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Developing Key Concepts for the Design of Hypertext for Printed Books

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Abstract: In the modern world, computers and interactivity are becoming an ever-increasing phenomenon, but this means that the tactile appeal of the printed book is giving way to the increasing popularity of digital interactivity. This research explores how one of the integral concepts of computer interaction, hypertext, can be applied to the medium of print and the advantages that this can bring to the reading environment. The interaction used to read a printed book is different to that of reading material in an electronic form. Books are linear, moving forward, whereas electronic material is laterally associative. However, reading material in an electronic form, such as hypertext, allows the readers to customise and reorder knowledge for their own needs. In comparison, navigation of paper documents is aided by the information being fixed, and readers can easily refer to several documents simultaneously. The considerations that need to be made when combining the benefits of two such contrasting media needs careful attention. Six key design concepts applying hypertext methods to books are discussed to assist the production of effective reading media.

Keywords: Non-linear Reading, Hypertext, Non-fiction, Book Design

Introduction

THE TACTILE APPEAL of the physical book is becoming increasingly overlooked with computers and interactivity gaining greater focus in our reading environments. Printed books and interactive media both provide benefits to readers; these benefits should be embraced and adapted to enhance reading environments. How can the associative benefits of hypertext be combined with the physical benefits of printed books? This research explores six key concepts that need to be considered when one of the integral concepts of computer interaction, hypertext, is applied to the media of print.

Printed and electronic forms of reading material require very different types of interaction to consume the information contained within each of the media. The book is generally considered to be a linear medium, whereas interactive media are laterally associative. The associative aspect of hypertext material allows readers to customise and consume knowledge in an order that is relevant to their own needs. In comparison, the fixity of information in a printed medium aids the navigation of the content. The fixity of information in a book means that the reader can construct meaning from the information with greater ease, and this contributes to paper documents remaining the preferred medium for most readers. The advantages that printed media hold over digital media are due to the ways in which the reader interacts with the document. Paper is durable, flexible, portable, light, cheap and adaptable. These physical advantages, when combined with the associative advantages provided by hypertext, can create a reading environment that benefits reader acquisition of knowledge. The design of the printed media that incorporates the benefits of hypertext needs to be carefully con-

sidered to deliver the most usable environment for reader. Attention needs to be given to the structure, visual attributes used, reader orientation, and linking and searching facilities. These important considerations are addressed and discussed through the development of six key concepts for the design of hypertext books.

The Advantages of Books

A book represents a unit of meaning, a representation of knowledge pertaining to a single topic. It is a finite unit of expression from one person to another. "The book in any technology is a receptacle, a place to put verbal ideas" (Bolter 1991, p.88). Gatenby explains this further and elaborates on the concept of the purpose of a book by saying that, "Books serve not only as a close at hand reference for the information they contain, but people also attach themselves to the meaning the objects represent" (Gatenby 2005, p.21).

The book is a physical object that people must interact with. Readers must open the cover and turn the pages in order to be able to gain the knowledge that exists; this interaction has become natural and automatic. Navigation through paper documents is quick and flexible, and people are familiar with the interaction required to navigate through a book. Printed books are traditionally linear; however, a non-fiction book is not necessarily read in a linear manner, from cover to cover. People have been reading non-fiction texts in a non-linear manner for a long time. The reader of a non-fiction text may only want to read one section or chapter of the book, or they may begin by turning to the index to search for a specific topic. The reader may then move between sections in a non-linear way as new areas of interest become apparent. In a book, learners will navigate between the covers to find the information necessary for their learning task. The main navigation aid relied on by the reader for this style of reading activity is the index. This type of reading behaviour is non-linear in nature, by enhancing linking opportunities within the text; hypertext is being introduced to the printed book.

The major difference between print and electronic media, according to Birkerts (1996), is that print is a forward-moving linear succession of information, whereas electronic media are laterally associative. The vertically cumulative nature of print is created by the reader turning pages, reading down the pages through the information, which is organised to shape the reader's comprehension. Cunningham et al. (2000) believe that the static printed form of the book will be replaced by hypermedia and personalisable databases. They believe that the way forward is individual customisation and reorganisation of fixed knowledge. However, this hypothesis does not mean that the printed book will become obsolete, the medium of print must merely adapt to the changing needs and preferences of readers.

The Advantages of Hypertext

The development of hypertext and electronic books has challenged the way a printed book is perceived in two ways. First, it has created a new medium for reading and writing, a new surface, which is interacted with in new and different ways. The second way is the one with which this research is concerned; it has challenged the way in which reading occurs. As people become more accustomed to hypertext reading they have developed new expectations of their reading materials. "Hypermedia as a medium conveys the strong impression that its links signify coherent, purposeful, and above all *useful* relationships, from which it follows

that the very existence of links condition that reader to expect purposeful important relationships between those materials” (Landow 1997, p.125). Hypertext and electronic books have offered an alternative way of reading, a new rhythm with more choice and reader freedom. Readers are no longer satisfied with the author dictating to them the linear order in which the information that they have placed on the page is consumed. Through hypertext, readers have been shown that they can have the freedom to select the information that is personally relevant to them and consume it in the order that is most meaningful to their purpose. Hypertext has given users these capabilities in a computer-based situation, but there are still many disadvantages to accessing information in an electronic form. By taking the methods used in hypertext environments and making them available in printed books those cognitive advantages are made widely accessible to learners.

Hypertext is often considered to give the reader more freedom, as it gives the reader options on how they want to navigate the information as an individual. “Pages in hypertext are organised in a network, as opposed to a sequence in printed books; and the progression in hypertext is user defined, as opposed to predefined by the author” (Rouet et al. 1996, p.12).

Benefits to Learners

For learners, the greatest benefit of hypertext being applied to a printed book is that hypertext uses and develops the cognitive skills of learners over and above those developed from reading text structured in a traditional way (Kozma, 1991). Hypertext learning environments encourage active participation by the learner as they have to make decisions about connections between information. “Hypermedia has been recognized as having great potential in providing content to learners because relationships between concepts can be made explicit with hyperlinks, and the same material can be organized along different dimensions presenting the material to be learned from different views” (Hübscher, 2002, p.185). The learner is required to take responsibility for accessing and sequencing information and creating meaning from this; however, information should still be presented in a linear order when necessary. Retention of some linearity and a clear structure can help to ease the disorientation that can occur for readers who are unfamiliar with the topic, as the removal of all linearity can produce an environment that potentially makes the knowledge more difficult for the reader to comprehend.

In a hypertext learning environment the reader is encouraged to develop cognitive skills relating to the integration and structure of ideas. The disadvantage is that disorientation may occur when learners are unfamiliar with a topic and therefore find comprehension of the text far more difficult.

When designed with consideration, hypertext learning environments have the potential to provide learners with knowledge that has context and can be reorganised along different dimensions. Careful attention needs to be given to the structural design and visual attributes implemented to construct a functional reading environment.

Conclusion

The freedom of hypertext lies in the way in which readers use this technology. Readers of printed text can choose to read in the predetermined linear order – cover to cover – or utilise the flexibility of a book, to flick from page to page without restriction by hypertext links.

Currently the reader may be aided in this interaction by the table of contents, index, citations, references or other traditional navigation devices commonly found in linear printed material.

The challenge with developing hypertext systems for printed books is in retaining these advantages of reader freedom and incorporating the guidance and freedom that hypertext provides to readers. Hypertext books need to incorporate the current navigation aids of books such as tables of contents and indices with the advantages of the network of relationships that hypertext offers to readers.

The benefits of linking related material (nodes), as is the fundamental objective of hypertext, would also be incorporated into the format of a printed book. These hypertext functions would work alongside the traditional navigation aids. This added functionality would aid readers in being able to access the relevant information or level of information that they require. This hypertext structure would guide readers to information related to what they have just read, more in-depth information, or related exercises and examples. It would also mean that readers for whom this information was not relevant would not have the flow of their reading experience disrupted by having to follow a hypertext link that was not necessary for their learning needs. To best embrace the potential benefits of hypertext methods being applied to a printed book a set of key concepts needs to be developed to ensure the benefits are optimised.

Key Concepts for the Design of Hypertext Books

As with the design of interfaces for electronic media, the layout and functionality of the interactive experience needs to be carefully considered. By considering the benefits and potential disadvantages of the application of hypertext concepts to printed non-fiction books, a greater understanding can be gained of how to best transfer the advantages of the structure to the medium of printed books. Timpany (2009) found in analysing the way some books currently employ hypertext methods, that the methods for implementing non-linear navigation were diverse. In the six books that were analysed, a range of methods were implemented to apply the non-linear format to the knowledge, some methods offering greater benefits for learners than others. There are several key considerations that need to be made in order for the interactive environment to be of greatest benefit to the reader. In the case of the application of hypertext to printed books, there is a need to develop clear guidelines to ensure the greatest benefit can be offered to the reader. By considering the findings of Timpany (2009), as well as the factors that contribute to creating successful reading and learning environments, a set of key concepts can be developed for the design of hypertext in printed books. The key concepts will aid the design of hypertext books so that the benefits to learners can be enhanced.

Structure

Concept One: Readers should be given an overview of the structure of the text before they begin.

When designing a hypertext system, the user's anticipated strategies need to be predicted; users without knowledge of the system also need to be considered. Because of the non-linear nature of a hypertext environment an overview of the structure of the information will aid

the reader in their successful navigation. In a hypertext environment material should be divided into self-contained units, and an overview of the relationships between these units will assist the reader in their reading experience. An introduction at the start of the book explaining the organisation gives the reader a clear view of the book's structure in a similar way to a contents page, as is convention in standard book structures. Giving a more informative overview of the structure of a hypertext environment can be done using a list or a graphic organiser, also known as a map or web; a graphic organiser is a diagram or chart that shows the relationships between ideas and information in a text. Miholic (1990) recommends constructing a semantic map for textbooks, especially for adults and at secondary and college levels. When introducing learners to a print based hypertext environment it may also be crucial to provide the reader with a section at the beginning of the book that describes how to use the book, its hypertext features, and possible strategies for navigating the text. Book structures that are more complex may include features such as key words indicated by a different font treatment, text in separate boxes, and side indices; the way in which the reader can navigate these features needs to be made clear.

Visual Attributes

Concept Two: The placement and function of navigation aids should be consistent and obvious and should not distract the reader.

The visual attributes of a hypertext environment are important and should be a strong consideration in the design of non-linear learning environments. Visual attributes can include font, colour, size, layout, borders, and the overall position of elements within the page. The spatial layout of text gives the user much information, especially between the navigation aids and the body of text. The overall layout of the page should be stable, with the consistency of the placement of navigation aids a crucial aspect.

The function of each navigation aid should also be obvious. O'Hara & Sellen (1997) raise an important argument in relation to this key concept; they state that fixity of information in regards to the physical page is important for navigation. Visual attributes with different purposes should be visually distinct with their own purpose, and not easily confused with other attributes. Two visual attributes that have the same features will be seen by the reader as being associated. Users find it beneficial if there is a visual indication as to where they have previously been, this may be difficult to replicate in a print based environment, but should still be considered.

One way of distinguishing important information is to highlight it in some way. A common method for doing this is to put it in a shaded box, separate from the rest of the text. The relationship between this separated text and the information in the body of text should be indicated clearly.

In the layout of text, it is important that distractions are kept to a minimum; the visual attributes should not distract from the text and the overall page should be kept uncluttered. Distractions that hinder perception are aspects such as letters in different colours, variations in text size or other features which may make it difficult for the reader to see the overall shape of the word (Elsom-Cook 2001). One way to reduce clutter, especially with icons, is to be able to turn them off, allowing the reader to not be distracted when they are focusing

on the text. In a print based environment this could be replicated in a variety of ways, for example, with the use of invisible inks or removable overlays.

Concept Three: Visual indicators should point to pages commonly referenced or familiar to the reader.

Tabs are visual and physical attributes frequently used to aid readers of hypertext documents. In printed books they are commonly on the foredge. Their purpose is generally to allow readers to quickly and easily access commonly referred to sections of a document such as indices, glossaries or tables of contents. In a hypertext environment this is especially helpful if a reader becomes lost and needs to find their way to a familiar location. Tabs are also useful in aiding readers to easily search for particular sections within a book. The tab can function in a printed environment in much the same way as a bookmark is used in a hypertext environment. Bookmarks in hypertext can ease disorientation. Bookmarking a page will mean that if a reader becomes lost as they continue through the hypertext, they can always return to the familiar location which they have marked (Bernstein, 1988). Readers can also use bookmarking to indicate information they wish to reference frequently. The function of a tab is an essential visual element in the design of a printed hypertext environment.

Orientation

Concept Four: Readers should be able to identify where they currently are within the structure of the book.

The purpose of orientation cues in hypertext is to help the user to identify their current position within the overall structure. There are many orientation methods familiar to readers; these are chapter headings, headers, page numbers, footers, position in book and many other visual indicators. These orientation indicators are generally placed on the page according to convention, for example the book title and chapter title at the tops of the pages of a spread. This type of information provides the reader with information about context and higher-order information units. The physical form of the book itself also provides an orientation cue for readers that digital forms of hypertext do not provide. The reader of a printed book can quickly determine their location within the text by the physical cue of how many pages are both before and after their current position, this is an intuitive and familiar orientation method for most readers.

It is important to show the reader the context of the node they are currently reading. Being able to visualise the overall structure of the document gives the reader much information for aiding their orientation. This can be facilitated through the use of orientation methods such as: detailed tables of contents, map or web diagrams or other visual representations of the documents structure. Consistent and coherent design is also essential so that the reader can easily read the text and understand the navigation. Orientation information should be both at the beginning to provide an overview and throughout the pages to maintain orientation, and provide ease of navigation.

For ease of meaningful navigation, a structure that indicates recommended paths, relevancies and dependencies to the reader can help to prevent a reader of hypertext from becoming lost. Being able to mark a path that a reader wants to return to is also a useful orientation

tool. A variety of visual attributes that aid the reader in identifying their current location at different granularities, and indications of their anticipated paths through the text. Being able to easily identify their position within a book's structure aids the reader in their navigation and understanding of the text.

Links

Concept Five: Links should be easily identifiable and their purpose clear.

The ability to link between aspects of information is a key feature of hypertext environments. In order for a reader to be able to follow a link, the reader needs to be able to clearly identify where the links are. Designers of links must consider the purpose of the system, the desirability of user control, and the potential problems of display clutter and ambiguity. The function of a link should be clearly indicated, whether it is through a graphical or a textual indicator. The anchor for a link can range from an insertion point to an entire document, or any size in between. The marker for a link can indicate the beginning, middle or the extent of the link. Icons are a commonly used and appropriate method for indicating links in a hypertext system, as well as highlighting the extent of the text by changing the font, colour, outlining or underlining the text.

In a non-linear text, it is important for links to communicate the relationship between the two nodes. This improves comprehension as it gives the node greater context for the reader to better understand the relationship between nodes. This can be done through the use of a verb, for example “support” would show the reader that the link to follow would take them to information that supports the information currently being read. This gives the reader more information about the relationship between the two nodes and provides a better understanding of whether they want to pursue that link. Another method for giving readers additional information through links is by specialising them to do a specific task. This could mean that different types of links are assigned different visual attributes or types of link icons. The reader then has a better understanding of the type of link that they are following and the information they will be provided with when they follow that link.

Searching

Concept Six: Searching facilities should be easily accessible and clearly laid out.

Searching for information is a key aspect of hypertext systems. There are conventional systems for searching already commonly used in current book structures. The most common searching aids that are useful for navigation are; alphabetised indices, tables of contents, bibliographies, glossaries, sections and chapters. It is important for the reader that these features are easily identifiable and that they have easy access to these searching facilities. The alphabetical index is the searching facility that readers are most commonly familiar with in the printed book. The index is an important aid that provides readers with information at a variety of granularities of where their target information is throughout the book structure. The table of contents is also an important device as it helps the reader in searching for the information that they require, but also gives them an overview of the information that the document contains. The contents page therefore needs to be clearly laid out and include the

page numbers and structure of chapters, sections and paragraph headings to make it most beneficial for readers. Some books have two tables of contents, a simple one which acts as an overview, and a more detailed one which provides greater detail. A strong relationship can be created between section numbers in the contents and those throughout the book by setting them in the same font colour, size and style.

Providing a contents page at the beginning of each chapter, which is specific to that chapter, can be beneficial to the reader. Another method for aiding searching of a book is to provide a list of sections outlining what will be covered in that chapter; this can help to give a sense of context.

Glossaries are frequently referred to by the reader and therefore need to be easy to access. Conventionally, the glossary is compiled as a single list at the beginning or end of the document. For easier access by the reader, there are several approaches that may be preferable. One solution is to have smaller glossaries throughout the book at the end of each section; another approach may be to have the glossary on a separate sheet that can be moved to the current reading location for quick reference.

The index is the printed book convention that most closely aligns to searching methods provided in hypertext environments. This convention can be developed and adapted to provide the reader with a greater amount of information to aid their searching activities. Tabs may be one visual method that could be implemented to further aid the ease of information searching.

Conclusion

Through the research conducted, six key concepts were developed to aid in the design of hypertext structures in printed books. These concepts take into consideration the overall layout of the pages, the importance of orientation for the reader, book and page structure, and link and searching functions. When applying hypertext methods and developing the structure and navigation for the printed book it is important for the well-established and effective conventions that readers are currently familiar with to be maintained, but expanded on. By utilising aspects common in hypertext and applying them to the printed book, readers can benefit from advantages of both print and interactive media.

The key concepts developed take into consideration the predominant characteristics of a hypertext environment and the needs of a reader when interacting in this way. It is important that attention is given to the design of the interface with cues being employed to provide the reader with functional navigation and adequate orientation aids. The design of navigation aids is crucial to providing a functional interface for the user. The navigation should be easily identifiable and its appearance and function should be obvious; it should also be easily accessible. The design of orientation aids is also important as they enable the reader to navigate efficiently to the location or information that they desire. This means providing information that will allow the reader to easily identify where they are within the structure of the book and to be able to effectively navigate to the information that they need. The six key concepts developed provide guidance for the successful design of print based hypertext books to ensure ease of use and reader orientation.

When all of these key concepts are applied when designing a non-fiction book with hypertext functionality, learners should be able to easily navigate their way through the information

most relevant to them. This ease of navigation should enable the reader to gain a greater understanding as they have a greater role in the acquisition of the knowledge.

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Claire completed her Masters in Computer Graphic Design at Wanganui School of Design, New Zealand. She is currently a lecturer in Computer Graphic Design at the University of Waikato, New Zealand, teaching both print and screen based papers. Claire's main areas of interest and research are typography, print design and physical interaction design. Because of her love for both printed books and interactivity this is where her research interests lie. Her research is currently focussed on the way in which people interact with printed material and how the benefits of electronic media can be applied to traditional media, such as print, to aid it in developing and become more beneficial and keeping up with the digital age.

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