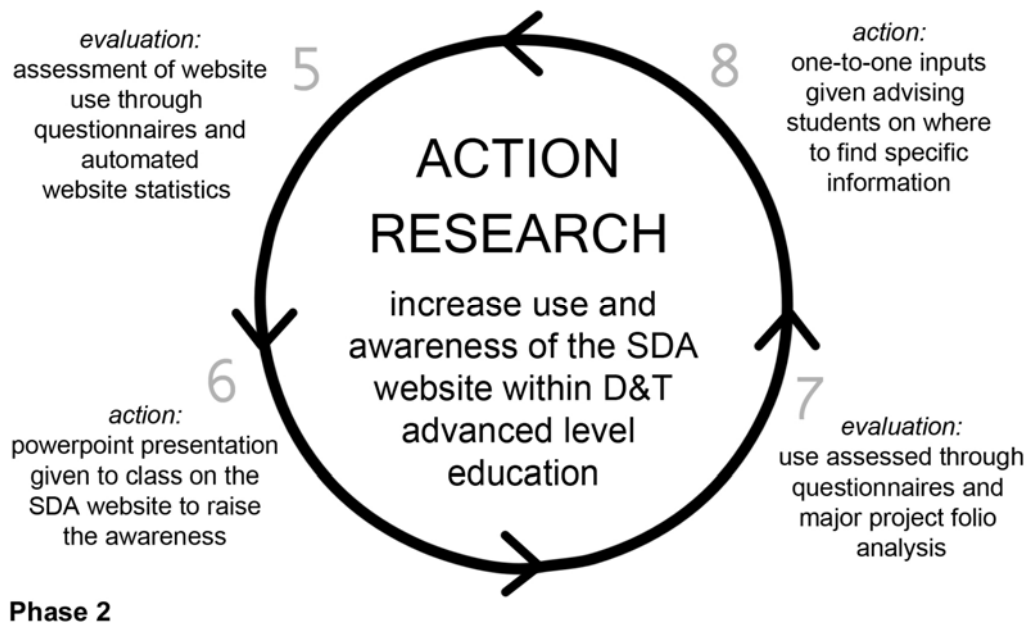


Figure 5-5: SDA website effectiveness action research method diagram (**phase 2**)

Communication has proved a vital component in the development of the scheme to both teachers and students through different forms of media, from handbooks to teaching sessions and a dedicated website. From training days to key one-to-one inputs in schools, the SDA scheme aimed to raise the profile of sustainability for the designers of the future. The need for provision of a website became a viable option to the SDA Steering Committee, both in terms of funding and use. The website would be a versatile and accessible resource for both students and teachers to reach key information to support their educational needs. The Sustainability Handbook and other SDA resources would support this by advertising the website as a useful resource tool. As such the website could be seen as an action taken by the SDA to enable sustainable design practice to become an integral part of 16+ Design and Technology education for students in England and Wales.

5.4 Pilot studies

This section reports the research methodology of three pilot studies:

- website use questionnaires (AS/A2 level);
- usability checklists (undergraduates);
- usability questionnaires (undergraduates).

These studies would form the basis for the methods used in the main study and give the practitioner a dry run in their use. Table 5-3 shows where these three pilot studies fit within the framework of the main study.

	before use	during use	after use
questionnaires	website use questionnaires (13 AS/A2)	usability questionnaires (59 undergraduates)	
checklists		usability checklists (59 undergraduates)	
observational studies			
interviews			

Table 5-3: An overview of the pilot studies within the framework of the main study

As Blalock (1970:48) noted, the ‘wording of questions is a very crucial factor in survey research, and it will usually be necessary to develop several ‘pre-tests’ before the final instrument is prepared’. The questions used in the pilot studies were assessed before the main study.

‘...you can design pilot studies specifically to test your ideas or methods and explore their implications, or to inductively develop grounded theory.’

(Maxwell 1996:44)

As the author (practitioner) was able to design the Sustainable Design Award website for the initiative, schools that had been involved in the scheme were chosen to be the subjects. Not all of the AS/A2 level students at the school had chosen to undertake the SDA.

The undergraduate Industrial Design and Technology degree course was chosen as the practitioner had graduated from the same course and would have a good knowledge of the department and its modules, as well as the ease of access to the undergraduate students. This thesis also builds on other research undertaken in the Design and Technology department, Loughborough University.

The pilot studies were designed to test three data collection methods in the chosen context to see how applicable they were. The pilot studies did not only allow the data collection methods to be improved for the main study, but also gave an opportunity to collect information on a range of sustainable design websites before the main study

focused on a specific website. The pilot studies also ensured that useful information could be gathered to help answer some of the main research questions.

The literature did not offer a comprehensive review of the websites being used, and the pilot studies would enable this. The usability checklists would enable a review of all the websites usability and also the usefulness of the checklists. The pilot study could then help in the classification and reduction of websites for the main study.

The lack of prior art on website effectiveness meant that the pilot studies would also be used to establish a robust method of data collection for the main study. The process for this is recorded within this thesis as a method for the development of best practice for website effectiveness data collection and analysis.

5.4.1 Pilot study: website use questionnaires (AS/A2 level)

5.4.1.1 Reasons for the pilot study

A questionnaire designed to help answer the research questions for this study was devised by the practitioner. These questionnaires were initially trialled at 'School A' with eleven advanced level students, and later refined for the main study.

The study helped test the questionnaire structure and the method of collecting the data. It focussed on the users past experience of sustainable design and website use which are key in helping to answer some of the research questions. The pilot study allowed for the questionnaire to be tested within a real-life environment within the classroom, testing the feasibility of using the method.

5.4.1.2 Methodology

The questionnaires posed questions on the students own experiences of sustainability within their classes. The questionnaire also asked about the involvement of the student with the Sustainable Design Award and the use of websites within their Design and Technology projects. The questionnaires used open questions to ask about these areas:

- *What is your background in sustainability? Have you studied it as part of your Product Design lessons?*

- *Are you taking part, or considering taking part, in the Sustainable Design Award?*
- *Have you been on any study days/weekends such as the Sustainable Design Award?*
- *Have you used any websites in general to help your design work?*
- *At which stage in your design work do you use websites?*
- *Have you used any sustainable design websites? If so, which ones?*
- *Have you been on the Sustainable Design Award website? Was it useful? At which point in your work did you use it?*

5.4.1.3 Results

Some of the answers to the website questionnaire were difficult to interpret as the answers were all qualitative not quantitative. The questions were too open to different interpretation, quantitative questions on website use, may help to facilitate a more precise study. The results revealed that general websites, sustainable design websites and the SDA website had been used at different instances in their design work but this is difficult to quantify.

Website use questionnaire answers	
What is your background in sustainability? Have you studied it as part of your Product Design lessons?	<ul style="list-style-type: none"> • Three students had not studied sustainability; • Eight students had used sustainability within their work pin-pointing a cardboard furniture project where they had used recycled cardboard boxes. One student said that they felt that as a result they thought about sustainability during designing.
Are you taking part, or considering taking part, in the Sustainable Design Award?	<ul style="list-style-type: none"> • Five students have taken part in the award; • Two students were considering taking part in the SDA; • Four students have not taken part in the award and not going to do so.
Have you been on any study days/weekends such as the Sustainable Design Award?	<ul style="list-style-type: none"> • Five students had attended a Sustainable Design Award study day at Loughborough University.
Have you used any websites in general to help your design work?	<ul style="list-style-type: none"> • Eight students had highlighted using Google to research and find images of existing products; • One student highlighted the SDA website and one had said that a teacher had used information from the website.
At which stage in your design work do you use websites?	<ul style="list-style-type: none"> • Nine students had used websites whilst researching, one student commented that this was research looked

	<ul style="list-style-type: none"> at existing products; Two students used websites for ideas and to investigate choices of materials.
<p>Have you used any sustainable design websites?</p> <p>If so, which ones?</p>	<ul style="list-style-type: none"> One student mentioned using www.sda-uk.org; Three students highlighted using www.designinsite.dk; Eight students said they had not used any sustainable design websites.
<p>Have you been on the Sustainable Design Award website?</p> <p>Was it useful?</p> <p>At which point in your work did you use it?</p>	<ul style="list-style-type: none"> Two students used the SDA website for research; Two students said that they found the SDA website extremely useful for information and good examples; Eight students had not used the SDA website at all.

Table 5-4: An overview of the results from the website use questionnaire pilot study

5.4.1.4 Conclusions

As well as studying the responses to the eleven questionnaires, the method was used was analysed by a group of researchers and lecturers in the Design and Technology department at Loughborough University. The discussion highlighted a need to define questions more specifically to enable more accurate responses. In conclusion the questionnaires would be improved by including more closed questions that specifically add clarity to the answers.

5.4.2 Pilot study: usability checklists

5.4.2.1 Reasons for the pilot study

59 Industrial Design and Technology undergraduate students reviewed the selected websites for usability using a checklist similar to that of Nielsen's work (1993) and using an adaptation of a standard checklist (Nielsen 1993, Gaffney 1998). The sessions were also used to introduce Web X-act, an automated checklist tool.

The usability checklists allowed for an analysis of all 25 sustainable design websites and their usability. It allowed for an independent review from a large number of students and would test the response to closed questions on the checklist. The tasks were undertaken comprehensively and were embraced by the students as a suitable way of gathering usability data.

5.4.2.2 Methodology

The undergraduate students were given two A4 sheets with two tasks outlined. They were given one of the 25 sustainable design websites at random, and they were allowed up to two hours to complete the tasks. The tasks directed the users to <http://webxact.watchfire.com>, an automated usability tool, and also to assess a website using a usability checklist manually. The checklist contained closed questions on navigation, functionality, control, language, feedback, consistency, error prevention and visual clarity (Figure 5-6).

5.4.2.3 Results

The automated usability checklist directed the user to a website assessment tool and the feedback on this was limited to discussion. The tool itself was used by the practitioner on the sustainable design websites to gather more usability assessment information.

Name: William Beck

Website name: biothink.org Website URL: www.biothink.org

Task Three - Usability evaluation checklist

Navigation	Always	Sometimes	Never	Notes
Indication of current location	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	at the top of the page
Clear link to home page	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	link to home page
All major parts are accessible from home page	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	link to home page
A site map is available	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
The structure is simple with no unnecessary levels	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
An easy to use search function is used	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Functionality	Always	Sometimes	Never	Notes
All functionality is clearly labelled	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
All necessary functionality is available without external sites	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
No unnecessary plug-ins are used	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Control	Always	Sometimes	Never	Notes
User can cancel all operations	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Clear exit point on each page	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	at the bottom
All graphics links are available as text links	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	at the bottom
The site supports the users' workflow	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
All appropriate browsers are supported	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Language	Always	Sometimes	Never	Notes
The language used is simple	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Jargon is avoided	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

Feedback	Always	Sometimes	Never	Notes
It is always clear what is happening on the website	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Users can give feedback via email or form	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Users are informed if a plug-in or browser version is required	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Online help is available	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Consistency	Always	Sometimes	Never	Notes
One word is used to describe one item only	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Links match the page titles which they refer	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Standard colours are used for links and visited links	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Terminology is consistent with general web use	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Error Prevention	Always	Sometimes	Never	Notes
Errors do not occur unnecessarily	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Error messages are clear	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Error messages describes what action is necessary	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Error messages provide a clear exit point	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Error messages contain contacts for further assistance	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Visual Clarity	Always	Sometimes	Never	Notes
The layout is clear	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Sufficient 'white space'	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
All images have ALT text assigned to them	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Unnecessary animation is avoided	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Evaluation Checklist adapted from Gerry Gaffney © 1998 Information & Design Pty Ltd (www.infodesign.com.au)

Figure 5-6: An example of a pilot study sheet for task 3

The feedback from the usability checklists (Figure 5-6) was analysed with the answers and notes being collated. This feedback was then used in the website selection part of the study. The information gathered from this, due to its closed question nature, was very specific with areas of strength and weakness in the websites being identified relatively quickly. The students also commented on the ease of the method used and wished to use the checklist as a method of improvement for other projects.

5.4.2.4 Conclusions

The manual usability checklists proved extremely useful in gaining feedback needed for the websites' usability. The checklists helped to confirm findings that were gathered by the practitioner's own completed usability checklist analysis. It gave an overview of this and also aided in selecting the websites to take forward in the initial part of this research study.

5.4.3 Pilot study: usability questionnaires

Several questions were asked of the undergraduate design students to gather a general view on their thoughts of effectiveness and website impact.

5.4.3.1 Methodology

59 Industrial Design undergraduate students were asked about how they would measure the effectiveness of websites and how usable their selected website is?

Each student was given one of the 25 sustainable design websites at random, they were allowed up to one hour to answer the questions on website effectiveness and to look through the website they had chosen. This was the same website as was used in the usability checklists.

5.4.3.2 Reasons for the pilot study

There were several reasons for carrying out the pilot study using these specific methods. To gain feedback on the meaning of effectiveness, adding to the information found in the literature review. The feedback also gave an open answer to how usable they felt their allocated sustainable design website was.

5.4.3.3 Results

The feedback to these questions raised the following points that could be used when considering the term 'effectiveness':

Structure

- layout is important;
- priority listing of links;
- consistency of layout;
- logical position of different areas.

Navigation

- ease of navigation, uncluttered;
- clarity of links – how clear are they and where they take you;
- obvious links, speed of use;
- ability to move between pages effectively;
- intuitive use of buttons to find certain pages;
- back button;
- time it takes to find information;
- use of icons;
- how easy is the menu system.

Usability

- user will leave the site if too difficult to control;
- speed of loading;
- no horizontal scrolling;
- long flash introductions a put off.

Content & use

- initial impression on conveying the site's subject;
- information is easy to find and clear;
- is there a clear purpose to the website?;
- ease of communication statements;
- use of text (too much/too little);
- readability of text (font/size);
- learnability of the information;
- to the point;
- clarity of information;
- good layout that's consistent;
- FAQs used effectively;
- contact information included;
- mission statement / purpose.

Aesthetics

- good aesthetics, the look of the site, professionalism;
- do I want to read on, stay on page?;
- is it visually acceptable? (background, text, colour, size etc);

- graphics – interesting, boring or overwhelming;
- professionalism – is it tacky? cheap?;
- quality of output - relevant images and text;
- use of colour (can users read?);
- graphics – too many / too few (relevant, dull, vibrant);
- limited use of Flash;
- visual feel matches the nature of the site;
- appropriate colour use;
- rollover graphics a good indication tool;
- visual stimulation.

Accessibility

- suitable to a range of users with different technology;
- website easy to find on search engine;
- clear font to read and size important;
- how many people visit it?;
- number of clicks of mouse to find specific information.

Impact

- does the user want to keep exploring the site? Does it look interesting enough?;
- speed of conveying content and theme;
- summary of site – title on top;
- what is my eye drawn to?;
- how it influences/educates its users? Amazon – how many books they sell?.

The range of answers again indicated the wide range of issues associated with effectiveness and brought up some interesting points that can be considered in the future research.

Website name *The Biothinker* Website URL *www.biothinking.com*

Task One – Usability

How would you measure the effectiveness of websites?

- Comprehensive navigation around site
- Keep links quite high to the top of page
- No boxed text
- Simple colour scheme
- Easy to find home layout
- Highlighted link when selected
- Good for both searching looking for specific information

How usable is the selected website?

- Very usable
- Plain clear text
- Simple colours - over large not over small font but you notice when you have selected a title link
- Good navigation comprehensive layout
- Easy & quick to use
- Pleasant to use
- First impression quite boring but service and plan

Task Two – Web Assessment

Open: <http://webxact.watchfire.com> and find the highlighted website from the list you wish to use and type the address into the 'Page URL' box.

Click on Go! Have a look at the results, this may prove a useful evaluation tool for your own websites.

Figure 5-7: An example of a pilot study sheet for tasks 1 and 2

5.4.3.4 Conclusions

In summary, the data collection method used had some success in gaining the information needed to take the research study forward. The open questions allowed for a broad overview of effectiveness and usability. This feedback helped to understand the students' perception of effectiveness and future evaluation of the websites.

5.5 Main study

The techniques used in main study were developed in the light of the conclusions following on from the pilot studies. This section reports the research methodology used in the main study including the data collection methods (shown in Table 5-5) and the cluster analysis.

	before use	during use	after use
questionnaires	website use questionnaires (73 AS/A2) post-presentation questionnaires (18 AS/A2)	usability questionnaires (41 undergraduates)	
checklists		usability checklists (41 undergraduates)	
observational studies			case studies (18 AS/A2) folio assessment (18 AS/A2)
interviews	SDA co-ordinator interview		

Table 5-5: An overview of the data collection methods used in the main study

These methods are reported in sections of ‘before use’, ‘during use’ and ‘after use’ of the websites as derived from the website effectiveness literature review.

5.5.1 Cluster analysis

The cluster analysis took place before the data collection methods described in Table 5-5. Initially 25 websites were selected due to their prominence in current sustainable development literature, internet searches or use within education from AS/A2 to degree level. All of the websites aimed to communicate sustainable development principles.

The websites were split into three groups (business, education, and design) based on content to try to categorise the websites. This proved ineffective as some of the websites fell into more than one group. Consequently it was decided to use cluster analysis.

To enable a cluster analysis of the 19 sustainable design websites, each website was compared against the 12 features model of sustainable design. The 12 features model in section 4.1.5.2 has been adapted to help communication and detailed measurement of sustainable development practice. The adapted model is

appropriate to help in the assessment of the selected websites output, and also as a selection tool to analyse their content.

For each of the 12 features a rating was given from 1-5. A rating of 1 would mean no content was present on this area. At the other end of the scale a rating of 5 would mean the content was extensive on the area. The criteria for ratings for each of the 12 features are shown in Table 5-6.

Criteria for rating each websites' content for each of the features					
Ratings	1	2	3	4	5
12 features of sustainability	Not present	Some content but major areas were missing	Covers most areas	Only a few omissions in content	Extensive content

Table 5-6: Criteria for rating each websites' content for each of the features

Each rating was inputted into a spreadsheet on Microsoft Excel, this data can then be easily imported into SPSS (the Cluster Analysis software).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1															
2															
3	Website no.	Websites/12 features	1	2	3	4	5	6	7	8	9	10	11	12	
4															
5	1	Biothinker	5	4	5	4	3	1	2	4	2	5	4	2	
6	2	Earth from Above	3	2	4	4	4	1	1	5	1	5	2	1	
7	3	Barking Crickets	3	1	2	1	1	2	3	1	2	1	3	1	
8	4	O2 Network	2	3	2	1	3	2	2	5	3	4	1	2	
9	5	Conservation Economy	4	5	5	2	4	5	4	5	5	4	5	5	
10	6	Forum for the Future	3	4	3	2	4	4	2	4	3	5	2	3	
11	7	PRRe	3	4	2	4	3	2	4	2	5	2	3	4	
12	8	RMIT Centre for Design	4	4	3	3	4	3	4	5	4	4	3	3	
13	9	Inspire Recycle	5	5	4	2	4	1	5	4	5	4	5	3	
14	10	Rocky Mountain Institute	3	3	4	3	5	4	5	3	4	2	4	4	
15	11	Clean Production Action	4	5	5	4	2	1	2	2	1	3	5	2	
16	12	SustainAbility	3	4	4	2	5	2	3	4	3	3	4	3	
17	13	International Institute for Sus. Dev	5	3	4	4	3	2	3	5	5	4	4	2	
18	14	Information / Inspiration	3	4	4	2	4	2	3	4	4	3	4	3	
19	15	Sustainable Design Award	3	3	4	3	4	3	2	4	4	4	5	2	
20	16	Demi	4	2	2	2	3	4	4	3	4	2	4	2	
21	17	Centre for Sustainable Design	3	4	3	3	4	4	5	4	5	3	3	4	
22	18	Centre for Alternative Technology	5	1	5	5	1	3	3	1	5	5	5	1	
23	19	Redefining Progress	5	4	5	4	5	3	4	4	4	4	5	4	
24															
25															
26															

Figure 5-8: 12 features ratings inputted into Microsoft Excel

5.5.1.1 Visual model webs

To represent the websites visually, the websites were assessed by the practitioner comparing each point on the 12 features model to the content covered on the

websites. The websites were wide-ranging in content, aims and their audiences. An example of one of the website content diagrams is shown in Figure 5-9.

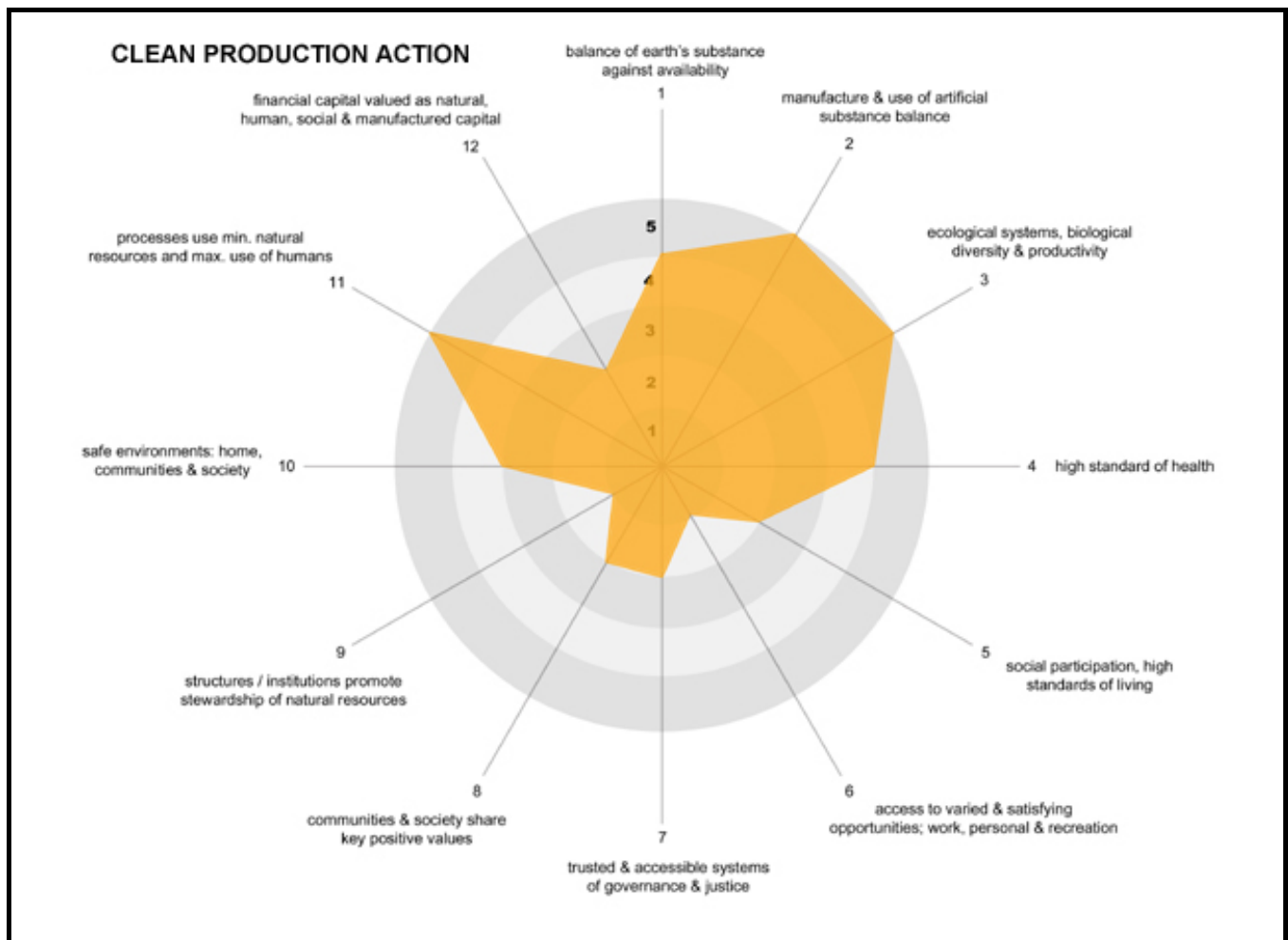


Figure 5-9: Website content diagram showing criteria for each spoke

The visual design webs helped to illustrate which websites covered which aspects of sustainable design. This was considered when reducing the number of websites in the study. SPSS compared each website element rating with each other using hierarchical algorithms, the sustainable design websites were then classified into clusters.

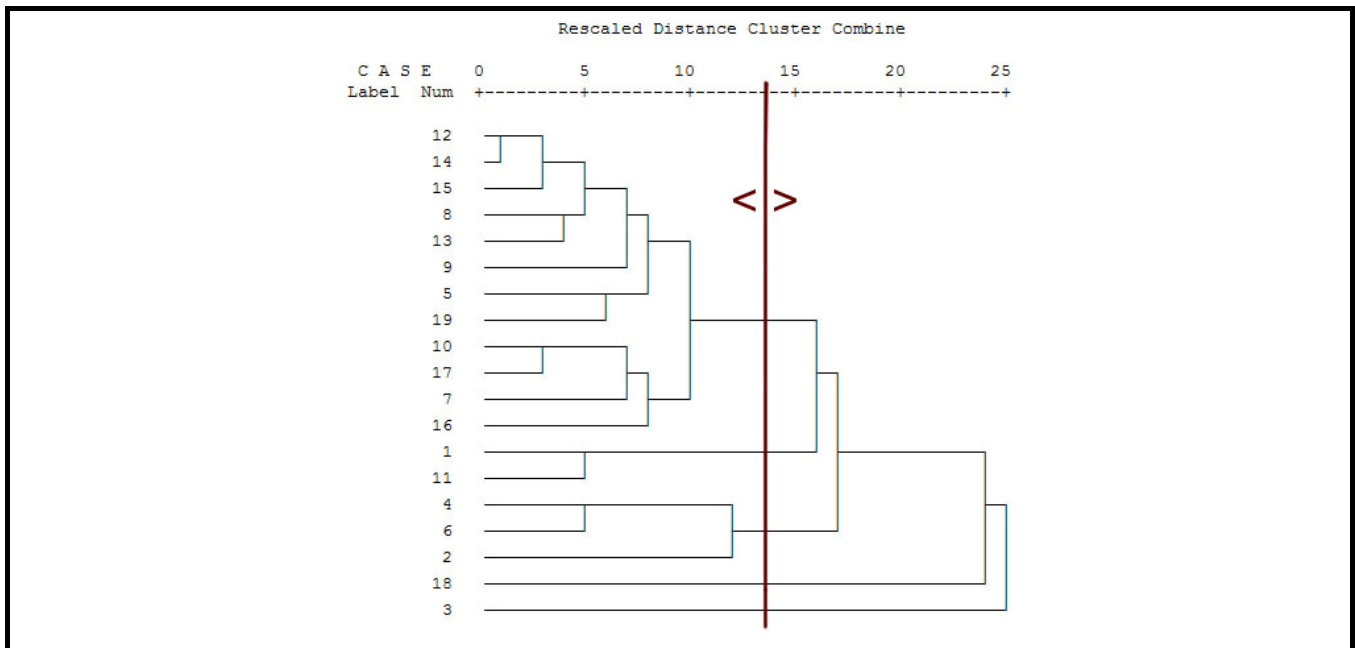


Figure 5-10: An example of a cluster analysis

Figure 5-10 gives an example of an output of a cluster analysis. The case numbers down the side would represent each website. The closer these are together in the list the more similarities there are between them. The clusters are shown when a line is drawn (maroon in Figure 5-10) along the scale. The amount of clusters were determined by the practitioner with some clusters in the result more defined than others, its clarity varies between cluster analysis.

5.5.2 Before use

5.5.2.1 AS/A2 level: website use questionnaires

5.5.2.1.1 Reasons for the study

The study would help reveal users' past experience of sustainable design, website use and the SDA website, these areas would be key in helping to answer some of the research questions. The alterations to the study from the pilot would enable a quantitative analysis of results to be reported. This quantitative data could then be used to help support or refute any emerging theories.

5.5.2.1.2 Methodology

The website use questionnaires included closed questions to help give specific answers and also open questions relating to their background in sustainable design,

asking whether they had taken part in the Sustainable Design Award. It also asked about their use of general websites, sustainable design websites and the Sustainable Design Award website.

5.5.2.2 AS/A2 level: post-presentation questionnaires

5.5.2.2.1 Reasons for the study

An input was given to the students describing all areas of the Sustainable Design Award website, highlighting parts that may prove useful in their design work. After giving the students an initial website use questionnaire, 18 of the students were followed up later in their project work.

The follow-up questionnaire would help to indicate their website use after completing their major design project. This would report the use of general websites, sustainable design websites and the SDA website. Given the input after the completion of the previous questionnaire, the time lapse between the two would indicate whether directly indicating to a group which areas of a sustainable design website were aimed to help them with their work had any effect on their usage.

5.5.2.2.2 Methodology

A follow-up visit took place with students asked to fill in another questionnaire about their website use. This was the same questionnaire as was used in the first study (5.4.2.1).

5.5.3 During use

5.5.3.1 Undergraduates: usability questionnaires for the Sustainable Design Award website and the Information:Inspiration website

5.5.3.1.1 Reasons for the study

The undergraduate design students were asked to explain their understanding of website effectiveness and the impact of the website given. This helped to gain feedback on the meaning of effectiveness to add to the information found in the literature review. To get an open response to how usable they felt their selected sustainable design website was. This view would help form opinions of website

usability to enable a more informed view when selecting the websites to use in this study.

5.5.3.1.2 Methodology

59 Industrial Design undergraduate students were asked about how they would measure the effectiveness of websites and how usable their selected website is? Each student was allocated either the SDA website or the Information:Inspiration website and allowed up to one hour to look at the website and answer the questions. After the questionnaires were collected in, the participants were given a lecture explaining some of the key findings from the literature review to help define a clear picture of website effectiveness. Website usability was explained as part of this in preparation for the usability checklist study (5.5.3.2).

5.5.3.2 Undergraduates: usability checklists for Sustainable Design Award website and Information:Inspiration website

5.5.3.2.1 Reasons for the study

Following on from the usability checklists completed in the pilot studies, the main study repeated the usability checklists but just looking at two websites in particular: the Sustainable Design Award website and the Information:Inspiration website.

The usability checklists allowed for an in-depth manual analysis of the Sustainable Design Award website and Information:Inspiration website, focusing on their usability. Independent reviews of the websites would help in bringing to the fore any issues to do with website usability. It would help to tease out any issues that may affect the use of the website within the project work. As the literature concerning website effectiveness largely centred on usability, this was thought to be a good starting foundation for the rest of the study. The assessment could also be seen to reinforce the usefulness of the websites in terms of content for the students undertaking project work themselves.

5.5.3.2.2 Methodology

41 undergraduate students who were in their final year of their Industrial Design and Technology degree at Loughborough University took part. These students were chosen at random and had varying levels of computer competence. As with the pilot study, the undergraduate students were given two A4 sheets with two tasks outlined.

The first task was to use an automated usability checklist and the second task was fill out a usability checklist. This time the students were given either the Sustainable Design Award website or the Information:Inspiration website to assess, and they were allowed up to two hours to complete the tasks.

The students were directed to use the automated usability checklist tool at: <http://webxact.watchfire.com>, although after assessing its value after the first pilot study i.e. all the results are identical, this feedback was not sought. As with the pilot study the manual checklist contained closed questions on navigation, functionality, control, language, feedback, consistency, error prevention and visual clarity.

5.5.4 After use

5.5.4.1 AS/A2 level: case studies

5.5.4.1.1 Reasons for the study

18 AS/A2 level Design and Technology students were tracked. Their answers to the questionnaires, folio observations, and project timelines were collated together in Powerpoint to enable a detailed analysis of the student activity to take place.

5.5.4.1.2 Methodology

Annotations were made to help assess each of the collated Powerpoint presentations. The answers looked at what they were looking for and why they were using it in their project. One Powerpoint is illustrated in the results section but all 18 of the presentations can be found in the annexes.

5.5.4.2 AS/A2 level: folio assessment observations

5.5.4.2.1 Reasons for the study

Whilst the students may have indicated a certain amount of website use in the follow-up questionnaires it was felt that further analysis was needed.

The study allowed for a greater understanding of the prominence of the use of websites, sustainable design and sustainable design websites within student folio work. It allowed the practitioner to access what the students actually did as opposed to what they thought they did, and allowed the practitioner to see how these

instances may have influenced their design outcomes. The interaction with the students allowed the student to highlight any moments when these reference points were found to be key to their project work.

The students could also remind themselves of their project work in relation to this use. The study would allow the practitioner to draw conclusions of what type of websites, sustainable design practice and sustainable design websites had been used, what influence they had on their design work, when these had been in the project work and how regular they occurred.

5.5.4.2.2 Methodology

18 AS/A2 students took part from two of the schools used in the initial questionnaires. The students had different levels of sustainable design knowledge and competency of website use.

Firstly the practitioner assessed each folio with no input from the student, with detailed notes taken with any reference to sustainable design, websites and sustainable design websites. Photographs of this work, and where possible copies of the work, were collected. The student design folios were examined for any references to any use of the internet or sustainable design issues. These were recorded and cross-referenced to the photocopies or folio copies.

Through some follow-up questions the students were then asked to expand on these notes concerning any key areas of their work that had been highlighted. This helped to clarify their use of the internet or the sustainable design issue that they were addressing. The students were also advised of specific areas of the SDA website that may be able to help them with their project work. This advice was again documented as part of the research data. The results are reported in three categories looking at general website use, sustainable design integration, and sustainable design website use.

5.5.4.3 An interview with Ian Capewell, Practical Action

5.5.4.3.1 Reasons for the study

The structured interview guided discussion towards the Sustainable Design Award programme as a whole, the Sustainable Design Award website and its use, and also

comment on any initial findings from the study overall. This feedback would help to support or refute any conclusions that may be made.

5.5.4.3.2 Methodology

A structured interview took place with a questionnaire to guide the interview questions. The interview was recorded with key points being noted to highlight and emphasise clarity within the text.

CHAPTER 6 SUSTAINABLE DESIGN WEBSITES

This section reports design and development of the Sustainable Design Award website and the analysis of 25 leading sustainable design related websites accessible at the start of the PhD research. The websites were analysed and compared to each other, looking at their content and characteristics.



6.1 Sustainable Design Award website

6.1.1 Website development

As a part of the PhD, a website was designed and created by the practitioner of this research for the Sustainable Design Award. It was seen as a key resource for AS and A2 students and lecturers to use in supporting their design work. The process of development undertaken by the practitioner of this study and the SDA Steering Committee is reported in this section.

After a meeting with the Steering Committee a first website was set-up with an initial brief. A study weekend was held where teachers were able to use the SDA website and feedback directly to the practitioner. The main suggestion from the feedback indicated that splitting the website into two sections (*teachers* and *students*) would help the users' navigation and the clarity of the websites' structure. An inclusion of a checklist for students to use during their project work was also suggested to help guide students through their project work. The SDA website was developed to reflect

these suggested changes before any further assessment of the SDA website was undertaken.

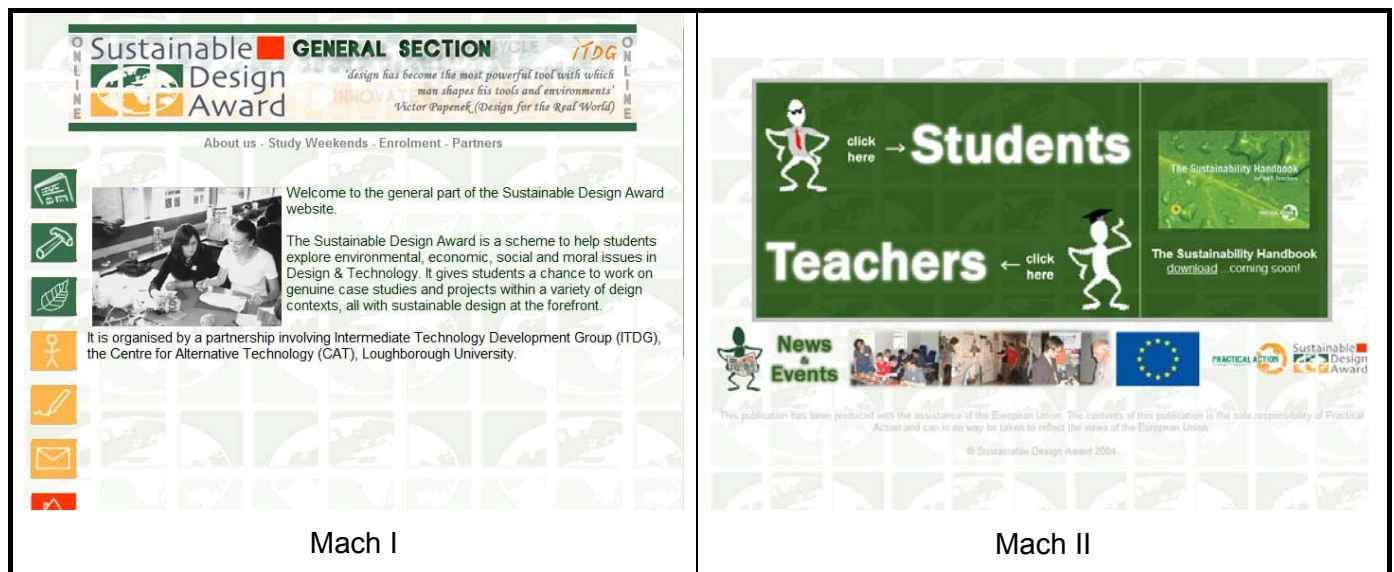


Figure 6-1: Development of the Sustainable Design Award website - Mach I to Mach II

As part of development of the SDA website students were also consulted and shown the website. This took place at a Sustainable Design Award study day. Figure 6-1 shows an example of one of the slides from the presentation, the full presentation can be found in the annexe. The presentation outlined the areas of the SDA website, pointing the students to relevant areas for their design folio work. The students indicated that help in selecting their project on the website would be beneficial. Their feedback went further in developing the website.

6.1.1.1 Design considerations

The design of the SDA website addressed many aspects of the criteria outlined in the literature review of website effectiveness in 3.2.2, this included issues of cognitive psychology.

The design brief for the development of the SDA website listed both teachers and AS/A2 students as the main users of the website. The SDA website would be used to inform teachers about the award and to make tools and information readily available for them to use. The brief also outlined an expectation for the website to be used by students throughout their design projects. The website would be expected to give the

students information about sustainability issues and examples of inspirational products.

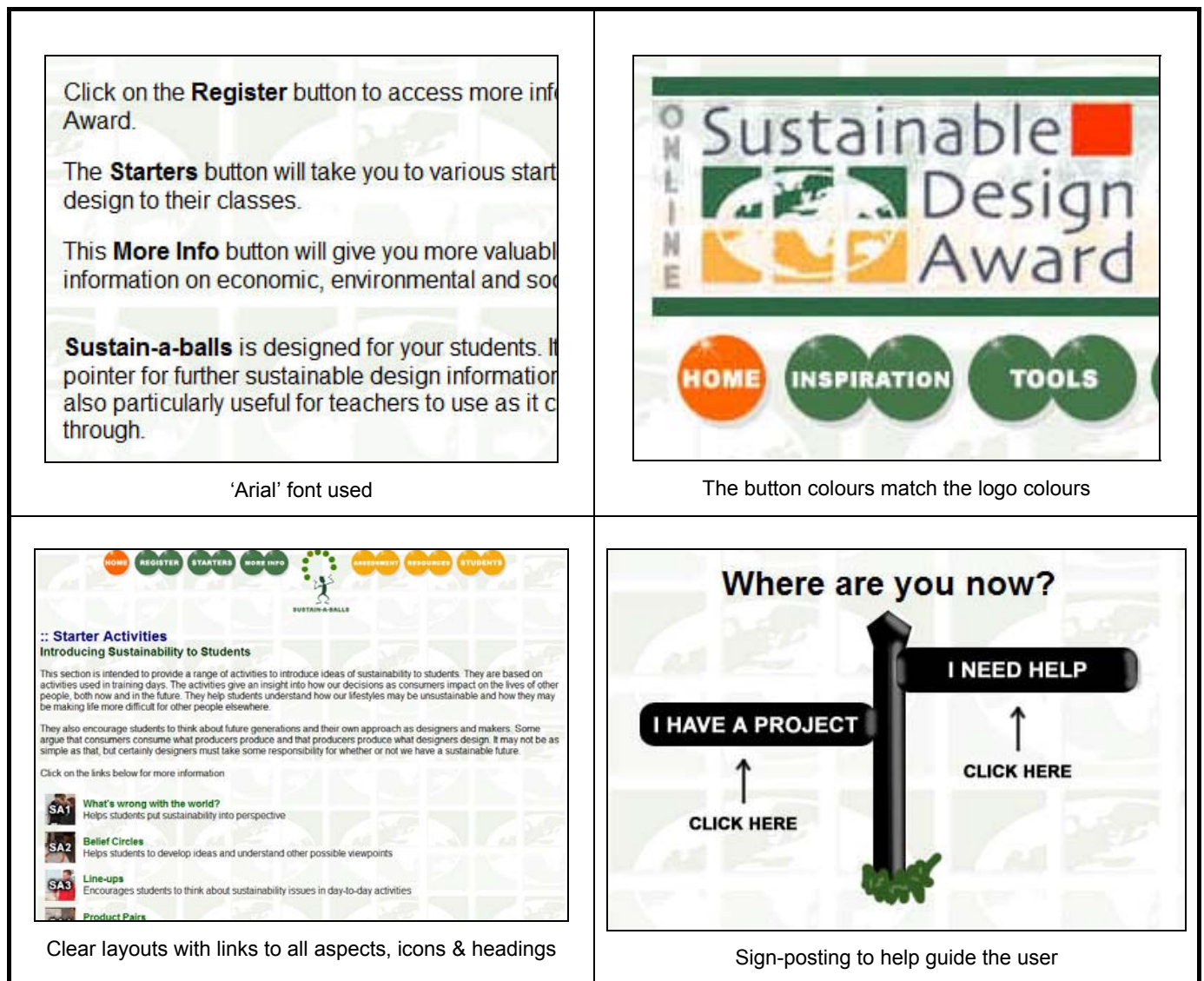


Figure 6-2: Examples of elements of the SDA website
(Capewell 2004)

To improve human-computer interaction, the text used 'arial' font as this is easy on the eye and available on most computers as a default font. The layout was regular with the appropriate tabs consistent on each page, and the colours used reflected the Sustainable Design Award colours of green, red, yellow and white. Visual cues to guide the users through the website were used with part of the website including a checklist. The checklist could be used to help guide the user through their project with links to specific sustainability sections. This was intended for the website's usability.

Images and icons were used alongside text to help indicate sections for example in the tools section. The terminology of the text was worded to be suitable for each user group.

6.1.1.2 Sustainable Design Award study day

The study day took part at Loughborough University where eight schools signed up for the Sustainable Design Award spent a day working on sustainable development issues within designing. 60 design students were introduced to the Sustainable Design Award and undertook a design brief for the remainder of the day that covered various eco-design tools. These reflected current literature in that it raised questions of weighting of the issues and value judgements made in taking design decisions. The full timetable for the day is shown in Table 6-1. The presentation introducing the SDA website is highlighted in the timetable. The students were given opportunities to access the website and the tools as much as possible.

<u>SDA study day timetable</u>	
10.00am	Introduction to SDA & sustainable design
10.15am	Understanding sustainability issues
10.30am	Setting group design brief & website support
10.45am	Sustainable development in life-cycle analysis (in groups)
	REFRESHMENTS
11.30am	Eco-design tools (eco-indicator & Design Abacus)
12.30pm	***LUNCH***
13.30pm	Design brief group work begins (brainstorming issues)
14.15pm	Designing in groups
16.00pm	Report back and presentations
16.30pm	Depart

Table 6-1: SDA study day timetable

The input itself involved a PowerPoint presentation to the students showing them different areas of the website after the initial input on sustainable development. The full presentation is available as an annexe.



Figure 6-3: An example of a page from the Powerpoint presentation

The students were then introduced to some eco-design tools before tackling the design brief for the day. The afternoon was spent designing in small groups (Figure 6-4) with a final design idea presented to their groups. These designs were specifically aimed at drawing out sustainable development issues within designing and justifying their design decisions.



Figure 6-4: Photographs from the SDA study day

The Sustainable Design Award had focused a large part of the study day on eco-design tools. In response to this emphasis, the students felt that it would be useful for these to be included on the website. Teachers also suggested that the tools be available to enable them to easily use the tools with their students in future sessions.

In response to these points several steps were taken to make eco-design tools on the SDA website more prominent and accessible. Links and icons were included on the website from both the 'teachers' and 'students' side. Each eco-design tool had step-by-step instructions with printer friendly tabs. Blank copies of each of the tools could be downloaded easily as well as examples of the tools being used.

6.2 Sustainable design website selection

6.2.1 Characteristics of the websites

Several key characteristics emerged from the practitioners own experience as a website designer as being important aspects to consider when reviewing each website. These, combined with the broad issues of sustainability as adopted by the SDA, were categorised under these characteristics:

- audience - who the website is aimed at;
- web objective - what the website is aiming to do;
- mission – longer term strategy relating to sustainable design;
- principles - the main theories proposed by the website;
- environmental / social / economic - the focused area of sustainability;
- materials - what and how much information is on materials;
- main areas from home - accessible pages from the homepage.

The seven characteristics are shown in Table 6-2 an access date for each website is noted, in no particular order.

6.2.2 Format of the websites

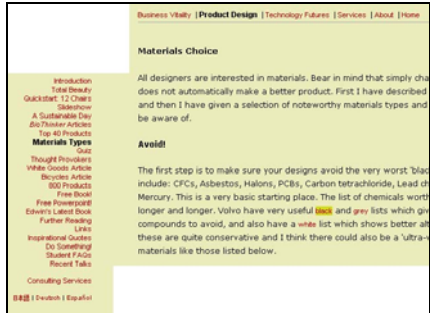
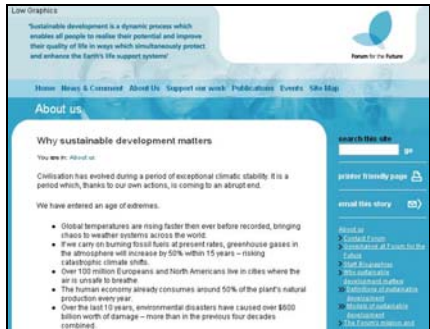
The format of the information shown on the websites fell into four broad categories, although some of the information does fall into more than one category.

- *Downloadable resources* - websites that did not directly give the information but give downloadable papers, software, checklists and activities that can be used to further knowledge in specific areas;
- *References* - websites that referred to other websites for information and collated these website / information locations in one website;
- *Inspiration* - websites that aimed to inspire through innovative design examples, projects and photographs of the world as it stands;
- *Direct information* - websites that provided information primarily aiming to give the user as much information as possible, to aid in the design process.

Table 6-2 shows the initial 25 websites categorised into these four areas after initial website analysis, with subjective notes made under each format category.

6.2.3 Navigation visuals of the websites

Table 6-2 includes screenshot images of the 25 websites. The images act as a visual indicator, showing each website, indicating its content and complexity. It is also a useful illustration of the variety of appearances and navigational structures of the websites. The visual images of each website can help to give an instant perception of how the user navigates around the website, the target audience of the website, and if the user likes the appearance of the website.

SUSTAINABLE DESIGN WEBSITE ANALYSIS	
<p>Biothinker www.biothinking.com</p> <p>Access date: 16/01/06</p> 	<p>CHARACTERISTICS</p> <p>Audience: Designers, students and businesses Web objective: Air own views on sustainability, to give guidance Mission: Redesign everything... 100% sustainable products by 2010 Principles: Based around products and Cyclic / Solar / Safe Environmental / social / economic: Environmental, social, economic Materials: Specific pages, referred to in product information Main areas from home: Business Vitality, Product Design, Technology Futures</p> <p>FORMAT</p> <p>Downloadable resources: Self-promotion References: Some to products Inspiration: Mainly serves to inspire through product examples Direct information: Detailed specific advice</p>
<p>Forum for the Future www.forumforthefuture.org.uk</p> <p>Access date: 16/01/06</p> 	<p>CHARACTERISTICS</p> <p>Audience: Business, education, organisations Web objective: Provide a platform for information on sustainable development Mission: To aid companies implement a sustainable way of living Principles: Implement own view of sustainable development in everyday life Environmental / social / economic: Environmental / Social / Economic Materials: Only in the context of sustainability Main areas from home: Every area is accessible</p> <p>FORMAT</p> <p>Downloadable resources: - References: Some references to companies elsewhere Inspiration: - Direct information: Very informative website</p>

Barking Crickets

<http://eco.barkingcrickets.org>

Access date: 16/01/06



CHARACTERISTICS

Audience: Industrial designers

Web objective: To collate sustainable design websites

Mission: To provide a quick & easy access to sustainable design websites

Principles: None followed

Environmental / social / economic: Environmental / social / economic

Materials: Mentioned through links

Main areas from home: Links split into sections

FORMAT

Downloadable resources: -

References: Used solely as a reference site with links to other websites

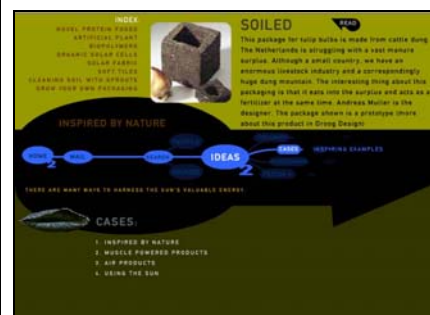
Inspiration: -

Direct information: -

O2 Network

www.o2.org

Access date: 16/01/06



CHARACTERISTICS

Audience: Designers, professionals, sustainability experts

Web objective: To provoke sustainable design solutions

Mission: Provide a network of professionals as resources to achieve environmental product solutions

Principles: None specifically followed... promotes websites and discussion of principles

Environmental / social / economic: Environmental

Materials: Mentioned in products and references, experts in different areas

Main areas from home: Search, ideas and people links

FORMAT

Downloadable resources: -

References: Referenced to selected websites and experts/people

Inspiration: Cover sustainable design products

Direct information: Good selection of information and made available through a network of people

Conservation Economy

www.conservationeconomy.net

Access date: 16/01/06



CHARACTERISTICS

Audience: General public, business, government (applicable to all)

Web objective: To communicate developed framework for sustainability

Mission: To give a framework for sustainability for people to apply, develop and work from

Principles: Based around Conservation Economy's sustainability framework

Environmental / social / economic: Environmental / social / economic

Materials: Touched on throughout via waste and services Information website with inspiration, references and resources balanced extremely well

Main areas from home: Easy to navigate framework.

FORMAT

Downloadable resources: Resources available in download

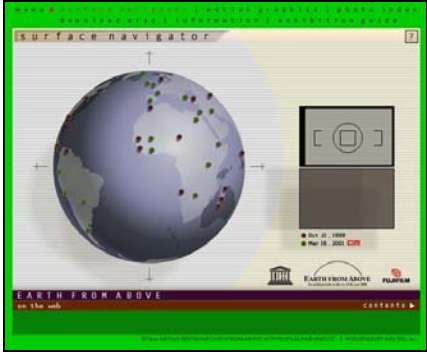

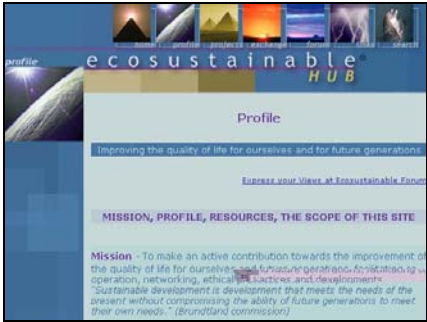
References: A handful of useful links

Inspiration: Gives inspiration through previous case studies

Direct information: Excellent information provided

Earth from Above

CHARACTERISTICS

<p>http://home.fujifilm.com/efa/mm/</p> <p>Access date:16/01/06</p> 	<p>Audience: General public, widespread appeal Web objective: Commemorate the end of millennium initially, to help raise awareness of the project and sustainability issues Mission: To support the promotion of sustainability Principles: None followed, facts stated with each photograph used as driver Environmental / social / economic: Environmental / social / economic Materials: Only mentioned briefly in annotation Main areas from home: A surface navigator, motion graphics, a photo index, a download area, information about the project and an exhibition guide</p> <p style="text-align: center;">FORMAT</p> <p>Downloadable resources: Downloadable clips References: - Inspiration: Whole site is based around images to inspire Direct information: -</p>
<p>Yann Arthus Bertrand www.yannarthusbertrand.com</p> <p>Access date:16/01/06</p> 	<p style="text-align: center;">CHARACTERISTICS</p> <p>Audience: General public Web objective: Inspire people through a portrait of the earth Mission: Inspire people to preserve the earth Principles: Links to other peoples websites and principles Environmental / social / economic: Environmental / social / economic Materials: Mentioned briefly in photo annotation Main areas from home: Photographs, Backstage, News, Practical Info, Bonus, & Have your say.</p> <p style="text-align: center;">FORMAT</p> <p>Downloadable resources: Some downloadable movies References: References to sustainable development websites Inspiration: Whole site is used to inspire people through images and design Direct information: -</p>
<p>Ecosustainable Hub www.ecosustainable.com.au</p> <p>Access date:13/01/06</p> 	<p style="text-align: center;">CHARACTERISTICS</p> <p>Audience: Designers, researchers and the general public Web objective: To provide links for free to useful sustainable websites Mission: Provide a range of sustainable sites, promoting sustainability Principles: Concentration on resources available in company: activities, focus, professions & sectors Environmental / social / economic: Environmental / social / economic Materials: Mentioned through links Main areas from home: Links split into sections</p> <p style="text-align: center;">FORMAT</p> <p>Downloadable resources: - References: Used as a reference website Inspiration: Through project links Direct information: Limited as most is linked to other sites</p>
<p>PRé www.pre.nl</p>	<p style="text-align: center;">CHARACTERISTICS</p> <p>Audience: Professionals and business consultants Web objective: Sell and promote eco-design tools</p>

Access date:20/04/06



programs

Mission: Develop & implement practical environmental tools through life-cycle analysis (LCA)

Principles: 10 golden guidelines for eco-design all environmental

Environmental / social / economic: Environmental

Materials: Throughout tools and in 10 points

Main areas from home: About, LCA software, LCA, Indicator, Eco-design, Eco-design software

FORMAT

Downloadable resources: Resources for download available, main part of site to sell downloadable products to business

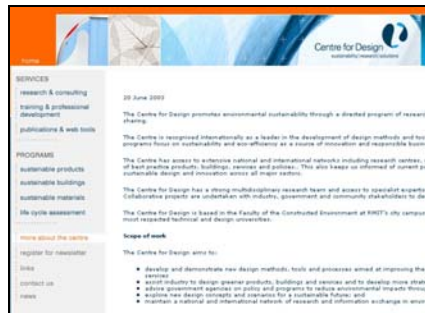
References: -

Inspiration: -

Direct information: Limited information through 10 principles

RMIT Centre for Design
www.cfd.rmit.edu.au

Access date:13/01/06



CHARACTERISTICS

Audience: Professionals & business

Web Objective: To support professionals by offering consultancy and training in sustainable design

Mission: To train people in sustainable design

Principles: Follows environmental basics

Environmental / social / economic: Environmental

Materials: Only linked in training projects / programs

Main areas from home: Programs, research consultancy and publications

FORMAT

Downloadable resources: Downloadable links to course outlines

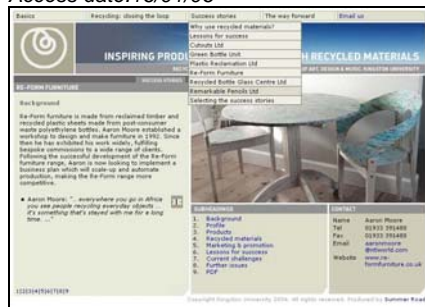
References: Vague references from the RMIT site to magazines

Inspiration: -

Direct information: Only professional research projects and training

Inspire Recycle
www.inspirerecycle.org

Access date:16/01/06



CHARACTERISTICS

Audience: Small business/enterprise in design & manufacture

Web Objective: To support and inspire recycled projects

Mission: To provide information and inspiration

Principles: Government legislation used as driver

Environmental / social / economic: Environmental

Materials: Mentioned throughout, materials specific site

Main areas from home: Guides to the site info, materials information and inspirational projects

FORMAT

Downloadable resources: -

References: Some useful references used

Inspiration: A lot of inspiration projects

Direct information: Good selected information specific to the topic

Rocky Mountain Institute
www.rmi.org

Access date:13/01/06


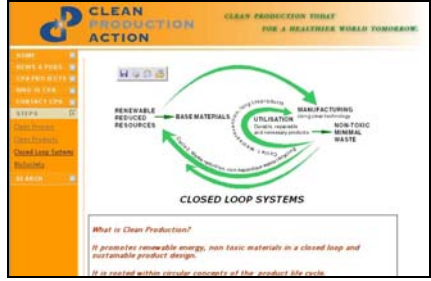

CHARACTERISTICS


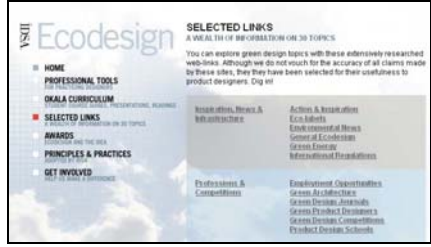

Audience: Business and organisations


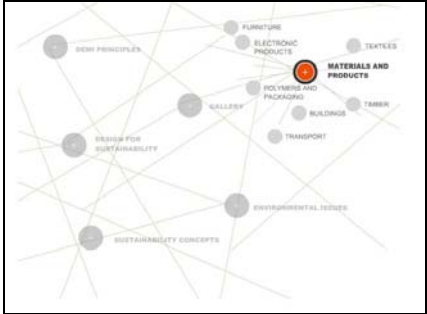

Web Objective: To provide easy access to RMI consultancy




Mission: To provide information on RMI's views and values

Principles: 9 key principles put forward by RMI

	<p>Environmental / social / economic: Environmental / economic</p> <p>Materials: Materials are mentioned in the impact section</p> <p>Main areas from home: Every section</p> <p>FORMAT</p> <p>Downloadable resources: A section on resources and downloads</p> <p>References: A few references within the website</p> <p>Inspiration: News articles</p> <p>Direct information: Information based website</p>
<p>Clean Production Action www.cleanproduction.org</p> <p>Access date: 13/01/06</p> 	<p>CHARACTERISTICS</p> <p>Audience: Business</p> <p>Web Objective: To support a shift to renewable energy sources</p> <p>Mission: Support companies in a move away from toxic materials for a cleaner future</p> <p>Principles: 4 key areas: Clean Process, Clean Product, Closed Loop Systems, BioSociety</p> <p>Environmental / social / economic: Environmental / social</p> <p>Materials: Mentioned in dematerialisation and recycling</p> <p>Main areas from home: All main parts</p> <p>FORMAT</p> <p>Downloadable resources: Used at the end of information wisely</p> <p>References: References organisations as inspiration</p> <p>Inspiration:</p> <p>Direct information: Useful information with a good use of diagrams</p>
<p>SustainAbility www.sustainability.com</p> <p>Access date: 16/01/06</p> 	<p>CHARACTERISTICS</p> <p>Audience: Business and organisations</p> <p>Web objective: To provide an information base for consultancy work</p> <p>Mission: To provide independent advice on a policy shift to sustainability</p> <p>Principles: Companies are committed, advice is taken on board and agreements are worked to</p> <p>Environmental / social / economic: Environmental / social / economic</p> <p>Materials: Limited information due to focus on general policies</p> <p>Main areas from home: Every part of the website can be accessed</p> <p>FORMAT</p> <p>Downloadable resources: Downloadable PDF's and further reports on sign-up</p> <p>References: Links to clients via projects</p> <p>Inspiration: -</p> <p>Direct information: Consultancy based information website</p>
<p>International Institute for Sustainable Development www.iisd.org</p> <p>Access date: 16/01/06</p>	<p>CHARACTERISTICS</p> <p>Audience: Business, education, organisations</p> <p>Web Objective: Better living for all -sustainably</p> <p>Mission: To champion innovation, enabling societies to live sustainably</p> <p>Principles: 6 principles outlined</p> <p>Environmental / social / economic: Environmental / social / economic</p> <p>Materials: In energy it refers to natural resources</p>

	<p>Main areas from home: So much easy to get lost</p> <p>FORMAT</p> <p>Downloadable resources: Plenty of resources for download, good teaching aids also</p> <p>References: Not too many present</p> <p>Inspiration: -</p> <p>Direct information: Information dominates the site and is vast</p>
<p>IDSA www.idsa.org</p> <p>Access date:13/01/06</p> 	<p>CHARACTERISTICS</p> <p>Audience: Professionals, designers and business</p> <p>Web objective: Collaborate industrial design resources</p> <p>Mission: To influence design with good practice</p> <p>Principles: Uses and adapts other peoples expertises in the area... refers to IDEA's principles</p> <p>Environmental / social / economic: Environmental</p> <p>Materials: References and resources in the Eco-design part</p> <p>Main areas from home: Information, Journals, Downloads and News</p> <p>FORMAT</p> <p>Downloadable resources: Downloadable guides from other companies</p> <p>References: Links to other websites prominent part of site</p> <p>Inspiration: -</p> <p>Direct information: -</p>
<p>Information:Inspiration www.informationinspiration.org.uk</p> <p>Access date:13/01/06</p> 	<p>CHARACTERISTICS</p> <p>Audience: Designers and students</p> <p>Web objective: Provide support for putting eco-design into practice</p> <p>Mission: To introduce eco-design good practice to designers</p> <p>Principles: Mostly relating to environmental issues... most principles covered through reduce, reuse, recycle and avoid.</p> <p>Environmental / social / economic: Environmental</p> <p>Materials: Own in depth section in Information, cover through products in Inspiration</p> <p>Main areas from home: Information and Inspiration split</p> <p>FORMAT</p> <p>Downloadable resources: -</p> <p>References: Links to other sites</p> <p>Inspiration: Major section of the website</p> <p>Direct information: Major section of the website</p>
<p>Sustainable Design Award www.sda-uk.org</p> <p>Access date:16/01/06</p>	<p>CHARACTERISTICS</p> <p>Audience: Teachers and AS/A2 students</p> <p>Web objective: Use as a tool to help the integration of sustainable design</p> <p>Mission: To integrate sustainability into mainstream education</p> <p>Principles: Teachers: Refers to 5 dimensions of biotinker as cyclic, solar, safe, efficient and social Students: uses stages of design process (Sustain-a-balls)</p> <p>Environmental / social / economic: Environmental, social, economic</p> <p>Materials: Referenced throughout, link to separate 'know your materials' website which is in depth</p>

	<p>Main areas from home: Students and teachers split, also News & Events</p> <p>FORMAT</p> <p>Downloadable resources: Starter activity resources & registration downloads</p> <p>References: Many links</p> <p>Inspiration: Small sections of inspiration for teachers & students</p> <p>Direct information: A lot of specific information to help through A2/AS level</p>
<p>Demi www.demi.org.uk</p> <p>Access date: 16/01/06</p> 	<p>CHARACTERISTICS</p> <p>Audience: Higher educational students & staff</p> <p>Web objective: To collate various sustainability knowledge to produce a resource</p> <p>Mission: Promote sustainability in education</p> <p>Principles: Efficiency, equity, scale, sufficiency, systems and appropriateness</p> <p>Environmental / social / economic: Environmental / social / economic</p> <p>Materials: Mentioned in depth in own section</p> <p>Main areas from home: Demi principles, gallery, design for sustainability, environmental issues, sustainability concepts, & materials and products</p> <p>FORMAT</p> <p>Downloadable resources: -</p> <p>References: Links can be found within the information to other sites</p> <p>Inspiration: Limited inspirational products are included</p> <p>Direct information: Major plus from the website is the information it holds</p>
<p>Centre for Sustainable Design www.cfsd.org.uk</p> <p>Access date: 16/01/06</p> 	<p>CHARACTERISTICS</p> <p>Audience: Teachers, business & students</p> <p>Web objective: To support sustainable design training and activities</p> <p>Mission: To train people in sustainable design</p> <p>Principles: The 3e's; Environmental, Ethical, Economic</p> <p>Environmental / Social / Economic: Environmental / social / economic</p> <p>Materials: Only in downloads and linked sites</p> <p>Main areas from home: About CfSD, Training and Journals</p> <p>FORMAT</p> <p>Downloadable resources: Mostly downloadable sections</p> <p>References: A lot of referenced sites</p> <p>Inspiration: -</p> <p>Direct information: Only on training and workshops</p>
<p>Centre for Alternative Technology www.cat.org.uk</p> <p>Access date: 16/01/06</p>	<p>CHARACTERISTICS</p> <p>Audience: General public & teachers</p> <p>Web objective: To provide information on the centre and the technologies used</p> <p>Mission: Promote a sustainable way of living</p> <p>Principles: Promote sustainable living by hands-on technologies</p> <p>Environmental / social / economic: Environmental</p> <p>Materials: Referred to in information sheets</p> <p>Main areas from home: One-way links mostly</p>

	<p style="text-align: center;">FORMAT</p> <p>Downloadable resources: Downloadable resources in the consultancy part</p> <p>References: -</p> <p>Inspiration: Inspire through hands on activities at the centre</p> <p>Direct information: Information about the centre and alternative technologies</p>
<p>Redefining Progress www.rprogress.org</p> <p>Access date:16/01/06</p> 	<p style="text-align: center;">CHARACTERISTICS</p> <p>Audience: Business, organisations and education</p> <p>Web objective: To communicate assessment of a shift in policy</p> <p>Mission: To shift policy to sustainability</p> <p>Principles: 3 key areas: measurement tools, design policies and new frameworks</p> <p>Environmental / social / economic: Environmental / economic</p> <p>Materials: Not mentioned at all</p> <p>Main areas from home: All main sections relating to the three areas/principles</p> <p style="text-align: center;">FORMAT</p> <p>Downloadable resources: Good downloadable resources, mostly publications</p> <p>References: Some useful references</p> <p>Inspiration: -</p> <p>Direct information: A website full of information on assessment of change and projects relating to this</p>
<p>Ecological Footprint www.myfootprint.org</p> <p>Access date:16/01/06</p> 	<p style="text-align: center;">CHARACTERISTICS</p> <p>Audience: General public, individuals, business, education</p> <p>Web objective: Give an indication of a persons/groups impact on the environment</p> <p>Mission: Inspire through impact assessment</p> <p>Principles: principles address food, goods, shelter and mobility, they promote local authority leadership</p> <p>Environmental / social / economic: Environmental</p> <p>Materials: Not mentioned at all</p> <p>Main areas from home: First page of footprint quiz</p> <p style="text-align: center;">FORMAT</p> <p>Downloadable resources: Resources to write to local authority</p> <p>References: References used as further help</p> <p>Inspiration: Inspirational website through own assessment</p> <p>Direct information: -</p>
<p>Design for Environment http://dfe-sce.nrc-cnrc.gc.ca</p> <p>Access date:13/01/06</p>	<p style="text-align: center;">CHARACTERISTICS</p> <p>Audience: Business and professionals</p> <p>Web objective: To provide information that can be easily understood</p> <p>Mission: To give a resource for businesses to integrate DfE principles easily</p>

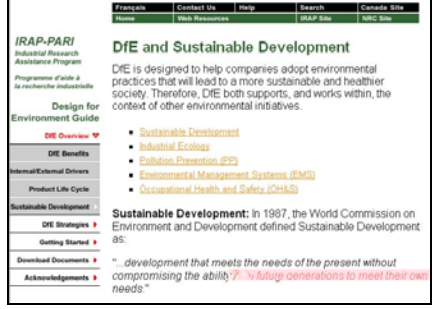

 <p>IRAP-PARI Industrial Research Assistance Program Programme d'aide à la recherche industrielle</p> <p>Design for Environment Guide</p> <p>DfE Overview</p> <ul style="list-style-type: none"> DfE Benefits Internal/External Drivers Product Life Cycle Sustainable Development DfE Strategies Getting Started Download Documents Acknowledgements <p>DfE and Sustainable Development</p> <p>DfE is designed to help companies adopt environmental practices that will lead to a more sustainable and healthier society. Therefore, DfE both supports, and works within, the context of other environmental initiatives.</p> <ul style="list-style-type: none"> Sustainable Development Industrial Ecology Pollution Prevention (PP) Environmental Management Systems (EMS) Occupational Health and Safety (OHS) <p>Sustainable Development: In 1987, the World Commission on Environment and Development defined Sustainable Development as:</p> <p>"... development that meets the needs of the present without compromising the ability of future generations to meet their own needs."</p>	<p>Principles: Sustainable Development, Industrial Ecology, Pollution Prevention, Environmental Management Systems, Occupational Health and Safety</p> <p>Environmental / social / economic: Environmental / social / economic</p> <p>Materials: Direct information, specific</p> <p>Main areas from home: Every part of the website can be accessed</p> <p>FORMAT</p> <p>Downloadable resources: All sections are available in a downloadable format</p> <p>References: Selected links away from information</p> <p>Inspiration: -</p> <p>Direct information: Outstanding resource for information</p>
<p>RecycleZone www.recyclezone.org.uk</p> <p>Access date: 16/01/06</p> 	<p>CHARACTERISTICS</p> <p>Audience: Students and teachers</p> <p>Web objective: To provide an innovative information tool</p> <p>Mission: Promote good waste management</p> <p>Principles: Reduce, reuse, recycle</p> <p>Environmental / social / economic: Environmental</p> <p>Materials: Referred to in waste and recycling sections, not specific</p> <p>Main areas from home: Every part including About Us</p> <p>FORMAT</p> <p>Downloadable resources: -</p> <p>References: Some references to Waste Watch supporters</p> <p>Inspiration: Inspiration through innovative presentation</p> <p>Direct information: Information based website with good navigational properties</p>

Table 6-2: Review of the sustainable design websites

The 25 sustainable design websites are available as movie files in the annexes.

6.3 Website selection summary

The initial analysis of the 25 sustainable design websites enabled them to be categorised in terms of format, characteristics and visual navigation. It also gave the research practitioner an extensive overview of the websites. This process helped to reduce the number of websites down to 19.

The six sustainable design websites removed from the study and reason for their removal is as follows:

- *Yann Arthus Bertrand*: lack of information, professional photography;
- *Ecosustainable Hub*: limited information and external websites linked;

- *IDSA*: information limited to industrial design;
- *Ecological Footprint*: focused on finding out the users' ecological footprint, limited information;
- *Design for Environment*: lacks graphics, just specifically information on the environment and could only be downloaded as documents;
- *RecycleZone*: the target audience is too young and although well presented graphically it has limited information;

It would be difficult to investigate 19 websites, given the timescale, and the research methodology needed and so a further reduction would take place. Section 7.1 describes the cluster analysis undertaken to help analyse the websites in more detail. The cluster analysis would allow websites to be assigned to a type. A more comprehensive investigation could then take place in the main study that looks in depth at the effectiveness of a particular type of sustainable design website.

CHAPTER 7 MAIN STUDY: FOCUS FINDINGS

This chapter reports the categorisation of the sustainable design websites using 12 features model design webs and cluster analysis. The chapter also reports the main part of the study exploring designing within AS/A2 level Design and Technology education. It describes the findings of the research categorised into three sections of 'before use', 'during use' and 'after use'.



After reporting the research methodology (Chapter 5) and looking at the sustainable design websites (Chapter 6), the results of the main study are reported in this chapter presented in the following categories:

Cluster analysis

- 12 features webs;
- cluster analysis.

Before use

- *AS/A2 level:* website use questionnaires, post-presentation questionnaires;

During use

- *Undergraduates:* usability questionnaires, usability checklists.

After use

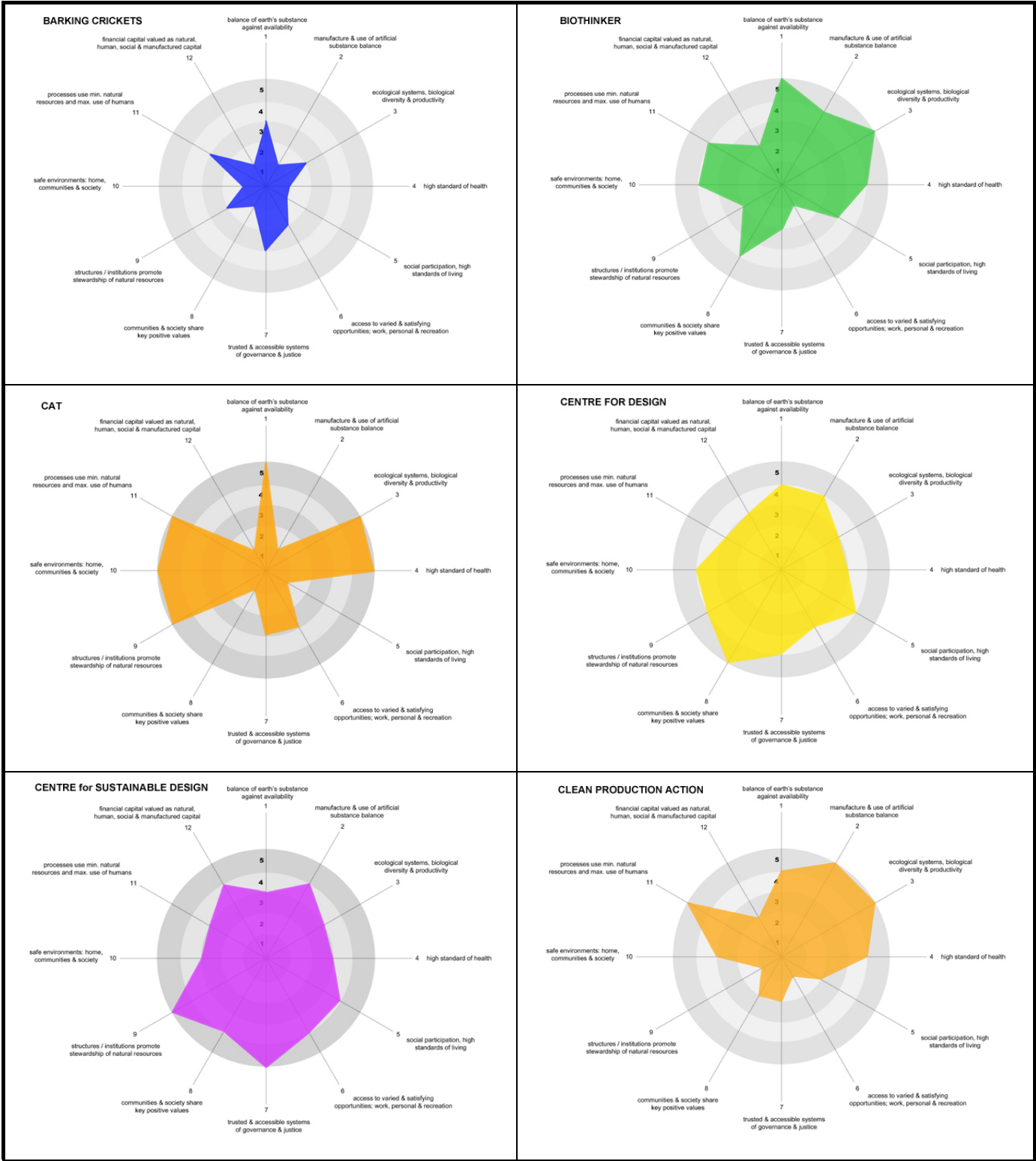
- *AS/A2 level:* case studies, folio assessment observations.

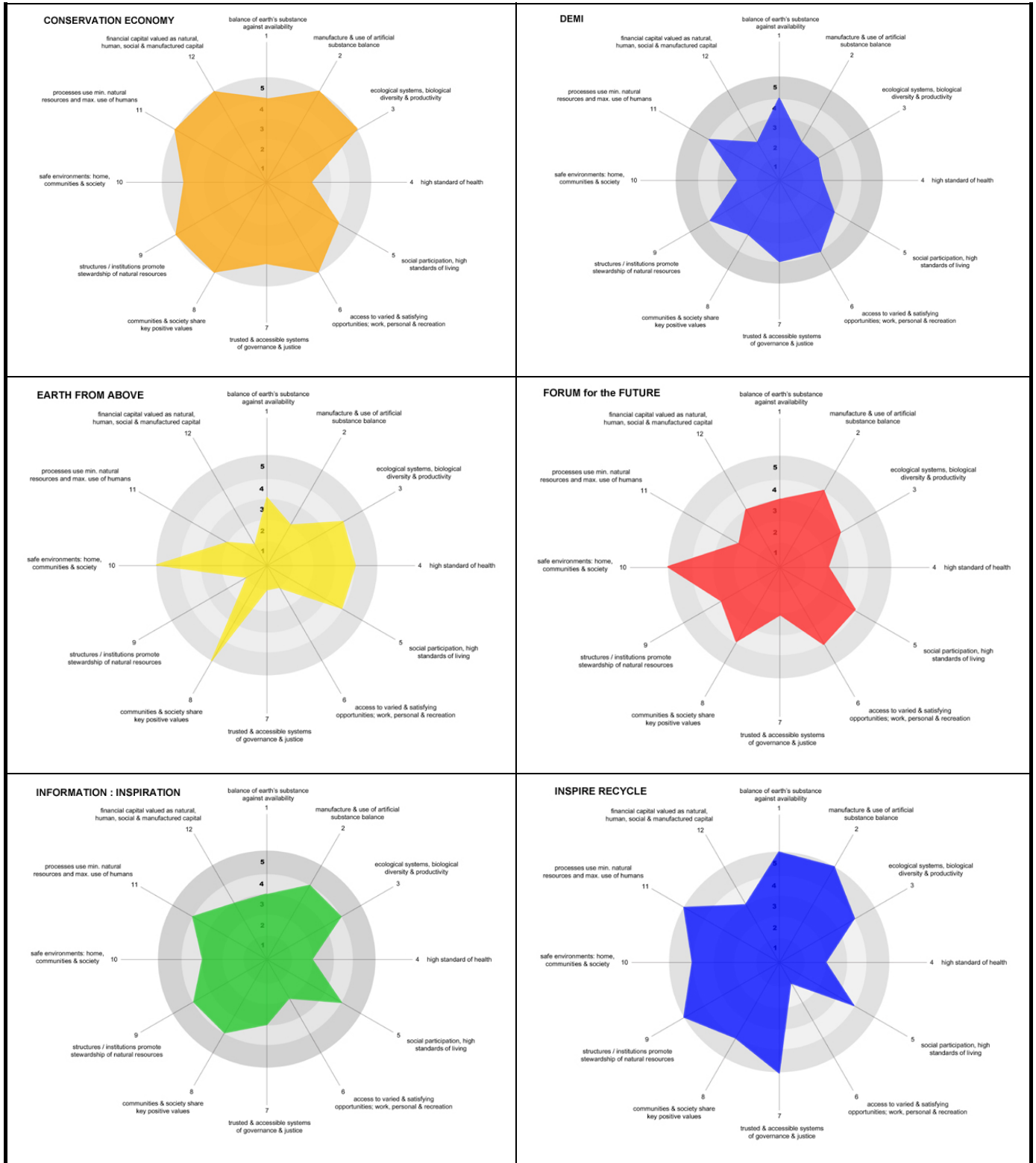
Interview

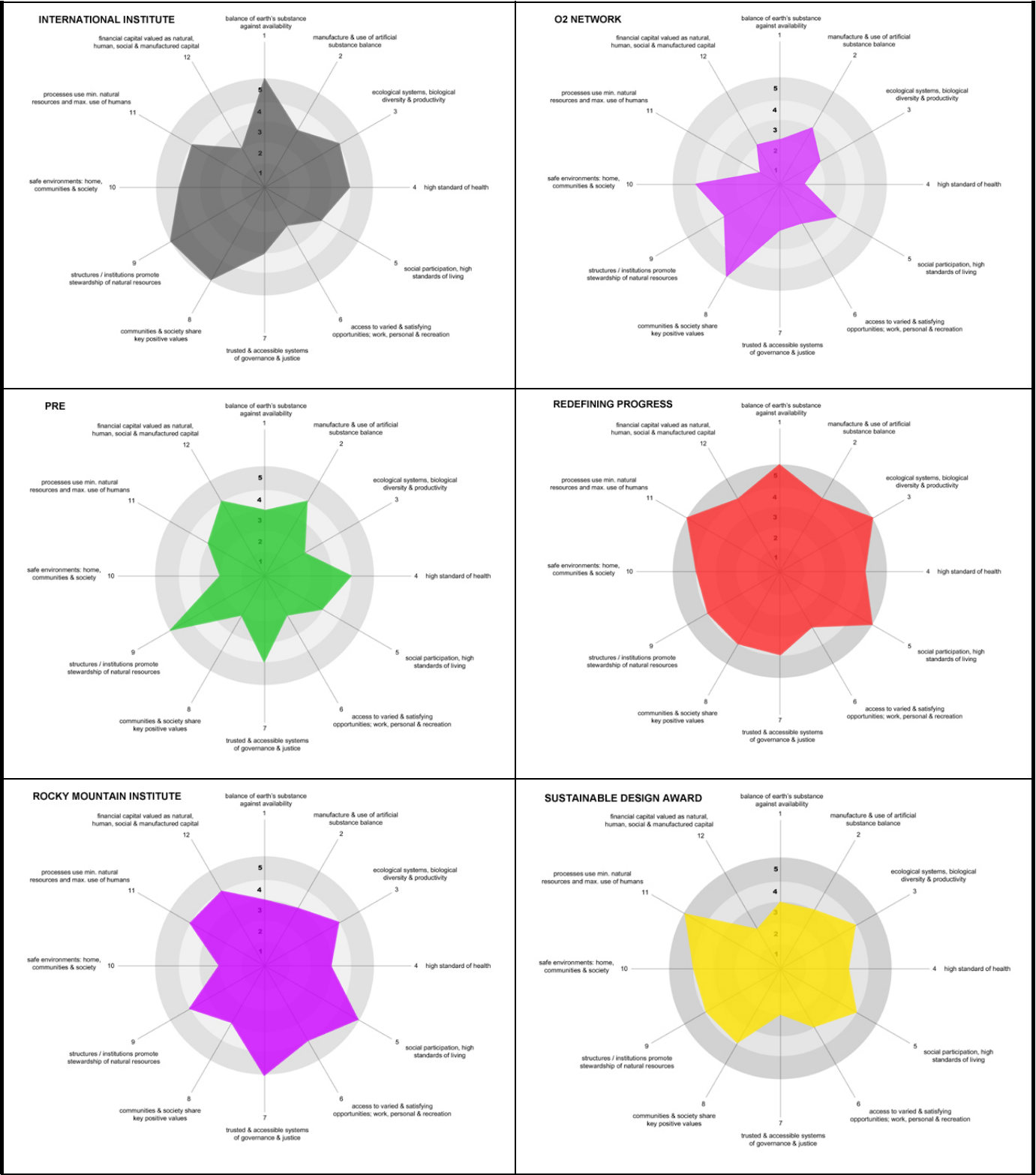
- *Education co-ordinator:* Ian Capewell – Sustainable Design Award, Practical Action.

7.1 Cluster analysis

The results from each of the 19 websites are shown in Figure 7-1, websites are in alphabetical order.







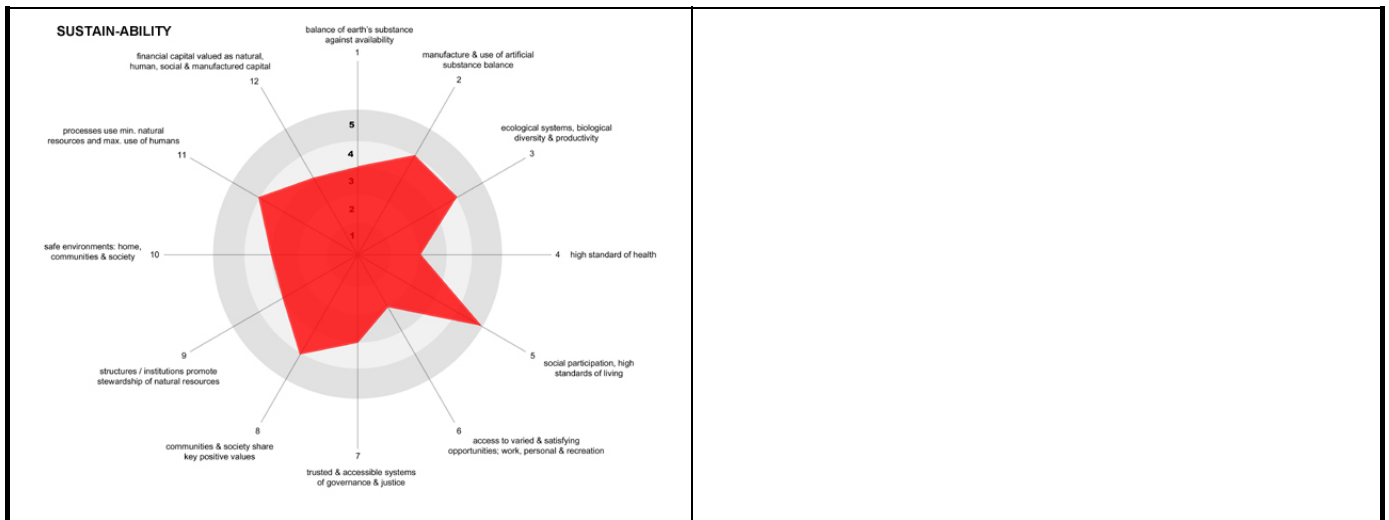


Figure 7-1: Sustainable design content webs based on the 12 features model (Johnston 2003)

These enabled a greater comparison of the websites. For example it is easier to detect a website with low content on some areas in comparison to others. It also enabled an easier visual comparison across the specific target audiences. The new method was then presented in a conference paper at the Design and Technology Association's annual conference (Simmons and Badni 2006), with extremely positive feedback.

7.1.1 12 feature model web summary

The diagrams are useful in displaying the content of the sites visually and they have proved a useful tool in selecting the specific websites to look at. For example, the Barking Crickets website did not have information present on some areas and had major omissions. Conservation Economy scores highly on most of the 12 features, including extensive content on most areas. These design webs can be useful tools in showing which websites contain which information. The framework could also be used by other studies in the future.

7.1.2 Cluster analysis

The content analysis graded the websites content from 1-5 on the amount of information about a specific area of sustainability (as illustrated by the design webs in Figure 7-1). A rating of 5 would indicate extensive content about an area or a rating of 1 would indicate information is not present. A cluster analysis then grouped these

websites into 2 main clusters based upon how they rated in this content analysis; cluster A and cluster B.

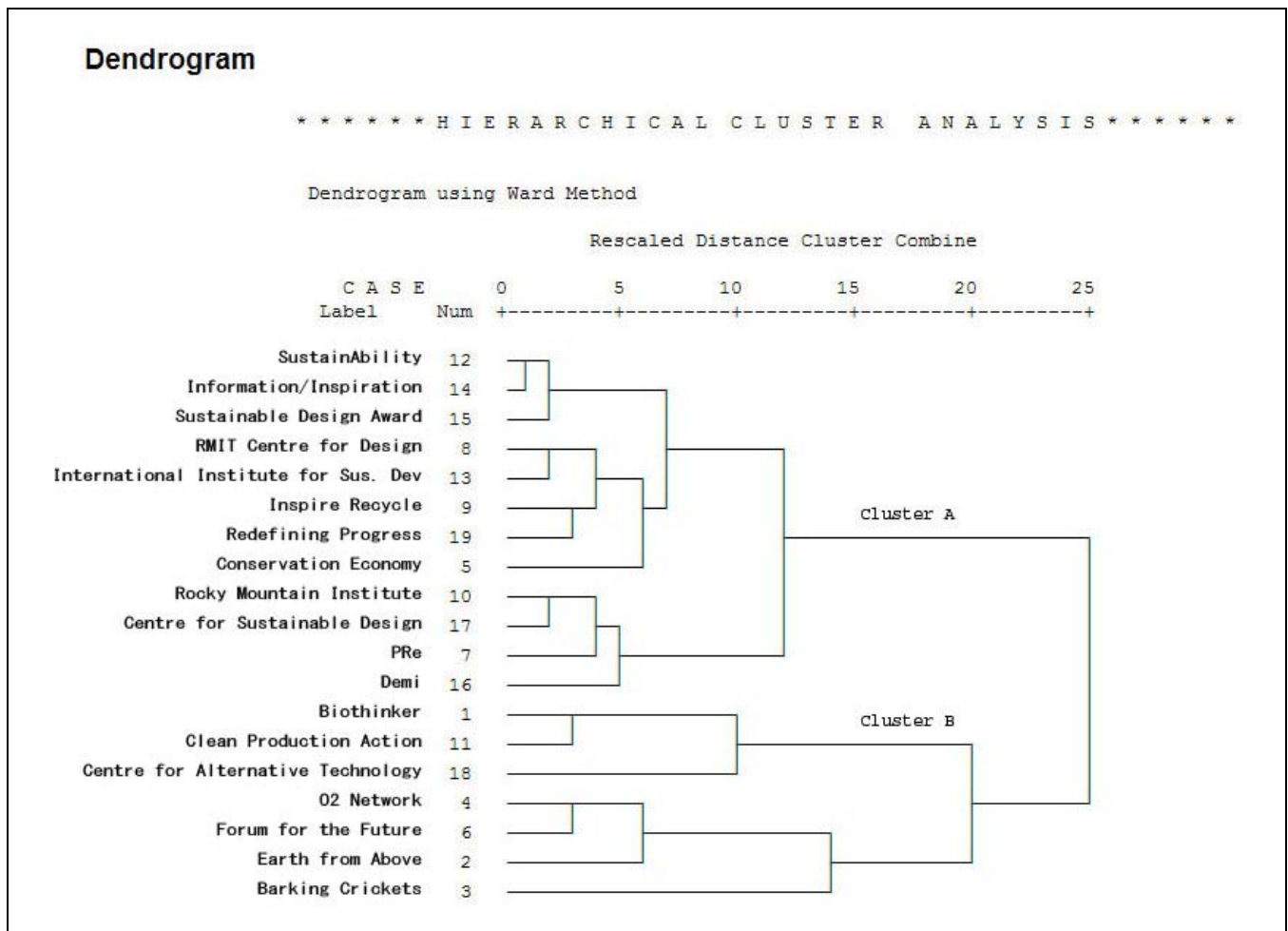


Figure 7-2: Cluster Analysis of 19 sustainable design websites

The clusters have identified two main types of website. Cluster A are websites that mostly give direct information, contained on the website itself. Cluster B contain websites such as sustainable forums and hubs that link to other external websites.

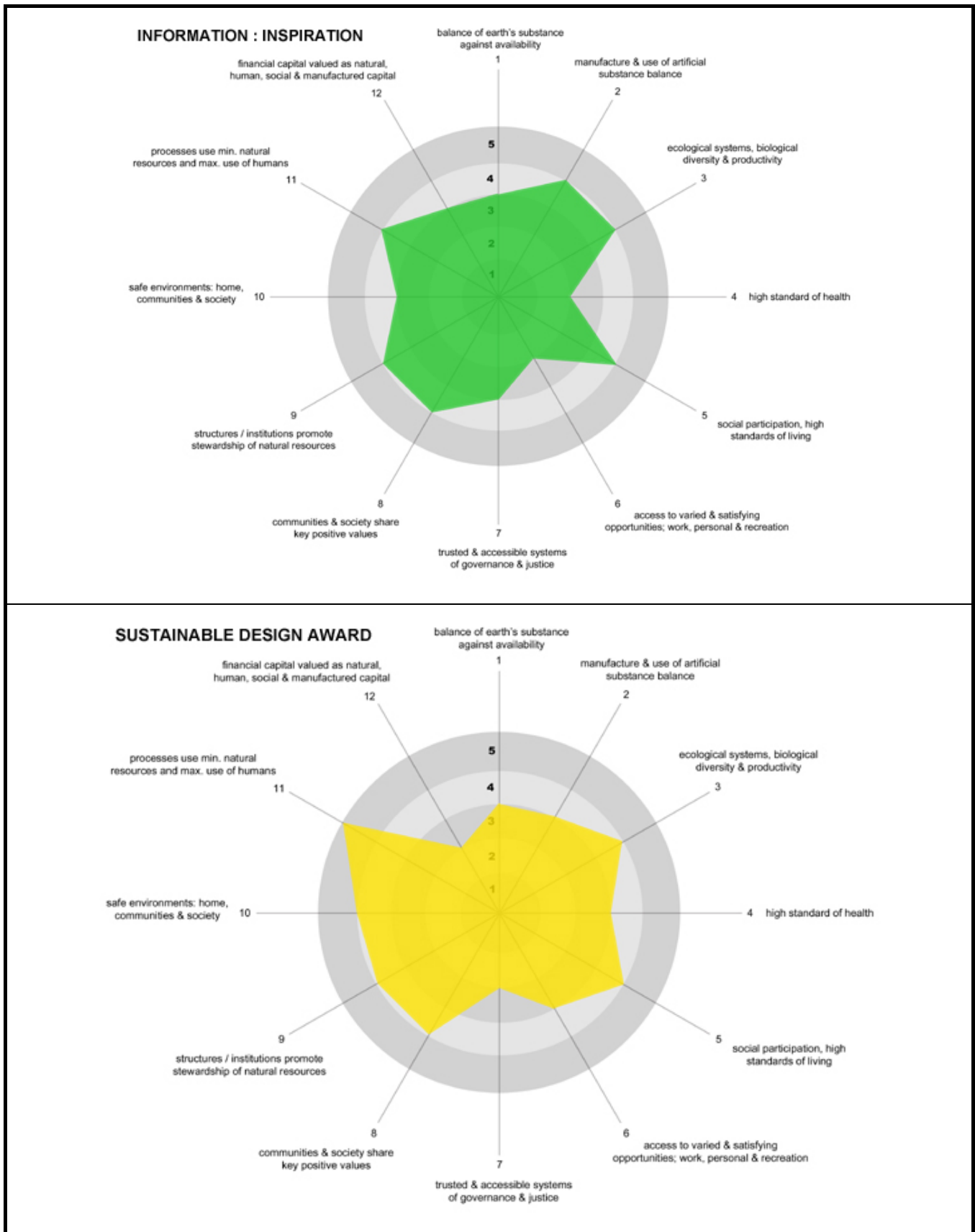


Figure 7-3: Website content diagrams for the Information:Inspiration and SDA websites

The investigation has become more focussed since this analysis, looking at sustainable design scheme websites from Cluster A such as the SDA and Information:Inspiration. Figure 7-3 shows examples of the two content diagrams presented in 2006 for these two websites.

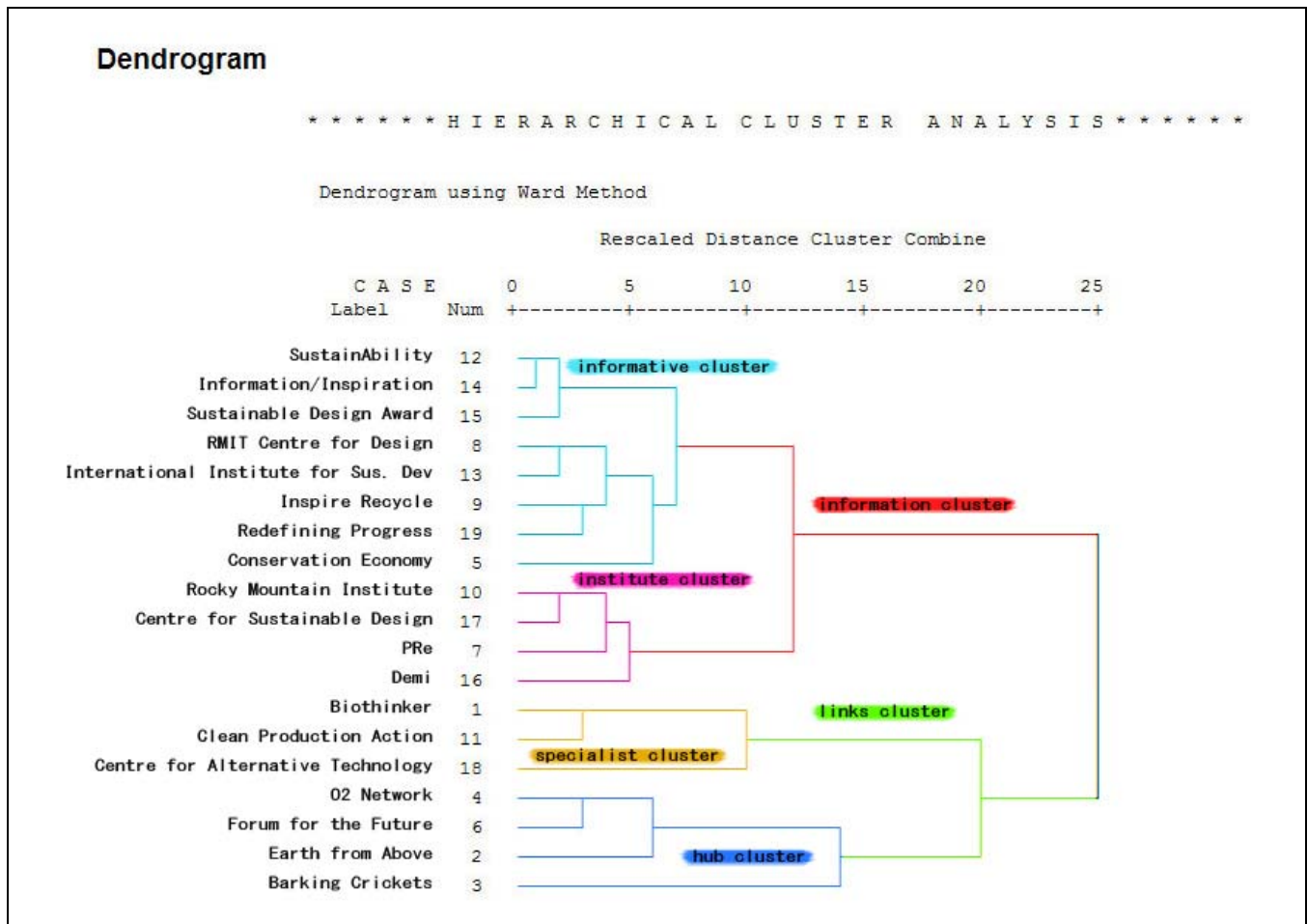


Figure 7-4: Cluster Analysis with cluster labels

The labels were given to the clusters in Figure 7-4 to reflect the analysis of the websites in Table 6-2. Two main cluster groups have been outlined that look at the format of the websites, these are:

- **information** (informative and institute clusters) – contains detailed information on sustainable design directly on the website which is aimed at educating;
- **links** (specialist, hub) – these websites do not give much information directly on the website and typically reference off to other websites which hold greater information.

The websites were broken down into a further four clusters:

- **informative cluster** – includes websites such as the Sustainable Design Award, Information:Inspiration and Redefining Progress that includes detailed information on sustainable design;
- **institute cluster** – these websites are mainly websites from institutions or websites that have been collaborated on by educational departments, still includes a lot of detailed information but is focused at one target audience;
- **specialist cluster** – these websites seem to focus on one specific area of sustainable design and limit themselves to that i.e. Clean Production Action looks at cleaner production, Centre for Alternative Technology focuses on alternative methods;
- **hub cluster** – these websites do not hold much information on the website directly, but refer to other sources or networks, Barking Crickets for example is a hub website that refers to other websites in sustainable design, the O2 Network is more of a way of connecting people that have an interest in sustainable design rather than informing them.

The 19 websites aim to inform young designers of the issues surrounding sustainability. They also aim to guide their design decisions by giving them access to more specific sustainable information. Their success may be determined by analysing how effective they are at communicating the information, ‘before use’, ‘during use’ and ‘after use’.

7.2 Before use

7.2.1 AS/A2 level: website use questionnaires

Five schools participated in the study, four schools had volunteered at a SDA study weekend and one other. 72 students aged 16-18 were given questionnaires.

School B, Trial A2, Student 30

Name..... Age 18.....

~~AS~~ A2 Graphic products

Sustainability and website use in design projects

1) What is your background in sustainability? Have you studied it as part of your design lessons?
Yes, in Graphic products as part of my project I decided to do the sustainability award

2a) Are you taking part, or considering taking part, in the Sustainable Design Award?
Yes, I'm doing the second part of the award

2b) Have you been on any study days/weekends such as the Sustainable Design Award?
no

3a) Have you used any websites in general to help with your design work, if so, which ones?
Sustainability website

3b) When do you use websites in your design work? (please tick as appropriate)

0-30 days into your project:	all the time <input type="checkbox"/> sometimes <input checked="" type="checkbox"/> rarely <input type="checkbox"/> not at all <input type="checkbox"/>
30-60 days into your project:	all the time <input type="checkbox"/> sometimes <input checked="" type="checkbox"/> rarely <input type="checkbox"/> not at all <input type="checkbox"/>
60-90 days into your project:	all the time <input type="checkbox"/> sometimes <input checked="" type="checkbox"/> rarely <input type="checkbox"/> not at all <input type="checkbox"/>
More than 90 days:	all the time <input type="checkbox"/> sometimes <input type="checkbox"/> rarely <input type="checkbox"/> not at all <input checked="" type="checkbox"/>

4a) Have you used any sustainable design websites? If so, which ones? Which parts, if any, did you find useful?
Information on economic & social issues

4b) When do you use sustainable design websites in your design work? (please tick as appropriate)

0-30 days into your project: all the time ☒ sometimes ☐ rarely ☐ not at all ☐

30-60 days into your project: all the time ☒ sometimes ☐ rarely ☐ not at all ☐

60-90 days into your project: all the time ☐ sometimes ☒ rarely ☐ not at all ☐

More than 90 days: all the time ☐ sometimes ☒ rarely ☐ not at all ☐

4c) Which parts of sustainable design websites did you like and dislike?
The help with the course work and areas of sustainability to develop the projects

5a) Have you been on the Sustainable Design Award (SDA) website? Which parts, if any, did you find useful?
yes, the eco web analysis was very useful

5b) If yes, when did you use the SDA website in your design work? (please tick as appropriate)

0-30 days into your project: all the time ☒ sometimes ☐ rarely ☐ not at all ☐

30-60 days into your project: all the time ☐ sometimes ☒ rarely ☐ not at all ☐

60-90 days into your project: all the time ☐ sometimes ☐ rarely ☒ not at all ☐

More than 90 days: all the time ☐ sometimes ☐ rarely ☒ not at all ☐

5c) Which parts of sustainable design websites did you like and dislike?
I liked how they simplified the information making it easier to understand

Thank you for your time and feedback.

*note 'all the time' was explained as every two days

Figure 7-5: Example website use questionnaire used in the main study

Sustainable design practice

The results of the questionnaire indicated that sustainability is a prominent part of Design and Technology education with 78% having had some sustainability input. Around two thirds of the AS/A2 students were intending to take, or had taken, the Sustainable Design Award. Only 25% of all the AS/A2 level Design and Technology students had attended an SDA study day.

Sustainability background	Yes	Some/intend to	None/No
Have you had any sustainability education as part of your design lessons?	38%	40%	22%
Are you taking part, or considering taking part, in the Sustainable Design Award?	35%	33%	32%
Have you been on any study days/weekends such as the Sustainable Design Award?	25%	-	75%

Table 7-1: Students sustainability background

Website use during design project work

	Have you used any websites?	
	Yes	No
General websites	71%	29%
Sustainable websites	52%	48%
SDA website	28%	72%

Table 7-2: Website use in AS/A2 design project work

71% of the students said that they had used websites within their design work and that this use was more frequent at the start of their design projects. The use of websites was seen to decrease throughout a project. This was a trend throughout the results for both sustainable design websites and the SDA website. Around half of the students had used sustainable design websites but only 28% of the students had used the SDA website.

Website use stages in design projects		Every 2 days	Sometimes	Rarely	Not at all
0-30 days into the project	General websites	35%	44%	7%	14%
	Sustainable websites	9%	29%	15%	47%
	SDA website	11%	9%	2%	78%
30-60 days into the project	General websites	14%	46%	23%	17%
	Sustainable websites	6%	19%	21%	54%
	SDA website	2%	15%	4%	79%
60-90 days into the project	General websites	6%	35%	36%	23%
	Sustainable websites	0%	17%	25%	58%
	SDA website	0%	6%	14%	80%
90+ days into the project	General websites	7%	21%	35%	37%
	Sustainable websites	0%	13%	19%	68%
	SDA website	0%	2%	12%	86%

Table 7-3: Website use during AS/A2 designing

Table 7-3 indicates that website use is fairly frequent early on in their design work and as the project progresses this usage fades. These percentages drop after 90 days of a design project, indicating significantly less use of websites as projects move on to more hands on and perhaps evaluation activities. For design projects that run for more than 90 days there is a substantial increase in those students that do not use websites at all in their design work.

The percentage of AS/A2 level Design and Technology students not looking at sustainable design websites at all rises from 47% in the first 30 days to 68% after 90 days into the project work.

7.2.2 AS/A2 level: post-presentation questionnaires

18 of the 72 students, who took part in the website use questionnaires (7.2.1), were tracked in more detail. The 18 students were asked to complete a similar questionnaire after they had seen a PowerPoint presentation (Figure 7-6).

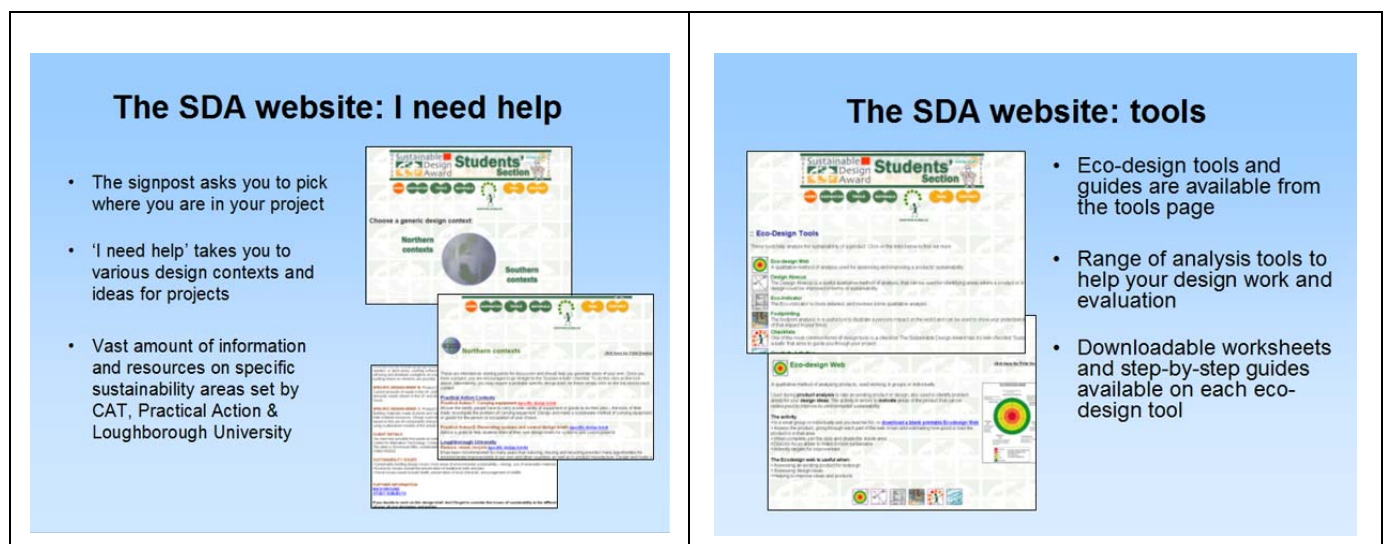


Figure 7-6: PowerPoint slide examples

The PowerPoint highlighted to the group areas of the Sustainable Design Award website which were aimed to help their design work. The 18 students' design work is then assessed (7.4.2).

The questionnaire (Figure 7-7) included the same closed questions on website use that were used in the website use questionnaire. It also asked what they were looking for and how long it took them, for general websites, sustainable design websites and SDA website. It also asked them which month during their AS/A2 level year that websites were used.

School D, Trial B1, Student 117

Name: _____ Age: 18

AS or A2: A2 Examination board: OCR

Project title: Recycling bin

Sustainability and website use in design projects

Student Notes

1a) When do you use websites in your design work? (please tick an appropriate)

0-30 days into your project: every 2 days ☒ sometimes ☐ rarely ☐ not at all ☐

30-60 days into your project: every 2 days ☒ sometimes ☐ rarely ☐ not at all ☐

60-90 days into your project: every 2 days ☒ sometimes ☐ rarely ☐ not at all ☐

More than 90 days: every 2 days ☒ sometimes ☐ rarely ☐ not at all ☐

1b) What were you looking for?

I was looking for existing products which would guide me in the direction of a sustainable design. I was also looking for a range of ideas for this.

1c) How long did it take you to find it?

I spent about an hour searching for a range of ideas.

2a) When do you use sustainable design websites in your design work? (please tick an appropriate)

0-30 days into your project: every 2 days ☒ sometimes ☐ rarely ☐ not at all ☐

30-60 days into your project: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

60-90 days into your project: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

More than 90 days: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

2b) What were you looking for?

I was looking for ways in which I could make my design as sustainable as possible.

2c) How long did it take you to find it?

I only searched about an hour in different areas for a range of ideas.

3a) When did you use the SDA website in your design work? (please tick an appropriate)

0-30 days into your project: every 2 days ☐ sometimes ☒ rarely ☐ not at all ☐

30-60 days into your project: every 2 days ☐ sometimes ☐ rarely ☒ not at all ☐

60-90 days into your project: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

More than 90 days: every 2 days ☐ sometimes ☐ rarely ☒ not at all ☐

3b) What were you looking for?

I was looking for ways to improve my design. I was also looking for ideas and choices given.

3c) How long did it take you to find it?

I was told to use it by my teacher. I spent about 30 mins using it.

Thank you for your time and feedback.

Figure 7-7: An example of the second post-presentation website use questionnaire

Although statistically insignificant having just focused on 18 students, the case studies were useful to examine the answers in detail.

Website use stages in design projects		Every 2 days	Sometimes	Rarely	Not at all
0-30 days into the project	General websites	7	7	1	0
	Sustainable websites	3	3	2	7
	SDA website	1	4	1	9
30-60 days into the project	General websites	2	9	3	1
	Sustainable websites	0	4	5	6
	SDA website	0	2	4	9
60-90 days into the project	General websites	1	5	5	4
	Sustainable websites	0	1	7	7
	SDA website	0	2	4	9
90+ days into the project	General websites	2	4	1	8
	Sustainable websites	0	0	5	10
	SDA website	0	0	4	11

Table 7-4: Website use during AS/A2 designing, post-presentation

The results in Table 7-4 indicate a higher number of people look at websites at the start of projects than at the end. The results indicate that sustainable design website use decreases both over time and in the regularity of use.

Finding information from websites		Questionnaire responses
What were you looking for?	General websites	Research, photographs, existing products, mood board materials, history of products, joining methods, inspiration, company information
	Sustainable websites	Ways to recycle, sustainable practice examples, sustainable materials, non-toxic materials
	SDA website	Sustainability information in general, existing product examples, project topic ideas which found on website
How long did it take you to find it?	General websites	Seconds on search engine, an hour, within 2 hours, not long
	Sustainable websites	Not long, half an hour, a long time
	SDA website	Not long, 10 minutes, 30 minutes, spread over days

Table 7-5: Finding information from websites during AS/A2 designing, post-presentation

The results from the questionnaires shown in Table 7-5 indicate that the students used websites in general for research into existing products and material choices. It also showed websites were used for decorative images.

Recycling, material choice and general sustainable practices were highlighted by the students as what they were looking for from sustainable design websites. There was a variety of responses regarding how long it took the students to find this.

The indication from the results is that the SDA website was used for information on sustainability generally, existing product inspiration and sustainable project briefs. Most of the students reported to find this information within half an hour of accessing the website.

7.3 During use

7.3.1 Undergraduates: usability questionnaires

The usability questionnaires were completed before their computer studies lecture, so as not to influence any feedback. The usability questionnaires aimed to help refine the assessment of the SDA website and the Information:Inspiration website. They were analysed in the pilot studies by 59 undergraduate students along with 23 other websites. The main study focused on two websites specifically, to allow greater accuracy in the data of the usability analysis, the lecture contained 41 undergraduate students.

The answers from two questions concerning sustainable design and website effectiveness are reported in Table 7-6.

Did you take the sustainable design module or undertake any sustainable design education?	
Yes	24 - Recycling, sustainability and environmental issues, important for design of the future
No	17
How would you measure the effectiveness of websites?	
Navigation (how instinctive navigation is, its complexity, no scroll, directness to information, logical links between pages) Layout (impact of graphical layout, flow of page, balance of text and graphics, links are instinctive, clearly defined sections) Download time (no long flash downloads) Content (information easy to find, user attention, delivery of the information, usable and accessible, quality and authenticity)	

Table 7-6: Questionnaire responses from the undergraduate students

Table 7-6 shows that 24 out of the 41 students questioned had either taken the sustainable design module or had undertaken some sustainable design education. Several students reported that they felt sustainable design practice was important for the future. The undergraduate students highlighted four areas that they would consider when measuring effectiveness: navigation, layout, download time, and content.

The feedback identified how instinctive, logical, complex, and direct, the navigation of the website is as being important. The clarity of layout, flow of pages and balance of each page would aid the graphical impact. The students also identified download times as being an important aspect as well as the management of the content. The content needed to be easy to find, capable of retaining attention, accessible and authentic. The undergraduates were then given either the Sustainable Design Award website or the Information:Inspiration website to analyse.

Sustainable Design Award website

Undergraduates who had been given the Sustainable Design Award website were asked to respond to how usable they thought the website was? These comments were not guided but were summarised into four emerging categories: navigation, layout, visual impact, and content (Table 7-7).

How usable is the Sustainable Design Award website?
<ul style="list-style-type: none"> • Navigation (easy to navigate, clean and clear diagrams/information to support sections; good help menu; home buttons help to navigate back) • Layout (responsive buttons are easy to use; good links embedded in the text; good referrals to supporting websites; inspiration section is quite effective with rollover buttons) • Visual impact (good graphical user interface, visually attractive; change to solid background colour despite good visual contrast; images are well labelled; quick loading) • Content (large amount of useful information, which sometimes can be tiresome, is split into appropriate sections throughout the website, as a result some styles are inconsistent; Sustainaballs and materials sections open new windows; Sustainaballs section breaks down the sections well; tick boxes in don't do anything)

Table 7-7: Sustainable Design Award website questionnaire feedback

The results indicate that the students found the website easy to navigate with clear buttons and links to supporting information. Visually the website was also praised, strongly contrasting colours being used to add clarity. Although a student did mention that they would change the background. All images were well labelled and quick loading. The website was said to contain a lot of information that had been compartmentalised, which resulted in inconsistent styles for example with the materials section in comparison to the main website pages.

Information:Inspiration website

As with the Sustainable Design Award website, the undergraduate students who were given the Information:Inspiration website were asked to give their feedback on the website concentrating on its usability. The feedback is displayed using the same categories which had emerged for the SDA website: navigation; layout; visual impact; and content.

How usable is the Information:Inspiration website?
<ul style="list-style-type: none"> • Navigation (easy to navigate but could reduce parts; clear consistent menus which help to guide you through the website; product icons not very clean, no need for 'more icon' next to images; search goes to Google rather than searching the website itself) • Layout (a lot of information to display but logical layout, sometimes over difficult; no clutter but it can be annoying to scroll for just a little information) • Visual impact (graphical lay out could be better; different labelling to distinctively separate sections; image sizes are appropriate as thumbnails are used although not all use ALT tags; slow to load due to bitmap images; too much blank space; cluster of images on home needs further explanation; too much text so pages not visually stimulating) • Content (eco-information screen no use)

Table 7-8: Information:Inspiration website questionnaire feedback

The results in Table 7-8 indicate that the Information:Inspiration website uses clear consistent menus to help guide the user through the website. The users found the layout to be logical but the scrolling to be annoying. They suggested that the information be reduced. This may help eradicate any problem with scrolling and page sizes indicated in the feedback. Visually the feedback indicated that the images could have been stronger and not all included ALT tags. The image sizes were seen as appropriate although the download time was often lengthy due to the bitmap format used.

7.3.2 Undergraduates: usability checklists

As part of the usability analysis of the websites, undergraduate students gave a manual assessment of the Sustainable Design Award website and the Information:Inspiration website. This assessment took into account: navigation, functionality, control, language, feedback, consistency, error prevention and visual clarity. As well as completing a checklist the students were asked how usable they felt the both websites were. The students' answers to the open question have been presented as a list in 7.3.1.

The results of this usability analysis are shown in Table 7-9 and Table 7-10, the undergraduate students were asked to tick which box they feel is most applicable when accessing the website. The numbers of students selecting each fulfilment box: always, sometimes and never are shown in the tables.

7.3.2.1 Sustainable Design Award website

20 undergraduate students used the usability checklist to assess the Sustainable Design Award website. The checklist results (Table 7-9) indicate that the SDA website did not include a site map or search facility, although the links to the home and major parts of the SDA website were accessible. The undergraduates found the functionality of the SDA website fairly straightforward with no plug-ins and a clearly labelled layout. The control aspects of the website analysis indicate that it is supported by all appropriate browsers, navigation and exit buttons were compatible. The indications from the results are that the language use is appropriate to the target audience and unnecessary jargon is avoided.

Website use stages in design projects		Always	Sometimes	Never	Notes
Navigation	Current location indication	5	11	4	Few pages
	Clear link to home	11	9	-	Header link error
	All parts accessible from home	7	8	5	Clear signposting
	A site map is available	-	2	16	
	Simple structure	2	9	9	
	Easy to use search function	3	2	15	
Functionality	All functionality is clearly labelled	7	11	1	Could be clearer
	Functionality without external sites	9	7	2	
	No unnecessary plug-ins	15	3	2	
Control	User can cancel all operations	10	6	2	Back buttons
	Clear exit point on each page	6	10	2	
	All graphics links as text links	9	6	3	Bitmap based
	Site supports user workflow	4	9	4	Good flow
	Appropriate browsers supported	12	3	-	
Language	Language used is simple	16	4	-	Targeted audience
	Jargon is avoided	13	7	-	No complexity
Feedback	Clarity of what is happening	5	12	1	Clear windows
	Users can give email feedback	7	1	9	
	Users informed if plug-in required	-	1	6	
	Online help is available	2	4	10	FAQs
Consistency	One word descriptions	7	8	3	
	Links match the titles	12	6	-	Clear links
	Standard colours for links/revisits	9	8	1	
	Web terminology consistent	16	2	-	
Error Prevention	Unnecessary errors do not occur	10	4	-	
	Error messages clear	11	3	1	
	Errors describes action necessary	5	3	4	
	Errors show clear exit point	6	-	5	Header links
	Errors give contacts for assistance	4	1	5	
Visual Clarity	The layout is clear	2	12	2	Not to start
	Sufficient 'white space'	9	8	3	Good spacing
	All images have ALT tags	11	3	1	Good
	Unnecessary animation avoided	17	2	-	

Table 7-9: Results of the usability checklist for the Sustainable Design Award website

The SDA website is reported to be clear but there is some confusion over feedback and no support offered to the user of how to use the website. Most of the undergraduates agree that the consistency of the website's colours, links and terminology was high.

Errors were not reported throughout the SDA website. The visual clarity reports a clear layout sometimes, with sufficient white space, ALT tags and unnecessary animation is avoided.

7.3.2.2 Information:Inspiration website

21 undergraduate students used the usability checklist to assess the Information:Inspiration website (Table 7-10).

Website use stages in design projects		Always	Sometimes	Never	Notes
Navigation	Current location indication	19	2		
	Clear link to home	20	1		
	All parts accessible from home	12	7	2	Confusing sub menu
	A site map is available		2	19	
	Simple structure	14	7		
	Easy to use search function	12	6	2	Powered by Google
Functionality	All functionality is clearly labelled	9	12		
	Functionality without external sites	10	10		Google search used
	No unnecessary plug-ins	18		2	
Control	User can cancel all operations	11	5	2	
	Clear exit point on each page	11	8	1	
	All graphics links as text links	15	6		
	Site supports user workflow	8	9	1	
	Appropriate browsers supported	7	4		
Language	Language used is simple	10	8		Appropriate level
	Jargon is avoided	6	12		Avoidable terms
Feedback	Clarity of what is happening	11	9		
	Users can give email feedback	7	7	5	
	Users informed if plug-in required	5	4	5	
	Online help is available	2	6	11	
Consistency	One word descriptions	5	16		
	Links match the titles	18	3		
	Standard colours for links/revisits	14	4	2	
	Web terminology consistent	18	2		
Error Prevention	Unnecessary errors do not occur				No errors
	Error messages clear				No errors
	Errors describes action necessary				No errors
	Errors show clear exit point				No errors
	Errors give contacts for assistance				No errors
Visual Clarity	The layout is clear	16	5	1	
	Sufficient 'white space'	14	6	1	A little messy
	All images have ALT tags	12	5	1	
	Unnecessary animation avoided	21			No animation

Table 7-10: Results of the usability checklist for the Information:Inspiration website

The usability checklist indicated that the Information:Inspiration website structure was simple to use and although there was no site map, the website does contain a search facility. The Information:Inspiration website links are clearly defined with the appropriate level of terminology for the target audience.

The website is clear, aided by consistent terminology and colour use. No errors were reported with the website. The layout is clear with sufficient white space used.

7.4 After use

7.4.1 AS/A2 level: case studies

18 AS/A2 level Design and Technology students were tracked, looking at the effectiveness of websites within their design folio work. The 18 case studies were used to enable an in-depth look at the detail of the role of websites within design work and the prominence of sustainability within design education. This section reports the results from these case studies generally and gives an example of a case study. All of the case studies are available as annexes to the thesis.

An AS/A2 level Design and Technology student, 'student 127' who studied at 'school D', is used as an example of one of the 18 case studies in Figure 7-8. Figure 7-8 gives the example of a filled in website questionnaire and an overview of the results from the 72 students together presented in a pie chart.

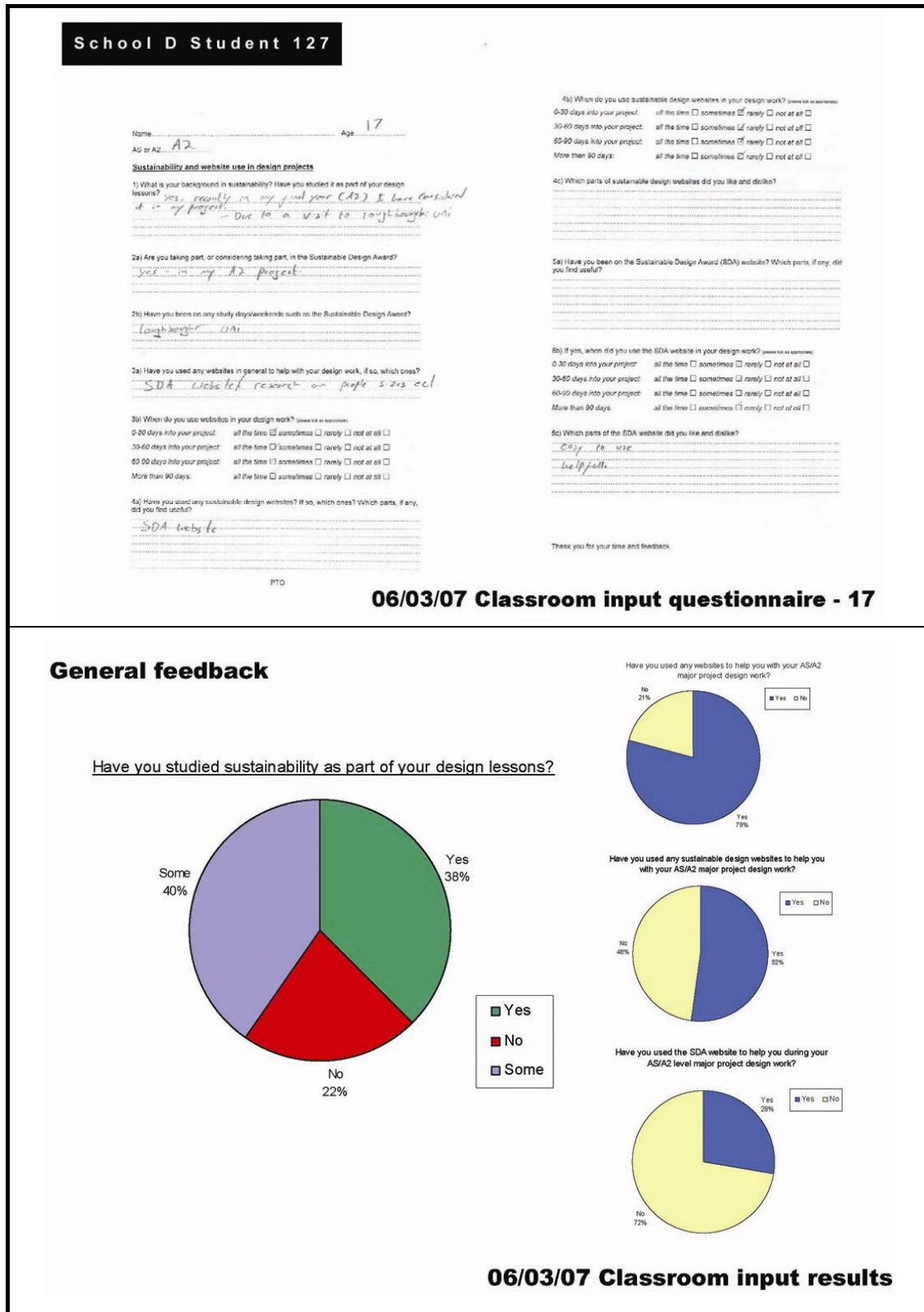


Figure 7-8: A website use questionnaire by student 127 with overall group pie-charts

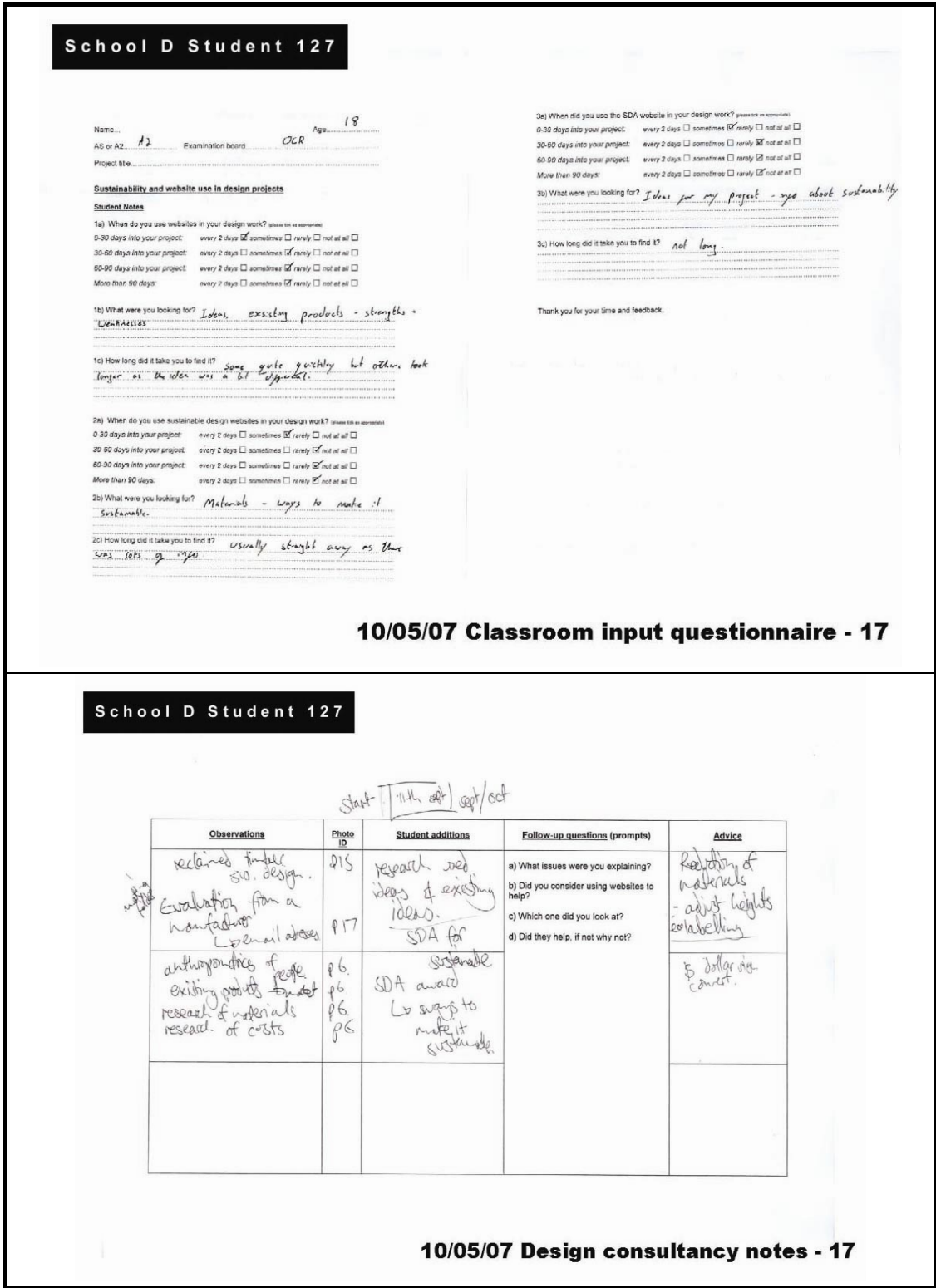


Figure 7-9: Questionnaire notes taken from consultancy alongside the student portfolios

The student answered another questionnaire, shown in Figure 7-9, it gave an example of notes taken whilst talking through the design folio with the student. Observations of sustainable design and website activity were noted and photographs

or page numbers were referenced. The student was asked to comment on each point that was also noted. Four follow-up questions were used as prompts to help guide this information:

- What issues were you explaining?
- Did you consider using websites to help?
- Which ones did you look at?
- Did they help, if not why not?

After the notes were taken, advice was given to the student as to where they could have found the information they were looking for. This advice was also recorded on the sheet.

Figure 7-10 highlighted examples of references to sustainable design issues mentioned within the design folio work of student 127. On this occasion the student is considering using reclaimed timber as a material for their outdoor seating product. This is mentioned on the evaluation and testing sheets. Feedback was also gained to assist the evaluation in this section using the internet (Figure 7-10).

Figure 7-10 gives more examples of the students' design folio work. It shows a design sheet planning the types of information the student is planning to use and the sources where the information would be gathered from. Two occasions where the internet has been referenced as a resource have been highlighted. The Sustainable Design Award website is also referenced directly on the page.

School D Student 127

Product Testing and Evaluation –
On this page I will evaluate how the bench lived up to the specification I created in the design folder.

Tests	Against specification
<p>Test 1 – allow different people to sit on the seat to see how it performed.</p> <p>Method – I firstly sat smaller pupils on it as it was designed for them then allowed larger people to sit on it. I asked them how comfortable they found it.</p> <p>Results – the smaller children thought it was a great idea and they found it useful and comfortable. Although they were facing different directions which they said was a weakness. It also supported the larger pupils well and they also said they found it comfortable.</p>	<p>Function 7/10</p> <p>Comfort for years 7, 8, and 9 – all people that tested it said that it was comfortable and useful, some commented that it could be more comfortable if it had a back rest and soft material to sit on. As an outdoor bench it meets their needs as a bench. It exceeded the specification by also seating older people and adults comfortably. I seated many people on one side of the seat to see if it was stable, it did not move, look or feel unstable. I have a low width base that means a low centre of gravity so it is very unlikely to be unstable. It is not as ergonomic as possible so I highlighted this weakness.</p>
<p>Test 2 – Usefulness and how it appeals to the users</p> <p>Method – over a period of 5 days I left the seat outside the music school to see how and when it would be used. When I had time I would see how many people would use the seat and if it attracted many people.</p> <p>Results – as it was a new addition to the school many people were intrigued and went to see the new bench. It caught people's eyes as they walked past and they went to have a look. It was used regularly at break and lunch and before lessons, by the end of the week people were less interested. It was mainly used by the younger female pupils as the boys played football the girls could then sit on the bench after the game.</p>	<p>Aesthetics 8/10</p> <p>The main aesthetic feature is the musical notes on the bench, it makes the bench part of the music school and does not look odd and out of place. It was attractive and many people said it was a very good piece of work, they liked it. It met all the aesthetic specification requirements, people of all ages used the bench so it went beyond the requirements.</p> <p>It can be more aesthetically pleasing if it looked more comfortable. An example is the massage chair, people have to try to sit on it look very appealing.</p>
<p>Test 3 – weather resistance</p> <p>Method – knowing that it was going to rain over the weekend I left the seat outside in a secure place, this does not just for weathering over time or against adverse elements. It is to see how well it stands up to slight weather conditions and to see if I need to make any changes to the surface finish.</p> <p>Results – there was no visible change to the surface finish of the product, and also it did not weaken the product as I sat people on the seat so satisfaction of strength.</p>	<p>Materials 8/10</p> <p>This is a sustainable design, as the materials I used was reclaimed timber, this met the required specification. The wood has to meet many requirements before it can be used.</p> <p>The wood is quite light which has its advantages but also may result in the wood being quite weak. The wood is strong enough as I have tested it but I have not tested it over time, it will get a lot of use in a school so it may need to be stronger.</p> <p>The wood has good outdoor properties and also the bench has 3 coats of varnish so it can withstand the weather conditions. This is proved by the test I carried out.</p>

Use 2023 – making folder School project website

evaluation and testing in November

reclaimed timber used

Sustainability reference - 17

School D Student 127

2.2 - External Evaluation
I carried out a questionnaire, I questioned five teachers in the school and sent pictures to a furniture manufacturer for some more evaluation.

This is a copy of the questionnaire I gave to the music school. There are two of the teachers I questioned.

I did not take interest in music so I did not know the teachers very well, they were the evaluation. Because they are from the same school I asked for some analysis from a furniture manufacturer.

I also received some external evaluation from a private furniture manufacturer:

I emailed the manufacturer explaining about the bench and that I would like some external evaluation. I found the email address on the internet as he was selling products online.

He wrote a constructive email back explaining that it was an imaginative idea, he gave it overall 7/10. This was useful and he gave ideas for modifications and improvements. He was honest as he highlighted some problems which I will correct in the modifications section.

I used the music school and the teachers as the clients for the seat, they gave me evaluation throughout the production. The seat was firstly specifically designed for their needs, they decided on the music for the seat. They also provided me with 5 final questionnaires for evaluation of the product, from this I learnt:

msn Hotmail

1 minute response

Use 2023 – making folder School project website

evaluation information from manufacturers via email

Sustainability reference - 17

Figure 7-10: Examples of sustainability and website use within the folio work of student 127

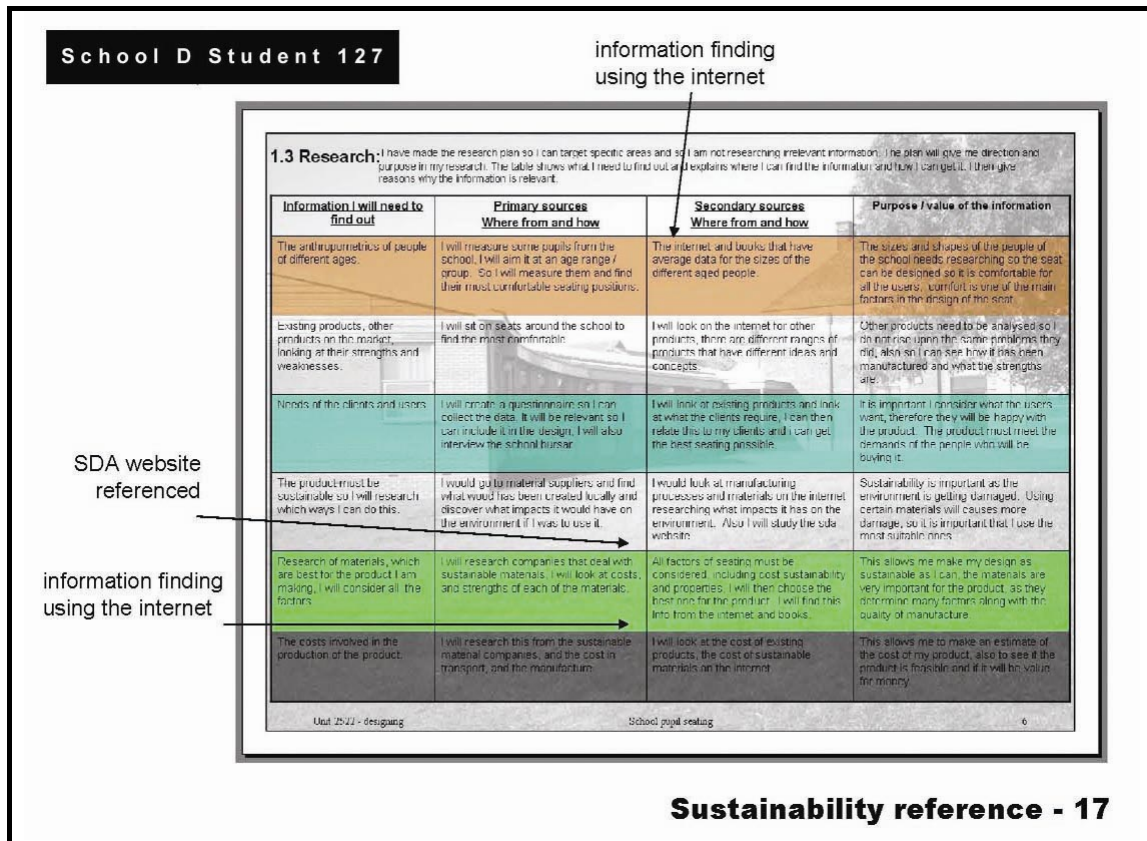


Figure 7-11: Sustainability references within the folio work of student 127

Figure 7-11 charts an overview of the design folio work, classified within months of the year to show when in the project areas were focused on. Students tend to start their major project work in September and complete it in May. The graphs illustrate references to instances of both sustainable design and website use with the work.

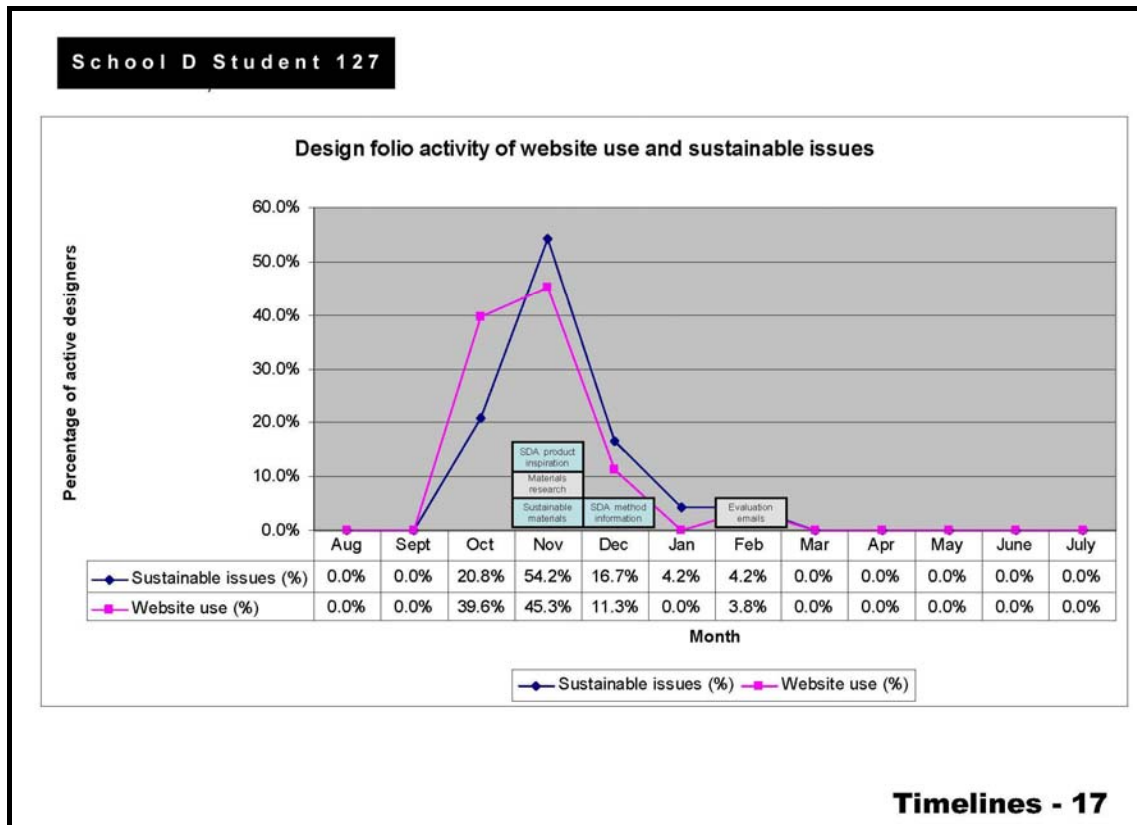


Figure 7-12: Design folio activity of website use and sustainable issues of student 127

The blocks in the graph in Figure 7-12 represent instances within the design folio work alongside website use and sustainable issues. For this particular student the graph shows that website use and sustainable issues are prominent during November, instances of website use during the month before and after are prominent. This would indicate that when information on sustainable issues is being sought, websites are used but not necessarily to do with sustainable design. This pattern is repeated amongst the case studies in 7.4.2.

Annotations were made on each of the pages to help highlight any key points made in the folio work. An example of the type of notes taken is shown in Figure 7-12.

evaluation and testing in November

reclaimed timber used

Sustainability reference - 17

Evaluation and testing in November indications of sustainable issues being looked at with reclaimed timber suggested.

What?
Sustainable references: reclaimed timber used in Materials evaluation.

Why?
Used to enhance its sustainability.

Figure 7-13: Notes taken on each of the Powerpoint pages

7.4.2 AS/A2 level: folio assessment observations

The AS/A2 level design folio assessment observations took place with 18 students, all of which are illustrated in the case studies. The design folios are expected by Awarding Bodies as part of the AS/A2 level design major project. The work helps to illustrate their designing from the start to the end of their project work. The analysis was designed to enable a comparison with the initial findings from the website use questionnaires used in 7.2.1.

The results from these folio observations have been divided into three categories:

- website use within AS/A2 level design folio work;
- sustainable design within AS/A2 level design folio work;
- sustainable design website use within AS/A2 level design folio work.

Examples of the findings have been used to illustrate the results, however all of the examples are part of the case studies Powerpoint presentations listed as an annexe to this study.

7.4.2.1 Website use within AS/A2 level design folio work

This section looks at website use within student design folio work for Design and Technology AS/A2 level education. It illustrates when during the academic year websites were accessed, which areas students browsed when using the internet, and specific detail of what students used within their design folio work.

The graph in Figure 7-14 illustrates all of the instances where in the student design projects the internet was used, and this has been illustrated through months of the academic year.

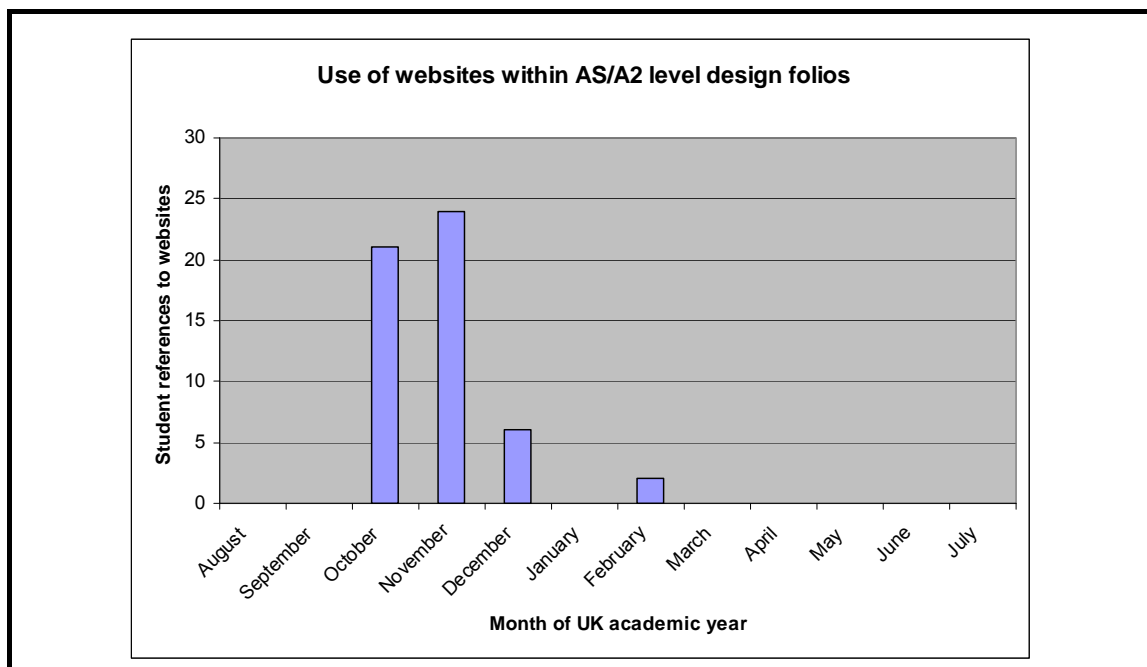


Figure 7-14: Use of websites within student design folios

October and November proved prominent months for website use with 21 and 24 instances of websites being accessed during those months respectively. AS/A2 level students in England and Wales typically start their projects in September, and so October and November represent a period when the projects were likely to have been well underway. It was observed that during this period students are likely to be researching and developing their initial design ideas.

For many students use of websites within folio work has become second nature and almost an expected resource to be used within their work. The students appeared to

access websites on a range of areas based around the current products on the market. These instances covered six different areas with varying degrees of regularity:

- product research;
- product inspiration;
- target audience and product comparison;
- sustainable design issues (7.4.2.2);
- images searching;
- evaluation.

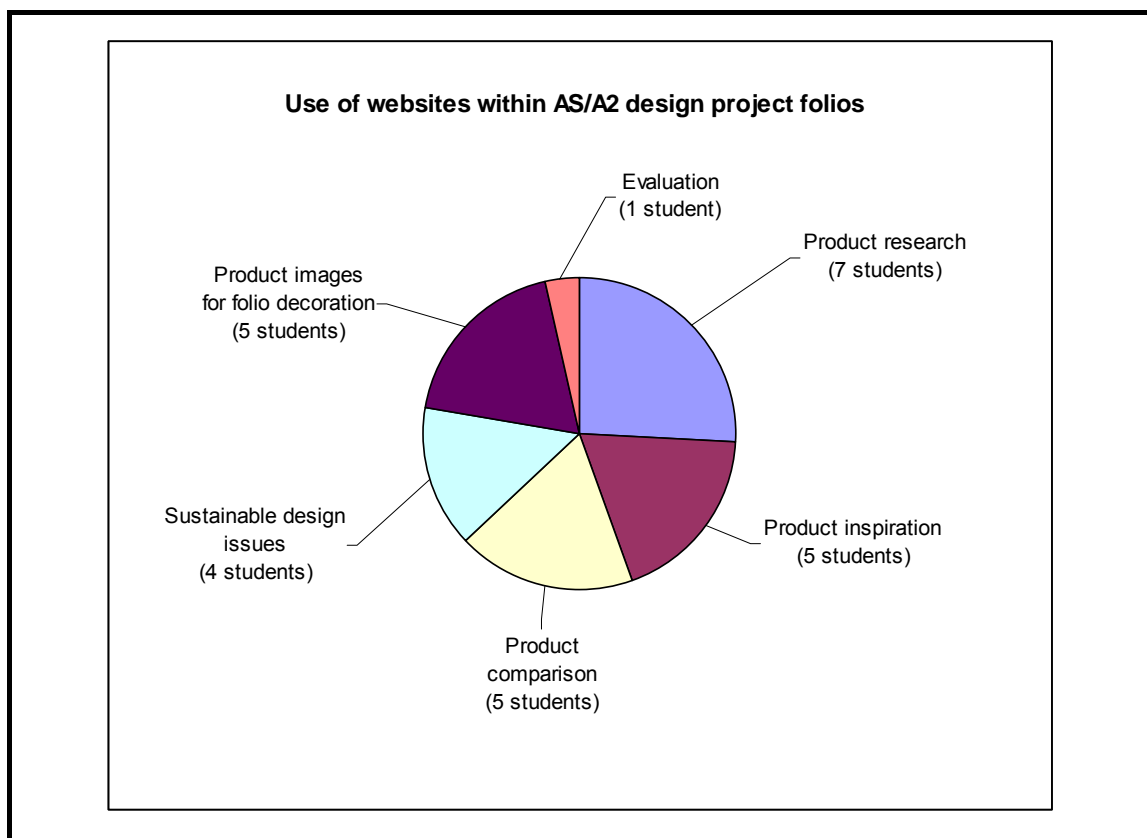
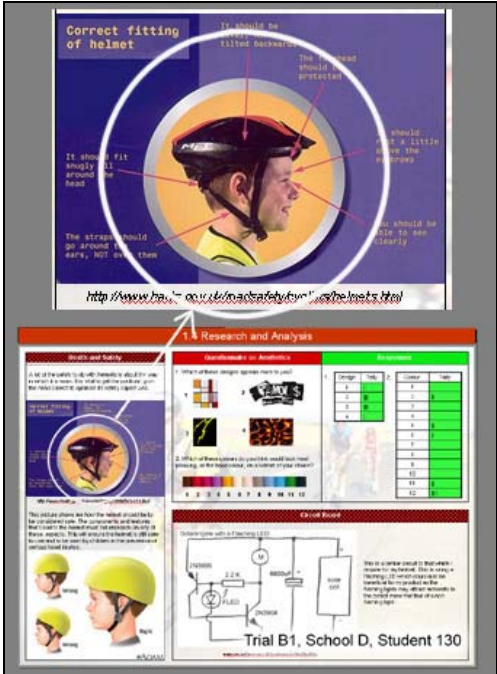



Figure 7-15: Pie chart of student website use for within AS/A2 design folios

For each of these areas students had referenced a use of the website in their design folios, these are shown in Table 7-11.

Description	Example images
<p>Product research</p> <p>Student 130 refers to two instances within their design research where websites have been used to further their knowledge. The first instance looks at health and safety, and the second on circuitry for a flashing LED with a solar cell. In both cases the projects based large sections of their work on what was discovered. Such is the nature of the internet, that there is a danger that students could become reliant on inaccurate information.</p> <p>In this instance the student has used government advice on health and safety and so this information would appear to be reliable. But throughout the projects there seemed to be a sense of trust in information found on the web with very little questioning as to its validity.</p>	
<p>Product inspiration</p> <p>Several students used images from the internet in their work, mostly looking at similar or inspiring products, including the example shown. In this example, student 117 looks at images of current waste bins for inspiration in their own work.</p> <p>The student comments on the environment it would be used in, its bright colours, the materials used and its construction. These are all factors that may have influence during the later development of design ideas.</p>	
<p>Target audience and product comparison</p> <p>The image shows product comparison being made within student folio work. Student 7 has used images of kettles and information taken from the internet to help</p>	

them make comparisons between the different products available on the market.

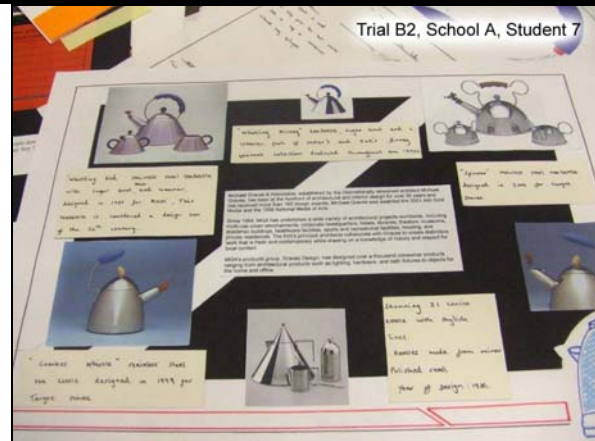


Image searching

The example shows product images taken from the internet by Student 10 to include in their design folio work. In this instance the student has searched for images of antique coffee tables and collated them on a page in the folio. These were used to show the range of products currently on the market and used for inspiration for their design ideas.



Evaluation

An area that was not so prominent in the design folios was the use of the internet during evaluations.

One example was Student 127 who used the internet for correspondence via emails to gain feedback on their work from potential clients and sales staff.

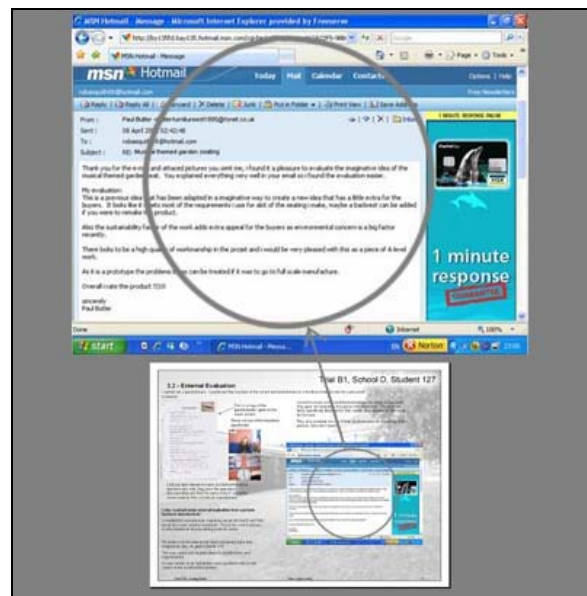


Table 7-11: Examples of website use within AS/A2 level design folio work

7.4.2.2 Sustainable design within AS/A2 level design folio work

Figure 7-16 shows the all of the incidents of sustainable design issues within design folio work indicating the stage in the academic year that they were most accessed. Generally the students looked at sustainable design during the first three months of their design work. Five instances of sustainable design activity were recorded for October whilst November saw the most focus on sustainable design issues with the students referring to sustainable design within their work 13 times.

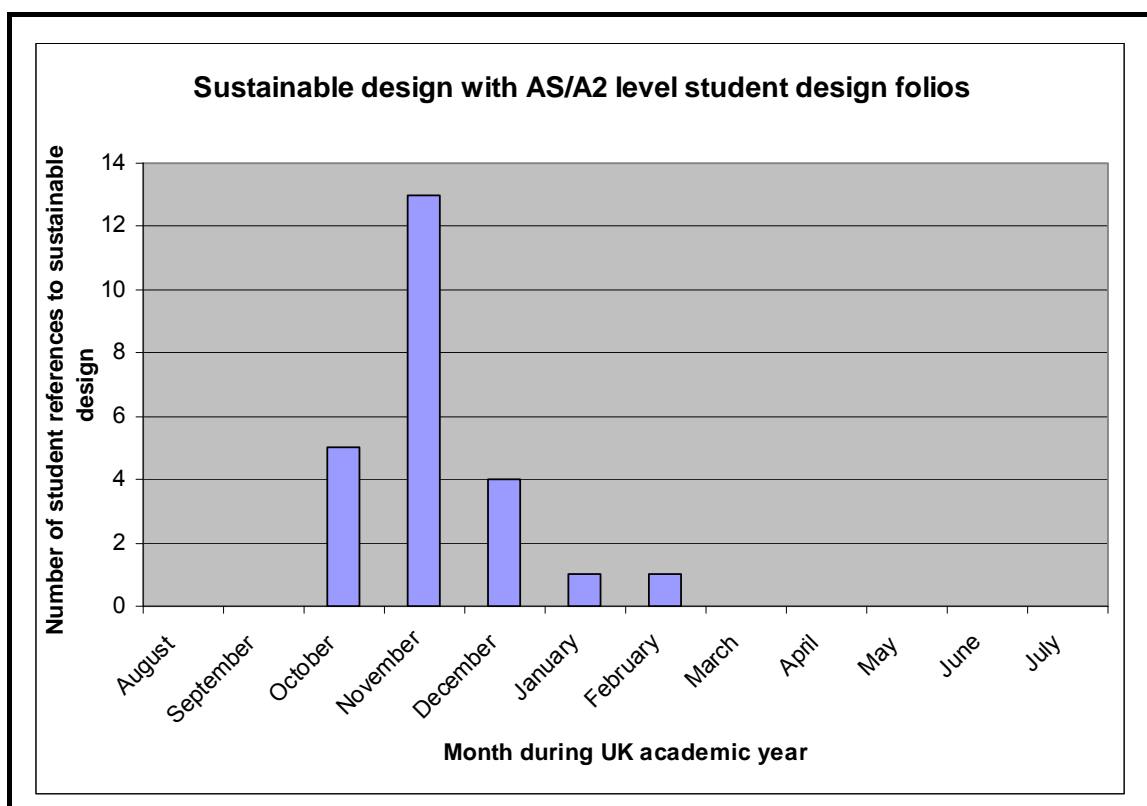


Figure 7-16: Use of sustainability issues within student design folios

This number (see Figure 7-16) decreases with four instances where sustainable design can be seen in the student design folios during work completed in December and just one instance in January and February. None of the students have recorded instances of sustainable designing after February.

The results indicate that students address sustainable design issues through product inspiration and material selection during the research and initial design phases of the project. During later project activities such as modelling and making and associated

evaluation, no sustainable design issues were recorded in the design folio work.

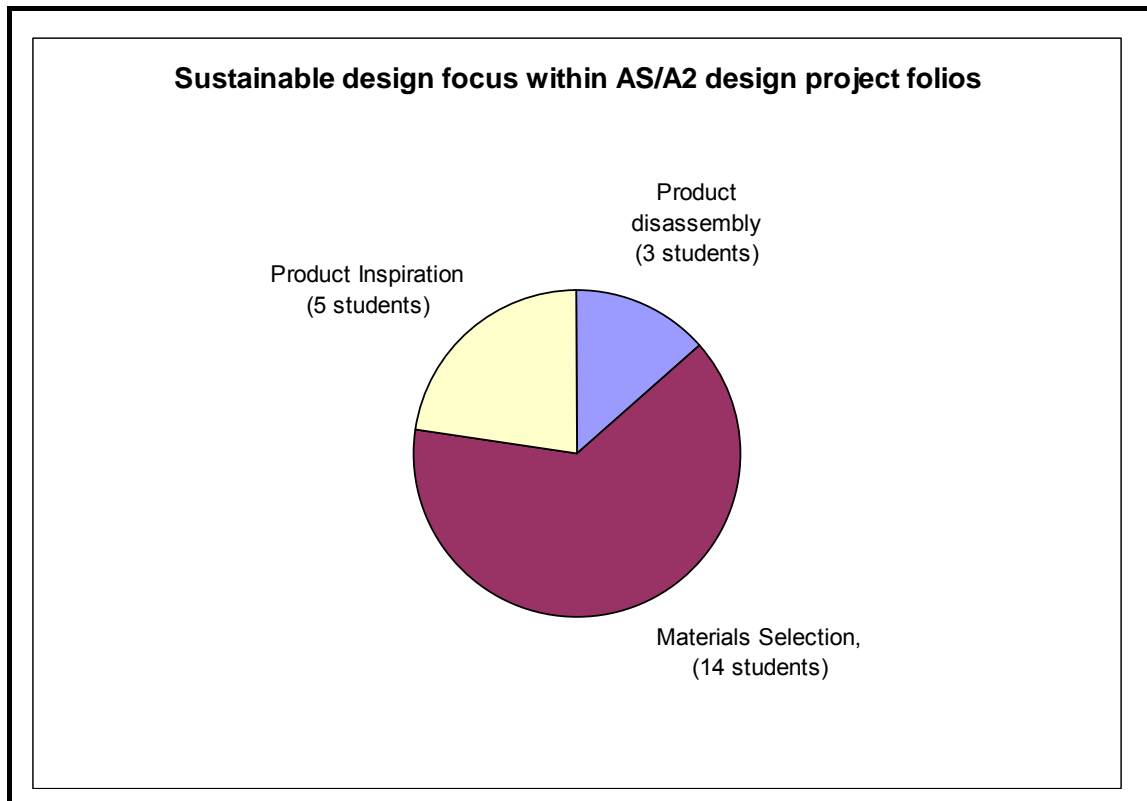
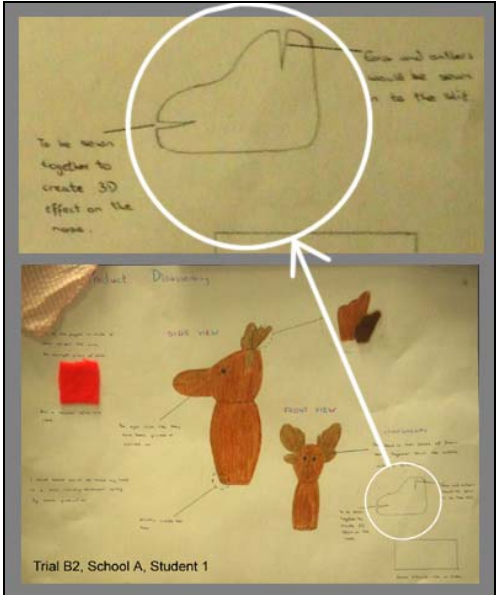
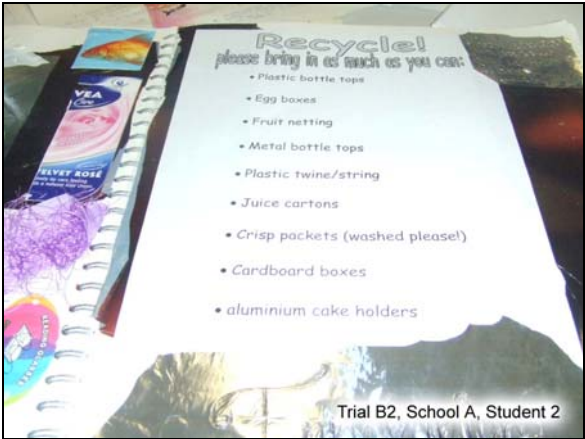


Figure 7-17: Pie chart of sustainable design issues present within AS/A2 design folios

The areas of sustainable design explored in the design folios are shown in Figure 7-17. The work showed three main areas that these students had concentrated on:

- product disassembly;
- materials and recycling;
- product inspiration from existing sustainable products.

Three of the students in their research looked for information on product disassembly, five looked for inspiration through other sustainable products in the market and fourteen included information on sustainable materials and recycling in their design work on materials selection. On limited occasions the internet was used to gather this information.

Description	Example image
<p>Product disassembly</p> <p>The image illustrates two examples of student work that focus on product disassembly within their design projects. It shows that sustainable design issues do appear in current design education practice.</p> <p>The student 1 is showing consideration for using slots in the wood to join the materials to allow for an easy disassembly of the product. The product disassembly aspect would also indicate that students are considering sustainable design issues throughout a product's lifecycle.</p> <p>Product disassembly may also influence other areas such as material selection and appropriate joining techniques.</p>	 <p>Trial B2, School A, Student 1</p>
<p>Materials and recycling</p> <p>Recycling and material selection were other areas that were highlighted in the student design folios. The images show two instances of this, the first image shows a list of recyclable materials collected to use within their design project.</p> <p>The second image highlights the choice of materials within their evaluation of products during their research. This was then considered when making choices for their own design project. Student 127, for example, produced a bench from reclaimed timber.</p>	 <p>Trial B2, School A, Student 2</p>

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7.4.2.3 The use of the sustainable design websites within AS/A2 level student design folios

Figure 7-18 shows all of the instances when sustainable design websites have been used in the design folio work investigated during the academic year. The results indicate that seven instances of sustainable design website use occurred in October. Six instances occurred in November with three being recorded for December. No sustainable design websites were looked at after December.

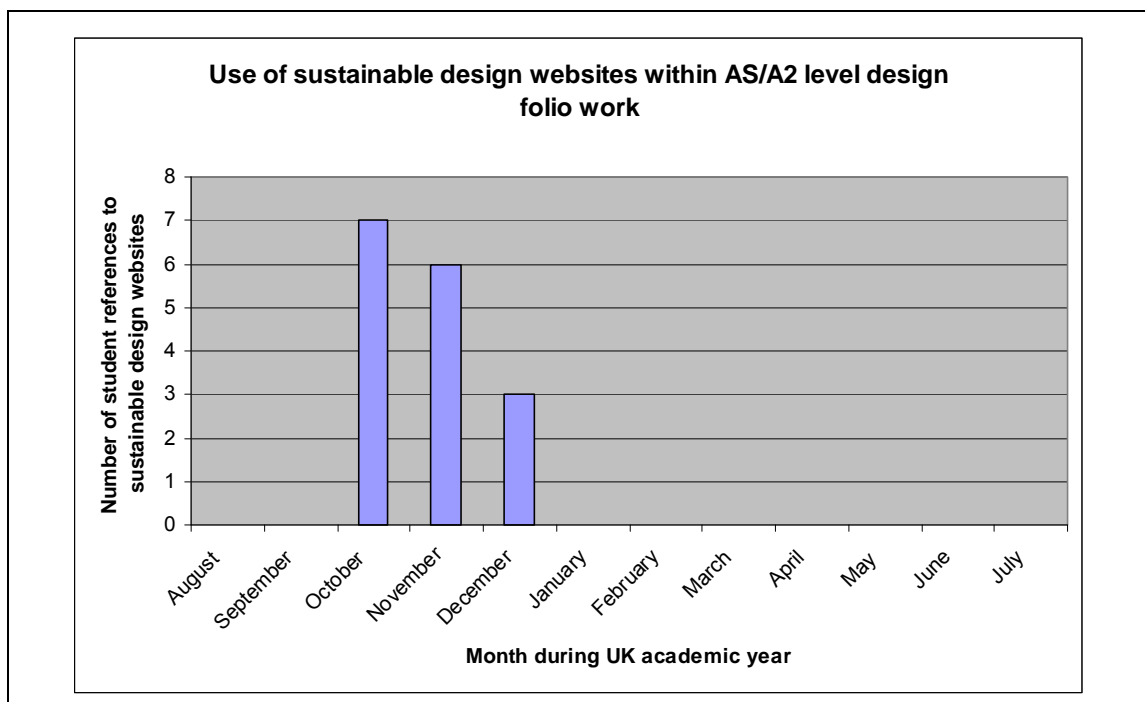
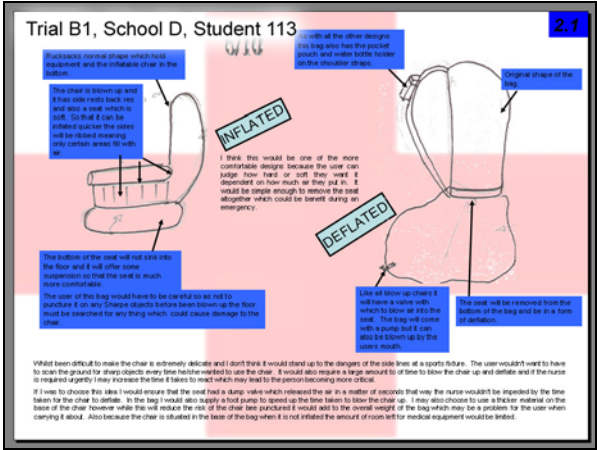
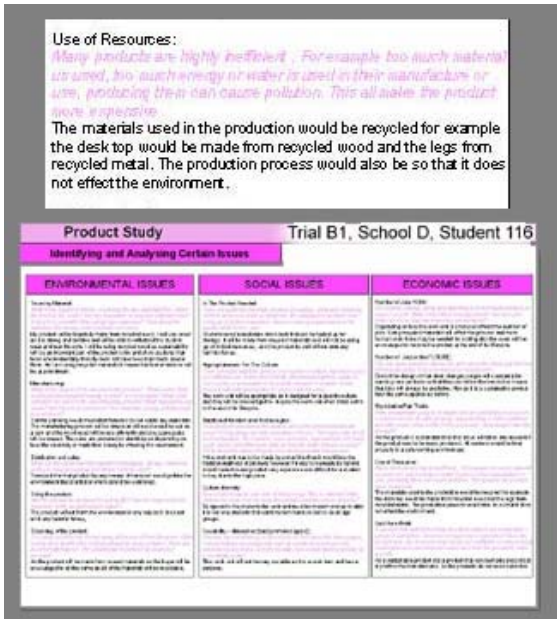


Figure 7-18: Use of sustainable design websites within student design folios

Three of the students indicated in their AS/A2 level design folio work that they had accessed the SDA website directly to help them with their work. Four areas were indicated:

- inspirational products;
- materials and recycling;
- information on sustainability issues;
- materials evaluation.

Description	Example images
<p>Inspirational products</p> <p>The image shows an example where the idea of an inflatable product has been explored after looking through the inspirational products section of the SDA website. Student 113 notes that the inflatable idea may make the product more sustainable due to its ability to be reduced in size and therefore more could be transported during distribution.</p>	
<p>Materials and recycling</p> <p>Student 116 has used the SDA website at the start of their project, indicating sustainable materials will be considered during the project with the SDA website materials section being consulted.</p>	
<p>Information on sustainability issues</p> <p>Information on sustainability issues was also identified early in student projects, Student 116, for example, uses the SDA website to help inform their project generally looking at materials and the impact on the environment: 'by visiting the SDA website I am able to gather information on how different materials and products affect the environment' (student 116).</p>	

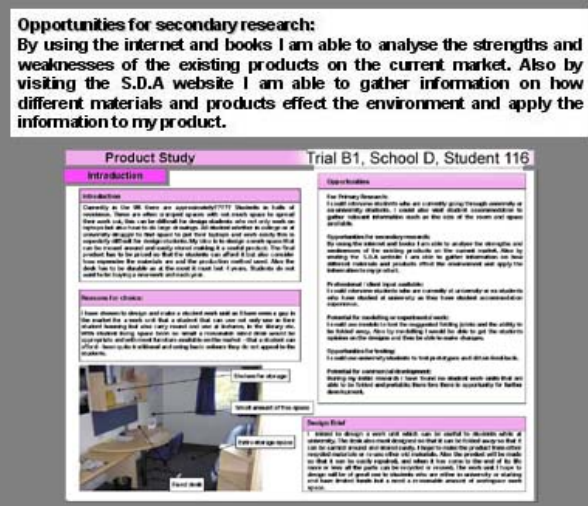
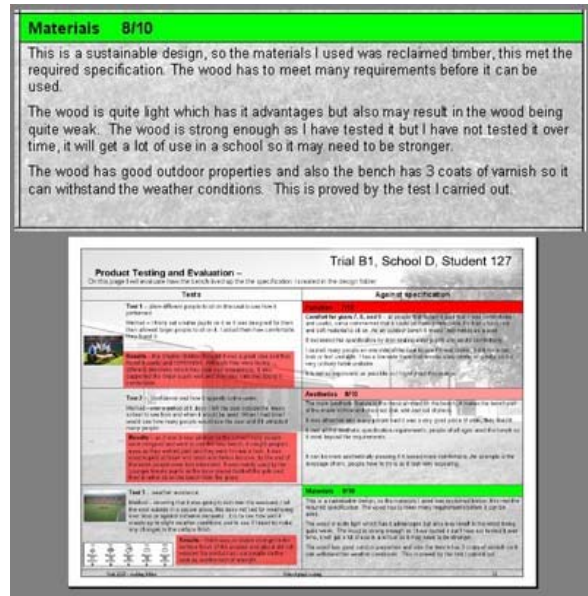
	<div><p>Opportunities for secondary research: By using the internet and books I am able to analyse the strengths and weaknesses of the existing products on the current market. Also by visiting the S.D.A website I am able to gather information on how different materials and products effect the environment and apply the information to my product.</p></div>
<p>Materials evaluation</p> <p>The SDA website was again used during testing and evaluation at an early stage in the project by student 127 as shown. The website was used to help to evaluate materials, supporting the student with the information they needed in order to make an informed choice.</p>	<div><p>Materials 8/10</p><p>This is a sustainable design, so the materials I used was reclaimed timber, this met the required specification. The wood has to meet many requirements before it can be used.</p><p>The wood is quite light which has it advantages but also may result in the wood being quite weak. The wood is strong enough as I have tested it but I have not tested it over time, it will get a lot of use in a school so it may need to be stronger.</p><p>The wood has good outdoor properties and also the bench has 3 coats of varnish so it can withstand the weather conditions. This is proved by the test I carried out.</p></div>

Table 7-13: Examples of sustainable design websites within AS/A2 level design folio work

7.5 An interview with Ian Capewell, Practical Action

This section reports the results from an interview with Ian Capewell who worked in the education department at the charity Practical Action. Capewell's primary role was to help integrate sustainability practices into education. Capewell responded to questions in relation to his own experiences in the Sustainable Design Award directly. The interview was broken down into three sections: website use, sustainable design, and sustainable design websites. The interview took place at the Bridgeman Centre, Loughborough University.

Website use

Having reviewed a paper published with initial results from this study, the interview started with questions on website use within AS/A2 level Design and Technology. This focussed on the use of websites within student folio work and the areas where websites were prominent.

Capewell said that he expected students to be using websites within their design work and that he viewed sustainable design as a part of that. The Sustainable Design Award produced a website to be used by students and teachers.

... I would expect the website to be the first port of call. Let's stick 'sustainability' into Google and see what it comes up with. So yes, I'd have thought that would be the most likely place that they were going to look. I would expect students to use websites. I would be surprised if there were any students who hadn't done that.

The results shown in the paper (Simmons and Badni 2007b) indicated websites were not used throughout designing but just during research for product inspiration or to use product images within the 18 student portfolios.

...I'm not surprised but probably a bit disappointed that that is the case.

Sustainable design

Capewell was asked to describe what he saw as the drivers behind design decision-making generally, in order to help understand the thinking behind sustainable design decision-making. He believed that a common decision for design students would be

to select a material and that they would consider: what materials are available in their school? How much it costs? And is it fit for purpose?

They don't get into 'what's the impact on the environment?', 'are there any social or economic factors that I should think about?'.

Capewell also made reference to the Awarding Bodies as a driver behind design decision-making. For example, one Awarding Body does not consider cardboard as a resistant material. Teachers are also under pressure in turn to guide students to the maximum marks.

I've been to some of the Awarding Bodies meetings where the subject officers have virtually said 'on page 10 of the folio I'd expect to find this, on page 15 I'd expect to find this'. That has undoubtedly some impact.

Capewell was asked to describe the principles that the Sustainable Design Award followed and introduced to AS/A2 level design students. The SDA followed the words environmental, social, economic, cultural, spiritual and moral initially before concentrating on three words 'social', 'economic', and 'environmental'. Capewell did not feel they had been ultimately successful in integrating these principles into sustainable design within Design and Technology education.

No, I don't think so. Integration implies that it's something that students do naturally. I was doing a talk recently where I said that we'll have succeeded when you ask a student what sustainable design is and they say 'it's just ordinary design isn't it?'. We are nowhere near that.

It is regarded by a lot of teachers as something that you can teach as a separate thing. Sometimes it's just added on at the end, or it's that students are told that they have to put a page in their folios about sustainable design. So rather than it being seen as something that is fundamental it's seen like aesthetics or fit for purpose, it's seen as something that's an addition. There's a long long time to go before it's a natural part of design, like aesthetics for example.

Capewell explained that the drivers of sustainable design practice would come from governing bodies in the shape of Awarding Bodies or legislative measures. Generally in legislation such as WEEE has helped but is 'not fundamental to most designers thinking'. In Capewell's experience the complex nature of balancing design decisions

across environmental, social and economic values puts designers off from choosing sustainable solutions that they often believe have no real affect on the bigger picture. But the main drive towards sustainable solutions at AS/A2 level Design and Technology is the Awarding Body.

The client for a student is the exam board, that's the determining factor. That's the primary reason kids do it. The evangelists who were on their own now find themselves in demand.

Sustainable design websites

After discussing both website use and sustainable design issues with Capewell, this section looks at the role of sustainable design websites. Capewell was asked if he felt that sustainable design websites influence designer decisions?

The evidence that I've seen from student portfolios is that they do in a limited number of cases. It depends on the school that you're at and the teacher that you get. There have been some real sustainable design evangelists. In their schools and in their student portfolios you would have seen considerable use of the websites and considerable evidence that students had been influenced by what they'd seen on the websites. Including extensive use of eco-design tools that are right at the beginning of the project when they were doing research, and then again at the end when they were evaluating the product. You would think it would vary immensely. But there is a lot of evidence to suggest it hasn't made much impact.

The vast majority of students interviewed were not using online resources to support their sustainable design decisions. Despite the students knowing that the resources are available for them to use, and that some students had even been on the SDA study weekends that promoted the website within their design sessions. Capewell felt that there are some schools who promote sustainable design in every lesson, mentioning that he knows one teacher who has the Sustainable Design Award website up on the whiteboard every single lesson. Capewell does concede that this is a rare case.

...the vast majority of teachers don't think about it all that often. So you can't expect the students to think about it all that often either. I think you have to be a pretty dedicated teacher to constantly teach it... one teacher who was interviewed said that the best approach was the drip, drip, drip approach. Just keep feeding bits about sustainable design. But that is another exception.

As an output to the Sustainable Design Award the website was created with an aim to help with informing and supporting both students and teachers about sustainable design and the SDA initiative. Capewell discussed the stages in designing he hoped would have been affected by sustainable design websites, and which areas of the website he felt would be most useful.

One of the objectives of the Sustainable Design Award website was to get students away from designing and making being a linear activity. Sustain-a-balls is the crux of that. I would hope that at some stage, sustainability is just a natural part of the way that students design at all stages throughout their projects. That those students are just thinking about the issues all the time of what the implications are of environmental, social and economic sustainability.

Capewell said that the SDA progressed to focussing on the use of eco-design tools within their work and that he would expect them to use eco-design tools during product evaluation for their own projects and existing products. Capewell's own feeling was that the use of these tools were increasing particularly the 'eco-design web and the abacus, both of which are relatively simple to use. I've seen very few examples of eco-indicators being used but certainly a lot more'.

Focusing on the Sustainable Design Award website, Capewell said that he felt students needed to find what they were looking for instantly. He said that they knew there was a lack of information in graphics and systems and control. These were areas that he looked to improve on and he felt that the supporting input of the Sustainability Handbook may help to address this.

Capewell felt that the students were mostly interested in marks and that the website, like any website, on its own was insignificant.

...unless you can link everything to the way in which the mark schemes are set-up, I don't think the website will be particularly significant.

Capewell also said that for people in the scheme it may have played a part in changing their thinking.

What you are trying to do is to encourage young people to change the way in which they look at the world. I don't think websites are the way in which that happens. It is more likely to be the influence of inspirational teachers or things like Al Gore's 'An Inconvenient Truth'. That

had some impressive features to it like the diminishing glaciers and the rising sea levels. Those are the sorts of things that seem to impact on kids and make them think differently. Kids, if they go to buy something, it's not sustainability they think about. It's 'is it fashionable?' or 'can I afford it?'. So I think websites aren't going to be particularly significant.

To support the website, Capewell indicated that more training of teachers was important to show them that the information exists and how useful it is throughout design education. Capewell again alluded to the importance of the role of the examination boards...

In Key Stage 4, from nothing the Awarding Body have to allocate 15 to 35 percent of their marks to 'values issues' as they are described. This obviously includes sustainability, and for the 2009 specifications, I've looked at a review of QCA and most of them have awarded 25 to 27 percent of the marks. So there is now a specific paper on sustainable design in all the Awarding Body exams. So that is going to be a significant push to make teachers do it.

7.6 Chapter Conclusions

7.6.1 Cluster analysis

The cluster analysis identified two broad clusters of websites those that contained *information* and those containing *links*. Further analysis gave four clusters *informative, institute, specialist* and *hub*.

The Sustainable Design Award website was developed following best practice outlined in the literature, with consultancy from teachers, students and the SDA Steering Committee. The cluster analysis identified the SDA website as belonging to a certain type of cluster, the informative cluster. The websites associated with this cluster have detailed information on issues of sustainable design. Other websites in this cluster include Information:Inspiration and the Redefining Progress websites.

The institute, specialist and hub clusters have focused target audiences, specialise in specific areas of sustainable design and act as reference websites to other resources.

7.6.2 Before use

Sustainability is identified as a prominent part of Design and Technology education, 78% having received an input on sustainability. The majority of the students questioned in this study had either taken, or were intending to take, the Sustainable Design Award.

Overall the use of websites in the AS/A2 design projects is high, as evident in the website use and post-presentation questionnaires, but sustainable design websites are only a small part of that use. It could be inferred that sustainability is not at the forefront in Design and Technology education, as sustainable design website use is low, and that the students use websites to help with other areas of design.

The students that used websites generally were looking for images to use in projects, existing products for inspiration, company contacts and materials information. The students questioned that did use sustainable design websites were looking for information on sustainable materials, current products embodying inspirational messages concerning sustainability, and recycling practices.

Of the 72 students questioned 28% said that they had been on the SDA website. Only 12% accessed the websites at least every two days during the first 30 days, 9% some of the time and 2% rarely used it. The majority of student designers did not use the SDA website at all in their designing. The Sustainable Design Award website was used to look for sustainable topic ideas, inspirational product examples and general information on sustainability.

For the students that did access the website, the data indicates that as their design work continues, website use decreases. It would be reasonable to assume that this may be due to design decision-making becoming less frequent, as ideas are progressed, with the designers perhaps undertaking other activities. This could represent an aspect of common AS/A2 practice, and design decision-making activity. Students are expected to complete types of work at certain times of the year which is a suggestion of a linear nature to the process. This would not reflect research into the general nature of designing.

The length of time spent on a particular website varied according to what the student designer was looking for.

7.6.3 During use

The undergraduate students assessing usability identified *navigation*, *layout*, *download time*, and *content* as important aspects of website effectiveness.

The students assessing the usability of the Sustainable Design Award website found the navigation to be easy, highlighting signposting of links and presence of supporting information as an aid to the user. This was also helped by a compartmentalising of information. The aesthetic properties of the website were praised with clear text and well labelled images.

7.6.4 After use

The case studies enabled an in-depth analysis of sustainable design, website and sustainable design website activity within design projects at AS/A2 level.

Instances of sustainable design, website use and sustainable design websites were recorded in the design folio work undertaken in October, November and December. The instances for all three areas decrease as the projects progressed, with the last recorded instance in February.

The sustainable design instances identified three different areas: materials and recycling; product disassembly; and inspirational products. The majority of the students considered sustainable issues when they were looking at materials selection.

Websites were used to inform six areas of design: product research; product inspiration; target audience and product comparison; sustainable design issues; images searching; and evaluation.

Sustainable design websites were used to look at: inspirational products, materials and recycling, sustainable information use, and materials evaluation.

7.6.5 An interview with Ian Capewell, Practical Action

Ian Capewell from the Sustainable Design Award expected students to be using websites within their design work and felt that sustainable design would be part of that, specifically highlighting material selection as a prominent area. An aim of the SDA was to get students away from a linear brief and show them each area that could be integrated where applicable. Capewell was disappointed but not surprised that websites were not used throughout the whole of a design project just at the start.

Capewell felt Awarding Bodies were key stakeholders in introducing sustainable design although some teachers would do the bare minimum. The influence of sustainable design is also dependant on each classroom, if and how it is taught. The SDA concentrated on three areas of sustainability: economic, social and environmental, although he felt they had not been successful in integrating these. Unless the SDA website was linked to the Awarding Bodies mark scheme he felt it would be insignificant, as students are mark driven.

Capewell said that he felt sustainable design websites influence design decisions in a limited number of cases. Capewell believed eco-design tools had been used throughout projects with little effect on the end outcome. He felt that use to be increasing. Capewell felt the SDA had been successful in changing the thinking of students who had attended the study days, big impacts came from things like Al Gore's 'Inconvenient Truth' film.

CHAPTER 8 DISCUSSION

This discussion compares the findings from the literature review, data collected and the views of leading practitioners. It discusses sustainability within AS/A2 level Design and Technology education, website effectiveness and drivers of change. The significance of wider sustainability issues and the implications for curriculum development and research are suggested in the light of this discussion.



This discussion is divided into six sections each of which addresses one of the research questions, which are restated below for convenience.

1. What is sustainable design within AS/A2 Design and Technology education?
2. Can leading sustainable design websites be classified according to their characteristics?
3. What is effectiveness in this context?
4. How do you measure the effectiveness of websites?
5. What are the key principles governing the effectiveness of the Sustainable Design Award website?
6. Are the findings more widely applicable?

This research study compares the findings from the literature review, data collected and the views of leading practitioners. The sources of that evidence are shown against each research question (indicated by 1 to 6) in Table 8-1.

Evidence / research questions	1	2	3	4	5	6
Designing & Information Retrieval – Literature Review			***		**	*
Website Effectiveness – Literature Review		**	***	***	***	*
Sustainable design - Literature Review	***	**			*	*
Cluster Analysis		***	**	***	***	*
Before use – Website use questionnaires	**		**	**	**	
Before use – Post-presentation questionnaires	*			*	**	
During use – Usability questionnaires				***	*	
During use – Usability checklists				***	*	
After use – Case studies	**		***	***	***	*
After use – Folio assessment observations	**		***	***	***	*
Interview with Ian Capewell	***	*		**	***	***
Pitt and Lubben Report	***	*			***	***
Awarding Bodies requirements	***	*				**

Table 8-1: Discussion evidence against each research question

*** suggest a major source of evidence, ** suggest a minor source of evidence, * suggests some significant evidence

8.1 Sustainable design within AS/A2 Design and Technology education

8.1.1 Approaches to sustainable development

The literature review revealed that authors (e.g. Charter and Chick 1997, Walker 1998, Spangenberg 2001) felt that sustainable design should be integrated into design practice. The interview revealed this was a view shared by Capewell with regards to AS/A2 level education, who also concurred that the communication of sustainability issues and providing access to detailed information is essential for a successful integration.

A conclusion from the literature review was that designers will determine how much weighting to give sustainability issues within their design decision-making. This is supported by the findings in the folio assessment that show some students engaging with sustainability issues to varying degrees and some not. A determining factor highlighted by professional designers was the requirements of the client (Lillis and Clark 2008). For student designers in AS/A2 level Design and Technology, the role of the teacher and requirements of the Awarding Body were important (Pitt and Lubben 2007). It has been identified (Pedgley 1999, Coles 2006) that designers rely on an informed decision base of knowledge, skills and values when making those design decisions. The literature review concluded that sustainability needed to go past a surface deep sustainability marketing position and embrace sustainable issues

throughout their decision-making. It was thus anticipated that the SDA website could supplement the limited knowledge, skills and values that the 16+ students already possessed, and thereby enhance and deepen their decision making in relation to sustainability.

Pitt and Lubben (2007) recognised websites as a key communication tool to help to support design students. The SDA website could play a direct part in influencing design outcomes for the AS/A2 level student designers. The literature reports a range of sustainable development models for this research study to use as a context for analysis. The SDA promoted the environmental, economic and social model for teaching, but it was established by the pilot study that the 12 features model would give a greater level of detail when comparing each of the sustainable design websites in this research.

One of the ways of helping to introduce sustainable development is through eco-design tools.

8.1.1.1 Eco-design tools

The SDA report (Pitt and Lubben 2007) showed that an emphasis had been placed on eco-design tools on the SDA website and at the study weekends, as the tools were seen to be an integral part of the SDA. Pitt concluded in the report that ‘starter activities and the eco-design tools are widely used and teachers are very positive about the learning outcomes’ (Pitt and Lubben 2007:54). Capewell also believed this to be the case, stating that eco-design tools had been used throughout projects, but with little effect on the end outcomes. Capewell also felt that the use of eco-design tools was increasing.

In contrast, there was no evidence from the research data obtained in this study of the use of eco-design tools in the student design folios. Bhamra (2008) indicated in a private communication that a low usage of eco-design tools was to be expected. Bhamra indicated the tools were not all easy to use and, because of their subjective nature, difficult to justify. This view was supported by professional designers in a private communication (Lillis and Clark 2008) who had looked at eco-design tools. Lillis and Clark commented that they felt that they did not have enough information to make a decision and use them in their work. Lillis and Clark felt the eco-design tools

were too subjective to be used in an industrial situation where they need to appear as an 'expert' to the client.

The findings concerning the use of eco-design tools are inconclusive, and further work could be developed in this area to assess the usefulness and integration of these eco-design tools.

8.1.2 Sustainable design principles within AS/A2 Design and Technology

The interview results suggest that inputs concerning sustainable design are prominent in AS/A2 level Design and Technology education with 56 out of the 72 students interviewed having had some sustainable design input. 24 out of 41 undergraduate designers questioned said that they had also had some input concerning sustainable design. Capewell suggested that, although sustainable design could be found in a few timetables in Design and Technology education at AS/A2 and undergraduate level, sustainable design had not become integrated into design practice.

The sustainable design issues found in the AS/A2 design folio work appeared in October, November and December, which was the same time in their projects that the student designers were using general websites to inform their work. The incidence of sustainable design issues being identified decreased as the projects progressed. Some students did not mention sustainable design issues in their work, prioritising other areas.

Of the students that did consider sustainable design, the issues they raised could be categorised under specific information (energy, materials and end of life) and inspiration (current products), as Lofthouse found for professional designers (Lofthouse 2001a). These sustainability issues reflected the same two areas of information that the student designers were recorded as looking at during their website use as found in the design folio work. The majority of the students included environmental issues when discussing materials for their designs. This provides supporting evidence for the first of three notions of sustainability which teachers were highlighted as having in the SDA evaluation report (Pitt and Lubben 2007). These were:

- reuse and durability of materials;
- environmental, social and economic issues;
- stewardship of the world for future generations.

The second and third of these notions were discussed in the interview with Capewell, in which, he highlighted that the SDA used a broad model of environmental, social and economic issues. The requirements for AS/A2 level Design and Technology differed depending on the Awarding Body, but the examples found in the folio assessment did not illustrate social and economic issues being embraced by the students. Teachers' own understanding and delivery of sustainability differed, and may have been influenced by the ethos of their own educational institution.

The SDA was set-up by Practical Action, the Centre for Alternative Technology and Loughborough University, and considered its role to be convergent with the four Awarding Bodies: OCR, AQA, Edexcel and WJEC. Pitt and Lubben (2007) reported that there is a perception that the SDA requirements are close to examination requirements, but there is no evidence that the requirements of one Awarding Body are closer to the award criteria than any other. The Pitt and Lubben report (2007) concluded that some teachers for example used an SDA assessment checklist and were able to draw the links between the SDA and the requirements of the Awarding Body. Other teachers did not use it with their AS/A2 students so as not to confuse the examination requirements. A suggested outcome of the report was to produce four specific checklists that reflected the requirements of each individual Awarding Body.

8.1.2.1 Drivers of change

Despite the initiatives that have attempted to help the integration of sustainability into designing, the findings indicate that sustainability has not been integrated fully. Capewell felt that the teachers played a pivotal role in delivering change and suggested that their training would be vital to integrating sustainability into AS/A2 level Design and Technology education. Capewell highlighted that those teachers who embraced the concept would see greater productivity in terms of sustainable design outcomes. For those teachers not engaging with the sustainable design agenda however stronger drivers may be needed in the form of requirements from the Awarding Bodies.

The integration of sustainability in designing appears to be driven by regulatory measures, whether that is Design and Technology syllabuses from Awarding Bodies in education, or government legislation and policy for professional designing. Capewell agreed with this position. Pitt and Lubben (2007) noted the success of the SDA in persuading the regulatory bodies to include sustainability in their curriculum requirements.

‘The SDA project has been successful in putting sustainability on the curriculum agenda in all three countries. Its advocacy has contributed directly to changes in national strategies and examination specifications at all levels of secondary education in the UK.’ (Pitt and Lubben 2007:25)

The inference from the Pitt report and the results from the main study were that where Awarding Bodies asked for evidence of sustainable design consideration within the student work it was present. This was supported by Capewell who suggested he expected a correlation between specifying marks for sustainable design inclusion and students including it in their design folio work. The indications from the case studies suggest that where students have identified and responded to sustainable design issues within their work, it has not extended beyond the topic areas which students pursue in general practice.

‘...the urgent transformation to technology education for sustainability citizenship must begin with a critical examination of existing practices and assumptions which underpin unsustainability...’ (Elshof 2008:133)

The SDA evaluation report concluded that the SDA had a considerable impact on the QCA Awarding Body in the National Curriculum in England, as well as future examinations specifications. The SDA report concluded that this would be a ‘significant driver in future for integrating SD (sustainable design) into the way that D&T is taught’ (Pitt and Lubben 23:2007) as teachers would be aiming to help students gain high grades.

The use of some SDA materials such as the exemplar portfolios were not seen as comprehensive and including all areas required by the Awarding Bodies. The folios were not seen as relevant to AQA participants (Pitt and Lubben 2007). The report also concluded that the level of the commitment to the SDA from the Awarding

Bodies varied; there was no evidence of any impact of the SDA on the WJEC Awarding Body.

Sustainable design within AS/A2 2009-10

Awarding Body	Work Type	What?	Time
AQA (Cresswell 2009)	<i>Lessons</i> AS: Materials, components & application A2: Design and Market Influences: sustainability and environmental concerns	AS: Biodegradable polymers & disposal A2: Biodegradable polymers, manufacture, 3Rs green approach and innovation, cradle to grave, product analysis.	AS: 6 lessons A2: 8 lessons
EDEXCEL (Beard 2010)	<i>Examinations, design & make</i> A2: specification, testing, evaluation Designing for the future Commercial Design	Product specification, life cycle, cradle to grave, reducing impact, materials, manufacture, energy, packaging reduction, 'four R's' (reduce, reuse, recover, recycle) renewable sources (wind, water, solar, biomass and biofuels, nuclear, fossil fuels), developing countries in relation to social, economic and environmental issues, carbon footprint, disposal, recycling <ul style="list-style-type: none"> • www.biiothinking.com New ecology derived techniques. • www.cat.org.uk Globally sustainable, whole and ecologically sound technologies and ways of life. • http://ecodesign.lboro.ac.uk Environmentally and socially responsible products. (Information:Inspiration) • www.sda-uk.org Helping to bring issues of sustainability into mainstream designing. • www.stepin.org Raising awareness of sustainable technology. <i>The Sustainability Handbook for D&T Teachers</i>	20/270 19 hours
OCR (OCR 2008a, OCR 2008b, OCR 2009)	<i>Lessons, design & make, examinations</i> The impact of design and manufacturing on the environment	Product design, manufacture, life cycle, social, moral and cultural issues, environmental issues, materials, energy, recycling. <ul style="list-style-type: none"> • www.sda-uk.org • www.sustainability.com • www.reduceuse.co.uk • www.d4s-de.org • www.cfsd.org.uk • www.pre.nl • www.energy.gov • www.energyquest.ca.gov • www.designgreen.org 	2.5 hours
WJEC (Howells 2008, Stockley 2008)	<i>Report, design & make, examinations</i>	Ethical, environmental & social influences, product analysis, life cycle, disposal, legislation, values, manufacturing and materials, energy.	2.5 hours 20%

Table 8-2: Examination board requirements 2009/10

A criticism of the SDA was that the initiative was too late to influence the Awarding Body criteria in Design and Technology at AS/A2 level. As with other aspects of designing, when sustainable design practice was required, this was reflected in the

folio work. Assessment was seen to be driving the curriculum and Pitt and Lubben (2007) also identified the key role for the Awarding Bodies.

The presence of sustainable design within the criteria laid out by the Awarding Bodies has developed to differ greatly in the years subsequent to the SDA. Table 8-2 gives an overview of the four Awarding Bodies in relation to the current position on sustainable design within AS/A2 level Design and Technology.

Table 8-2 shows that two years after the SDA was concluded sustainable design had become a part of the criteria for each Awarding Body, but to varying degrees. WJEC, for example, recommended 2.5 hours to be spent on sustainable design issues. Edexcel outlined 19 hours worth of sustainable design activity, which still amounts to only around 8% of the allotted marks. The emphasis seemed to be placed upon the A2 level Design and Technology students, with all four Awarding Bodies including sustainable design in these activities.

The Awarding Bodies outlined sustainable design criteria applicable during lessons, to reports, in examinations, and in design and make activities. AQA only featured sustainable design issues in lessons focusing on materials and manufacture. Edexcel outlined sustainable design issues in recommended examinations and within the design and make activities including: the product design specification, product testing and evaluation.

Edexcel recommended a range of possible areas for the teacher to cover including: product life-cycle analysis, material selection, manufacturing, renewable energy sources, and packaging reduction. They also mentioned wider issues concerning developing countries in relation to social, economic and environmental issues, and carbon footprinting. Edexcel also recommended five sustainable design websites, including the SDA and *the Sustainability Handbook for D&T Teachers* which is a Practical Action publication with references to the SDA website.

OCR looked at the impact of the design on the environment, its life-cycle and in manufacturing. It also highlighted environmental, moral, social and cultural issues. OCR also recommended several websites, four of which were analysed in this study.

WJEC focused on ethical, environmental & social influences in product analysis, life-cycle analysis, legislation, manufacturing, material selection, and energy. These were only within WJEC examinations.

The progress from Awarding Bodies has only taken place since the SDA was completed, and there does still seem to have been little affect on AQA and WJEC. As Table 8-2 indicates, Edexcel and OCR have gone further and have referenced sustainable design websites including the SDA as a resource tool for students to use. Whatever the indications as to the short term impact of the SDA within AS/A2, in the longer term, some impact has been made on the Awarding Bodies. The SDA project succeeded in influencing long-term changes in Awarding Body policy and had direct impact on the specifications of one of the Awarding Bodies. However:

‘Influencing the shape on curriculum policy seems to occur through visionary key individuals, rather than through a project voice.’

(Pitt and Lubben 55:2007)

Sustainability is now part of the Awarding Bodies’ curriculum agenda for Design and Technology, and the SDA project has been successful in contributing to changes in national strategy and examination specifications.

However even Edexcel, who represent the biggest shift towards sustainable design issues, only feature it for 8% of their expected classroom time slots. Edexcel do appear to be the most open to looking at sustainable design issues throughout designing by outlining criteria for the specification, testing and in the evaluation.

The inclusion of more sustainable design issues within curriculum criteria may lead to more website use, as AS/A2 level design students seek the latest information. Two of the Awarding Bodies (Edexcel and OCR) have recommended prominent sustainable design websites in their 2009-10 guidelines. Edexcel recommended four websites assessed in this study (Biothinker, CAT, Information:Inspiration, and the SDA website) and the STEP website aimed at a younger age group, which was not looked at. OCR recommended five websites used in the research study (the SDA website; SustainAbility, Design for Sustainability, Centre for Sustainable Design, and PRé). Four new websites are also recommended: Reduce the Use; Energy; EnergyQuest;

and Design Green. Both Edexcel and OCR currently recommended the SDA website which was central to this research study.

8.2 Classification of sustainable design website characteristics

Having reflected and acted on the literature review on best practice of website effectiveness reported in Chapter 3, the Sustainable Design Award website was developed. The SDA website's development was also guided by the SDA Steering Committee and feedback from both students and teachers. The SDA website was therefore reflective of best practice and included the information needed by the SDA, students and teachers as a tool for them to use.

Initially 25 sustainable design websites were identified for the study from the sustainable design literature, recommendations from the SDA and Google searches. The sustainable design websites were then reviewed considering seven identified characteristics: audience, web objective, mission, principles, environmental / social / economic, materials, and being able to reach the main areas from the home page. After this review, six websites were removed from the study as they were identified as lacking information or being too focused on a specific area (Yann Arthus Bertrand, Ecosustainable Hub, IDSA, Ecological Footprint, Design for Environment, and RecycleZone).

The remaining 19 sustainable design websites were then analysed against the 12 features model, producing visual design webs. Following an unsuccessful attempt to group the visual design webs based on their shapes, cluster analysis was used to categorise the websites into two main clusters: *information* (detailed information aimed at educating) and *links* (references to other websites) clusters. It was important to develop the cluster analysis to help categorise the websites, so that the characteristics of effective practice could be related to groups of websites rather than analysing them individually or relying on solely usability analysis.

There is no evidence of research methods similar to this cluster analysis being used although Preece (1993) does identify two user groups as *surfers* and *information retrievers*. These two user categories do reflect the two broad clusters discussed above. Websites with detailed *information* reflects the *information retrievers* user

group. Whilst the *links* cluster, with references to other websites, would be more suitable for the *surfers*.

These were further broken down into four more cluster types: *informative*, *institute*, *specialist* and *hub*. The SDA website was grouped in the informative cluster alongside SustainAbility, Information:Inspiration, RMIT Centre for Design, International Institute for Sustainable Development, Inspire Recycle, Redefining Progress, and Conservation Economy. The Sustainable Design Award website and Information:Inspiration website, both in the informative cluster, have similar content of information and inspirational products but are aimed at different age ranges. All of the websites in the informative cluster were identified as including detailed information about a range of sustainable design issues. These websites could be described as prominent within sustainable design.

8.3 Website effectiveness in design decision-making within AS/A2 Design and Technology education

The practitioner conducted a literature review of designing and information retrieval in order to place the overall research study into context. Information retrieval was identified as an aspect of skill within the APU document model of designing (Hicks 1982). Chapter 2 revealed designers have a thirst for information to support their design activity and that the method of seeking information had changed with rapid developments within computer technology (Hallam 2009).

A literature review of website effectiveness was peer reviewed and published at the Design and Technology Association Annual Conference in 2007 (Simmons and Badni 2007). The literature review revealed three distinct areas within website effectiveness: 'before use', 'during use', and 'after use'. In assessing sustainable design website use in this study, these three areas were appropriate to categorise the application of each research method. Much of the literature focused on usability analysis 'during use', with little literature on the 'before use' phase and gaps in the 'after use' literature. The research aimed to address these gaps and investigate all three areas of website effectiveness.

The majority of AS/A2 level students had used websites within their design work, which was shown in both the 72 website use questionnaires and 18 AS/A2 level case

studies. Capewell (SDA co-ordinator) supported this and said that he expected students to be using websites within their design work. *Before use*, the website use questionnaires did reveal a large number of people using the internet in their design work, but a low number of people accessing the SDA website with only 28% using it. The literature revealed a lack of emphasis placed on maintaining users that had already visited the website. Companies seem reliant on raising awareness techniques of marketing, word of mouth, and search engine optimisation, rather than user feedback through social-networking and blog websites.

During use revealed that the SDA website had been designed to best practice in accordance with the literature and the website could be assigned to a type of cluster. The literature review of website effectiveness had highlighted rhetoric as one of six key areas important during their use. It listed rhetoric as involving the websites' architecture, persuasive value, depth and content. The validity of the information looked for by the website user may not be as trustworthy as conventional sources, and some students had based some of their design resolutions on information from unchecked blog websites and potentially politically motivated websites. Evidence of these sources was found in the design folios.

After use revealed little impact from the website directly into their design folio work. Those students that did use the SDA website did so early on in their design work and then this use tailed off. The students had used them regularly at the start of their project work, October and November. This figure drops with no interaction after January. After the first 30 days this decreased as their projects progressed. Capewell indicated that he was slightly disappointed but not surprised that websites were not used throughout the whole of a design project but just at the start.

The results show that AS/A2 level Design and Technology students had used the websites to look for: **inspiration** (product inspiration, images searching) or **specific information** (product research, user profiling, product comparison, sustainable design issues, materials information, contact details, evaluation).

These results indicate a consistent picture of website use in AS/A2 design education. The websites are not used in the later stages of designing such as prototyping and evaluation. This despite the commonly understood perspective of designing as a wicked problem, in which, understanding and resolving the problem happen

concomitantly (Rittel and Webber 1984). It might have been expected that as the understanding of the design task developed, website use might have continued. It is also possible that this use did continue but was not recorded by the AS/A2 students, perhaps as a result of the Awarding Bodies' requirements.

The literature revealed a gap in establishing the influence of websites on the user. The folio-tracking and follow-up interviews helped to address this gap by looking to establish how the websites had impacted onto student design folio work.

The SDA website was designed in accordance with best practice from the literature review and through the guidance of the SDA Steering Committee. This was useful in developing the website to contain the information needed by the Committee. The website was also developed in consultation with both teachers and students, which proved useful as they were identified as the two main audiences. As a result of their input suggesting splitting the website information focussed onto each of these groups separately, much of the SDA website was developed. The literature review did not reveal different types of website that the SDA website could belong to. The research study successfully clustered 19 sustainable design websites with the cluster analysis identifying four types of clusters that could be described.

8.4 Measuring the effectiveness of websites

The literature concerning designerly activity suggested that the research methodology be comprised of a variety of methods to help build up an overall picture of design activity rather than analysing a method in isolation (Lawson 2004). The development of the SDA website could be seen as part of action research (Simmons 2008), as this was developed as preparation for the research study through actions being taken, with evaluations from key stakeholders. The cluster analysis enabled the SDA website to be grouped to a specific type of website prior to using the main study website effectiveness research methods.

The website effectiveness literature helped to shape the direction of the main study and revealed methods for investigating website usability, but not within each aspect concerning before use, during use and after use. The investigation focused on various methods of research to help address these three areas.

Although succeeding in recognising *revisiting*, *recommendations*, *website advertising*, *searches* and *domain names choice* as influencing factors in *before use*, mentions of the area in the literature were sparse. Most of the literature focused on website effectiveness once the student was using the website. *During use* of websites areas such as cognitive psychology, human-computer interaction, usability, linguistics, rhetoric and likeability were considered. Little literature covered the impact of the websites *after use* which had identified patterns of use, usability reviews, web sales, influence and likeability as key factors. The influence of websites was identified as a key area that had been ignored in sections of the literature that could prove crucial to the success of a website.

This study used a mixture of both quantitative and qualitative research methods throughout the study in order to build a broad picture of effectiveness. The range of methodology used helped to draw a picture of website use and effectiveness within AS/A2 Design and Technology and so this objective was fulfilled.

8.4.1 Quantitative research methods

Quantitative research methods in this study were in the form of questionnaires and checklists. The website use questionnaires were used to help assess the before use stage of website interaction by the AS/A2 students. The questionnaire used in the main study had been improved from the pilot study to give more closed questions when asking about the frequency of website use. 73 of these were given to the students and produced a statistically significant sample. The questions revealed only 28% of the students were using the SDA website. The questionnaires helped to illustrate that although the SDA website was usable and produced to best practice, the number of people accessing it in the first place was low.

Although in much lower number, the 18 post-presentation questionnaires results revealed, that out of the 18 students questioned, a high number of students felt they used sustainable design websites at the start of their project; a pattern reflected later by the qualitative methods. To improve the significance of these results a greater sample number would need to have been used. No significant difference was determined between the results of the website use questionnaires and the low number of post-presentation questionnaires, thus no conclusions could really be

drawn suggesting that having a supporting input would impact upon website effectiveness.

Usability questionnaires and checklists were completed by 41 undergraduate students to help assess websites in the during use phase. The assessment helped to assure that the SDA website was designed to match with best practice. The usability questionnaires revealed four areas as being important factors for website effectiveness by the student designers: navigation, layout, download time, and content. The students assessed either the SDA website or the Information:Inspiration website, the open questions enabled a frank assessment of the websites and highlighted that both were logical in their approach and usable websites with a lot of information. This method helped to highlight the broad areas of website effectiveness that the undergraduate students identified as being important.

A detailed assessment usability checklist was used to assess each area of the website in turn by answering closed questions on its usability. These were completed on all of the 25 sustainable design websites in the pilot study. The main study usability checklists were completed by the undergraduates on just the SDA website and Information:Inspiration website.

For the SDA website, the checklists indicated a well-labelled and straightforward navigation system, although they highlighted that there was no search facility within the website. They also highlighted that the control aspects of the website were compatible. No problems were reported in finding aspects of the website, with clear labelling highlighted as a positive outcome of the SDA website design. The usability checklists indicated that the SDA website did not encourage further interaction, some undergraduate students, for example, could not find out how to give feedback on the SDA website. This could play a small part in retaining users and encouraging them to revisit the website. Errors were not reported on the website with the look and layout consistent with the SDA brand.

8.4.2 Qualitative research methods

The qualitative research methodology revealed more information on the impact of the SDA website on design folio work within AS/A2 level Design and Technology. The

qualitative methods employed included: case studies, folio assessment and an interview reviewing the findings with the co-ordinator of the SDA.

18 AS/A2 level student case studies were focused upon to help indicate what information designers seek and how they seek it. The method allowed the practitioner to identify specific instances within their folio work and consider that alongside when they recognised they used websites within their work. The case studies included a time directly with the AS/A2 student where the practitioner was able to ask: what issues they were explaining within their work, their consideration of using websites, which websites they looked at and if they helped.

The detailed analysis enabled instances within the folio work to be identified and matched across the length of the project to help indicate when students were looking for sustainable design information, when they used websites, and when they used the sustainable design websites within their work.

An interview with a leading figure within the SDA helped triangulate the information gathered, helping to confirm or refute the findings. Capewell was able to indicate expectations of the SDA regarding student use of websites, the integration of sustainable design and the impact of the SDA within student design folio work. Capewell indicated for example that he expected eco-design tools to have been present in the folio work in contrast to the findings. Capewell also confirmed the importance of wider sustainability issues being integrated. The interview enabled a broad discussion of findings and the expectations of a key player within the SDA to be compared with the survey outcomes. The practitioner recorded this interview with some prepared questions guiding the discussion towards triangulating the findings.

8.5 Key principles governing effectiveness of the SDA website

8.5.1 The effectiveness of the SDA website

Only half of the AS/A2 level Design and Technology students had used sustainable design websites, and only 28% had used the SDA website. As indicated in section 8.3, those students who have been on the SDA website seem to be using it early on in their design work. Capewell said that he felt sustainable design websites influence

design decisions in a limited number of cases, and unless the SDA website was linked to the mark scheme of the Awarding Bodies he felt the number of such instances would be insignificant. The AS/A2 level Design and Technology students, that did use the SDA website, found the information useful and included some of the information in their folio work. An aim the SDA Steering Committee was for the structure of the SDA website to encourage a non-linear approach to designing, illustrating that sustainable design issues are applicable to each area of the students' project work.

The design undergraduate students assessing the SDA websites' usability found the website easy to navigate due to the compartmentalisation of information in appropriate sections. Splitting the information into sections allowed for less congested visual graphics and quicker download times. The students reported that the volume of information on the SDA website limited the style of the website.

The sectioning of the website had been a response to the initial feedback from mach I of the SDA website design. The visual and navigation aspects had taken the information gained in the literature review to improve the design for mach II; for example, a plain font was used throughout the SDA website to aid the labelling (Rosen and Purinton 2004). The SDA website did not include a site-map or search facility. This was overcome by the user through following clearly labelled links. Consistency in colour choice added to this clarity.

8.5.2 Supporting inputs for the SDA website

The SDA report by Pitt and Lubben (2007) suggested that teachers played vital roles as facilitators of the resources and as the teachers are able to point the student to the SDA website. This was highlighted by Capewell who suggested that that he would have expected more SDA website use in the schools where the teachers were the most keen to introduce sustainable design.

The report also highlighted the role of the Awarding Bodies as being a key driving factor in requiring sustainable design to be a part of AS/A2 level Design and Technology education. Requiring the inclusion of sustainable design into AS/A2 creates a demand for readily available information. The 2009/10 guidelines for the OCR Awarding Body suggest several sustainable design websites as well as *the*

Sustainability Handbook for D&T Teachers (Capewell et al. 2007). This handbook was distributed to all the secondary schools in England and referenced the website throughout. Capewell felt that the Handbook would help to cover areas of design at AS/A2 level where he felt the SDA was weak, for example: food, graphics, and systems and control.

The results of the post-presentation questionnaires are very similar to the website use questionnaire and design folio findings. Both questionnaires indicated that websites were used early on in the design project work, specifically to look at similar existing products and material selection, which is generally in line with the design folio findings. Sustainable design websites were used in a limited number of cases concerning material selection and recycling. The SDA website was also used for specific information on sustainable design issues and existing product inspiration. This would suggest that on its own the supporting input had little impact on SDA website use within designing. Even though the AS/A2 level Design and Technology students were presented with all the areas of the SDA website, including areas that would help during development and in evaluating their projects, these were not indicated within their design work folios.

8.5.3 Stages in designing

The detailed analysis of the 18 design project folios revealed sixteen instances where sustainable design websites had been used. As has been reported in section 8.3, thirteen of these instances occurred before December, no instances occurred after December. This suggests that sustainable design websites are used at the start of the project. Generally this reflected the general website use by the students, as forty five instances were recorded of students using websites during this same time period with the usage dropping after that. The design folio work also recorded instances of sustainable design consideration during these early months, because on thirteen occasions during this time students referred to sustainable design.

Roberts (1992) criticises a linear approach to the nature of models of Design and Technology used within education, as failing to describe a much more complex problem than the linear model would suggest. Edexcel did present a cyclic model within their 2009/10 guidelines and appeared to be progressive when introducing sustainable design. However, the idea that all design requires continual appraisal

and reappraisal is not reflected throughout modern Design and Technology education (Roberts 1992). AQA, OCR, and WJEC all seem to base their exemplar AS/A2 work as having a very linear model, i.e. stage by stage designing. In this instance, sustainability seems to have been used as a stage that the student designers need to address to gain marks, before they move on to other areas of Design and Technology. It could be the case that sustainability decisions are perceived as easier to take at the beginning of design projects, and the recorded instances just reflect that.

At the start of the projects, for all the four Awarding Bodies the students would have been expected to research and produce a design specification, working towards design ideas. However from this point, the use of sustainable design websites and references to sustainable design decreases as the student's project work progressed. Capewell commented that this pattern of sustainable website use was to be expected. It appears that sustainable design was being associated with setting the direction of designing, but not with their later execution.

On three occasions the use of the SDA website was recorded by students within their design folio work. Capewell supported these findings and commented that the website use had been limited. At the time, the Awarding Bodies were only just beginning to implement sustainability policies into their syllabuses. The AS/A2 level Design and Technology students had used the SDA website to look for inspirational products; information on sustainability issues, materials and recycling. These are the same topics that students recording sustainable design issues had indicated in their design folio work, apart from product disassembly. The sustainable design websites were referenced on limited occasions, although students were using other websites to inform their designing in relation to: product research, product inspiration, target audience research, images to use, and during the evaluation.

Resolving even the simplest of design decisions when considering sustainability issues is complex (Norman 2006). Making those value judgements when fully informed of all the pros and cons is difficult, but without the appropriate information and knowledge of the arguments it is pretty much impossible. There are no definitive answers when choosing sustainable design solutions, design students need to have the knowledge to inform their design or have access to resources to teach them. Perhaps the complexity of these decisions is one of the aspects that is putting off

both teachers and students, so much so they do not include these judgements within their work.

The sustainable design issues recorded in the student design folios match the topics that are covered by Edexcel in the Awarding Body 2009/10 specifications. In the specification Edexcel covered a range of issues including: material selection, product life-cycles, renewable sources, wider issues within developing countries (e.g. social, economic, and environmental issues, carbon footprinting, disposal and recycling). The 2009/10 curriculum specifications for the AQA Awarding Body focussed on material selection and areas of reduce, reuse, and recycle during sustainable design lessons. OCR concentrated on looking at materials, energy, recycling, and social, moral, environmental and cultural issues. WJEC highlighted life-cycle, legislation, materials energy, and ethical, environmental and social influences.

When instances of sustainable design issues are shown in students' design folio work, the level of detail and connection with wider sustainability issues is surface deep. Edexcel, OCR and WJEC included in their Awarding Body requirements for 2009/10, sustainable development issues as being required during the students' design and make coursework. AQA only included these sustainable development challenges within lessons, these were not assessed. Edexcel, OCR and WJEC all included sustainable development lessons with examinations, outlined in their curriculum specifications.

None of the AS/A2 Design and Technology students used or recorded using Eco-design tools in their design folio work. The Awarding Bodies have also omitted the inclusion of eco-design tools both at the time of the SDA and in the current 2009/10 specifications. Eco-design tools were seen by the SDA Steering Committee to be the link between the bigger issues of sustainability, such as resource depletion and global warming, with practical Design and Technology frontline issues, such as design decision-making. However, the role of eco-design tools in connecting the detailed decisions within designing to the wider sustainability agenda, was apparently not appreciated in the same way by students and teachers.

For example, there has been a major investment by the PRé consultancy to develop the eco-indicator tool. The eco-indicator eco-design tool has had a vast number of issues built into their eco-points system to help relate these bigger issues of resource

depletion, human well-being and biodiversity to design decisions concerning such matters as materials selection. The inference from the design folio work is that students addressed the issues by choosing materials that are recyclable for example, rather than really getting into issues of energy consumption, transportation or carbon emissions, and wider sustainability issues that are perhaps less obvious. Perhaps students and teachers do not realise the research and development involved in tools such as the eco-indicator which has attempted to be a tool to help designers make those complex decisions. By using the eco-design tools to help address their issues they could be engaging with these wider issues and even if their knowledge of them is incomplete. Making such connections would then rely on the teaching or Awarding Bodies to explain or require knowledge of how the tools were developed.

8.5.4 Improving website effectiveness through social media

The SDA website could be further developed to optimise its search engine capabilities. The latest criteria to optimise the SDA website for the UK's popular search engine Google change continuously. If the website was designed to be used in other countries, further work would also be needed to prepare the website for their popular search engines. Hallam (2009) suggested key points that could help keep the SDA website to the top of the Google searches. Repetition of key words and phrases throughout the website, increasing links from trusted websites, and including Google friendly downloads will all help its Google position in the rankings.

Addressing this emphasis on engaging with technology and social practices, the latest information retrieval techniques discussed in 2.2 may be useful in promoting sustainable design websites. The developments in social networking websites, and web news feeds, may enable the latest sustainable design information to reach users who are already using websites such as *facebook*, *twitter* and *netvibes* regularly. Blog websites may also be useful in keeping the information present and scoring well on search engines that the student and professional designers use already.

8.5.5 Improving website effectiveness through smart decision-making

In 2006, Coles published work on value judgements and their role during designing. Decision-making is influenced by values and different sets of values influence design

decision-making at various stages (Coles 2006). These values are considered in two categories:

- *internal* (perceived societal values (PSV), perceived identified stakeholder values (PISV), perceived economic system values (PESV), embedding values in design, designer's personal values (DPV) and meta-values (MV));
- *external* (societal values (SV), identified stakeholder values (ISV), economic system values (ESV), values embedded in design (VED)).

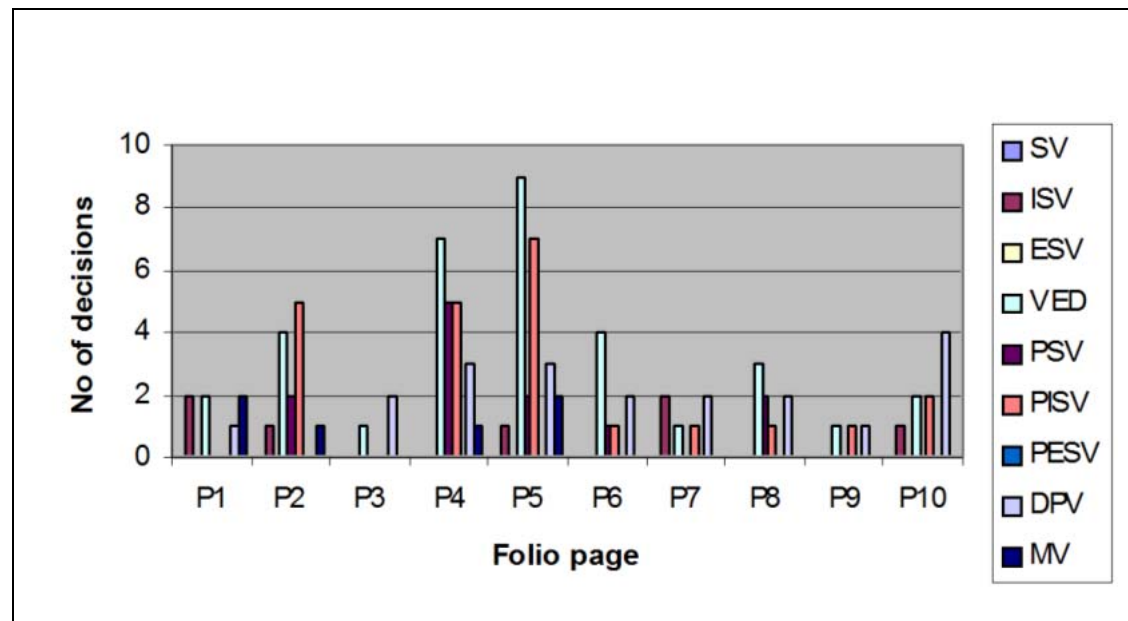
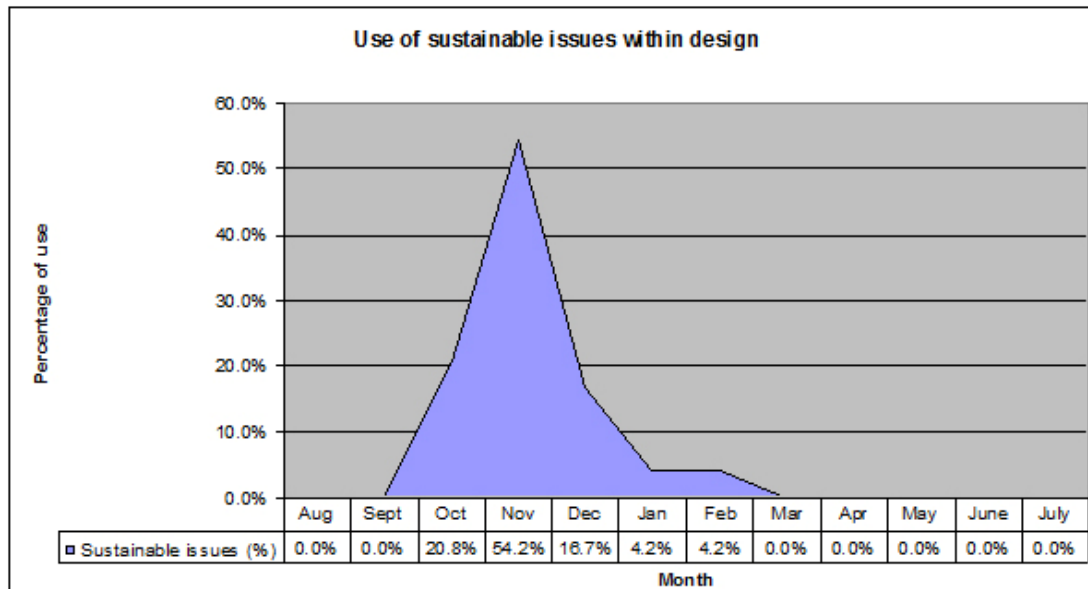
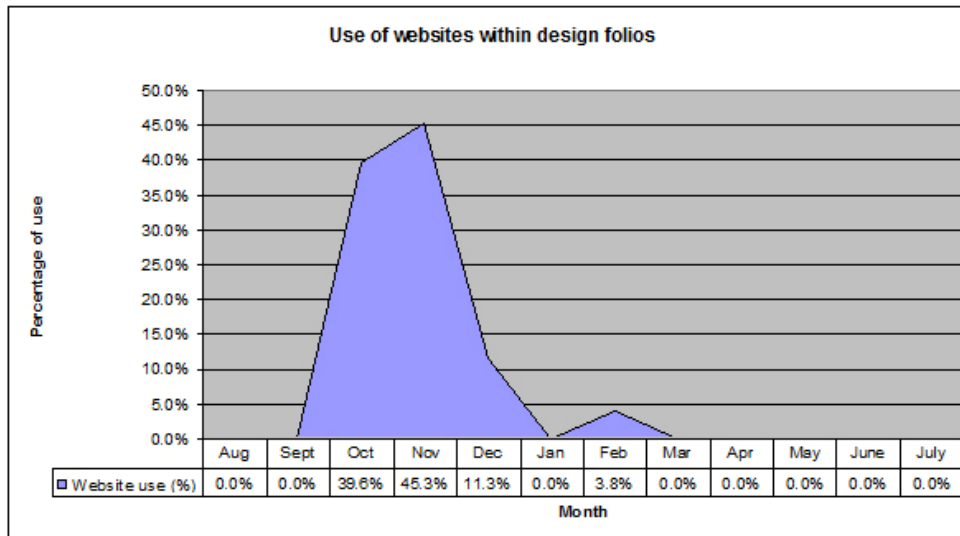


Figure 8-1: The occurrence of value judgements during project work (Coles 2006)

The findings reported in this chapter regarding the use of websites, sustainable design, sustainable design website use, and the correlation between when students are looking for information are shown in Figure 8-3.



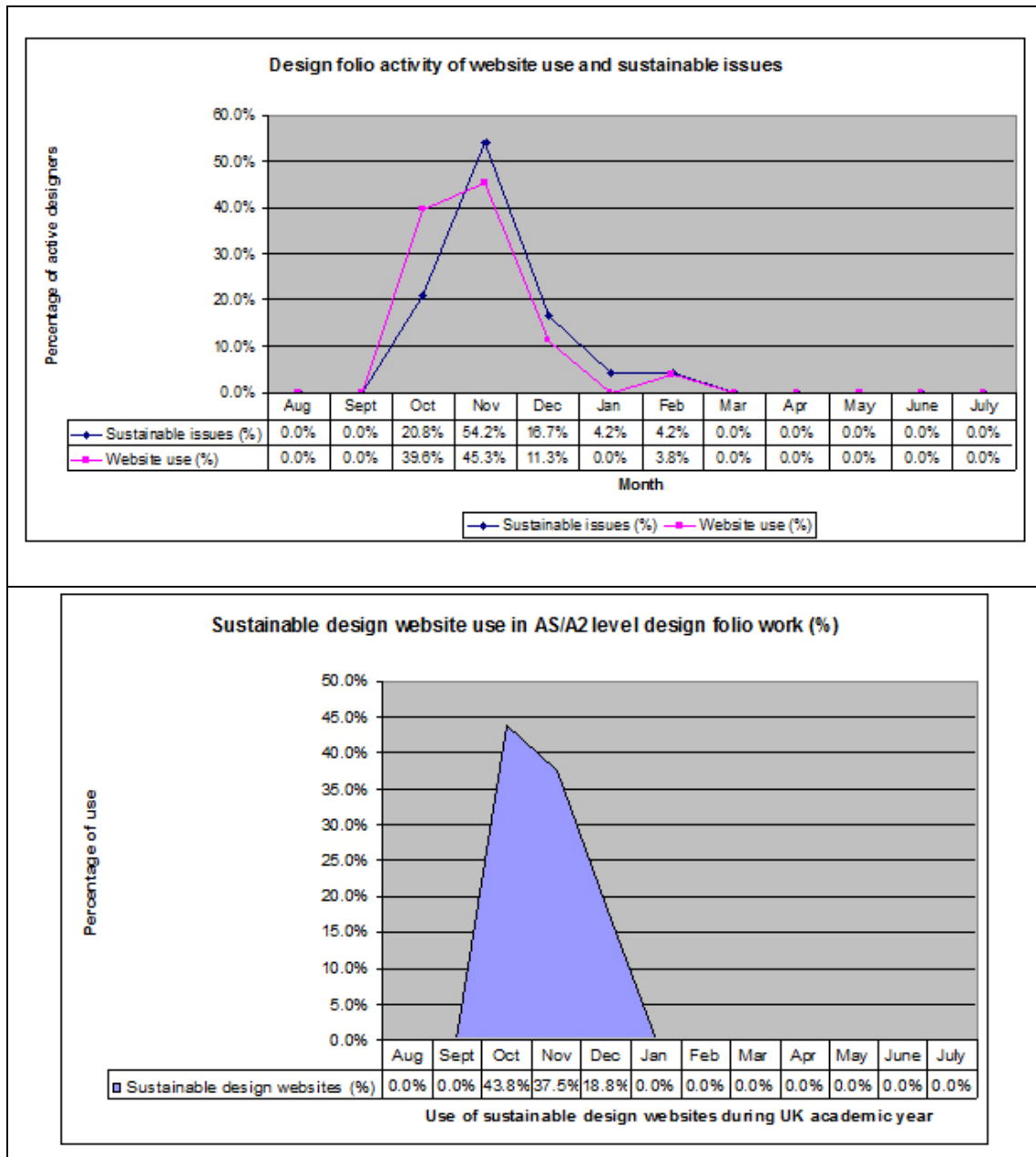


Figure 8-2: Graphs illustrating trends within design folio work

Student designers are looking to make informed decisions through the use of resources; the internet is a key resource for AS/A2 level students within Design and Technology. A useful future research direction may be looking to see if a website can be developed that gives the required information at the appropriate time during project work. When design decisions are taken on a particular area, the website could be transformed to focus on that area. Such a strategy would match with the research findings in this study suggesting that the exploration of sustainable issues closely follows the areas commonly pursued.

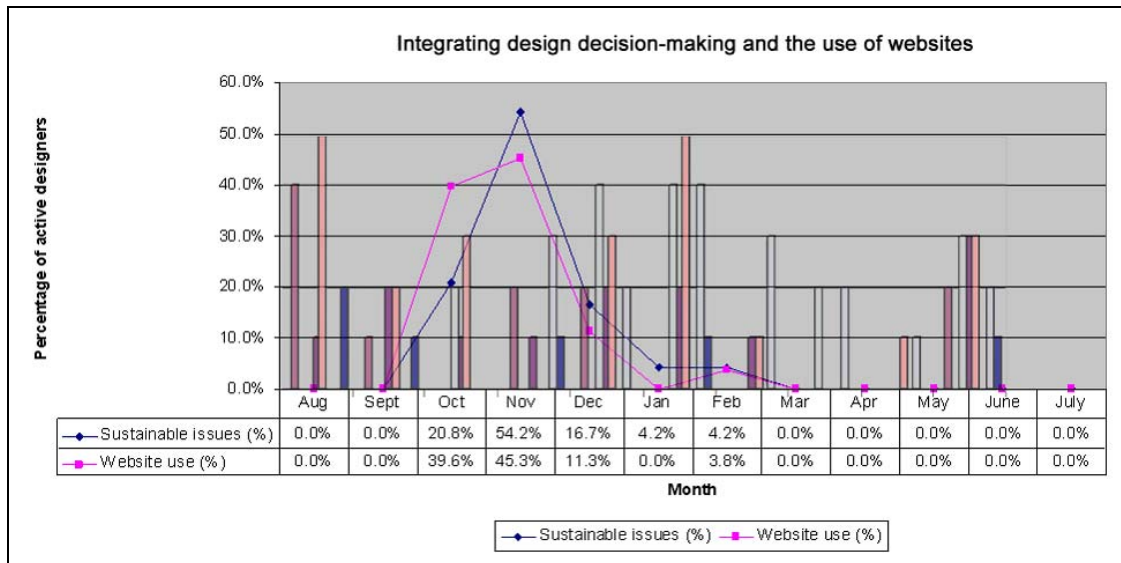


Figure 8-3: Integrating design decision-making and the use of websites
(Simmons and Trimmingham 2008)

Figure 8-3 shows the two bodies of work on one graph, mapping decision-making alongside website use and sustainable design issues. The proposal would be to transform this data into a website focused on student decision-making.

8.6 Applying the findings more widely

8.6.1 The integration of sustainable development into the design mainstream

“Tinkering on the edges’ of sustainable practices within technology education amounts to an inadequate educational response to the rapidly emerging sustainability crisis.’ (Elshof 2008:135)

Capewell would seem to agree with Elshof’s (2008) assertion that ideally sustainable design would become integrated into mainstream design rather than it being a separate entity. Designers would just consider it in terms of listing the benefits within aspects of their design.

As discussed in this chapter the integration of sustainable development into AS/A2 level Design and Technology is dependent on a number of factors. The main factors concern the teachers’ delivery and engagement of sustainable design with the students, and its requirement by the Awarding Body to be part of their work.

Huckle (2005) suggests that rather than perceiving sustainable development as a policy, it should be regarded as a state of mind. Is it conceivable to develop perception of sustainable development amongst the next generation of designers so that it is integral to their make-up, rather than an add-on or requirement? Part of the solution of sustainable development integration must be to engage the students in the bigger issues of sustainability.

Capewell feels raising awareness of the issues is a key strategy in making students want to make a difference.

What you are trying to do is to encourage young people to change the way in which they look at the world. I don't think websites are the way in which that happens. It is more likely to be the influence of inspirational teachers or things like Al Gore's 'An Inconvenient Truth'. That had some impressive features to it like the diminishing glaciers and the rising sea levels. Those are the sorts of things that seem to impact on kids and make them think differently.

The findings may have implications on how we teach and relate the broader areas of sustainable design. As Elshof (2008:141) suggests, 'new design conditions need to inform classroom practices' extensively to support this shift in wider sustainability ideals. Design education needs to embrace the bigger picture of eco-effectiveness and cradle-to-cradle (McDonough and Braungart 2002) thinking to help produce students practising with sustainability at the forefront of their thinking.

The opportunity to grapple with socio-political realities involving largely contradictory and complex issues is integral to the integration of sustainability into design education practice. This can be enabled through technological and social innovation that students relate to. Capewell indicates an example of that highlighting the impact of Al Gore's 'An Inconvenient Truth' and also the 'Earth from Above' exhibition that inspired this thesis. A change of culture may ultimately increase the use of sustainable design websites, as the issues become more integral to design decision-making.

Capewell did feel that the SDA had been successful in changing the thinking of students who had attended the SDA study days. Capewell also highlighted the importance of enthusiastic teachers in helping to communicate sustainable issues. Capewell felt that the influence that sustainable design has is dependant on

individual teachers and if and how it is taught. Pitt and Lubben (2007) seem to support this idea of integrating a sustainable development frame of mind into Design and Technology education teaching. Pitt and Lubben (2007:50) concluded that the SDA provided a platform for 'teachers who were already committed to the notion of SD to develop a frame of mind that places sustainability centrally within their teaching of technological design'.

This engagement with sustainable development as a state of mind must be driven by two of the main stakeholders identified in this report, the teachers and the Awarding Bodies. Awarding Bodies do have a major role to play and as has been drawn out in the discussion it is perhaps the perception of their role which is key to this integration. Is their role to be a supporter of curriculum implementation or is their role to be a driver of change? Until Awarding Bodies see themselves as the latter, engagement with the very real issues of sustainable development and their full integration into AS/A2 level Design and Technology may be on hold.

CHAPTER 9 CONCLUSIONS

This chapter outlines the conclusions from the main study and reports several contributions to knowledge. Recommendations for future work are also given.



In conclusion, website use is prominent in AS/A2 level designing but decreased as their project work progresses. In AS/A2 Design and Technology website use recorded in the student major project work stopped altogether after January, after this point design students would move towards making their project. The findings support the contribution to knowledge Lofthouse (2001a), recognising that AS/A2 level Design and Technology students appear to use websites to find two types of information: specific information to help with design detail and inspiration. Typical specific information sought from websites included material selection, manufacturing technologies and user profiling. Inspiration from websites was typically gained from other sustainable products and images.

Sustainable design was prominent in the AS/A2 education population studied in this research with around 60% of the students having had some sustainable input. But it had not been fully integrated into every aspect of student design work. The principles that are followed by sustainable design in AS/A2 level Design and Technology education were dependant on the delivery from the teachers and inclusion in the

AS/A2 level marking scheme provided by one of the four Awarding Bodies. The students that did consider sustainable design looked at information in two forms: specific information and inspiration. Specific information typically included material selection and energy use for example. Inspirational sustainable products were also used to inspire the student work. These align with the findings concerning the data gathered in website use.

Only half of the AS/A2 students had used sustainable design websites, these were most prominent in October, November and December in the folio work but the students stopped using them after January. The students used sustainable design websites to look for specific information and inspiration. The sustainable design websites were analysed for their content against the twelve features sustainability model with design webs produced to illustrate the findings visually. The websites were then successfully clustered with four group types established, informative, institute, specialist, and hub (7.1).

The importance of persuasive value was indicated in the results. Despite SDA publicity and usability enhancements, only 28% of the AS/A2 students had used the SDA website. A focused effort in improving the numbers of people accessing the website may result in more prominence within student design work because those that did use the SDA website used it to help support their design work.

The thesis has developed a method of assessment to measure the effectiveness of website 'before use', 'during use' and 'after use'. The principles of measuring effectiveness are also applicable to the assessment of other sustainable design websites and websites in general. The SDA website used as a research tool within this project and was designed to reflect best practice from the literature review on website effectiveness. At the lower level of design implementation, the findings from the usability analysis and feedback from students and teachers suggests that the following issues need appropriate treatment: navigation, functionality, control, language, feedback, consistency, error prevention and visual clarity.

The development of the SDA website successfully integrated feedback from the students and teachers. The feedback from mach I suggested the information be split into sections and broken down into sign-posted information. The literature review on the areas of website effectiveness (3.4) helped to prepare the website's design. The

feedback from the usability questionnaires suggested that this had been successful as it had made the navigation of the website easier and added clarity to the layout. The informative cluster represents the characteristics of a high level design strategy for effective development of AS/A2 level sustainable design websites. The appearance of the SDA website in the same cluster as websites such as Information:Inspiration, might suggest that the characteristics of the informative cluster represent principles of effective website design of more general significance.

9.1 Contributions to knowledge

This thesis makes several contributions to knowledge, and the main contributions are outlined below:

- greater understanding of the meaning of website effectiveness and how it can be evaluated 'before use', 'during use' and 'after use';
- an improved understanding of the design of a sustainable design website for AS/A2 level students in terms of higher level strategy and lower level implementation;
- improved knowledge of the use of websites, sustainable design and sustainable design in AS/A2;
- development of a web categorisation approach based on the twelve features model and hence facilitating associated cluster analysis;
- an indication of the characteristics of the informative cluster as representing the appropriate strategy for effective website design;
- confirmation of the importance of the role played by the Awarding Bodies at AS/A2 level Design and Technology in influencing sustainable design.

9.2 Recommendations for future work

From the discussion and conclusions four areas are recommended for future work.

Eco-design tools

Further work to investigate the impact of eco-design tools within design folio work and their usage. After being a main focal point for the SDA, Pitt (2007) reported that the tools had been a success. Capewell suggested that they had been successful in integrating the tools but felt there had been no impact on design outcomes. No examples of students using the tools were found within any of the design work.

Raising awareness

With a limited number of students accessing the SDA website, greater research looking at the 'before use' phase of website effectiveness could help to increase the number of people accessing the website. The latest advances in internet technologies may allow for creative solutions to attract more design students to sustainable design website.

Website clusters

Further investigation into the website clusters and their appropriateness if applied to other websites would help to further define the clusters discussed in this study. The implications of their use and expectations of use could then be assessed in terms of websites belonging to a cluster of websites with certain properties. A comparison of sustainable design website use between clusters may also prove valuable.

Design decisions

Further analysis of persuasive value, considering why designers choose one website over another, would help with the design of an effective website. A sustainable design website that is focused on giving students the information they seek at key instances during their design work when they need it is a suggestion for further study. This would build on the findings of the patterns of website, sustainable design and sustainable design website use within this study, and the work on value judgements by Trimmingham (2008).

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CHAPTER 11 APPENDICES

11.1 SDA website development

The development of the SDA website pages are shown below:

INITIAL DESIGN IDEAS

Index

General

- News*
- Tools*
- Sustainability Information*
- FAQs*
- Contact*
- About us
- Study weekends
- Enrolments
- Partners

Teachers

- News*
- Tools*
- Sustainability Information*
- FAQs*
- Contact*
- About us
- Study weekends
- Enrolments
- Partners

Students

- News*
- Tools*
- Sustainability Information*
- FAQs*
- Contact*
- About us
- Study weekends
- Enrolments
- Partners



Initial design ideas for the SDA website

MACH I

Index

Teachers

Inspirational products

Students

Support

Sustainability information

Assessment

Study weekends

Partners

Students

Students

*Original project – starting point**European brief – starting point**Developing country brief – starting point*

Inspirational products

Tools

SAQs

Contact

Message-board





SDA website Mach I

MACH II

Index

News & Events

Students

Teachers

Teachers

Teachers home

More about the SDA

What's the SDA all about?

How do teachers get involved?

Using the website

I've had training

Register

Starters

Starter activities 1: what's wrong with the world?

Starter activities 2: belief circles

Starter activities 3: line-ups

Starter activities 4: product pairs

Starter activities 5: the bigger picture

Starter activities 6: footprint analysis

Starter activities 7: stealing from the future

More information

Inspiration

Professional design work

Dimensions & definitions

Problems & development

Change & principles

Sustain-a-balls

Assessment

Resources

Students

Links

Books

People

Downloads

The good practice guide

Introduction to the SDA

Inspiration

Students

Inspirational products

Student design work

Student home

I have a project

Sustain-a-balls

Developing a specification

Generating ideas
 Initial investigation and analysis
 Fundamental issues of sustainability
 Planning manufacture
 Making/manufacture
 Testing and evaluation
 Develop, communicate & evaluate design proposals

I need help

Contexts

Textiles
 Practical Action design briefs
 Systems and control
 CAT design briefs
 Practical Action design briefs

Buildings
 Starting points
 CAT design briefs
 Practical Action design briefs

Product design
 CAT design briefs
 Loughborough University design briefs
 Practical Action design briefs

Graphics
 Practical Action design briefs

Food
 CAT design briefs
 Practical Action design briefs

Inspirational products

Tools

Eco-design tools
 Design abacus
 Eco-indicator
 Foot-printing
 Checklists
 Creativity activities

Materials

Know your materials

Sustain-a-balls

FAQs

Contact



TEXTILES

Click on the images below to turn the card over and reveal the brief. These are intended as starting points for discussion and should help you generate ideas of your own. Once you have a project, you are encouraged to go straight to the 'Sustain-a-balls' checklist. To do this click on the icon above.

sending messages

Textile products are often used to communicate messages. Find some messages that have been assigned to you in fashion products. What was the designer trying to tell you?

Check out: www.pinkmilk.co.uk
www.kidsworld.co.uk
www.clothingall.com
www.fashioning.com

more information

What's it made of?

Textile products are often used to communicate messages. Find some messages that have been assigned to you in fashion products. What was the designer trying to tell you?

Check out: www.pinkmilk.co.uk
www.kidsworld.co.uk
www.clothingall.com
www.fashioning.com

more information

It's not fair...

Textile products are often used to communicate messages. Find some messages that have been assigned to you in fashion products. What was the designer trying to tell you?

Check out: www.pinkmilk.co.uk
www.kidsworld.co.uk
www.clothingall.com
www.fashioning.com

more information

SUSTAIN-A-BALLS

When tackling an SDA project there are a lot of issues to consider. This section of the website is designed to help you to keep all your balls in the air. At each stage of your designing and making process, refer to the relevant sections below to help you juggle the different issues of sustainability.

Initial Investigation & Analysis

Generating ideas

Developing a Specification

Planning Manufacture

Making Manufacture

Testing & Evaluation

Starter Activities

SA6 Footprint Analysis

A tool used to raise awareness and illustrate a person's impact on the world. The website activity below is intended for students to use as individuals but discussion can take place in groups afterwards. This activity also features as a useful eco-design tool in the 'Sustainable' Section of this website.

When to use the activity

Use this activity when highlighting the link between consumption patterns and lifestyles and sustainability. It is particularly useful in making students think about their own behaviour as consumers and the impact they have as individuals.

Who is the activity for?

This introductory activity can be used at either A1 or A2 level. It can be either a group or individual activity or a combination of the two.

The Activity and hints on how to organise it

- Go to www.myfootprint.org or www.bestfootforward.com/footprintlife.htm
- You are asked a number of questions about your lifestyle
- Enter your responses into the drop down menus
- As you give your answers you can see how many planets are needed to support the way you live (if everyone adopted your lifestyle)
- If working in groups review the results and the students' reaction to them.

For further information about Footprinting [click here](#).

SA1 SA2 SA3 SA4 SA5 SA6 SA7 SA8 SA9

SDA website Mach II

235

11.2 Questionnaire examples

11.2.1 Website use questionnaires

10/05/07

Silcoates School, Wakefield

Name..... Age.....

AS or A2..... Examination board.....

Project title.....

Sustainability and website use in design projects

Student Notes

1a) When do you use websites in your design work? (please tick as appropriate)

0-30 days into your project: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

30-60 days into your project: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

60-90 days into your project: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

More than 90 days: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

1b) What were you looking for?

.....
.....

1c) How long did it take you to find it?

.....
.....

2a) When do you use sustainable design websites in your design work? (please tick as appropriate)

0-30 days into your project: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

30-60 days into your project: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

60-90 days into your project: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

More than 90 days: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

2b) What were you looking for?

.....
.....

2c) How long did it take you to find it?

.....
.....

3a) When did you use the SDA website in your design work? (please tick as appropriate)

0-30 days into your project: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

30-60 days into your project: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

60-90 days into your project: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

More than 90 days: every 2 days ☐ sometimes ☐ rarely ☐ not at all ☐

3b) What were you looking for?

.....
.....

3c) How long did it take you to find it?

.....
.....

Thank you for your time and feedback.

11.2.2 Post-presentation questionnaires

<u>Observations</u>	<u>Photo ID</u>	<u>Student additions</u>	<u>Follow-up questions (prompts)</u>	<u>Advice</u>
			a) What issues were you explaining? b) Did you consider using websites to help? c) Which one did you look at? d) Did they help, if not why not?	

11.2.3 Usability questionnaires

Name.....

Website name: **Sustainable Design Award Online**

Website URL: **www.sda-uk.org**

Did you take the sustainable design module or undertake any sustainable design education (if yes, please explain)?

.....

Task One – Usability

How would you measure the effectiveness of websites?

.....

.....

How usable is the selected website?

.....

.....

Task Two – Web Assessment

Open: <http://webxact.watchfire.com> and find the highlighted website from the list you wish to use and type the address into the 'Page URL' box.

Click on Go! Have a look at the results, this may prove a useful evaluation tool for your own websites.

11.2.4 Usability checklists

Name.....

Website name: **Sustainable Design Award Online**

Website URL: **www.sda-uk.org**

Task Three - Usability evaluation checklist

Navigation	Fulfilment			Notes
	Always	Sometimes	Never	
Indication of current location	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Clear link to home page	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
All major parts are accessible from home page	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
A site map is available	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
The structure is simple with no unnecessary levels	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
An easy to use search function is used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Functionality	Fulfilment			Notes
	Always	Sometimes	Never	
All functionality is clearly labelled	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
All necessary functionality is available without external sites	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
No unnecessary plug-ins are used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Control	Fulfilment			Notes
	Always	Sometimes	Never	
User can cancel all operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Clear exit point on each page	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
All graphics links are available as text links	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
The site supports the users' workflow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
All appropriate browsers are supported	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Language	Fulfilment			Notes
	Always	Sometimes	Never	
The language used is simple	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Jargon is avoided	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Feedback	Fulfilment			Notes
	Always	Sometimes	Never	
It is always clear what is happening on the website	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Users can give feedback via email or form	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Users are informed if a plug-in or browser version is required	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Online help is available	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Consistency	Fulfilment			Notes
	Always	Sometimes	Never	
One word is used to describe one item only	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Links match the page titles which they refer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Standard colours are used for links and visited links	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Terminology is consistent with general web use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Error Prevention	Fulfilment			Notes
	Always	Sometimes	Never	
Errors do not occur unnecessarily	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Error messages are clear	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Error messages describes what action is necessary	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Error messages provide a clear exit point	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Error messages contain contacts for further assistance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Visual Clarity	Fulfilment			Notes
	Always	Sometimes	Never	
The layout is clear	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Sufficient 'white space'	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
All images have ALT text assigned to them	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Unnecessary animation is avoided	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Evaluation Checklist adapted from Gerry Gaffney © 1998 Information & Design Pty Ltd (www.infodesign.com.au)

CHAPTER 12 ANNEXES

The annexes to this PhD are available from the author.

- 12.1 - website walkthroughs (.avi videos);
- 12.2 - classroom and lecture presentations (Powerpoint presentations);
- 12.3 - 25 website analysis reviews (word documents);
- 12.4 - web clusters of the 25 sustainable websites (images);
- 12.5 - cluster analysis details (excel spreadsheets);
- 12.6 - collated results from the main study (excel spreadsheets);
- 12.7 - usability checklist results (word documents);
- 12.8 - 18 case studies (Powerpoint presentations);
- 12.9 - undergraduate design boards (photographs);
- 12.10 - interview (transcript and audio files).