Designing Hypertext and the Web with the Heart and the Mind

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ABSTRACT
This chapter reviews continuing usability problems with hypertext and Web applications and highlights new issues, in particular, cultural and ethical, brought about due to internationalisation. It argues for a move away from treatment to prevention, from treating the end-user’s symptoms — themselves a reaction to bad design — to avoiding the bad design. Therefore, the way hypertexts and the Web are designed and built needs to be re-examined. It suggests that new approaches to Web modelling are required to address usability issues that might be due to human errors or design problems. This chapter concludes by suggesting several practical and theoretical contributions to address the deficiencies in current hypertext and Web design.

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BRIEF HISTORY OF HYPERTEXT AND THE WEB

When Vannevar Bush (1945) envisioned his hypertext “memex,” he dreamed of a personal microfiche-based system that would help him tackle the problem of information overload at that time. His vision of the “memex” heralded the beginning of a search for a system that mimics the human mind to access information quickly and intuitively by reference. In 1965, Ted Nelson (1987) coined the term “hypertext” and presented it as a radical new way of structuring textual information into nonsequential format, a computer-based incarnation of Bush’s dream “memex” (Berk & Devlin, 1991). Even though the technology in the “early” years of the hypertext history (for example, Conklin, 1987; Nielsen, 1995; etc.) was not sophisticated enough for many of the ideas to be realised, hypertext pioneers staunchly believed that hypertext technology had something special to offer. The hypertext systems that have evolved over the past five decades give us some clues on the different perspectives taken by hypertext authors with regard to what they think hypertext is, what hypertext could be used for, and the then available technology that supported its implementation (Theng, 1997).

Not surprisingly, as the years roll by, hypertext systems grow more sophisticated and computer is the technology that has enabled the concept of hypertext to be seen and not just heard. For example, computers have greater processing power than before to adequately support complex hypertext systems running into thousands of nodes. Technological advancements in hardware, etc., enable high-resolution screens to be produced, thus make reading easier and more pleasant than earlier character-based ones.

The growing popularity of the Internet and advancements in networking saw the birth of networked hypertext systems, such as the Web. The Web project initiated in 1990 was originally created as an online information tool for high-energy physics research at CERN (the European Center for Nuclear Physics Research in Geneva, Switzerland). Tim Berners-Lee and colleagues, the originators of the Web, built it based on the hypertext paradigm. Information is organised as a series of documents referring to each other with links of search and retrieval of text, images, sound and video. Link in a document may go to other server machines containing the actual information. Based on its likeness to a spider’s web, this world of hypertext links is also called the Web.

Although the Web was first made available in 1991, it was only after the release of Mosaic by the National Center for Supercomputing Applications (NCSA) in January 1993 that it really gained prominence. Mosaic, NCSA’s
Web client, made the Web accessible to a wide and diverse user community because of its easy-to-use, graphical interface. Mosaic and the Web succeeded in establishing a universal hypertext. With the release of Netscape Navigator in 1994 by a commercial company co-founded by the original author of Mosaic, the number of end-users on the Internet escalated to a phenomenal figure. Today, the Web is used by millions across the world. It has changed the Internet to the extent that it has become almost synonymous with the modern use of the Internet.

CONTINUING USABILITY PROBLEMS WITH HYPERTEXT AND THE WEB

Organisational principles for writing books took centuries to develop (Thimbleby, 1992), and we take for granted many organisational structures in books, like page numbers and alphabetical orders in reference books. Yet, writing a good book is difficult. Creating good hypertext is even more difficult. In hypertext systems, we are provided with a powerful and flexible mechanism to browse non-sequentially via a network of richly connected nodes and links, and extract only that part of information relevant to us. Hypertext authors are faced with a vast range of potential structures and an astronomically large number of choices when creating a hypertext document (Thimbleby, 1995). The central organising principles in books cannot be used in hypertext, otherwise we end up with an electronic, conventional book. How can we find better organisational principles for hypertext?

With the exponential growth of the Web in 1994 and 1995, the problem of finding resources on the Internet became particularly acute, and this is made even worse by the Web’s reliance on hypertext links, and its lack of metasearch facilities (Maurer, 1996). As the use of the Internet and the Web grows, scalability not only refers to the handling of the increased number of servers, but also of handling many and large applications with more and more people using them.

Much work has been done to address problems on the Web. Some solutions are aimed at helping hypertext and Web end-users, others are aimed at helping hypertext and Web designers (Theng, 1998).

Although much effort has been invested to address problems faced by end-users in using hypertext systems or the Web, we are still not producing better, usable hypertext and Web applications.
The question we want to ask is:

Could it be possible that these well-intentioned efforts are not achieving their aims because wrong or inappropriate solutions are being sought based on incorrect or incomplete assumptions?

If it is a psychological problem, then it may be entirely due to end-users’ inability to exploit computer screens, complex information structures, and that nothing in the design is going to ameliorate this. Thus, as a psychological problem, it can be alleviated but not solved by better design.

If, it is an engineering problem, it can be attributable to bad systems design, and poor design causes psychological problems. The “blame,” therefore, should not rest on end-users alone. Design failures could be prevented if designers were to take explicit consideration of human producing characteristics in the context of the task, a view taken in Cognitive Engineering (Roth, Patterson, & Mumaw, 2001).

The next section explores solutions sought based on assumed end-users’ supposed failings, and examines factors that might have contributed to poorly designed systems.

Since the same usability issues arise in multimedia, hypermedia and the World Wide Web, we will call them all “hypertext/Web” for conciseness.

User Problem

Most solutions addressing problems in hypertext and the Web assume end-users’ supposed failings. Not surprisingly, therefore, many research solutions involve the use of graphical browsers and query/search mechanisms. They seem to make the following assumptions in the context of human-machine environments:

- End-users have a wrong or incomplete conceptual model of how information is structured and linked within the hypertext (Elm & Woods, 1985).
- End-users experience “lack of closure” because they are not able to tell the extent of a network or what proportion of relevant items remains to be seen (Shneiderman & Kearsley, 1989).
- End-users face the “embedded digression problem” where they lose track of digression, because they are distracted from the main tasks by lots of interesting information (Foss, 1989).
- End-users generally lack the experience in using hypertext for learning, and this makes it difficult for them to remember, consolidate and understand the semantic content of nodes, resulting in a lack of detailed memory of any particular item and an inability to summarise what has been covered (Foss, 1989).
Design Problem

Though failings can arise in conceptual space (within the end-user’s mind), which most research findings support, this chapter argues that the “blame” should not rest on end-users alone. It may be an engineering problem, implying that problems faced by end-users could perhaps be attributable to bad system design, and poor design causes psychological problems too (Theng, 1997).

Many hypertexts are, however, poorly designed and built in terms of how information is structured and displayed. When Brown (1990) conducted an assessment on the quality of hypertexts designed by 70 student authors, some prevalent faults identified were poor design of the visual appearance of material, overuse of technology with lots of clever effects but no attempt made to redesign for the new medium, and lack of a coherent overall structure and presentation style.

Nielsen (1996) listed the top ten mistakes in Web design, and these include the use of the following: (1) frames; (2) bleeding edge technology; (3) scrolling text, marquees, constantly running animations; (4) complex URLs; (5) orphan pages; (6) long scrolling pages; (7) lack of navigation support; (8) non-standard link colours; (9) out-dated information, and (10) overly long download times. When Nielsen (1999) revisited these mistakes three years later, he concluded that all the ten mistakes are still mistakes in 1999. Apart from scrolling long pages which is causing fewer navigation problems, the other nine
mistakes still cause significant usability problems and should be avoided in modern Web sites.

A survey of current work (e.g., Wu et al., 2001; Park, 1998; Li et al., 1998; Jones et al., 1998; Perkowitz & Etzioni, 1998; etc.) presented at recent Hypertext/Hypermedia and World Wide Web conference publications seem to suggest that hypertext/Web applications still have one or more of the following problems: (a) structured search for documents is not sufficiently supported; (b) proving properties of Web sites is difficult or impossible; (c) maintenance is not supported by formal mechanisms; and (d) personalising of information, or adaptation to user groups, is difficult or impossible.

**NEW USABILITY PROBLEMS SURROUNDING HYPERTEXT AND WEB APPLICATIONS**

The world is becoming a global marketplace with end-users from across the world. However, according to Galdo and Nielsen (1996), this heightened interest in internationalisation and localisation has not yet been translated into increased usability for international end-users. “International end-users” refer to end-users from countries other than the one where the product was designed (Galdo & Nielsen, 1996).

**Coping with Internationalisation**

The revolutionary nature and global character of digital technology has generated a new lifestyle, new standards of human behaviour, new values, giving rise to a new culture/civilisation (Gorniak-Kocikowska, 2001). Globalisation brings with it new issues relating to culture and ethics. With respect to design, standard HCI guidelines may not be adequate. They may need to be modified, extended, or restricted.

To address the problem of producing international user interfaces, Galdo and Nielsen (1996) propose work at three levels: (1) processing and displaying the user’s native language, character set, notations and formats; (2) producing a user interface and user information that is understandable and usable in user’s native language; and (3) producing systems that will accommodate end-users’ cultural characteristics.

**Culture and Design**

Two pilot studies were carried out at Middlesex University to highlight the need to address cultural issues in the design of interactive applications. Culture
is defined as “learned behaviour consisting of thoughts and feelings” (Galdo & Nielsen, 1996).

The first pilot study was carried out to evaluate the usability of digital libraries (Theng et al., 1999). Although there is no general consensus to the definition of digital libraries, they are generally regarded as interactive applications with subject-focussed collections and more powerful search engines. In this study, ten computing staff and students were selected to evaluate three sample digital libraries: the Networked Computer Science Technical Reference Library (NCSTRL), the New Zealand Digital Library (NZDL) and the ACM Digital Library (ACMDL). These three digital libraries were chosen because they are available to the general public and are some of the better examples of digital libraries found on the Web in terms of information and coverage.

The findings suggest that there is little provision on the interface to cater to end-users’ browsing and intercultural needs. Lack of consideration for end-users’ browsing needs ranges from 30% (ACMDL) to 80% (NZDL). The subjects also indicated that the digital libraries have not taken cultural needs into consideration, ranging from 30% (NZDL) to 90% (NCSTRL and ACMDL).

One reason for the neglect of cultural aspects as indicated in our study may be that usability failure is rather commonplace, and cultural usability issues are hard to recognise as such, more so since designers cannot help but see the world from their particular cultural point of view. Designers also typically invest a lot of effort getting systems to work at all, and may be defensive about their work. This usually bolsters another cultural barrier, one between professional designers and computer illiterate users or what system designers perceive as such. Thus, cultural usability issues for system designers may come disguised as illiteracy problems or simply as “user faults,” rather than as cultural differences. This pilot study seems to suggest that the state-of-the-art digital library interfaces are not yet prepared to fully meet the culturally specific needs of their international users.

In another pilot study conducted by Duncker et al. (1999, 2000), a class of 60 second-year undergraduates from various cultural backgrounds took part in the experiment. About one quarter of the class were British English, while three-quarters of the students came from 13 countries distributed over several continents. The participants were also part of many different subcultures of Greater London. One interesting finding that came out of this pilot study is that students with different cultural backgrounds have different colour preferences. British English students preferred pastel colours with a lot of grey and low contrast. Scandinavian students tended to like dark colours with low contrast, whereas students with a Jamaican background preferred strong and
bright colours with high contrasts. African students usually chose black background with bright foreground objects. American students chose a bright background, black text and moderately colourful objects. Asian students did not have a particular preference for colours.

Apart from colours, cultural factors that can influence the design of interactive interfaces for international end-users include the following: spoken and written languages; the reading/writing direction; meanings and preferences of colours; interpretations of signs, pictures, symbols used; etc. (Galdo & Nielsen, 1996).

As current hypertext and Web applications become more complex, the facilities provided by them will increase, and the difficulty of learning associated with the complexity of using these facilities will also increase. In order to produce usable and useful interactive systems, designers need to ensure that good design features are incorporated into the systems, taking into consideration end-users’ cultural preferences.

**Ethics and Design**

This section discusses how an understanding of ethics would encourage more responsible, usable, and useful systems.

According to the Oxford Dictionary, ethics is the “study of right and wrong in human behaviour.” The notion of the code of ethics and professional conduct is not new. The general moral imperatives in the ACM code of Ethics and Professional Conduct (adopted by ACM Council 16/10/1992) include one’s contribution to society and human well-being, avoidance of harm to others, honesty and trustworthiness, fairness and non-discriminate actions, respect for property rights, privacy, and confidentiality. A specific professional responsibility in ACM Code of Ethics is to “give comprehensive and thorough evaluations of computer systems and their impacts, including analysis of possible risks.” “Ensuring that users have their needs clearly articulated during assessment and design of requirements” is one of the organisational leadership moral imperatives.

The Internet is a global network of computers speaking the same language that makes use of the same protocols to send and receive information (Gringras, 1997). Many applications have sprung up over the years to encourage human–human communication. For example, e-mails, teleconferencing, voicemail, bulletin boards, conferences, usenet groups, ftp, gopher, the Web, and digital libraries. Apart from ensuring that the technical aspects of the Internet are taken care of, designers need also to consider the ethical and legal issues that may arise owing to the increase in the use of computer-mediated communication.
Some pressing questions of concern include the following (see Table 1).

*These questions present many areas considered good and acting for the good toward users, supporting a central focus in user-centred design.*

In recent years, Cyberethics, a growing area of research, explores the application of classical ethics to the latest information communication technologies, including the Internet. The fundamental principles of Cyberethics are privacy, property, access, and accuracy (Barroso, 2001). They imply a new set of responsibilities for professionals and users of the Internet, and have implications for the design of safe, usable, and useful systems.

Duquenoy and Thimbleby (1999) explore the idea of justice to aid improved design. John Rawls’ classic “A Theory of Justice” is used to explain why design needs to consider these two principles: liberty and equality (Rawls, 1972). Applying the Principle of Liberty, designers should ask themselves whether their designs persecute, discriminate, and oppress users (Duquenoy & Thimbleby, 1999). The Principle of Equality advocates that design should address issues of equal access/opportunity use. But there are difficulties taking Rawls seriously. For example, could designers imagine all possible users so they designed under an unbiased veil of ignorance, providing equal access/opportunity use?

**Table 1: Some Pressing Ethical Questions of Concern**

<table>
<thead>
<tr>
<th>Question</th>
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<tbody>
<tr>
<td>Who is morally responsible if the information is poorly designed?</td>
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<tr>
<td>Who owns the copyrights of program codes/text/graphics &amp; images?</td>
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<tr>
<td>Who is responsible for the outcome of the information system?</td>
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<tr>
<td>Who can make use of database of data?</td>
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<td>Who is responsible for ensuring that the end-users with special needs are</td>
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<td>considered?</td>
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<tr>
<td>What are the requirements for a binding contract to be made over the</td>
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<tr>
<td>Internet?</td>
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<tr>
<td>How may someone be liable for damage caused from accidentally spreading</td>
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<td>a computer virus?</td>
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<tr>
<td>What is the level of copyright protection for works on the Internet?</td>
</tr>
<tr>
<td>When does one commit the computer misuse crime of unauthorised access</td>
</tr>
<tr>
<td>using the Internet?</td>
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<tr>
<td>With the Internet lacking security, what are the principles for adequate</td>
</tr>
<tr>
<td>data security over the Internet?</td>
</tr>
<tr>
<td>How do business rules apply to the Internet? Who are the regulators and</td>
</tr>
<tr>
<td>what activities do they regulate?</td>
</tr>
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</table>

devices (Gringras, 1997).
NEW APPROACHES TO HYPERTEXT AND WEB DESIGN

Brown (1990) argues that “although getting lost is often claimed to be a great problem, the evidence is largely circumstantial and conflicting. In smallish applications, it is not a major problem at all.” Brown’s remark raises an important issue: when we speak of documents being so small that end-users cannot get “lost” in them or so large that navigation aids are required to use them effectively, the implication is that information occupies “space” through which end-users “travel” or “move” (McKnight, Dillon, & Richardson, 1991).

Hypertext provides more locations in which to store information and more dimensions in which to travel compared with traditional linear text. There is thus greater potential for becoming disoriented using hypertext. When examining a book, readers can look for orientation cues in the form of overviews, summaries, contents-pages, etc. However, if these cues are not present in hypertext, as in most cases, end-users may lose track of the context through an external interruption or in the course of pursuing momentarily interesting links which prove to be dead ends (Bernstein, 1988).

Regardless of the putative constraints of hypertext and Web applications, it seems certain that end-users possess some knowledge that provides information on the probable structure and organisation of the elements in hypertext and Web applications. End-users build models of how the hypertext is organised, and they use these “mental models” in their interactions, for example, to set up expectations or to guide. To proceed in their interactions with hypertexts and the Web, end-users expect it to give them cues, otherwise they will need to rely on their prior experiences with hypertexts and computer systems. This in itself is not bad. However, there are occasions when end-users’ prior experiences interfere with their understanding and interactions with the current hypertext and the Web they are navigating.

Need for a Cognitive Engineering Approach

But, designing good, usable interfaces is not an easy task. Dix et al. (1993) argue that even if one has used the best methodology and model in the design of a usable interactive system, one still needs to assess the design and test the system to ensure that it behaves as expected and meets end-users’ requirements. Landauer (1995) points out that it is impossible to design an optimal user interface in the first try. If information access systems are to provide good, usable interfaces, designers must conduct some form of testing on the interface. However, without knowing where in a system users run into problems, one has little hope of improving the system.
We need to take explicit consideration of characteristics of the users and the domain tasks that they will be performing to prevent design failures (Roth, Patterson, & Mumaw, 2001). Past solutions to address hypertext problems failed to take into consideration the context of use of the systems. It is equally important to understand that surrounding circumstances could also affect end-users’ course of action, thus the perceived usability of the systems, a phenomenon highlighted by Suchman (1987) in her work on situated actions.

New approaches to hypertext/Web modelling are required. Discussions of improved design should be situated within the context of a cognitive system, which is composed of human and machine agents in a work domain that is delineated by roles, work and communication norms, artefacts, and procedures.

We also propose a shift in mindset to embrace a conscientious attempt designing with the heart to put end-users at the centre of design incorporating new issues arising from cultural and ethical perspectives as well as an engineering approach involving the mind working with end-users.

**Designing with the Heart**

Designers need to provide efficient ways to structure information and represent them digitally using computers. To design good, usable hypertext and Web documents, one requires knowledge about who will use them, what they will be used for, the work context and the environment in which they will be used, and what is technically and logistically feasible.

Although information in hypertext and Web applications is supposed to be available globally, its design, content provision, and use have remained local. This cultural diversity raises a number of questions regarding the cross-cultural usability of hypertext and Web applications. This complexity is further compounded by the fact that designers, content providers, and users can have different cultural backgrounds.

To provide multicultural interfaces to hypertext and Web applications, we envisage the development of “boundary objects” between different cultures accessing shared information resources. “Boundary objects,” from a social science perspective, are used by different communities without presupposing a fully shared definition of an object. They are flexible enough, such that each community can read a specific meaning from a boundary object sufficient to its needs. Simultaneously, they are “robust enough to maintain a common identity across sites” (Star & Griesemier, 1989). As such, they enable collaboration and communication across cultural boundaries on equal terms, for example, without recourse to a single-sided dominant mode of symbolisation.
To achieve the emergence of intercultural boundary objects in hypertext and Web applications, cooperative and communicative features need to be introduced that allow negotiation and articulation across sites. We offer some ideas for implementation of boundary objects in three areas to create culturally sensitive user interfaces:

- **Creation of boundary objects as part of the hypertext and Web interface**: Actually, a hypertext and Web application system with perfectly localised interfaces could function as a joint composite boundary object. However, small boundary objects and shared resources could start off a process of mutual cultural education between users, designers, and content providers. The introduction of asynchronous message systems, repositories, and frequently asked questions (FAQs) could serve such a function, because it allows users, designers, and content providers to quickly exchange information. Another idea is to build **graphical browsers** that rely on dynamically generated structure maps that adapt to end-users’ needs and come in various forms: global maps show the entire hyperspace; local maps show the vicinity of the current node in terms of hyperlinks to and from other related nodes; and fisheye views focus attention on important nodes by deliberately distorting the view.

- **Creation of a learning environment**: The emergence of boundary objects depends on mutual education of the participants. Therefore, in hypertext and Web application interfaces, a learning environment is necessary. In order to create a learning environment, we need to provide additional facilities that help end-users, content providers, and designers in fulfilling their tasks or even to provide intelligent intermediaries to do the tasks for them. More experienced users can offer informal help and advice to novice users. To create such a learning environment for end-users, we should provide suitable support features when collaboration between users is most effective. The construction of Community Memory Support Systems like Answer Garden and FAQ lists will allow end-users to gain an understanding of how systems can be used.

- **Creation of opportunities to create boundary objects by users**: Even the best designer cannot foresee all cultural problems and possibilities. The idea, therefore, is to create opportunities for end-users to create boundary objects. Giving end-users the opportunity to articulate and exchange their ideas and problems with regard to a particular hypertext and Web application may also provide surprising ideas that could be taken up by designers. Awareness mechanisms have to be developed that will allow end-users to be aware of when others are accessing the same
resource. The use of synchronous cooperative support tools like Chat Rooms and Meeting Rooms will allow end-users to discuss and debate different approaches to accessing the online resources. The core use of these tools is to support the cooperation and debate needed to resolve decisions. To help end-users tackle the problem of information overload as well as not to be lost in the wealth of information available, we suggest the use of interface agents in hypertext and Web applications to make them more adaptive to end-users’ needs. Interface agents make software more active and work autonomously without waiting for end-users’ command. One example of the use of software agents in hypertext and Web applications is the investigation of personalised information filtering systems to help end-users to eliminate irrelevant information and bring relevant information to end-users’ attention (Maes, 1994).

To enable equal access/opportunity/use, we suggest some ideas for implementation to create ethically sensitive user interfaces:

- **Provide adaptive and adaptable interfaces for users**: If systems are to be user-centred and provide equal access to all users, there is a need to make them adaptive and adaptable, taking into consideration end-users’ needs and browsing patterns (Brusilovsky, 1996). Cockburn and Jones (1995) propose building a graphical browser that dynamically adapts to, and reinforces, end-users’ browsing actions and mental models.

- **Provide workspace and equal opportunity for search results**: A comparison can easily be drawn between work patterns and the Principle of Equal Opportunity introduced as a heuristic for human–computer interaction (Runciman & Thimbleby, 1986). Here, the user can exploit the prior output of the computer as input to a further stage in interaction, with or without modification. For example, a “desk” for interaction on the basis of Equal Opportunity could be introduced. Discovered items could be collected, ordered, prioritised, remembered, etc., within the hypertext/Web space.

- **Integrate technology into social environment**: Nardi and O’Day (1999) call for responsible, informed engagement with technology in local settings, which they call information ecologies. According to Nardi and O’Day (1999), an information ecology is a system of people, technologies and values in a local environment. Hypertext/Web systems should be designed and integrated into a social environment where the human factor is not ignored.
Designing with the Mind

Knowing design guidelines is one thing, but applying them is another matter. How can designers be certain that they have considered essential dimensions necessary to ensure effective design and development of hypertext and Web applications? To address limitations in current research in hypertext and Web applications, a framework for an application development model to build user-centred hypertext and Web applications is proposed taking into consideration the matters that concern the mind, taking a systematic, engineering approach to design. The essential issues to be investigated in this framework include addressing these fundamental design and usability questions adapted from Theng (1999):

*What are hypertext and Web applications?*

We can think of a hypertext/Web application as being made up of four components: (i) information referring to the content of the hypertext/Web; (ii) structure referring to the metadata of objects described in the hypertext/Web collection; (iii) interaction elements referring to the dynamics of searching and browsing, screen design, dialogue between end-users and the hypertext/Web systems; and (iv) propriety referring to security, ethical, copyright issues, etc.

What appears on the interface design should reflect accurately the underlying structure of links and digital objects and their relationships with each other within the hypertext and Web structure. An experiment by Allinson and Hammond (1989) confirms that end-users’ lack of overview information or wrong understanding of the hypertext structure make them more prone to losing their orientation. In viewing structure in hypertext and Web applications, the conceptualisation emerges of information as space and the user as a navigator. There is a need to organise space to help end-users find their way in them. Designers should try to communicate the design model of hypertext and Web applications so that the mental models end-users form when using hypertext, and Web applications would match the design model. A good understanding of these interaction elements is important in helping end-users navigate around hypertext and Web applications without getting “lost” (Theng, 1997).

*For what purpose?*

Most hypertext and Web applications are used for diverse purposes by a wide range of people, and this lack of sharp focus may lead designers to ignore end-users as an unmanageably broad spectrum. Therefore, it is important that designers need to identify the goals of a hypertext and Web application from the perspectives of the author/developer as well as from the reader/end-user.
Author/developer goals refer to authoring strategies to consistently apply basic Web document design principles on every page in the hypertext and Web applications designers create (see Table 2).

Reader/end-user goals refer to the tasks readers/end-users commonly perform when using hypertext and Web applications. Designers should also bear in mind the different types of end-users in terms of their domain knowledge and experience with hypertext and Web applications. Central to any successful interaction is the idea that end-users must have an adequate understanding of the state of the hypertext and the Web. End-users should be given full and continuous feedback about the results of actions. At any point, there should be sufficient information to orientate end-users.

“Global maps” or “overview diagrams” have been introduced to give end-users an overview of the system and the documents and links between them. “Local maps” or “document finders” are used to provide end-users with information on what documents are linked to current user-defined document.
These maps aim to provide end-users with as much context information as possible so that end-users are able to answer questions like: Where am I?; Where do I go from here?; How much information is there?; How did I arrive here?, etc.

Furnas (1986) proposes using fisheye maps to show details about matters at the focus of attention, but as the information moves away, less and less of the details should be shown. Conklin (1987) suggests using graphical document browsers to display the structure of the document and allow end-users to assess what is there. This is because much of the problem in navigation and, in particular, disorientation is the lack of understanding of the document structure and the inability of end-users to assess the amount and size of information available.

Other solutions include indices, tables of contents, screen headings, etc., as landmarks to provide end-users with information on where they are in the hypertext and the Web, just as signposts, buildings, and street names aid navigation in physical environments. Maps, tables of contents, etc., are more appropriate for smaller hypertext and Web applications. However, with larger hypertext and Web applications, solutions include investigations into controlling the amount of displayed information using fractal views (Kioke, 1995), mapping the full hierarchy onto a rectangular region through the efficient use of space using tree-maps (Johnson & Shneiderman, 1991), etc.

How to?

To design user-centred hypertext and Web applications, we need to involve end-users and their needs throughout the different stages in the well-accepted iterative development life cycle: feasibility study, conceptual design, building, implementation, integration, and maintenance. Continuous usability evaluation techniques will be investigated.

Continuous usability evaluation of hypertext and Web applications should be encouraged to ensure that usable and useful hypertext and Web applications could be achieved. These evaluation techniques are categorised under real user testing and non-human user testing (Theng, 1997). Real user testing includes observations, surveys, expert evaluation, and experiments, and should be carried out before the hypertext and Web application is ready for implementation so that qualitative results and impressions can be obtained. Non-human user (or analytic) testing methods are encouraged as a means to perform evaluation early enough to influence design while it can still change direction. Analytic techniques are some ways of evaluating without requiring the attendance of real end-users.
**With what?**

This refers to the resources available for the development and delivery environments. They include data, rules, and authoring tools. Data refers to digitised objects (e.g., text, images, sounds, videos, etc.) used to build hypertext and Web applications. They can also refer to existing collections of related information found, for example, in archives or on the Web. Rules are defined as ways in determining data structures of the digitised objects, that is, how data are to be captured and presented. Authoring tools refer to the authoring help and environment provided for designers/developers of hypertext and Web applications. These tools should make authoring as well as maintenance of hypertext and Web applications as easy as possible.

**Level of abstraction?**

The description of hypertext and Web applications can be at three levels: instance level which addresses specific application and domain needs; modelling level which addresses the issues of how models for specific domain are created; and meta-modelling level which addresses the issues of how to go about creating a model.

**CONCLUSION AND FUTURE WORK**

Many hypertext and Web applications are poorly designed and built in terms of how information is structured and displayed. We argue for a move from treatment to prevention, from treating the end-users’ symptoms to avoiding bad design. This chapter makes several theoretical and practical contributions to address the deficiencies in hypertext and Web design by designing with the heart and the mind.

Ongoing work includes developing, refining, and validating the application development model with different collections and different types of designers and end-users. One future research aim is to build a hypertext and Web authoring tool incorporating the application development model so that user-centred applications can be generated. If some design ideas could be automated so designers need not worry about their implementation, chances are that better applications could be produced, because designers would be freed to concentrate on other critical issues that cannot be automated.

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