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A Usability Study for Promoting eContent in Higher Education

Norshuhada Shiratuddin, and Shahizan Hassan

School of Information Technology, Universiti Utara Malaysia

06010 Sintok, Kedah, Malaysia

shuhada@uum.edu.my

shahizan@uum.edu.my

Monica Landoni

Department of Computer and Information Sciences, University of Strathclyde,

Glasgow, G1 1XH, Scotland, United Kingdom

monica@cis.strath.ac.uk

Abstract

eContents used in education can be from a number of sources: from traditional electronic journals (eJournals), and electronic books (eBooks) to more specific formats such as: electronic research reports (eResearch-reports), electronic lecture modules (eLecture-modules), electronic lecture notes (eLecture-notes), and electronic lecture slides (eLecture-slides). This paper discusses a number of issues relevant to publishing of eContent. The first section describes the advantages, as well as the disadvantages of such contents. It also elaborates on how eContent can be promoted through the use of Internet, WWW and SMS. Next, related issues on the usability of eContent on the Web are discussed. Four popular usability design guidelines are studied and critically reviewed. The final part concludes that although designing and publishing eContent is more complex than the printed version, eContent has a huge potential in education.

Keywords

Digital content, usability

Introduction

Electronic content (eContent) or digital content is defined by those involved in creating, providing and distributing information as the digitised content, which is viewed on screen and not on paper. Contents that are produced and stored electronically rather than in print are the result of electronic publishing (e-publishing). The contents can be in any of the following forms:

- any one information type (for example fully textual, only graphics content, or only audio content);
- multimedia or hypermedia (i.e. mixing more than two information type).

Each category according to Borchers (1999) can be used in education (e.g. textbooks, research reports, theses), as reference (e.g. dictionaries, encyclopaedias), leisure (e.g. novels, magazines, comics), browsing (e.g. newspapers) and advertisement (e.g. brochures).

eContents use in education can be from the usual electronic journals (eJournals), and electronic books (eBooks) to electronic research reports (eResearch-reports), electronic lecture modules (eLecture-modules), electronic lecture notes (eLecture-notes) and electronic lecture slides (eLecture-slides).

Upon deciding to produce eContent, authors should then select the file format from various alternatives. eContents are available in a wide range of formats, the simplest of which is plain ASCII-standard text. However, this format is extremely unappealing to read, cannot preserve formatting and cannot handle graphics. To solve these problems, the following formats can be used (Allen, 2000; Armstrong & Lonsdale, 1998; Hawkins, 2000):

- Adobe Acrobat's Portable Document Format (PDF);
- Microsoft Reader's Literature (LIT);
- Rich Text Format (RTF);
- Night Kitchen's Tool Kit 3 (TK3);
- Markup Language (e.g. HyperText Markup Language - HTML, Standard Generalised Markup Language - SGML, eXtensible Markup Language - XML);
- Software for PDAs such as AportisDoc for Palm Pilots and Pocketbooks, Palm Reader and MobiReader for Palm Hand-held, Handspring Visor, and Window CE devices.

The most popular formats according to Hitchcock et al. (1997) are either HTML or PDF. Although their study is now rather dated, in general the findings still hold as throughout Norshuhada's (2002) research, the dominant formats encountered in existing eContent are still the ones mentioned earlier. However, this may soon change as LIT format is becoming widely used.

This paper discusses a number of issues relevant to publishing of eContent. The first section describes the advantages, as well as the disadvantages of such contents. It will also elaborate on how eContent can be promoted through the technology of Internet and Web sites. Next, usability of eContent on the Web will be explored thoroughly. The final part concludes that although publishing eContent is more complex than the printed version, eContent has a huge potential in education.

Advantages of eContent in Higher Education

Many higher education (HE) institutions publish books, research reports, lecture modules, theses and other information for academic purposes. All these publications are usually in-print form and stored in the university's library for fellow lecturers, researchers and students use.

Are there compelling reasons why these in-print publications should be in electronic form? To answer this it is necessary to identify the advantages and disadvantages of printed content (pContent) and eContent. According to Bonime and Pohlmann, (1998) eContents benefit from:

- hyperlinking - contents can be linked to other pages inside and outside the book;
- non-linearity - i.e. the order of access can be determined by users.
- addition of multimedia - i.e. content presentation is enhanced by mixing information type (i.e. sound, video and so on);
- data density - storage capacity is decreased while at the same time increasing portability;
- searching - the usefulness of the content is enhanced by the ability of the users to locate any piece of information, or to access any section instantly.

A comparison of paper book and electronic book features (see Table 1) provided by Bonime and Pohlmann (1998) and Rawlins (1991) can be used as a guideline when considering the possibility of converting printed information to eContent.

Table 1. Features comparison of pContent and eContent

Features	pContent	eContent
Tactile	Yes	No
Portable	Yes	Yes & No
Access without devices	Yes	No
Easy random access*	No	Yes
Multiple access at one time	Yes	Yes
Customisable (font size, annotations etc.)	No	Yes
Hyperlinks	No	Yes
Text	Yes	Yes
Pictures	Yes	Yes
Audio	No	Yes
Animation/video	No	Yes
Instant search facility	No	Yes
Easily and conveniently read	Yes	No
Easily damaged (i.e. tear)	Yes	No
Content updated easily	No	Yes
Go out of print	Yes	No
Highly interactive	No	Yes
Good legibility	Yes	No
Easily reproduced with the same quality	No	Yes

[*Random access in eContents requires less effort, thus probably is easier than pContents.]

Students can take advantage of this new type of content presentation. Results of some studies suggest that involvement with computers through the use of eContents and other new technologies, can promote positive attitudes towards learning and higher achievement among learners (e.g. Ebersole, 1997; Causey, 1996; AlKahtani, 1998; Cakir, 1999; Govil, 1997; Espinosa & Chen, 2001; McCreary et al., 2001). Studies also show that computer-based learning tools lead to significant gains in learner's performance in reading, mathematics, computer knowledge and grammar (Shields & Behram, 2000). Furthermore, computers and technology tend to have more positive effects than negative effects (Seniuk, 2001).

The existing academic publications in most HE institutions are in printed and bound forms which pose some disadvantages as outlined in Table 1. In addition, the publications have not been widely promoted and as a result their accessibilities have been very limited. Many researches and textbook publications by academics of the institutions, for example, have not been publicised properly and thus not noticed locally, and more importantly, internationally. These problems are easily tackled by producing eContents and distributing them through various strategies as discussed in the next section.

Promoting and marketing eContents

Promoting, publicising and marketing eContents are accomplished through electronic bookstores (eBookstores) such as Ecampus.com, Amazon.com, Barnes and Noble, Alibris, and McGraw Hill, electronic libraries (eLibraries) for instance eLibrary.com, Iowa State University library, and E-Library of Science of the University of New Mexico, company Web sites, personal Web sites and electronic shopping malls (eMalls) such as Wal-Mart and Books on tape. These platforms are developed as a portal for eContent community, for the readers, authors, and publishers. In particular, eBookstores and eMalls provide a marketplace and alternative channel for authors and publishers to market and sell their publications online without heavy cost and risk, at the same time extending the reach to the mass readers globally.

Normally, the Website features of eBookstores, eLibraries and eMalls are powered by an exclusively advanced custom-built engine. All revenues are based on profit sharing basis. Royalty is paid based on each item sold. Authors will get certain percentage (for instance 40%-50% depending on the content) from the retail price as royalty. Transactions are usually made by credit cards with authentication being done in real-time (with secured industry standard SSL encryption). Each publication which has been bought is downloaded by the customer.

To meet the demands of today's information user, customers want and expect extensive eBookstore/eMalls features such as in Table 2. These features are now available in most eBookstores.

Table 2. Features of eBookstore

eBookstore/eMalls features
Point-and-Click Browsing
Multi-Parameter Searching (configurable search criteria, quick search, advanced search)
Highly Relevant Search Results
Purchase Options
Flexible Account Types
Tracking (authors' submissions)
Usage Analysis
Content Partitioning
Electronic Delivery
User Registration
Account Maintenance
Shopping Cart
Publication and Service Subscriptions
Archives
Trials and Promotions
Discounts
Multiple Payment Options
Electronic Receipts
Transaction History
Online Help

Accessing, marketing and delivering eContents through the Internet are emerging scenarios. A good example of an eBookstore that offers users with advanced features is McGraw Hill's Primis Online system (www.mhhe.com/primis/online) (see Figures 1 and 2). One unique feature is that students can purchase books in several ways as described below, offering them greater flexibility:

- traditional printed text sold at bookstore;
- download file from eBookstore;
- view textbook online with proprietary eBook reader.

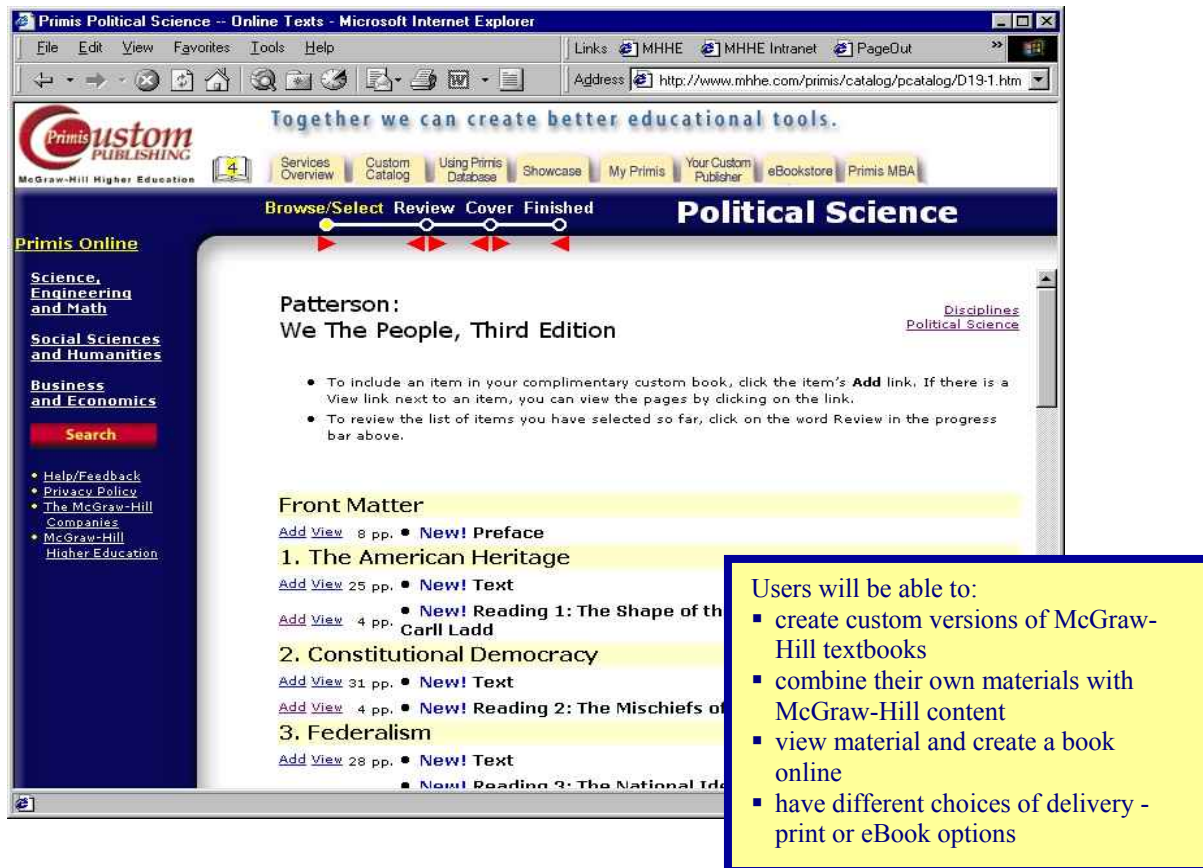


Figure 1. Primis Online

There is a huge potential in marketing eContents to students through the Internet and Web sites. Both parties (i.e. academics and students) can take advantage of this technology. For instance, academics could study new research area and promote their work easily. Students could get fast access to materials at cheaper cost.

To give an example, if lecturers were to market their lecture modules in electronic form, then "student-oriented" marketing strategies are required. Paying by credit cards is inappropriate, as students (especially the undergraduates in many Asian countries such as Malaysia) are not normally qualified to apply for the cards. Bank debit card also has yet to be introduced in this part of the world. Maybe the technology of wireless short message service (SMS) using mobile-phones could be utilised because the phones have been used extensively by the students. SMS is simple, inexpensive and widespread. Messages stating buying interests, which must be no longer than 160 alphanumeric characters and contain no images or graphics, are sent to an SMS centre (ADC, 1999). The SMS centre will then inform the HE institution and further actions will be taken (see Figure 3). This obviously requires further investigation and collaboration with the related corporations to decide on billing models and tariffs. We are currently working and researching in this area to market and provide eJournals, eBooks, eResearch-reports, eLecture-modules, eLecture-notes, and eLecture-slides to our students and community at large (Norshuhada et al., 2003).

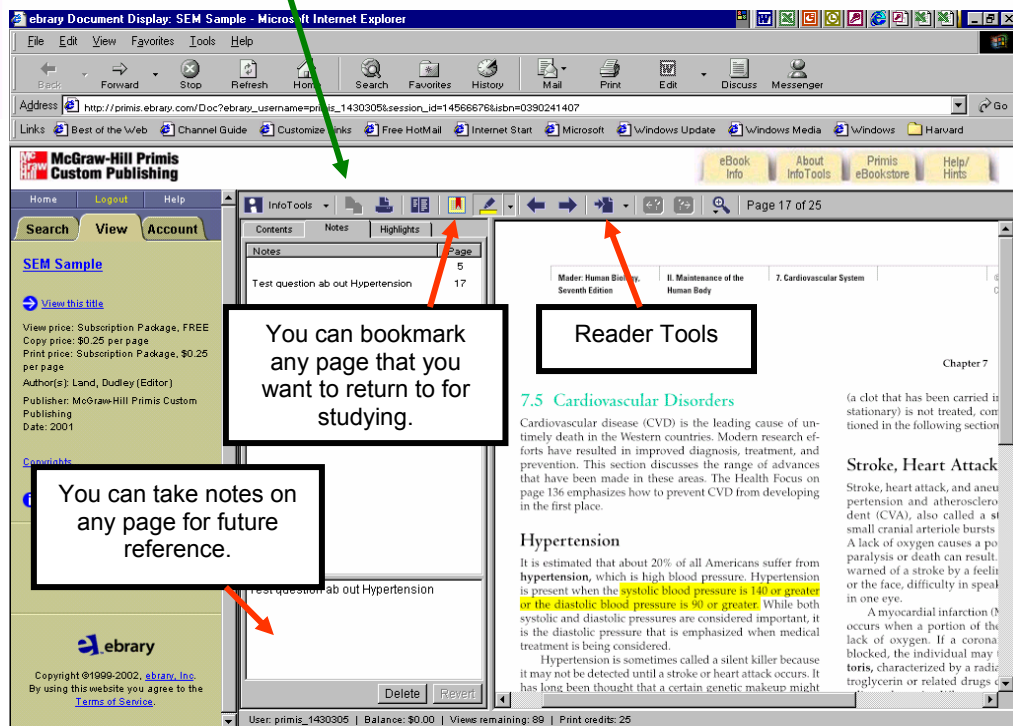
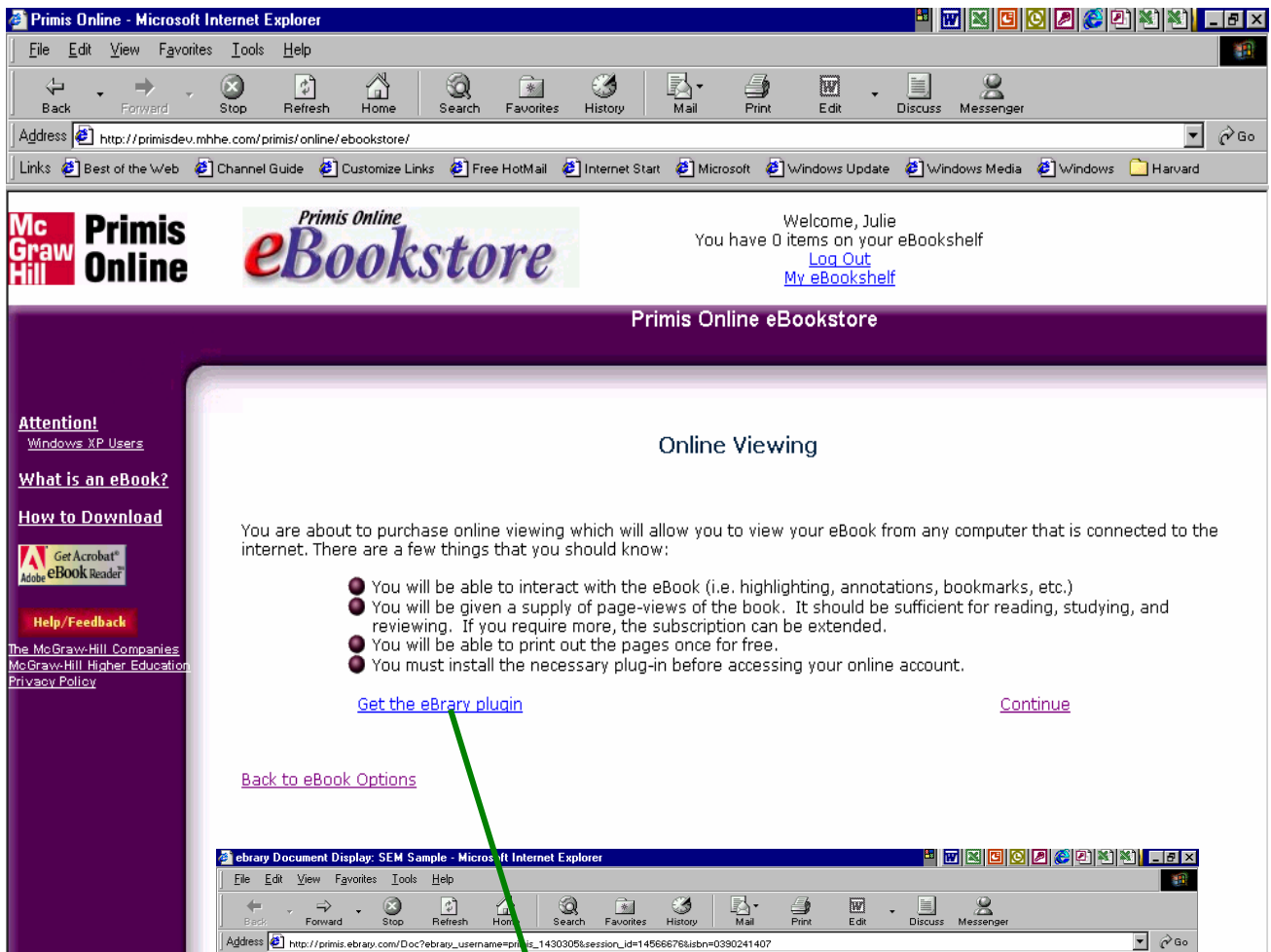


Figure 2. On-line reading features

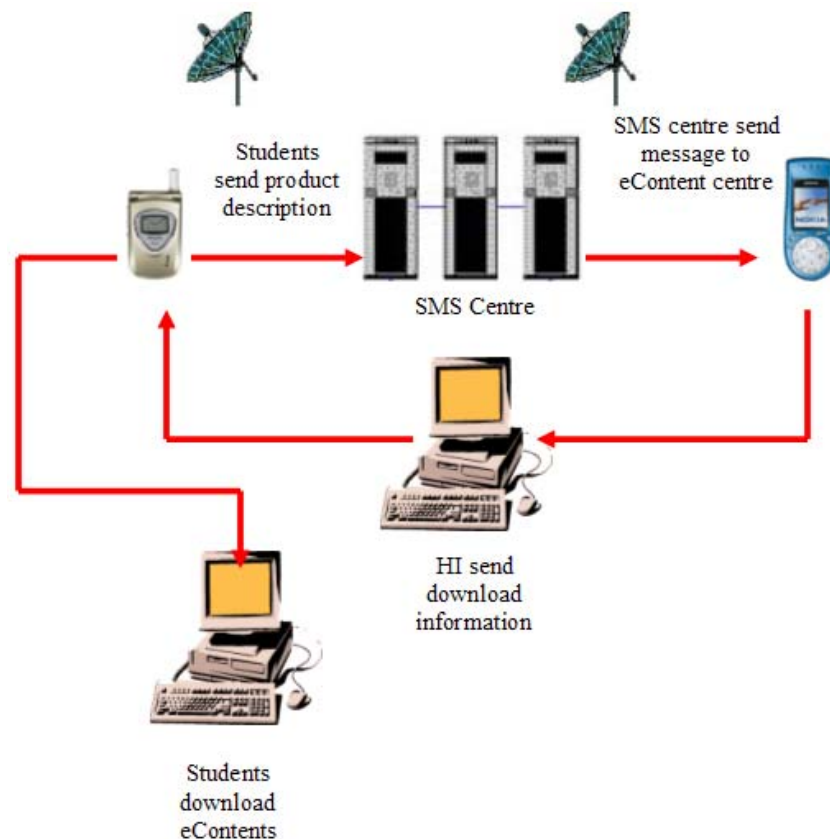


Figure 3. Collaboration architecture

Different formats of eContent require different design and publishing strategies. For example, contents which are in PDF and LIT are produced to imitate the traditional versions (i.e. to follow the structure and appearance of a printed book). Whereas for contents in HTML format, the design should be different from the pContent style. The issue of usability for eContents in HTML format in particular, has to be considered highly, and this is discussed in the next section.

Usability of eContent on the Web

Usability is a very broad concept in information system design. Generally, the word 'usability' suggests that it be related to how convenient, usable, and practicable an information system is for a user. According to Webster dictionary (1999), usability originates from the word 'usable' which means 'capable of being used' or 'convenient and practicable for use'.

The Institute of Electrical and Electronics Engineers (IEEE, 1990) defines usability as the ease with which a user can learn to operate, prepare inputs for, and interpret outputs of a system or components. In agreement with that definition, Marcus (1999) states that usability can be defined in terms of how easy or efficient a product is for a user to recognise, learn, remember, use, and enjoy. Apart from its' broad concept, usability is also defined differently by different Human Computer Interaction (HCI) scholars. Shaker (1991), Nielsen (1993), and Lu and Yeung (1998) define usability as an attribute to a product or system acceptance.

International Standard Organisation (ISO) 9241 part 11 also provides a good definition of usability and its dimension. With no reference made on other aspects or attributes of system acceptance, usability is defined as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use (ISO 9241-11, 1998)". From this definition, ISO 9241 suggests three aspects of usability as follows:

- Effectiveness: refers to the accuracy and completeness of users' tasks while using a system;
- Efficiency: refers to users' level of performance in completing the tasks, and;

- Satisfaction: refers to users' subjective perception of a system in terms of comfort and acceptability.

Although the approach towards defining the concept of usability is slightly different between each other, all models tend to have agreements on the dimensions of usability that cover aspects of effectiveness, efficiency, learnability, and user satisfaction.

One important issue with regards to usability definition is the question of whether content coverage of a system should be included as one of the elements of usability. Some people regard usability as an important area of systems' interface rather than the content, while others see content coverage as one of the aspects of systems' usability. Unfortunately, there is no clear explanation on this in the usability literature.

Nonetheless, most models of usability (e.g. Shaker, 1991; Nielsen, 1993; Lu & Yeung, 1998; ISO 9241-11, 1998) include 'user satisfaction' as one of the usability criteria. This element has indirect relationship with the need for content quality of a particular system. User satisfaction is related to users' subjective assessment on a particular system in terms of its ease-of-use as well as its usefulness. This is to say that users will be satisfied if a system is not only easy to be used but also useful in terms of its contents. From this, it can be said that both user interface and content together determine users' level of satisfaction.

Based on these arguments, it can be concluded that usability, one of the main attributes of systems' acceptability, is related to both systems' interface and content quality. Therefore, with respect to the discussion in this paper, we define the following:

- Effectiveness – relates to the accuracy and completeness of users' tasks while accessing a particular eContent in WWW environment;
- Efficiency – relates to users' level of performance while accessing a particular eContent in WWW environment;
- Learnability – relates to users' ability to learn a particular system containing the eContent, and;
- User Satisfaction - refers to users' subjective assessment concerning how useful and easy to use is the eContent.

Factors affecting Web usability

The concept of usability in terms of its definition, models, and scope has been discussed earlier. This section investigates the general factors that affect eContent usability by reviewing four major Web design guides as follows:

- Web Design: The Complete Reference (Powell, 2000);
- Designing Web Usability: The Practice of Simplicity (Nielsen, 2000);
- IBM Web Design Guidelines (IBM, 2000), and;
- Improving Web Usability and Appeal: Microsoft Web Workshop (Keeker, 1997).

The first two references were selected because both of the authors have a lot of experience in Web design and usability areas. Powell is the president and founder of PINT (www.pint.com), an instructor at the Computer Science department, University of California, and a recognised leader in Web design and development. He has been involved in more than 150 Web development projects throughout his career. Meanwhile, Nielsen's popularity in Web usability field is widely known. He is considered one of the usability gurus due to his massive experience in many usability projects. Both Powell and Nielsen have been actively participating in conferences, seminars, and workshops, and writing many books in computer related areas. The books used in this review are the most recent ones written by them. The other two references were selected because they are published by two leading companies in computer industries and Internet technology - IBM and Microsoft Corporation.

According to Powell, there are at least six factors affecting usability – site structure, navigation, linking, screen appearance, interactivity and local searching (Powell, 2000). Powell classifies site structure into two – logical structure and physical structure. Logical structure relates to the way in which documents are linked within a site. While physical structure describes the physical location of files within a site. Powell states that logical structure is more important in the usability aspect because it affects the way users navigate the content.

He also considers navigation as an important factor for usability. Good navigation helps users find their way within the content. It provides users with answers to questions such as:

Q1: Where am I?

Q2: Where should I go next?

Q3: Where have I been?

Navigation aids such as precise URL location, page label, and page title are Web elements that could provide answer to Q1. On the other hand, Q2 and Q3 relates to the question of whether users are informed of their whereabouts at all time and whether they know how to get back to the previous location. Web elements such as coloured links, history, and home link are examples of navigational aids for Q2 and Q3. Equally important is proper placement of navigational aids on the screen. According to Powell, there is no specific location for navigation elements but usually designers would place them on the top, left or right of pages depending on their creativities. In addition, he also emphasises the need for consistency in the use of navigational aids to avoid confusion on behalf of users.

Efficient page linking is a key to eContent usability. It not only affects the content structure, but could also determine whether users accomplish their goals. Page linking is created normally through text links, buttons, icons, and graphics. Screen appearance is another factor that needs to be considered. Powell outlines five major areas that are related to this factor - page layout, text, colours, image and background. Proper page layout concerns with elements such as page size, resolution, page type, header and footer. Besides page layout, designers also need to use text effectively in terms, for example, fonts, alignment, spacing, headings and sub headings, paragraph, and effects. Finally, effective use of colour and images is also said to have an effect on usability.

Equally important is the interactivity element such as user control, feedback, and dialogue. Additionally, providing local search could also be a factor to make a site usable. Powell's theoretical concept on factors affecting web usability is visualised in Figure 4.

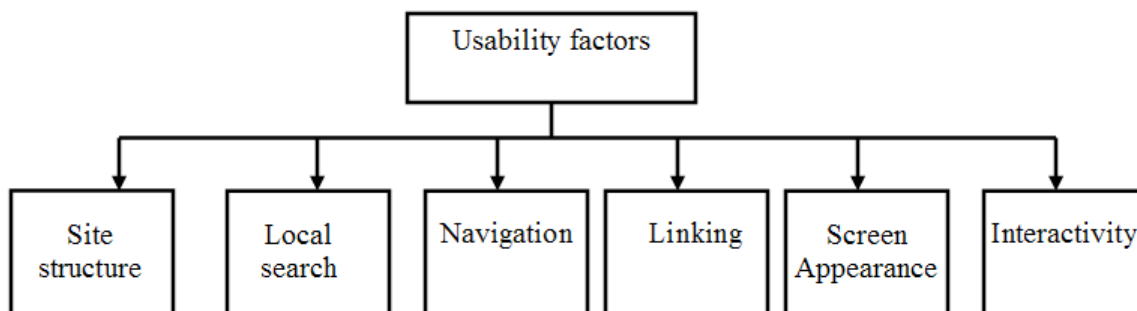


Figure 4: Powell's factors of Web usability

Unlike Powell, Nielsen (2000) describes Web usability in terms of page and content design. He emphasises the need for providing Web pages that can be assessed by different screen sizes and resolution. This argument is based on the fact that users get access to the Internet from different devices that have different screen types such as personal computers, hand-held computers, hand phones, and digital television. Based on years of researches in usability areas, he also concludes that users prefer pages that can load quickly (Nielsen, 2000). In other words, designers should design for speed of pages downloading to improve usability. Nielsen also sees effective use of linking between pages as a contributory factor towards usability. Proper linking would help users find information within the eContent. On the other hand, broken and inaccurate linking might force them to turn away from a particular content.

Apart from page design, Nielsen also emphasises on content design. He strongly believes that users prefer to scan for information before reading it. Hence, he recommends using short text, skimming features such as bold, italic and highlighted words, and page chunking. In term of language, he suggests using simple and plain language to accommodate different type of users' educational background.

Unlike Powell, Nielsen outlines the importance of proper integration of multimedia elements into pages. Despite the fact that multimedia elements such as video and animation could enhance presentation, they should be used properly so as not to affect usability. Additionally, unnecessary media should be avoided to prevent long downloading time. Nielsen's view on factors that affect usability is depicted in Figure 5.

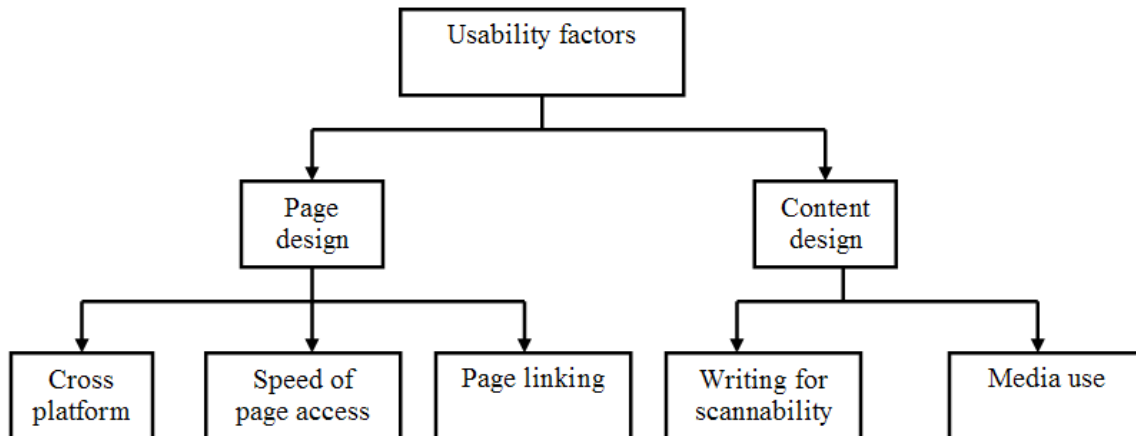


Figure 5: Nielsen's factors of Web usability

IBM Web design guidelines focus on five major factors. Three of which are Web structure, navigation and visual layout that have been described by Powell (Powell, 2000). The two other factors are proper use of text and effective use of media, which are related to content design as discussed in detail by Nielsen (2000).

IBM guidelines suggest designers to use structure that is suitable for the type of information being presented (IBM, 2000). The information needs to be organised in such a way that it makes sense to the users. Good navigation is also considered very important because it helps users moving around the site easily. Several tips are given to promote good navigation system such as using clear labels for links, providing feedback to users, and the use of ALT tag for images. The guidelines also suggest several ways for designing good visual layout.

Like Nielsen, IBM guidelines also remind designers to consider users' different use of technology to access the Internet. Hence, designers should anticipate users' different screen resolution settings and sizes of their monitors. There are also other elements of visual layout that are not discussed by Powell and Nielsen, for example, the need to avoid long scrolling and horizontal scrolling. One of the most important aspects of visual layout that is not discussed clearly by either Powell or Nielsen is the consistency of visual identity throughout one's Web site.

IBM guidelines also present information on how to use text on the Web. Most of it is explained by Nielsen (2000) that focuses on elements that improve scannability and readability. However, there are a few areas that are not mentioned by Nielsen, for instance, the need to design for default browser fonts. Although Nielsen proposes to use media effectively, he does not provide clear guidelines on how it can be implemented. IBM guidelines however outline clearly how media elements should be used to enhance usability. Some examples are as follows:

- Provide user control;
- Inform users of the content and size of media objects;
- Use animations to attract attention, and;
- Use animations to enhance explanation.

IBM usability guidelines are summarised in Figure 6.

One important aspect of Web usability that has been described by all the three guidelines is accessibility. The word 'accessibility' in this context does not refer to aspects of Web pages that provide access specifically to the less privilege users but to different technology used by users to access the Internet. Cross platform design, speed of access, and proper use of text are examples of this.

Microsoft also provides Web design guidelines to the public by presenting its research on Web site usability and appeal. Despite some similarities in terms of the usability factors compared to the previous guidelines, there are also some significant differences that are worth mentioning. One of the main focuses of Microsoft guidelines is content quality (Keeker, 1997). Based on its research, it was found that content quality significantly determines the usability of Web sites. Contents that are provided should be relevant and timely. All media elements especially animations should be used effectively and attractively. In addition, designers should ensure that they employ appropriate depth and breadth. By this, it means that links (number of clicks) to particular information

from the main page should not be too many and any information presented in a particular page should not be too long.

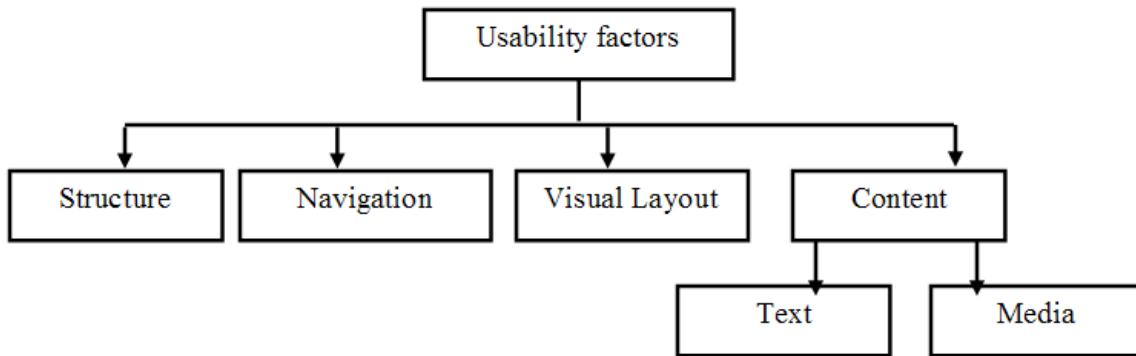


Figure 6: IBM's factors of Web usability

Unlike the other three guidelines discussed earlier, the Microsoft guidelines claim that designing for emotional response could also contribute towards usability. This means that a Web site should always be exciting and enjoyable whenever they are being visited including the regular visitors. One example of the elements of emotional response is the contents that are challenging. Nonetheless, this factor might not be applicable to all Web sites especially those that provide static information.

Besides content quality and emotional response, the guidelines also explain about Web structure. Microsoft believes that having simple and clear structure would improve users' navigation within a Web site. The word 'structure' used in this document is slightly different with Powell and IBM guidelines. While the former refers 'structure' to the logical structure of HTML documents within a Web site, the later refers it to the way information and navigational aids are presented on the screen. In other words, the structure here is more related to the visual appearance of a Web site. As a result, most of the checklist items provided under this category are associated with navigational issues such as the use of labels for navigation buttons, positioning of navigation bar, and avoidance of menu scrolling. Microsoft also suggests developers to provide feedback to users such as page titles, download warnings and reminders to avoid uncertainty on behalf of the users. The summary of the Microsoft usability guidelines is depicted in Figure 7.

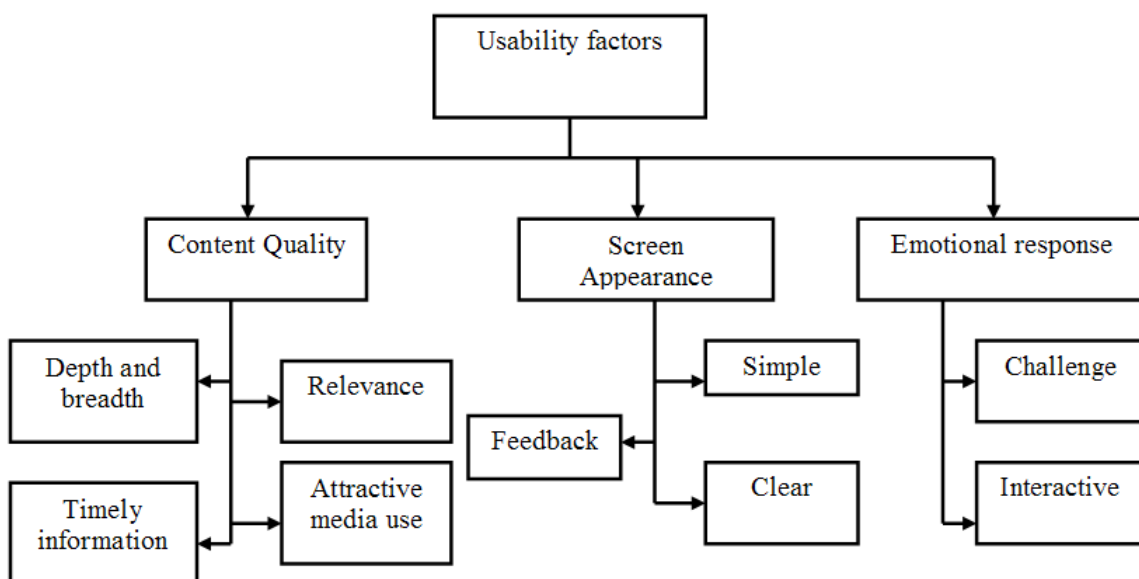


Figure 7: Microsoft's factors of Web usability

Based on the analysis of the four guides, it can be concluded that, there are at least seven general factors of usability which, for the purpose of this paper, are called the SCANMIC factors (Hassan & Li, 2001). Each of these is described below:

- Screen Layout or Appearance
Content should be structured and designed in such a way that users will find information easily and effectively.
- Consistency
Consistency in design is vital in determining users' familiarity in terms of for example, navigation icons, colouring scheme, and page structure.
- Accessibility
Having good design and useful content are inadequate without considering the accessibility factors. This means that designers should take into consideration of whether their information are accessible to all target users who use different technology to access the Internet.
- Navigation
Good navigation will help users find information easily and quickly especially for large amount of information.
- Media Use
The use of multimedia elements could enhance information presentation if used properly and effectively.
- Interactivity
Visitors should be provided with interactivity elements such as giving response, feedback, and searching for information.
- Content
Content provided should be useful, relevant, and up-to-date.

We have shown that publishing and accessing eContents through the Web involved special consideration on usability issues. Many issues have to be considered during authoring process as summarised in the SCANMIC factors. By suggesting to use the SCANMIC paradigm as a guide during the initial design of eContent for education we are in line with the findings of a previous research we did about usability of e-resources for teaching and learning in HE with a project called EBONI (Wilson et al, 2003). EBONI has produced a very detailed list of guidelines for the production of good resources that can be used by designers both in order to inform the design process and to set up the evaluation of the final system. We believe that the production of eContent is such a crucial process to require as much guidance as possible. Bad design can really alienate users and give eContent a bad name, and for this reason we have been paying all this attention to existing paradigms and come up with what we believe sums up all the essential components. Designers work under pressure and need effective and easy to use guidelines to support them during the various stages of development.

Thus while pContent has naturally evolved, over centuries of use, in the present formats where authors and publishers have been following well known paradigms for designing layout and appearance, in order to maximise readers' satisfaction. eContent has still to undergo a process of trial and errors where designers, authors and readers will have to validate a number of possible forms of presentation. The SCANMIC paradigm is a starting point and we believe will provide a step further toward users' satisfaction.

Conclusion

eContent use in education benefits from hyperlinking, non-linearity, addition of multimedia, portability, customisation and automatic searching.

All the above advantages have huge potential in increasing the satisfaction of students, as well as academics. As many HE institutions are introducing electronic learning (e-learning) environment through the Web to their students, it is essential that we investigate issues concerning the presentation, appearance, navigation and accessibility of eContents. Other relevant issues are marketing strategies of eContents and features of eBookstores, for the sole purpose of satisfying the authors and readers.

We believe that eContent can help promote academics work worldwide, assist students to immediate access to lecture notes, modules, and textbooks, and be designed to equally satisfy authors and readers. We also believe that in order to achieve these quite ambitious goals, good design is crucial and for this reason we have proposed the SCANMIC paradigm to help designers producing successful eContent.

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