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A review of the literature concerning website effectiveness: before, during and after use.

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Abstract

There is a need for effective websites to help to integrate sustainable development principles into design and technology education. This paper describes current sustainable design initiatives in education which aim to achieve this integration of sustainability principles. Despite large investment into information communication tools such as websites, the impact that these websites have within education is rarely assessed. This paper outlines the key areas of the broad topic of 'website effectiveness' according to literature in this area. It also investigates the comprehension of website effectiveness within this context, and identifies three distinct phases of effectiveness: before use, during use and after use. The paper uncovers gaps in the research in two areas; primarily a need for further research concerning influence after a website has been used and requirements for ensuring a wide knowledge of the websites existence. The paper also discovers some conflicting ideas of importance between a websites' usability and likeability.

Keywords

Sustainable design, effectiveness, websites, impact, decisions, usability

Introduction

The response by businesses and designers to sustainable development and more specifically sustainable design, has evolved over the past few years. Initially industry sought to reduce environmental impact through 'end of pipe' techniques in the 1980s. The emphasis later shifted to look at cleaner manufacturing processes that address issues of less waste and pollution. Currently the focus now 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, has therefore become integral to the movement's success.

Sustainable Development has become a prominent part of design and technology education. Schemes such as Design for the Environment Multimedia Implementation (DEMI) (Clare 2001) led by Goldsmiths College (University of London), Practical Action's Sustainable Design Award (SDA) (Capewell and Norman 2003) and Sustainable Technology Education Project (STEP) have all been championing the movement.

Bhamra (2004) identifies the current position of sustainability as combining technology, culture and nature, the success of which relies on the effectiveness, innovation and creativity of its implementation. Furthermore Bhamra (2004) identifies 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)

Sustainable design websites relate to various aspects of the features identified by Bhamra (2004). In design and technology education sustainable design websites are

often used as key communication tools for students to refer to, and it is their effectiveness that will be focused on. The internet could be seen as an appropriate tool for educating young people as they represent a significant part of the population of internet users (Wu 1999). According to FIND/SVP, 30% of people who use the internet are between the age of 18 and 29, and 42% of internet users hold degrees.

Sustainable design websites and their success may be determined by analysing how effective they are at communicating the information, *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 more sustainable methods. Effectiveness, in this instance, could be deemed to be when a student uses one of these more sustainable methods, acting from the website information available. Perhaps effectiveness could be defined as thinking about the issues in a different way after being inspired sustainability i.e. considering sustainability issues in their design work without necessarily employing the sustainable methods. 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 affect 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 the areas of website effectiveness and therefore it is very difficult to define. Most website assessments are focussed on usability or are assessed for aesthetical value but whether the websites are effective in communicating is left to chance. There is little prior art for which this research can be based. Any hypothesis must therefore derive from the research undertaken and defining website effectiveness is therefore imperative 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 extremely broad, 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 on how much influence it has on the user. The focus of this study concentrates on sustainable design education websites which are used by sustainable design initiatives as a tool to inform and inspire various aged students.

Sustainable design initiatives

The Sustainable Design Award (SDA) is run by charitable organisation Practical Action. They aim to 'help bring issues of sustainability into mainstream designing and making at AS and A2 level' (Capewell 2004). 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 sustainability to the designers of the future. The website has become an integral part of that education. The Sustainable Design Award website (www.sda-uk.org) averages around 13,700 visits a week (MediaHouse 2006), the majority from academic servers. The SDA website has 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. DEMI has also been a notable scheme that is 'responding to the need for sustainable development curriculum within and throughout undergraduate design programmes' (Clare 2001). It has similar aims to the SDA but is run solely as a website resource aimed at older students, predominantly undergraduates. 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 aim to bring together sustainable development issues and debate, whilst providing key information for students. Sustainable Technology Education Project (STEP) is a sustainable design scheme aimed at key stage 3 and 4 students. STEP is produced by Practical Action and is funded by the Department for International Development (DFID) and the European Commission. STEP 'aims to increase young people's awareness of sustainable technology, enabling them to recognise the economic and environmental impacts of the technology they choose' (Capewell 2003).

Website effectiveness

In order to establish a consensus of what is considered to be website effectiveness, an extensive literature review was carried out to draw together several ideas of effectiveness. 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).

In this instance website effectiveness covers a range of areas from content to usability. Initial research studies into usability and effectiveness have proved useful in establishing a firm understanding of the key areas. Theoretical studies of the effectiveness of the internet is sparse for two main reasons; it is a relatively new research area and people are still finding their way, secondly the people at the forefront researching this area are unlikely to sit back and reflect on developments (Day 1997: 109). The brainstorm in Figure 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.

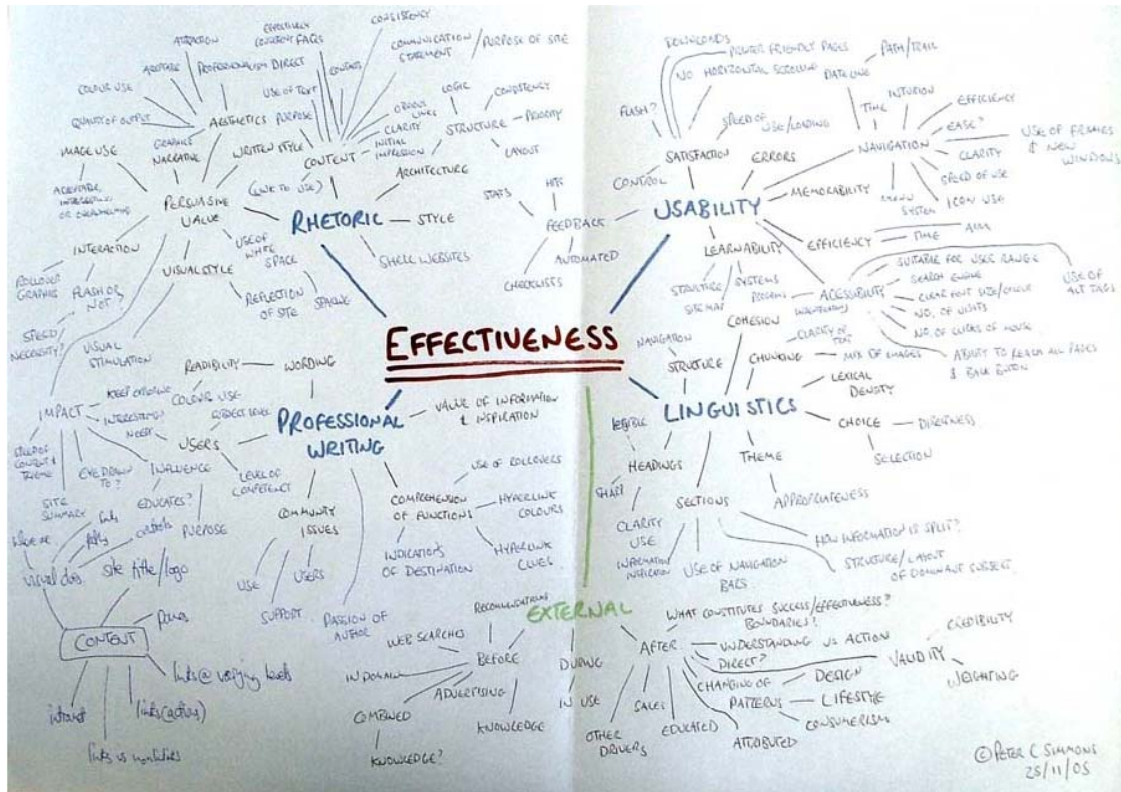


Figure 1: A brainstrom concerning the meaning of website effectiveness

(Durham 1999, Nielsen 1993, Mayhew 1999 and Preece 1993)

Table 1 highlights the phases of use and the specific authors in the literature review that address that particular area. The table used the brainstrom shown in Figure 1 as a basis for classification into specific phases of website use. The phases have been identified as before use, during use and after use. 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 table 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 1 is particularly useful in indicating areas of research and for illustrating gaps in the research. These gaps are highlighted with cross-hatching. The table shows that there is little literature into 'before use' areas; revisiting, advertising and the domain names of websites. 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 marketing. 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 websites success and could be used to justify money being spent on websites such as those like SDA, STEP and DEMI.

It is apparent that a greater knowledge of how the websites influence is needed to determine the success of websites and the worth of the investment put into them. A greater understanding of their existence is also an area that may need focusing on. With a topic such as sustainability, awareness of the issues and access to information is essential to progress the movement. Websites can often be relied upon to deliver that awareness and ultimately the influence. Given this scenario, these areas of low literature coverage, take greater importance in relation to a websites' success.

BEFORE WEBSITE USE					
Revisiting	Recommendations		Advertising	Searches	Domain name
	Rathswohl 2002			Bauer and Scharl 2000	
DURING WEBSITE USE					
Cognitive psychology	HCI	Usability	Linguistics	Rhetoric	Likeability
Mayhew 1999 Preece 1993 Day 1997 Durham 1999 Spool 1999	Mayhew 1999 Preece 1993 Katerattanakul and Siau 1999 Durham 1999 Wu 1999	Preece 1993 Nielsen 1993 Dumas and Redish 1993 Brajnik 2000 Spiliopoulou 2000 Durham 1999 Spool 1999 Olsina et al. 1999 Bauer and Scharl 2000 Katerattanakul and Siau 1999	Durham 1999 Bauer and Scharl 2000	Durham 1999 Olsina et al. 1999 Bauer and Scharl 2000	Day 1997
AFTER WEBSITE USE					
Patterns	Usability reviews		Web sales	Influence	Likeability
Spiliopoulou 2000	Brajnik 2000 Rathswohl 2002 Spool 1999 Olsina et al. 1999 Bauer and Scharl 2000		Spool 1999 Schubert and Selz 2001		Day 1997

Table 1: Classification of literature found in relation to website use

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 are therefore it is difficult for websites to meet the needs of both user groups. As organisations have little controls over who visits their website, unless it is password protected, it could be assumed that both types of user have access to the information. 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 tool, 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 factors that make a website likeable may be considered as part of the effectiveness story. Likeability is part of both during use and after use phases. Can a website be effective without it being likeable? Does an effective website focus on each of the areas of effectiveness equally? When considering a websites' entire design, Day (1997) argues it is more about doing the right things well.

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 a fair assessment of a websites' effectiveness, the website would need to be used. Conclusions can then be gathered from set assessment tools or a more subjective assessment of the websites' effectiveness during use.

...when websites 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)

Katerattanakul and Siau (1999) identify three areas that educational websites can be classified; 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. Aesthetical mean a website that has graphical appeal to the user. 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. Sustainable design schemes aim to inform, inspire and motivate, and so their corresponding websites they could be considered as effective if they achieve these aims.

The phases of website effectiveness

After an extensive literature review was carried out, three clear phases of effectiveness were identified as before use, during use and after use. 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). The review intended to expand these areas, to allow for a wider spectrum of criteria that relates to different phases of a websites' use.

Before use

Before use, takes into account the time before reaching the website and the possible paths that may have led you to the website. This section outlines the main contributory

factors to reaching a website. To most website designers the approach to finding a website is not a major consideration, concentrating on when the users actually use the website rather than how they got there. After all, the majority of websites dealt with in this study belong to companies who have other departments for marketing and technical support. It was felt that the before use aspect of effectiveness should be reviewed with the main focus being on the other phases; during use and after use. 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 revisit to a website may indicate that the site has been successful as you are returning to the site. Although a revisit may also be viewed as a failure, as the user may not have been successful using the website the first time. Recommendations from colleagues or leaders in the field may be considered as a measurement of success, as one would presume the website had been of some value to the recommender. Advertising and marketing of a particular website may also lead you to a 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. The other possibility is that the website was discovered by pure chance. This may indicate more the success of the appropriateness of a domain name rather than helping establish its effectiveness.

It is important to recognise that on a basic level websites cannot be effective unless the user finds it. A website cannot be effective if it is not used. It may be argued that the 'before use' measures are little to do with website effectiveness, only how strong the advertising is to attract the user to the website. In analysing what should be considered as website effectiveness, Rathswohl points to criteria that 'typically relate to a website's design and layout, content and navigation features' (Rathswohl 2002). This would relate more to use of the website itself rather than the success of trying to reach it.

During use

During use is a huge area when assessing a websites' effectiveness. The key areas identified under 'during use' are:

- 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)).

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) outlines two main ways of improving the design; providing knowledge about expectations of do's and don'ts, and identifying potential problems. Preece (1993) believes cognitive psychology is built up of various factors discussed in detail below: *visual perception, information processing, attention, memory, learning and mental models*.

Visual perception

People's visual perception of objects gives a three dimensional appearance, with website design; text, graphics, animation and video can help this. Many design aspects relating to computer interface design relate directly to website design for example is it: legible, distinguishable, comprehensible, uncluttered and meaningful structure to assist the visual appearance of the website. Even the organisation and presentation of tables can influence people's decisions as to the time spent on a specific page.

Information processing

Information processing means a response to look at a certain part of the screen, or performing an action as a direct result. Stages outlined by Preece 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). This ability to remember things has become a theoretical foundation on which cognitive psychology is often based.

Attracting attention

Grabbing people's attention is a vital, yet often overlooked quality of a website. Often we have so many other things around us, keeping the attention of the user is a difficult task. This is referred to as selective attention. 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, the structure is therefore crucial. The ability to allow users to multi-task but ultimately come back to the website flexibly (Preece 1993). Determining factors of this relate to the presentation of information, various visual and auditory cues, and partitioning of pages and their flow.

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 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 get exploited.

Learning

Learning to use a computer requires active involvement (Preece 1993: 29). Preece also identifies 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.

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).

Human-computer interaction

The way that users interact with their computers whilst using computer programs or websites can indicate factors that lead to improvements. Successfulness in conveying information or areas that are easy to use can indicate an effective human-computer interaction. There are many parallels between computer programs and websites in relation to their effectiveness. The aim is to produce a computer based output which safely, effectively, efficiently and enjoyably communicates 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, these three areas can also be applied to website design.

A focus on efficiency of tasks allows for information to be accessed directly for an improvement of products exterior and interior. Efficient use of sustainable design websites will hopefully help to result in a better world for current and future generations through an improved knowledge of sustainable principles. Human-computer Interaction requires a knowledge of the user, 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 also goes on to outline four key factors relating to users which is particularly relevant to 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 need to be addressed when assessing the users of the sustainable design websites. The credentials for each of these will be noted for each user allowing for a comparison. When assessing website effectiveness the human-computer interaction factors (physical, experience, psychological, socio-cultural) will help to determine the role of the user and if the users' background influences the effectiveness of sustainable design websites.

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 area of effectiveness, in terms of the three forms identified by Wu, it is the communication between the user and the website in general terms. 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 both users and the 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.

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)

Katerattanakul and Siau (1999) conclude that the volume of information is also an important factor when designing a website. Too much information can hinder a user trying to access the specific information they need as often the specific information becomes diluted or confused. The layout of that material can also determine how easy the information is to access. Information targeted at a certain audience can be more effective than large quantities of information.

Usability

Usability concerns how a product meets the needs of the user. According to Dumas (1993) the determining factors are; the time it takes to complete a task and how easy it was to complete it. Usability considers what task the user is trying to complete; researching, purchasing a product, downloading software, and also what the aim of the site is. Nielsen outlines 5 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 discusses three other aspects alongside learnability as being essential to usability testing, these are (Preece 1993):

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) and Preece (1993) can be seen as the key features for assessing the effectiveness of a website. It is imperative however that usability remains a part of a bigger picture. This study does not wish to just address a websites' usability, but rather its overall effectiveness. Several usability tests were carried out on the websites both automated and manual with an aim to assess usability, and also to reduce the number of websites in this study.

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

Mayhew 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. Mayhew goes further stating that quantitative issues surrounding system response time and its impact on user performance.

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 (design, lifestyle or consumerism)
- usability reviewed (validity, credibility and weighting);
- web sales and education value;
- direct or indirect influence.

In order for effectiveness of a website to be assessed, a key area has to be its influence. This could be seen in terms of a change in pattern of behaviour. More specifically a change concerning design decisions, lifestyle or consumption. The phase 'after use' also comprises of a websites' usability to assess its validity, credibility and weighting, all of which could be judged upon user decisions that follow. This may include a review of the statistics generated whilst the website was 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 peoples' perception then the investment may be deemed a failure. With an issue such as sustainability 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.

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 dependant 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). 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.

Day (1997) identifies 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;
- housestyle: integrity (consistency) and clarity (layout, assists and comprehension);
- action: communication of purpose and result.

Website effectiveness summary

5 Website effectiveness summary

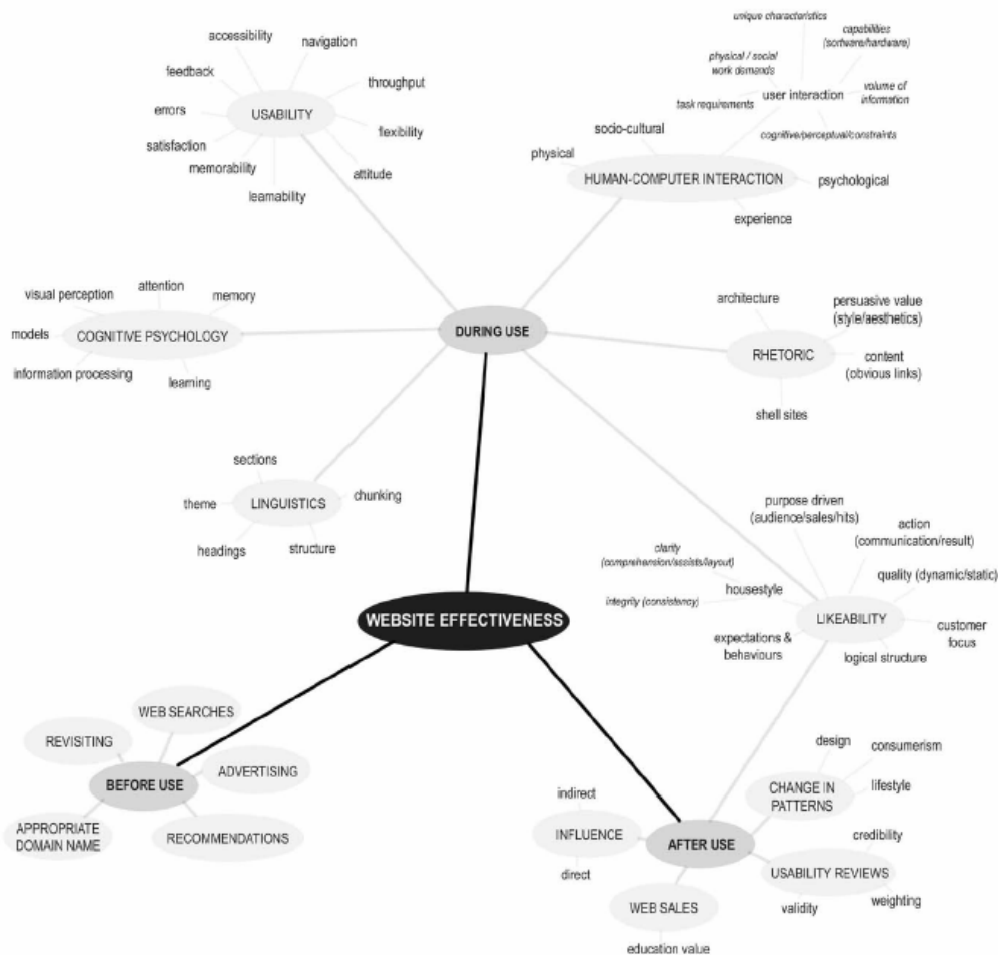


Figure 2: A summary of the issues relating to website effectiveness

In summary, the word effectiveness has a vast array of specific areas. From the literature three phases emerged in which effectiveness could be judged in this study. These concerned 'before', 'during' and 'after' use as shown in Figure 2. The figure shows the various aspects of website effectiveness research so far. The main part of this research will focus on tasks in the 'during' and 'after' use parts to see how websites can influence their designing. 'Before' use would only become prominent in selecting the websites to use, but most of the specific categories under this heading related more to its advertising and marketing strategy rather than how effective the actual website is. The websites selected hope to educate, and as a result, influence a decision taken in designing having used the website. The literature indicates a lack of material in tracing the influence of websites. This is surely a critical area of a websites' success and also its effectiveness in teaching, informing, inspiring and learning. It is in this context that the websites will be assessed.

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