
How do Learners Engage with Hypermedia in Vocational On-line Learning?

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The merger of computer, communication, and information technologies has enabled the current hypermedia capabilities found on the Internet and Intranets. The use of hypermedia to complement customary instruction or even to provide entire courses has a great deal of momentum in educational communities. For example, in the IT training market it has been predicted (IDC 1998) that technology based training in 2003 will comprise 14 percent of the market, up from 2 percent in 1998.

However, an understanding of how hypermedia technologies will support educational processes present us with a number of substantial challenges. For not only does the use of these technologies not guarantee effective learning, inappropriate uses may in fact hinder learning. Nonetheless, educators and authors (e.g. Hall 2000) argue that many aspects of technology make it easier to create environments that fit the principles of learning. This paper reports a preliminary analysis of data collected from students interacting with educational hypermedia in a vocational setting.

Introduction

The first part of this paper reviews the educational hypermedia literature in an attempt to better understand what it is and to articulate what is seen as its potential for learning. What seems apparent from this analysis is that there is still much to understand about how and why learners interact with educational hypermedia in the way that they do. The final part of this paper reports a preliminary analysis of data collected from four students interacting with educational hypermedia in a vocational setting. The study sought to map the actions of learners as they interacted with hypermedia driven courseware. The analysis of these actions moves toward a tentative understanding of some of the reasons behind these actions.

A definition of hypermedia

Hypertext is an idea that can have its historical roots traced back to Vannevar Bush (1945). Bush with his emphasis on the role of association in cognition dreamed of a technology that would allow us to deal with an exponentially growing knowledge base by quickly facilitating the selecting, retrieving and arranging of data. It has been the advent of the computer that has allowed for the realisation of this idea. According to Tricot, Pierre-Demarchy and Boussarghini (2000), hypermedia (the extension of hypertext) are

in effect, documents or organised collections of documents. A document is considered to be structured material that enables the user to 'build sense' (Tricot et al 2000). Hypermedia are electronic materials where the communication channel can be audio, visual or both; the code used can be linguistic, iconic or analogical (e.g. sounds, pictures, dynamic pictures); and the structure can be linear or nonlinear (see Fig 1). Thus, the concept of a hypermedia document is richer than the more traditional notion of a document that we associate with its paper based form. It is this richer notion of a document that leads to claims about its educational potential.

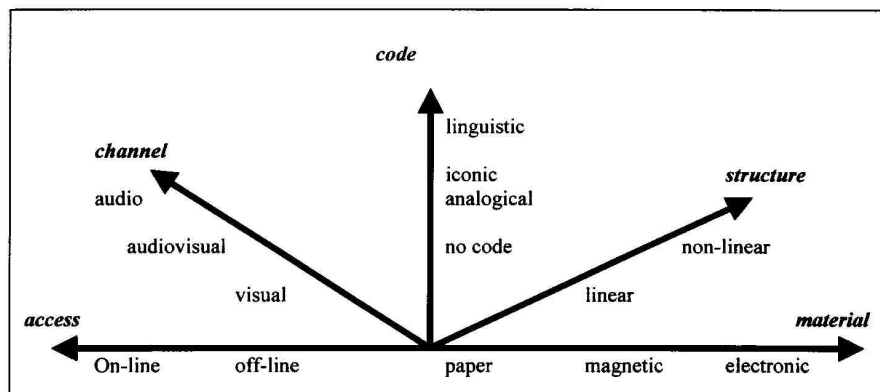


Figure 1

What is a (Hypermedia) document (Tricot et al 2000, p.104)
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What are the claims about hypermedia?

Hypermedia and information

Hypermedia presents a new way to interact with media that differs from reading standard linear media (e.g. textbooks, diagrams and charts). For example, within a textbook the text is typically presented in a linear form, in which there is a single way to progress through the text, starting at the beginning and reading to the end. In contrast, within hypermedia, information can be represented in a semantic network where multiple related sections of media are connected to one another (Foltz 1996). Users may browse through the sections of media, jumping from one node to another. This permits the reader to select a path through the media that is most relevant to their interest. The concept of user selected pathways in hypermedia to retrieve and read information is seen as having educational application as it has the potential to accommodate differing learning styles.

Educational hypermedia

In recent years, the emergence of digital documents has progressed from word-processed text, through stand-alone hypermedia, to the World Wide Web. When directed at educational purposes the technologies are collectively referred to educational hypermedia. Some commentators and educators (e.g. Landow 1992; Dryden 1994) have predicted major shifts in paradigm to the manner in which we understand the learning experience and the educational process as a result of these technologies. The promise of hypermedia has been touted as having 'the potential to become a significant application area: equalling or perhaps exceeding that of word processing, spreadsheets and general database application' (Begoray 1990, p.121). The nonlinear nature of hypermedia and assumptions about its educational value appear to underlie much of this argument.

Yet after a decade of research, other authors (Mcknight, Dillon & Richardson 1991, 1996; Dillon & Gabbard 2000) suggest that such strong claims are short of supporting evidence from studies of learners. Dillon (1996) argues that in the last decade of empirical evidence much has been generally assumed about hypermedia, but rarely demonstrated; 'that the unmistakable advantages of hypertext have rung hollow' (p.26). The lack of a general theory of hypermedia learning and a tendency to overlook the lessons learned from user studies of previous technologies are considered major reasons for these claims not being realised (Dillon & Gabbard 2000).

Welch and Brownell (2000) argue that technology is effective when developers thoughtfully consider the merit and limitations of a particular application while employing effective pedagogical practices. This stance argues that instructional objectives should drive decisions as to what technology is to be used and how. Tessmer (1993), almost a decade earlier, argued that developers should not just use a specific form of technology because "we can". Instead he urged developers to conduct, what he called a "front end" evaluation to carefully consider the suitability of a multimedia format in terms of the instructional objectives. This, he argues, would help to establish the extent to which the medium enhances the learning experience. In order to do this he suggested that developers employ formative evaluation procedures to test prototypes of multimedia products.

This brief review of the literature indicates a number of things. Firstly, there needs to be more work done with respect to the development of a general theory of hypermedia. Secondly, research so far has not yet established whether the claimed advantages of hypermedia for education can be realised. I would argue that research that seeks to gain a better understanding of the learners' experiences when engaged with educational hypermedia would play a crucial role in informing both of these issues. The next section reviews hypermedia and learning.

Hypermedia and learning

Learning with the use of computers has been a growing aspect of education for more than two decades. In more recent times, and with the advent of the World Wide Web, applications have developed which utilise web browsers as the underlying production and delivery engine. The earliest entries into computer based learning were usually written using programming languages and constructed in the main by computer

programmers. The pervasive nature of web browser technology, the underlying universally adopted Hypertext Markup Language (HTML) and software that enables the lay person to develop browser screens without any knowledge of HTML has led to a vast array of web-based products including educational products.

Hypermedia is a form of information access which is highly attractive to educational users because, on the surface at least, it leaves them in full control of that access while at the same time making it extremely easy. Hypermedia provides "learning environments that promote the active, personal exploration of information for both comprehension and information" (Welsh 1995, p.275). Thus, as a learning context, it is seen as turning control over to the learner, a construct considered central to effective learning. Hypermedia as such espouses a very constructivist (Billett 1994; Von Glaserfeld 1987) approach to learning: a view of learning emphasising active and interpretative knowledge acquisition, as individuals integrate and extend their knowledge in an effort to maintain its viability.

Web-based learning has been lauded as ushering in a new era of learning, and like many technologies in the past, as the mechanism to change the very nature of education and schooling in the future. Yet as Dillon (1996) asserts, during the last decade the empirical evidence does not support this view. He argues that the practice of hypermedia design has been accompanied by an uncritical acceptance of a host of quasi-psychological notions of reading and cognition. He goes on to argue that as a consequence hypermedia has largely failed to fulfil much of its early promise. Both he and others (e.g. Dreyfus 1998; Mayer 1999) believe that this is in part due to an inappropriate emphasis on the technology and not the learner. As with technologies and educational innovations of the past, research tends lag behind development.

Much of the research into the use of hypermedia in education has focused on the capability of hypermedia for flexible information organisation and retrieval, interface design, or mixed media. The use of hypermedia as a tool for mediating the nature of the cognitive interactions that occur between learners and the computer has been less thoroughly explored (Yang 2002). In addition, not much attention has been given to analysing the cognitive processes that go on in learner's interactions with the technology. Therefore, there is a need for further exploration of learners' interactions with hypermedia in order to understand better the cognitive processes it activates. The next section reports a preliminary analysis of data from a study that sought to map the actions of learners as they interacted with hypermedia courseware.

The study

Method

The study followed a qualitative paradigm and focussed on gathering data from students undertaking a web-based course in computer networking as they interacted with the web-based courseware. The data were collected using a screenbased video capture software (Camtasia) that recorded the learner's real time interaction with the software. Immediately following the initial capture the session was played back to the respondent and they were asked to explain what they were doing and why. Stimulated recall was used to get respondents to articulate their reasons for interacting with the software in the way they did.

The participants were 4 students who self selected by volunteering from a class group of 12. This class group was chosen for a number of reasons. Firstly, the learners were engaged in on-line learning. Secondly, as most of the web-based interactions happened on home computers, it was critical that the computer on which they were working had the disk capacity to hold video files and had a read and write CD-ROM for transferring these large files. Thirdly, the student cohort was known to possess the technical skills to load the capture software, activate the capture, and transfer the results to CD-ROM. All of the volunteers had computers of sufficient capacity and also had the necessary technical skills.

Data analysis

The courseware consisted of a series of topics constructed as a set of documents or screens. Each respondent was asked to work through a topic they had not previously attempted. The courseware allowed them to choose the manner in which they did this. For example, it was possible for them to move through the screens in a linear fashion following the structure of the courseware. Conversely, using a number of navigational aids that were provided, they were able to move around the screens in any manner they chose. A sample screen is shown below as Figure 2.

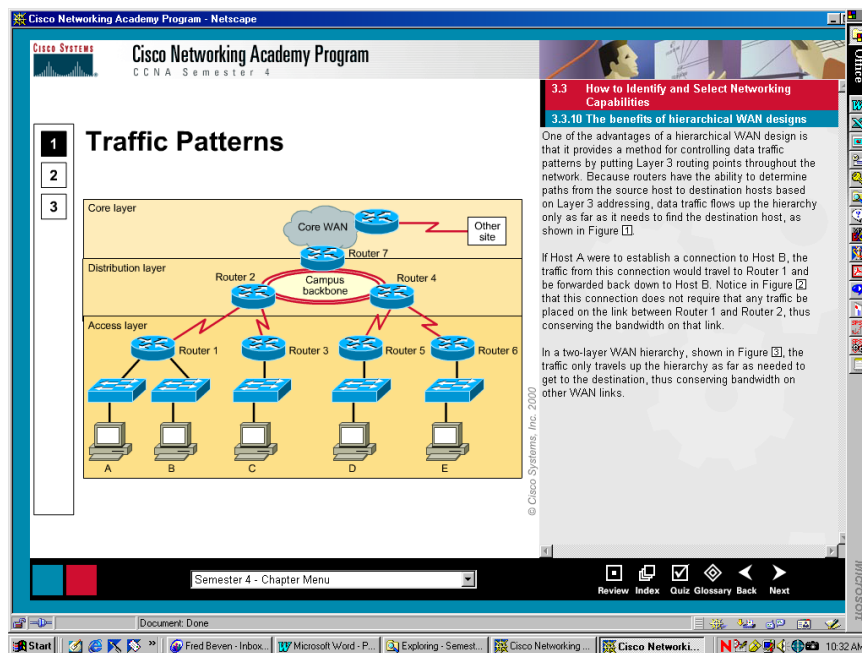


Figure 2
Typical screen layout and navigational devices

Each of the screens provided the learner with a consistent interface. The right hand side of the screen contained text, whilst the left had side provided a graphics display area. Not all screens had graphics and in these cases the graphics area contained a watermarked logo. Some screens contained multiple graphics, indicated by numbered buttons on the left side of the graphics segment (see Figure 2 as an example). The additional graphics could be viewed by placing the mouse cursor of the appropriate number. On some screens the amount of text was greater than that able to fit in the text window. In this case scroll bars would be provided. Navigational aids were provided across the bottom of the screen that allowed the learner to move forward or backward in a linear fashion or to move to some other part of the courseware. The bottom navigation bar also provided access to a set of review questions, a quiz and a glossary. As a result, the learners were able to follow the structure of the courseware in a linear fashion or choose to navigate through the material in a non-linear way, selecting a pathway of their own making.

In order to assist in the later analysis of the data the learners were asked to place the cursor in the area they were currently using. For example, if they were reading text they moved the cursor down the text as they read.

It was a recorded version of the learners chosen method of interacting with the screens accompanied by their stimulated recall of these events that formed the data set for initial analysis. A framework for the initial review of the data was developed. Each of the video files was viewed and the data mapped onto a four-column table (see Figure 3).

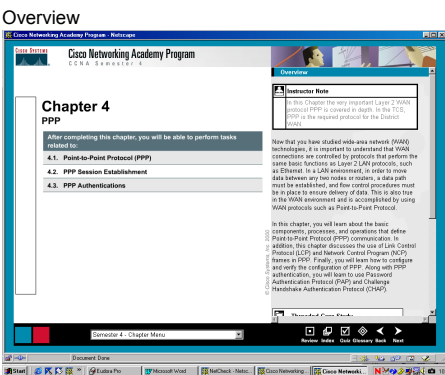
SCREEN	USED	RESPONDENTS STATEMENTS	USER TRANSACTIONS
	Yes	<p>I started to read the text and glanced briefly at the graphic.</p> <p>There were some acronyms here that were new to me</p> <p>Ignored threaded case study as I don't find it useful at this point</p>	<p>Started Notepad</p> <p>Typed acronyms in full in notepad</p> <p>Cut & pasted acronyms</p> <p>Reviewed text</p> <p>Ignored case study</p> <p>Glanced at the diagram</p>

Figure 3
Sample data used for the preliminary analysis

The first data column contained a graphic of the screens selected by the learners in the order in which they worked through them. The second column indicated whether or not the user engaged with the screen or whether they by-passed it. The third column was an abridged version of the utterances made by the learner during the stimulated recall recording. The final column was a record of the user transactions identified on the recording. Together they provided a rich picture of the navigational track chosen by the learner as well as providing some insight as to the reasons for some of those actions.

Discussion

Presented next are some observations from a first pass analysis of the data. These observations are presented with respect to the learners' use of the three main aspects of the software interface, namely, the Content Display area, the Media Display area and the navigation bar.

Content display area

This area made available the text material on a page by page basis. In most cases the page of text fitted in the content display area, however, when it did not, a scroll bar aided access. Arrows appearing in the navigation bar facilitated movement between text pages.

All learners read the text word for word in a forward linear fashion with only a few instances of backward and forward movement within a screen, and almost no backward and forward movement between screens. There was no occasion in which a learner moved between or around sub-topics (available via the navigation bar). There was some movement between the text and the graphics presented alongside. However, when finished with the graphic the learners returned to the text and took up where they had left off.

This seems to indicate that these learners were very much influenced by the structure of the text as provided. Given that they were learning new material this is perhaps not surprising. The coherence of the information, afforded by the structure imposed by the author, is familiar to learners (linear reading). Knowledge acquisition is generally perceived today as an active process of constructing mental representations and a coherence of the knowledge used in building these representations is likely to be of benefit in this process. This might explain why these learners did not take the opportunity to engage with the text in a non-linear way.

This might not be the case though when the purpose for engaging with the text is different. For example, reviewing material prior to assessment or undertaking a task might not necessitate a full linear engagement with the text. In this case, the learners' mental representations are likely to be better formed from the knowledge acquired from prior engagements with the text. Observations from this situation might reveal a more non-linear approach (e.g. skimming or skipping, or going directly to a particular point) of the text.

Hyperlinks were available throughout the text. These links were both internal (to within the module) and external (to outside the module). Whilst one learner used these links often, the other three made no use of these links at all. When questioned, those not making use of the links believed that the links often led them into far greater detail than

they felt necessary, and caused them to lose the thread of the topic as a whole. One learner thought that these links might be more useful when reviewing a topic rather than with initial learning.

One special hyperlink that was used by all four learners and marked 'Lab Activities'. This link led to a comprehensive outline of a practical activity the learners would be required to undertake later. All learners gave the same reason for following this link; they found it useful because the laboratory information sheet provided a comprehensive overview of the practical activity in which they were to engage and acted as a primer with which to decide what information in the unit might be important. This was interesting as it added further weight to the earlier proposition that learner interaction with the text is linked to purpose, in this case, the completion of a practical assessment successfully.

Media display area

The media display area sat alongside and to the right of the text window (see Figure 2). This window was an adjunct to the text and did not always contain a graphic. On some occasions the window contained more than one graphic, which were presented as overlays and accessed via mouse movement.

All four students engaged with the graphics. The time spent on the graphics was short indicating that they were not studied in any depth. The media display area had a zoom function that caused a selected part of the graphic to become enlarged within the window.

Learners made the following comments and observations about the media display area. Being situated next to the text window was generally seen as positive, however two of the four learners said that they found this a distraction. Three of the four found the graphics not always to be useful. Reasons given included that the diagrammatic representation presented were not always understood, often not seen as relevant, and sometimes were too complex. Respondents also reported that in some instances differences between the graphics on different pages were not obvious and caused them confusion (changes not highlighted or apparent). The zoom capacity was not used, and not seen as providing any useful purpose.

Navigation bar

This bar (see Figure 2) provided the means of navigating between pages as well as access to other functional components (e.g. a glossary). The Chapter pull-down menu and the index button provided direct access to various parts of the chapter. A review button took the learner to a set of review questions that are to be answered prior to commencing a new chapter. A quiz buttons took the learner to a series of questions, which helps them to determine if they have mastered the content of the chapter. The browser button launches a new window that contains a listing of important key terms used in the curriculum. Back and next buttons allowed the learner to navigate from page to page and were the primary navigational buttons.

The pull-down navigation bar and Index were not accessed by any of the learners. Movement between pages was carried out (in a linear fashion) using the next and back buttons. Although multiple ways of navigating the pages were provided the navigational

movements were aligned with the chapter structure.

The review questions (to be taken before starting on a chapter) were used by 2 of the 4 learners. Those not using them believed that the questions focused on simple concepts and therefore seen as having little value. This is in contrast to the Quiz, which was used by all 4 learners. The quiz was seen to be important in finding out whether they in fact knew what they were supposed to know. This would seem to be the on-line version of teacher feedback which research shows to be important.

The Glossary was not used during the recorded sessions. The learners informed me that they did not find it useful as the explanations provided generally lacked a context.

Conclusion

This preliminary analysis of the data has probably raised more questions for me than it has provided answers. Nonetheless, it does provide a tentative glimpse at what might be termed the differences between the formal and hidden curriculum with respect to this hypermedia. Some observations that might inform hypermedia developers include:

- Learners at present come from a background in which learning using text has been largely governed by the structure of that text as determined by the author. Providing the capability (through hypermedia) to learn with text in a non-linear fashion will not of itself cause learners to use it in this way (at least when learning new material).
- The superior form of graphics now possible through this medium may in fact be producing counter productive effects on learning.
- In this hypermedia example the glossary provided as a learning aid adopted a traditional paper based form and suffered from the same kinds of limitations. Adopting the hyper concept used by the rest of the materials could assist in providing the context the learners saw as missing.

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