The Usability of Digital Information Environments: Planning, Design, and Assessment

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Introduction

The proliferation of Internet-based digital resources has increased the need for well designed digital information environments: competition is fierce as users rapidly 'surf the web' in search of information, entertainment, and social connection. Twenty-first century information seekers have little patience for confusing interfaces, poor use of media, or sites that are difficult to navigate and understand. On average, users will spend only 25-30 seconds on a web page to determine whether it will meet their information needs (Nielson and Loranger, 2006). This finding is consistent with Poole's (1985) *principle of least effort* that posits humans will take the path of least effort to fill an information need; make the information seeking task too difficult and information seekers will quickly go elsewhere.

User-centred Design: Usability and Digital Environments

The chapter will first explore and define the concept of usability and establish its place and value in designing digital environments for use with the technology devices used to access them, especially in Web 2.0 and emerging tablet, mobile, and projected Web 3.0 environments.

User-centred design (UCD).

User-centred design (UCD) is, 'the practice of creating engaging, efficient user experiences' (Garrett, 2011) The terms *engaging*, *efficient*, and *experiences* are all, however, uniquely subjective to both designers of digital environments and the

people that use them. Another definition of UCD as defined by the United States government is:

> User-centered design (UCD) is an approach for employing usability. It is a structured product development methodology that involves users throughout all stages of Web site development, in order to create a Web site that meets users' needs. This approach considers an organization's business objectives and the user's needs, limitations, and preferences.[1]

Rubin (1984) describes UCD as an interrelated set of concentric circles involving eight factors, where '…users are in the center of a double circle' comprised of an inner ring that represents 'Context; Objectives; Environment and Goals' and an outer ring that represents 'Task Detail; Task Content; Task Organization and Task Flow'

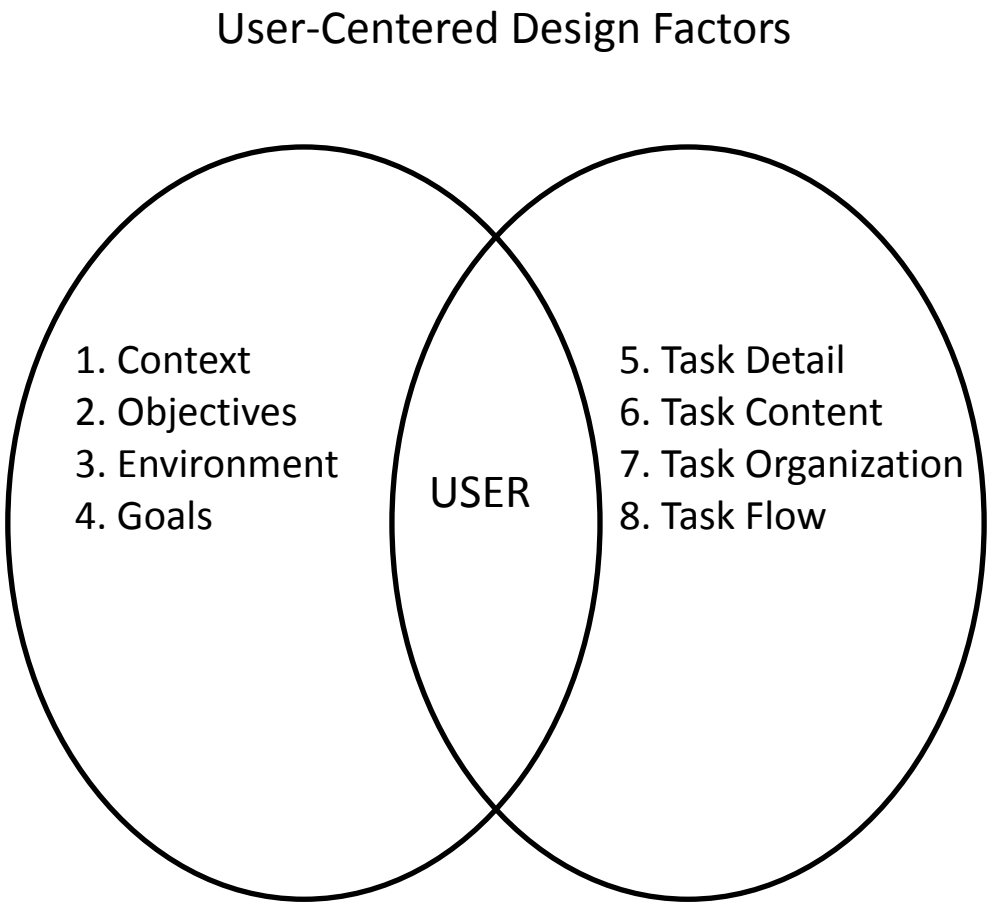


Figure 2.1 - UCD

According to the World Wide Web Consortium (W3C), UCD can also be considered *human-centered design* (HCD).[2] The International Organization for Standardization defines HCD in its standard ISO 13407 (1999) as, '…an approach to interactive system development that focuses specifically on making systems usable. It is a multi-disciplinary activity'.[3] According to this standard, HCD is comprised of four core principles, 'active involvement of users, appropriate allocation of function to system and to user, iteration of design solutions, (and) multi-disciplinary design' involving four major activities: understand and specify the context of use, specify user and organisational requirements, produce more than one candidate design solution, and evaluate designs against requirements.[1]

Table 2.1 - UCD Principles and Activities

Core Principles	UCD Core Activities
▪ Active involvement of users ▪ Appropriate allocation of function to system and to user ▪ Iteration of design solutions ▪ Multi-disciplinary design	1. Understand and specify the context of use 2. Specify user and organisational requirements 3. Produce more than one candidate design solution 4. Evaluate designs against requirements

While easy to understand, the successful implementation of the UCD process is much more difficult. One of the central problems is that designers frequently develop

digital information spaces utilising their own paradigms – what they deem to be important, organised in a fashion that makes the most sense to them – in absentia of the people that will actually be using it. This disconnect creates a gap between designer and user.

Chow, Smith and Sun (2012) coined the term *concept actualisation* in their research with 53 middle and high school aged youth in the United States. The research focused on how to deliver marketing and career-oriented information about computing and information technology in an age-appropriate fashion that youth found the most usable. The study found that it was difficult for adult web designers to develop digital information spaces for youth because their adult paradigm differed so greatly from those of youth. For example, what was considered clean, uncluttered design shaped by and for the adult-centric priority for seeking and accessing information as quickly and efficiently as possible, was not appropriate for youths' need for bright colours, use of animation, and preference for exploration and social interaction. They found that only by practising collaborative design or working with youth as design partners (Druin et al,1999) did *concept actualisation* take place where the UCD concepts of *engaging*, *efficient*, and (satisfying) *experience* could be implemented effectively for youth.

While UCD is the process for people-centred design, usability represents the overall utility and ease-of-use[4] a person experiences a digital environment while attempting to accomplish their information seeking goals. The International Organization for Standardization formally defines usability as the 'extent to which the product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use'.[5] *Effectiveness* is the 'percentage of goals achieved, percentage of users successfully completing tasks and average accuracy

of completed tasks,' *efficiency* is the 'time to complete a task, tasks completed per unit time and monetary cost of performing the task,' and *satisfaction* is a 'rating scale for satisfaction, frequency of discretionary use and frequency of complaints'(Chow et al. 2012).

Information seeking behaviour: need, information, access

Developers of digital spaces often mistake aesthetic design as the primary outcome, forgetting that most often visitors to digital environments are usually there for an explicit purpose centred around an information need; that is, visitors are on a hunt for information that make the usability concepts of effectiveness (finding what one is looking for), efficiency (minimising the time and effort it takes to find what you are looking for), and satisfaction (a combination of effectiveness, efficiency, and design aesthetics) extremely relevant and essential. Nielsen and Loranger's (2006) research suggests that users give a web page on average only 25-35 seconds to convince them that they are likely able to find what they are looking for. Google's web statistics analytics program calls this a *bounce rate* or the percentage of visitors that leave the page without visiting another page on the site (which suggests they may have not found what they are looking for). [6]

What is information seeking behaviour?

Taylor (1968) defines information seeking behaviour as information someone is searching for that helps 'fill out his picture of the world'. Belkin, Oddy, and Brooks (1982) define information need as an anomalous state of knowledge (ASK) and Derwin (1992) defines it as a process of 'sense-making'. Morris (1994) describes the information seeking process in general as, '(u) sers seek information to meet an

information need and this process is highly unique, contextualized and constructivist in nature' (Chow and Bucknall, 2011).

Taylor (1968) defined four, linear levels of information need:

1. A conscious or unconscious need for information where it '… may be only a vague sort of dissatisfaction. It is probably inexpressible in linguistic terms'
2. A conscious mental description of an ill-defined area of indecision usually articulated or conceptualized as, '…an ambiguous and rambling statement'
3. A qualified and rational statement of the question. The indecision becomes better defined as an '…area of doubt in concrete terms and he (she) may or may not be thinking within the context or constraints of the system from which he wants information'.
4. The question is articulated within the context of the environment with the anticipation of success. The information seeker must 'think in terms of the organization of particular files and of the discrete packages that are available – such as books, reports, papers, drawings, or tables (etc)'.

Taylor describes this as the question-negotiation process where information seekers approach an information system or organisation with an information need in various stages of concreteness and articulation and 'negotiates' this need within the context of the information seeking environment.

Pirolli and Card (1999) use a behavioural based hunting metaphor, *information foraging*, to describe the information need and information seeking relationship within technology environments. Their adaptive control of thought in information foraging (ACT-IF) theory suggests that humans are *informavores* hunting for *information scents* and that they will '…modify their strategies, or modify the structure of the interface if it is malleable, in order to maximize their rate of gaining valuable

information'. At the same time, the information provider will also tend to evolve - when '…feasible, natural information systems evolve toward stable states that maximize gains of valuable information per unit cost'. This theory is especially useful in helping designers develop information architectures that make information scents especially strong so that users can find what they are looking for quickly and with little effort (Morville and Rosenfield, 2008).

Information seeking and information provision match

'*Jacob's Law of the Web User Experience states that* 'users spend most of their time on *other* websites.'' [7]

If you want highly usable digital environments, then design information spaces for those who will use them and the information they usually seek. It is really that simple. The science of doing this, however, is more complex and represents an integration of the organisation and the user's goals. Websites, for example, have gone through several major changes in terms of the information and user interaction. In the early 1990's, the primary focus for first generation websites was making sure that they worked (Siegal, 1997); second generation websites began allowing users to customise their experience as browsers became capable of displaying more than just text through the use of colour, icons, and images. Third generation websites utilised expanded design and multimedia options to 'give visitors a complete experience, from entry to exit'.[7]

One of the most popular models for developing any kind of high performance product or service is the ADDIE model, which stands for **A**nalyze, **D**esign, **D**evelop, **I**mplement, and **E**valuate (Pirolli and Card, 1999). This model serves as the foundation of systems thinking and '…performance technology because it details an

easy to understand, systematic way of achieving goals in an efficient and effective manner', which closely aligns with both UCD principles and its recommended four activities – *understand the context of use*, *specify user and organizational requirements*, *produce multiple iterations*, and *evaluate design based on requirements* (Garrett, 2011)]. See Figure 2.2.

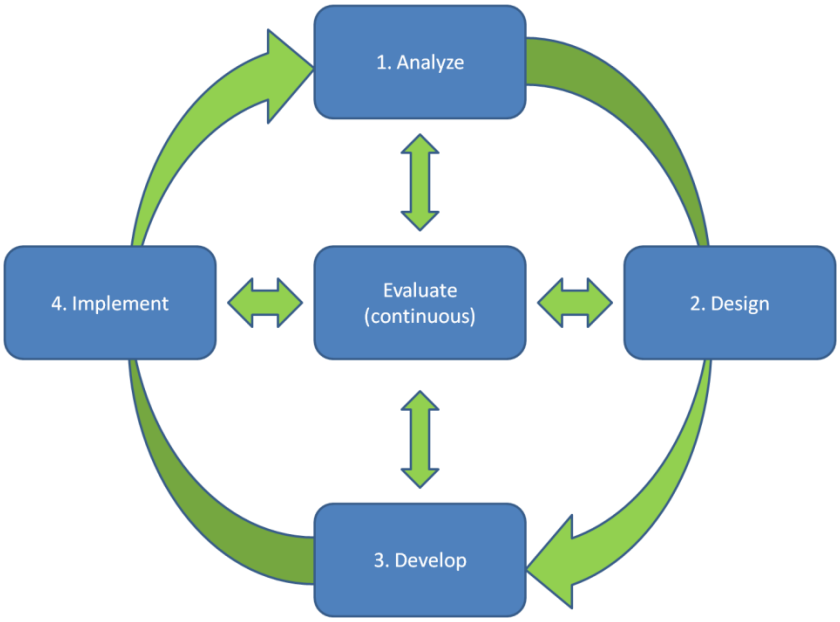


Figure 2.2 - ADDIE Model

The concept of *pervasive usability* is, *'*a principle of design that advocates the application of usability methods in every stage of the design process'.[8] Applying the ADDIE model with usability methods included at each stage led Chow (2012) to create an integrated web design and usability model called the Design, Develop, and Evaluation (DDE) model. See Figure 2.3.

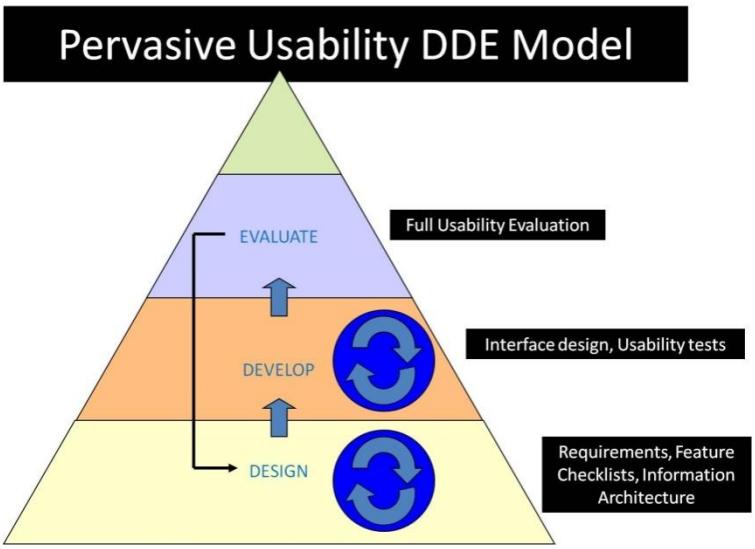


Figure 2.3 - DDE Model

The *design* phase involves establishing both user and organisational requirements where decisions around who, what, and how technology will be used to provide information to a discrete set of users. A few representative users should be brought on as design partners to help provide authentic perspectives and contexts for deciding preliminary needs and requisite system requirements necessary to meet these needs. It is also especially critical to attempt to ensure *concept actualisation* (Chow et al. 2012) with representative users, as what is considered good design, in terms of colour, use of animation, graphics and so on, may be operationalised in drastically different ways given likely divergent paradigms of designers, developers and the users of the site.

Once requirements have been established, priority feature checklists, identifying five to seven of the most important ways a user group will be using the site, should be created. This can be done in a simple table listing each unique user group and their respective information needs. For example, for a university website, typical users can be broken down into prospective students, current students, faculty and staff,

alumni, and other potential non-affiliated visitors. Table 2.2 illustrates a potential set of features each respective group may require.

Table 2.2 - Feature Checklist

Priority	Prospective Student	Current Student	Alumni	Faculty & Staff	Other
1	Degree information	Course offerings	News & Events	Contact Information	Contact Information
2	Tuition	Faculty	Faculty Contact Information	News & Events	Job opportunities
3	Faculty Overview of Program	News & Events		Policies and Procedures	Faculty Directions and map
4	Contact Information	Academic calendar			
5	Application information	Policies and Procedures			
6	Course offerings	Graduation information			
7	Directions and map	Contact Information			
8					

The final step in the *design* phase is to create an information architecture based on the preliminary analysis of user needs, informed by the project user design partners, and identified feature checklists. For websites, this means organising content around

major navigational links. Users want to find what they are looking for quickly and easily, and pushing the high priority items to the front of the home page, based on what users want, is an excellent way to make this happen. Continuing with this example, a preliminary information architecture map may look something like Figure 2.4.

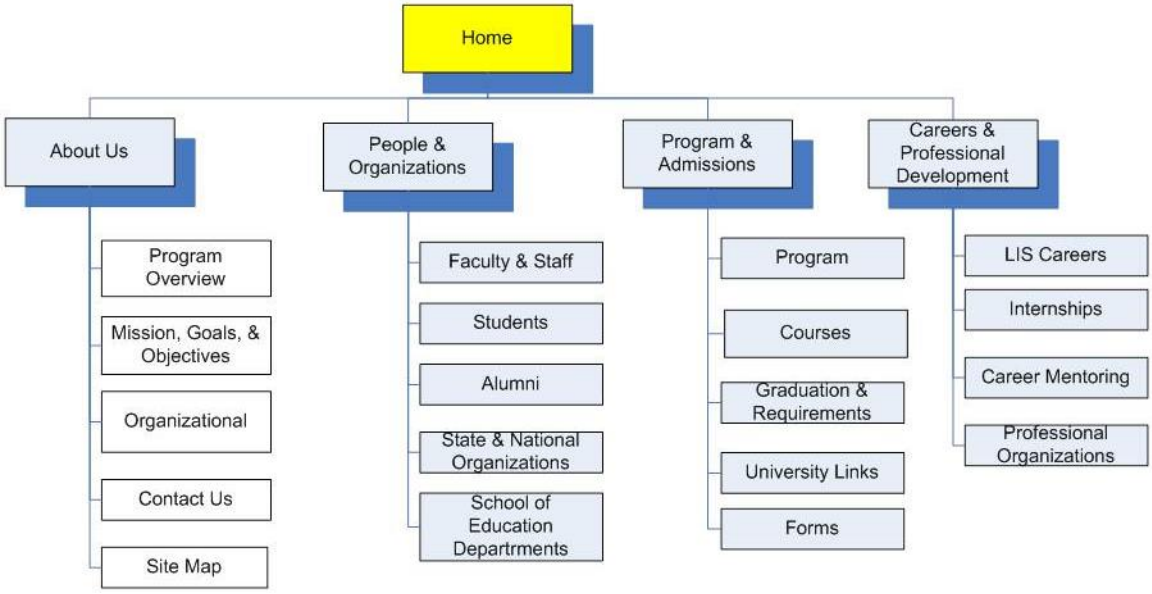


Figure 2.4 - Information Architecture Map

An initial usability test can be conducted with only a paper or electronic version of a preliminary information architecture by asking users what pathways they would take if they were searching for the high priority information identified in the feature checklists. This will test how well organised and how well the navigation has been labeled using language and words representative users understand. Early problems can be identified, and multiple iterations of the site's information architecture may be required. Similar to building a house, once the structure and foundation is well designed, the house will be solid and well made.

The *develop* phase entails establishing a preliminary interface design, which can be defined as all of '(t)he ways in which a user comes into contact with any system or technology product' (Moran, 1981). Garrett (2011) holds user-centred design examines, 'taking into account every possibility of every action the user is likely to take and understanding the user's expectations at every step of the way through that process'. He suggests websites are comprised of five discrete 'planes' – the *surface* plane (what a user sees – text, photos, colour, and so on), the *skeleton* plane (the architecture and organisation of the site and the infrastructure that resides underneath the surface plane), the *structure* plane (specific content and functionality and what a user will find and can do), the *scope* plane (the totality of what a user will be able to accomplish on the site), and the *strategy* plane (the shared goals of both organisation and its users).

Similar to the design phase, the develop phase will involve multiple iterations informed by the project's design partners. Formal usability testing also begins at this stage where representative users will be asked to actually seek information and perform high priority tasks on the design iterations. This is where the three factors of usability become more clearly apparent, where users can accomplish their intended goals with high levels of effectiveness, efficiency, and satisfaction. The third and final phase will be a full usability evaluation after the site has been made available to public. Let us now discuss some general design guidelines based on information seeking behaviour and tendencies.

Heuristics and design guidelines

Nielsen and Molich (1990) generated a list of 10 design standards or heuristics that have since been revised in 2008 (Nielsen, 2005).[9] These 10 design standards are as follows:

1. **Consistency -** Designing a product so that similar tasks are done in similar ways.
2. **Compatibility -** Designing a product so that its method of operation is compatible with users' expectations based on their knowledge of other types of products and the 'outside world.'
3. **Consideration of user resources -** Designing a product so that its method of operation takes into account the demands placed on the users' resources during interaction.
4. **User control -** Designing a product so that the extent to which the user has control over the actions taken by the product and the state that the product is in is maximized.
5. **Visual clarity -** Designing a product so that information displayed can be read quickly and easily without causing confusion.
6. **Prioritization of functionality and information -** Designing a product so that the most important functionality and information are easily accessible to the user.
7. **Explicitness -** Designing a product so that cues are given as to its functionality and method of operation.
8. **Match between system and real world -** The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order
9. **Recognition rather than recall -** Make objects, actions, and options visible. The user should not have to remember information from one part of the

dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

10. **Aesthetic and minimalist design -** Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

Kamper (2002), in his work with IBM, developed a theory of human-computer interaction (HCI) referred to as Lead, Follow, and Get Out of the Way (LF&G), which theorises that the optimal HCI experience is analogous to a facilitative learning relation: 'Like a good teacher, mentor, or coach, the usable user interface leads the user to successful completion of tasks and goals; follows the user's progress and provides appropriate feedback and information when needed; and gets out of the way of the user to allow efficient and effective completion of tasks as the user attains mastery of the system, its concepts, and operations. A set of 18 heuristics grouped under the 3 general principles of the title are provided for use across the tasks of design guidance, development refinement, and end-user evaluation of computer systems.'

Information seeking trends

Adult information seeking.

Research into adult information retrieval began with the notion that adult information searching represented a 'berry picking' style - search strategies usually focused on gathering information in pieces (Bates, 1989). Contemporary studies suggest that adult information seekers typically are mainly concerned with the information search and retrieval process, often ignoring features such as navigation bars, animation,

and sound effects and rarely paying attention to logos, mission statements, or advertising within a website on their quest for obtaining information with relevant content.[10] They prefer quick downloads, predictable responses, text-based links, and broad, shallow, tree structures for a site's information architecture (Lazar et al., 2003). Also, unlike children, adults are not averse to finding information through scrolling and reading text if necessary.[11]

Adult information seekers become easily frustrated with (word choice) information on the Web when navigation and search time becomes too long and/or requires too much mental effort due to poor design, unpredictable interference, dropped connections, and pop-up advertisements.[11] They often have little patience and do not take the time to learn about the site they are on, instead moving on to another site to find the information they are looking for (Lazar et al. 2003). Problems also occur because adults may not really understand where they are within a website's information architecture.[11] Recent literature supports the theory that relevant education and training as well as effective website design would improve general information retrieval and usability for adults.[11] Studies suggest that research on information seeking could be incorporated into interface design[10] and have found marked improvements in software interface design since incorporating user feedback (Large et al. 2002)

Age-appropriate web design for children and adolescents.

The general misconception adults have about younger information seekers is that they are 'techno-wizards' who, because of their frequent use of iPods, smart phones, gaming systems, and social media, are similarly adept at understanding how to navigate websites for information seeking purposes (Large et al. 2002). Considine and Horton found that while the 'Google generation' could access materials, their

ability to process those texts was somewhat limited. Their search strategies could be characterised as 'skimming and squirreling behavior. They do not have a strong understanding of their own information needs, had difficulty utilising effective information seeking strategies, and spent little time processing whether the information found was either accurate, relevant, or from a trusted source.

There is a growing body of knowledge about designing youth oriented websites, and some design models, such as Druin et al.'s (1999) *cooperative inquiry*, Read, et al.'s (2002) *participatory design*, and Large, et al.'s (2006) *bonded design,* place youth at the centre of any design efforts. Cooper (2005) suggests that youth oriented websites emphasise '…user control, be open-ended (encouraging exploration), active (as opposed to passive), involve multiple senses, offer quick feedback, balance novelty with familiarity, allow for and be responsive to child input, allow for progressive levels of expertise facilitating competence while offering new challenges, and support social interaction'.[12]

Websites for children should be 'colorful, relevant, and easy-to-use' (Dubroy, 2010) and animation and interactivity must not be used in a 'gratuitous' fashion as 'bells and whistles are useless if the content is irrelevant' (Blowers and Bryan, 2004). The design should be simple and easy to navigate, which ironically is often not the case for youth oriented websites; in 2002, Nielsen[13] conducted a study with 55 children and actually found that they tended to have an easier time navigating websites for adults rather than children because children's sites oftentimes are 'convoluted' (Nielsen, 2002, cited in Dubroy, 2010). Using metaphors and having help features available are also important website elements for youth as they can help reduce cognitive load for children by helping scaffold new information being presented to preexisting mental structures and images (Large and Beheshti, 2005). Help features

also have been found to be extremely important to children so there is somewhere to turn to if they get lost or confused (Large et al. 2002, Bilal and Kirby, 2002). Nielsen (2005) created a table that summarizes and compares some of the major differences between younger groups and adult information seekers.[11] See Figure 2.5.

Nielsen's Web Design Table Across Users

	Animation and sound effects	Mine sweeping for links	Advertising	Scrolling	Reading
Kids	☺	☺	☺	☹	☹
Teens	😐	☹	😐	😐	☹
Adults	☹	☹	☹	☺	😐

Key:

☺ Enjoyable, interesting, and appealing, or users can easily adjust to it.

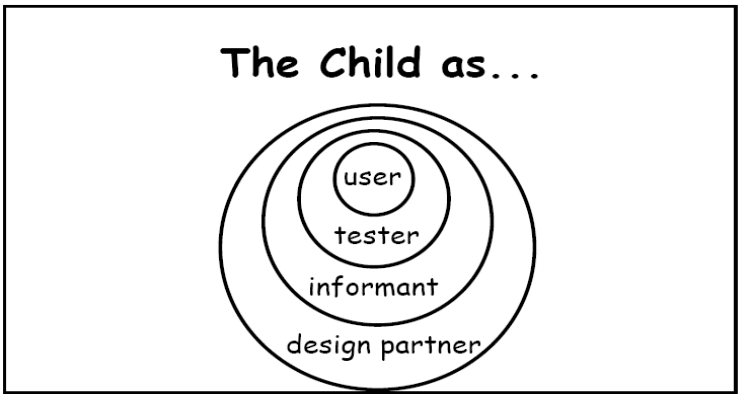
😐 Users might appreciate it to some extent, but overuse can be problematic.

☹ Users dislike it, don't do it, or find it difficult to operate.

Source: Nielsen, 2005

Figure 2.5 - Nielsen's Kids, Teens, and Adult Preferences

Druin's (2002) youth design model, suggests (seeFigure 2.6) a conceptual framework for a child's role as part of the design team, which starts atthe very beginning, serving multiple roles through the design and development cycle as it evolves.



(Source: Druin, 2002)

Figure 2.6 - Including Children in the Web Design Process in Multiple Ways

As websites are typically developed by adults, including youth from the very beginning of a site's conceptual and interface design is essential to developing user friendly, age-appropriate digital environments for youth.

Accessibility

In 1990, the U.S. Department of Justice passed landmark legislation in addressing and establishing design guidelines for accessibility called the Americans with Disabilities Act (ADA).[14], [15] This act '…prohibits discrimination on the basis of disability in employment, State and local government, public accommodations, commercial facilities, transportation, and telecommunications' (Bates, 1989). In 1998, the U.S. Congress amended the Rehabilitation Act of 1973 to address ADA requirements regarding federal electronic and information technology (EIT), by creating Section 508 (29 U.S.C. '794 d) ensuring that, 'agencies must give disabled employees and members of the public access to information that is comparable to access available to others'.[16] Section 508 addresses accessibility in electronic environments and defines accessible technology as 'one that can be operated in a variety of ways and does not rely on a single sense or ability of the user. For example, a system that provides output only in visual format may not be accessible to people with visual impairments and a system that provides output only in audio

format may not be accessible to people who are deaf or hard of hearing' (Bates,1989). Section 508 is comprised of four subparts, Standards A-D, addressing Technical Standards, Functional Performance Criteria, and Information, Documentation, and Support. Subpart B standard 1194.22 Web-based intranet and internet information and applications specifically addresses Web guidelines comprised of 16 rules (27).

Table 2.3 - ADA Compliance Rules for Web-based intranet and internet information and applications

The 16 Rules of Section 508, §1194.21 'Web-based intranet and internet information and applications'
(a) **A text equivalent for every non-text element** shall be provided (e.g., via "alt", "longdesc", or in element content).
(b) **Equivalent alternatives for any multimedia presentation** shall be synchronized with the presentation.
(c) Web pages shall be designed so that **all information conveyed with color is also available without color**, for example from context or markup.
(d) Documents shall be organized so they are readable without requiring an associated style sheet.
(e) **Redundant text links shall be provided** for each active region of a server-side image map.
(f) **Client-side image maps shall be provided instead of server-side image maps** except where the regions cannot be defined with an available geometric shape.
(g) **Row and column headers** shall be identified for data tables.

(h) **Markup shall be used to associate data cells and header cells for data tables** that have two or more logical levels of row or column headers.

(i) **Frames shall be titled with text** that facilitates frame identification and navigation.

(j) Pages shall be designed to avoid causing the screen to flicker with a frequency greater than 2 Hz and lower than 55 Hz.

(l) When pages utilize scripting languages to display content, or to create interface elements, **the information provided by the script shall be identified with functional text that can be read by assistive technology**.

(m) When a web page requires that an applet, plug-in or other application be present on the client system to interpret page content, **the page must provide a link to a plug-in or applet that complies with §1194.21**(a) through (l).

(n) When electronic forms are designed to be completed on-line, the form shall allow people using assistive technology to access the information, field elements, and functionality required for completion and submission of the form, including all directions and cues.

(o) A method shall be provided that permits users to skip repetitive navigation links.

(p) When a timed response is required, the user shall be alerted and given sufficient time to indicate more time is required.

The rules were derived from the Web Content Accessibility Guidelines 1.0 (WCAG 1.0) (May 5, 1999) published by the Web Accessibility Initiative of the World Wide Web Consortium" (Jordan, 1998), which were created with, 'The primary goal … to promote accessibility. However, following them will also make Web content more

available to *all* users, whatever user agent they are using (as for example desktop browser, voice browser, mobile phone, automobile-based personal computer, and so on) or constraints they may be operating under (as for example noisy surroundings, under- or over-illuminated rooms, in a hands-free environment, and so on). Following these guidelines will also help people find information on the Web more quickly'.[17] These guidelines are defined by two primary themes of accessible design - *ensuring graceful transformation* and *making content understandable and navigable* – which inform 14 recommended guidelines (Lazar et al. 2003). These guidelines are identified by priority order at three levels: Priority 1 (**must** satisfy), Priority 2 (**should** satisfy), and Priority 3 (**may** satisfy). Each of the priorities has checkpoint items that can be used as checklist items to ensure appropriate accessibility criteria are met. Table 2.4 includes a list of all 14 guidelines and their respective priority 1 checkpoints.

Table 2.4 - Priority 1 Web Accessibility Guidelines

14 Web Accessibility Guidelines
1. Provide equivalent alternatives to auditory and visual content.
1.1 Provide a text equivalent for every non-text element
1.2 Provide redundant text links for each active region of a server-side image map
1.3 Provide an auditory description of the important information of the visual track of a multimedia presentation
1.4 For any time-based multimedia presentation (e.g., a movie or animation), synchronize equivalent alternatives (e.g., captions or auditory descriptions of the visual track) with the presentation

2. Don't rely on color alone.

2.1 Ensure that all information conveyed with color is also available without color, for example from context or markup

3. Use markup and style sheets and do so properly.

4. Clarify natural language usage

4.1 Clearly identify changes in the natural language of a document's text and any text equivalents (e.g., captions).

5. Create tables that transform gracefully.

5.1 For data tables, identify row and column headers.

5.2 For data tables that have two or more logical levels of row or column headers, use markup to associate data cells and header cells.

6. Ensure that pages featuring new technologies transform gracefully.

6.1 Organize documents so they may be read without style sheets.

6.2 Ensure that equivalents for dynamic content are updated when the dynamic content changes.

6.3 Ensure that pages are usable when scripts, applets, or other programmatic objects are turned off or not supported.

7. Ensure user control of time-sensitive content changes.

7.1 Until user agents allow users to control flickering, avoid causing the screen to flicker.

8. Ensure direct accessibility of embedded user interfaces.

8.1 Make programmatic elements such as scripts and applets directly accessible or compatible with assistive technologies

9. Design for device-independence.

9.1 Provide client-side image maps instead of server-side image maps except

where the regions cannot be defined with an available geometric shape.

10. Use interim solutions.

11. Use W3C technologies and guidelines.

11.4 If, after best efforts, you cannot create an *accessible* page, provide a link to an alternative page that uses W3C technologies, is accessible, has *equivalent* information (or functionality), and is updated as often as the inaccessible (original) page.

12. Provide context and orientation information.

12.1 Title each frame to facilitate frame identification and navigation.

13. Provide clear navigation mechanisms.

14. Ensure that documents are clear and simple.

14.1 Use the clearest and simplest language appropriate for a site's content.

Source: W3C.org

Usability Evaluation: Building Sites High in Utility and Ease-of-Use

Jordan (1998) more precisely defined the usability factors of effectiveness, efficiency, and satisfaction Jordan (1998), and Chow (2011) adapted it into a usability scale consisting of eight factors. *Effectiveness*, the extent to which a goal or task is reached, is comprised of two criteria (1) task completion and (2) quality of output. *Efficiency*, the amount of effort required to accomplish goals, is comprised of four criteria (3) deviations from the critical path, (4) error rate, (5) time-on-task, and (6) mental workload. *Satisfaction*, the level of comfort a user feels in being able to accomplish goals, is comprised of both a (7) quantitative rating and (8) qualitative rating. These eight factors allow for explicit testing of the three core usability factors both in terms of quantitative and qualitative ratings, which allows for comparing

ratings across iterations and helps provide the specificity required to continuously improve and refine a website. See Table 2.5.

Table 2.5 - EES Usability Rating Scale

Criteria	Rating	Comments
Effectiveness: extent to which a goal or task is reached		
1. Task Completion Could you complete your tasks?		
2. Quality of Output What was the quality of your output?		
Efficiency: amount of effort required		
3. Deviations from critical path (note: a low number of deviations means that user should have a high satisfaction score) Did you deviate from the critical path?		
4. Error Rate (note: a low error rate means that a user should have a high satisfaction score) How many errors did you make?		
5. Time on Task (note: low time on task means a user should have a high satisfaction score) How long did it take (okay, too long?)		
6. Mental Workload (note: low mental workload means a user should have a high satisfaction score) How much mental effort did it take you?		
Satisfaction – level of comfort user feels in being able to attain goals.		
7. Quantitative		

Rate it on scale of 1-10		
Average your ratings		
8. Qualitative Why did you rate it as you did?		

There are two types of usability evaluations – empirical (with users) and non-empirical (without users) (Chow, 2011). Empirical usability methods include surveys, focus groups, natural observation, task analysis (try to complete high priority tasks), and think-aloud-protocol (verbalise thought processes during task analysis). Non-empirical (without users) methods include cognitive walkthroughs (mentally attempt to seek and find information as effectively and efficiently as possible), heuristic evaluation (rate the site based on established design standards), and log analysis (view site statistics for trends and user needs), (Chow, 2011). In the end, designing, developing, and maintaining usable digital environments require clear communication between users and information provider. It is not possible to design an information space that everyone will experience the same way due to a wide variety of physical, mental, and technological factors. How do you know if your digital environment is usable? Let us look at a combination of empirical (with users) and non-empirical ways to answer this question:

1. Create a feature check-list with the top five to seven primary information seeking needs your users want from your digital environment. You do this by:
    a. Interviewing a few representative users (once a year)
    b. Conducting a focus group of representative users (once a year)
    c. Forming and talking to an advisory group of representative users

(several times a year)

d. Sending out an electronic survey to representative users (once a year)

2. Design your site's information architecture and interface design around the primary information needs of users as well as standard web design conventions. You do this by:

    a. Redesigning or creating a navigation scheme around the main information needs you have identified (validated empirically with representative users).

    b. Creating a quick links area on your home page with most used and accessed information.

    c. Designing your home page for maximum access to high priority information as well as quick, at-a-glance information about what your digital environment contains.

    d. Ensuring your page follows these standard conventions: logo is top left or centre of your page, navigation is on the top or left of your page, search feature is top right of your page, and your footer contains your organisation's contact information (address, phone, email address).

    e. Kids' pages should be designed accordingly.

    f. Collecting and reviewing site statistics which will tell you overall site visits, which pages are being visited, and what information is being accessed and/or downloaded.

    g. Conducting a cognitive walkthrough ensuring the path to high priority information is as efficient and effective as possible.

h. Conducting a heuristic evaluation ensuring your digital environment takes into account primary design conventions.

i. Having representative users review your interface design and navigation.

j. Having representative users test your design by attempting to locate high priority information.

3. Develop and/or add tested changes to a test digital environment (alpha or beta versions) and conduct quick usability testing:

    a. Nielsen's five user rule suggests that testing with only five representative users can find 85% of a site's usability problems. Have your advisory group or a random sample of five representative users try and accomplish your identified high priority information needs and then complete the EES usability scale.

    b. These tests can be conducted in person or by emailing your users the tasks you want them to complete and then asking them to complete an EES scale.

    c. Make recommended changes and then seek follow-up input to ensure the changes are satisfactory

4. Read and react - have a permanent online feedback form for users to provide feedback and make changes accordingly.

5. Repeat this entire process every year.

Conducting usability evaluations and tests does not have to be either complex or expensive. Bottom line, usability is all about the relevancy and ease of access of the content for users. The best way to ensure this occurs is by collaborating with users throughout all phases of any design, development, or redesign of your digital environments. Although time consuming and labour intensive, developing sites in the absence of user input is akin to walking around in the dark hoping to find the right path to success.

Designing Highly Usable Future Pathways: An Art and Science

The designers of new office buildings and campuses will, at times, wait several months before putting in sidewalks so that the footsteps of users, slowly but surely creating a well worn pathway from building to building in the grass, show them the pathways commonly tread. Usability evaluation and testing is the same concept. While aesthetic beauty makes a significant first impression, universally true across most products and services, it is the utility and substance beneath that serves as a strong foundation for a long term, highly satisfying relationship. Strong relationships are also resilient and flexible, as change is a constant, cacophony of compromise, exploration, and refinement.

Usability evaluation and testing embraces the user, the information seeker, as the central point for designing and experiencing digital environments. ‘How do I know if my site is usable?’ is a question that is subjective and ever changing. Representative users must inform the nuance of what is effective, efficient, and satisfying for them. To attempt to project onto them what you feel they would like is removing them from the focal point of design, relegating them to a reactionary position to designs offered up through your own paradigm and context that will invariably be framed and

articulated in nuances too complex, too sophisticated, and too familiar for most novice users to understand and use easily.

In the end digital environments are for human use, and taking a human centred design with an emphasis on pervasive usability with representative users at the central core of design will help ensure that the digital environment is high on utility and ease-of-use. Usability is first a state-of-mind, and next a process for continuous improvement, which, collectively, will ultimately lead to highly usable environments for your users. Creating digital environments that are widely usable and popular by an ever diverse group of users is both an art of discovery and science of implementation and continuous improvement.

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