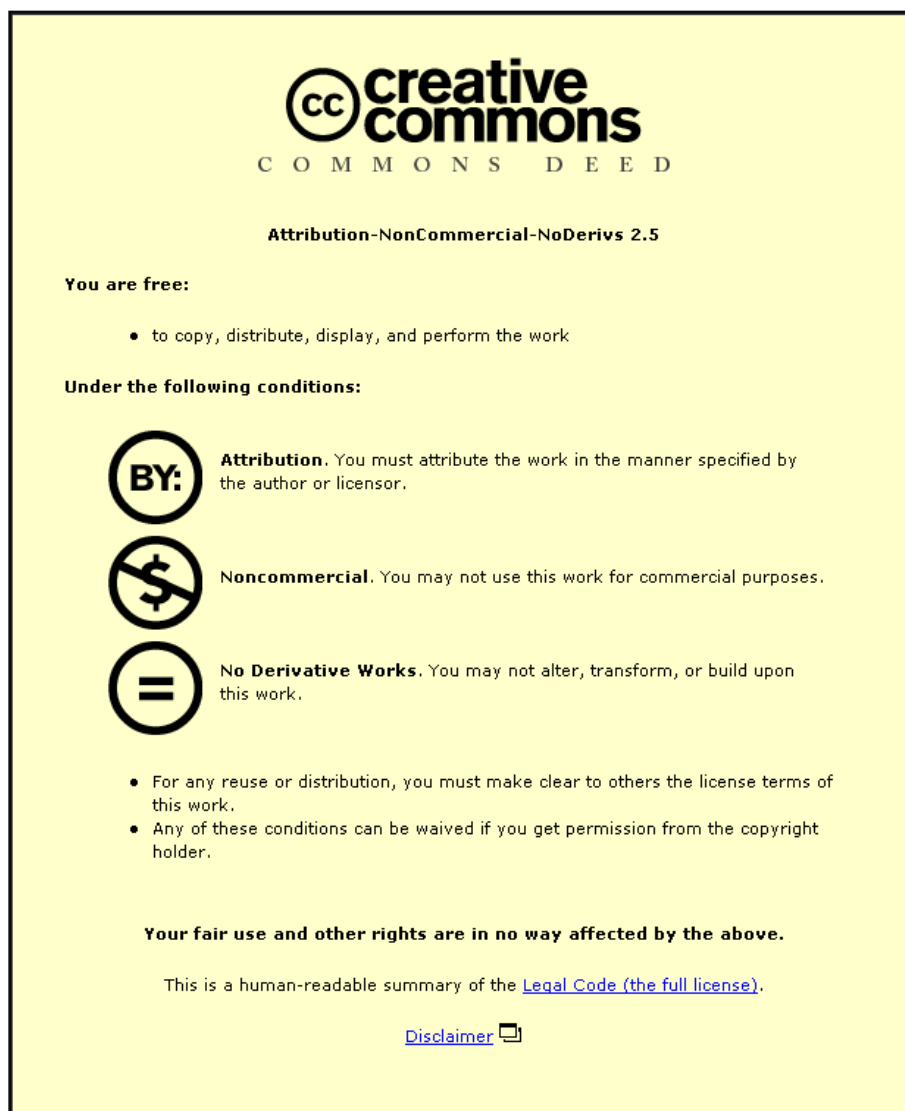


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14 . **Hypertext and the Training of Library and  
Information Studies Students**

*by*

**Chennupati Kodanda Ramaiah**

12  
A Doctoral Thesis  
Submitted in partial fulfilment of the requirements  
for the award of  
Doctor of Philosophy  
of the  
Loughborough University of Technology  
1993

Supervisor : Professor A. Jack Meadows  
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**To my GURUJI Sri Viswayogi Viswamji  
and my parents**

## **ABSTRACT**

As a result of the introduction of computers into teaching, a number of computer interfaces have been developed and used for teaching students at all levels. Among them, hypertext is one of the best known and most frequently discussed. Hypertext, as a non-sequential presentation of information, is a fairly old concept, but it has only recently become available for teaching purposes in a cheap and flexible form. Among the many hypertext systems now available, HyperCard is the most popular and inexpensive. It is also fairly simple to use, and has a multipurpose authoring system. Consequently, many teachers at different levels (schools, colleges and universities) are trying to use it as an instruction tool for their students. In this study, HyperCard has been chosen as a means of investigating hypertext teaching to Library and Information Studies (LIS) students. This has two particular values. The first is that few studies along these lines have been made of UK undergraduates. Secondly, LIS students represent an unusual group, who have a knowledge of the information domain, but varying amounts of computer experience.

The experiments on HyperCard teaching reported here were conducted during the years 1989, 1990 and 1991. They involved first and second-year undergraduate students in LIS, and employed different teaching methods with different student groups and varying group size. The experiments involved: (1) designing and comparing hypertext (HyperCard) and menu-based(dBase III+) interfaces to study their relative user-friendliness and ease of retrieving information; (2) comparing a plain text hypertext interface with coloured and graphic versions of the same interface. These studies examined the kind of problems encountered and types of errors made by naive and experienced users of computers when exploring hypertext, as well as reaction to it.

The outcome of these experiments has provided information on the circumstances under which hypertext can be usefully employed in undergraduate teaching and the amount and type of tuition required. It has also examined the importance of students' backgrounds in grouping their reaction to hypertext.

### **Key words :**

Hypertext; HyperCard; ToolBook, HyperTIES, Teaching; Training; CAI; CAT; Undergraduates; Teaching methods; Interface models; Courseware design ; LIS teaching and training; Novices problems with hypertext.

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[1990: Initial hypertext teaching experiment; 1991: Revised hypertext teaching experiment]

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## **INTRODUCTION**

Nowadays computer-based interactive systems are increasingly used for teaching and training in schools, colleges, universities and industry. Though mixing graphics, colours and sound with the text adds interest, these systems are still often too difficult to read and understand easily because of unattractive interfaces, poor presentation and poor organisation of information on the screens. It is obviously important for students to hear, see and interact with teaching materials easily if they are to understand and learn quickly and also remember what they have learnt.

Many computer/user interfaces have now been introduced, especially during the last five years, so it has become a difficult task for educators to decide which interface is better to use for educational software. Among recent interfaces, hypertext has probably had more influence than any other in the field of educational software design. Generally, students prefer illustrated materials to unillustrated materials when learning (Baker and Popham, 1965; Samuels, Beisbrock and Terry, 1974). Unlike most computer programs, hypertext has considerable power to generate and show model illustrations to students in a classroom environment. When this is combined with a video disc, live demonstrations can be easily provided for teaching. Students prefer realistic pictures for instructional illustrations (Myatt and Carter, 1979), although there are differences according to type of subject matter (Ramsey, 1982) and learner characteristics (Stewig, 1975).

From an instructional point of view, visual ideas are easier to grasp and remember than ideas presented wholly via hearing. As an old Chinese saying says :

That which I hear, I forget  
That which I see, I remember  
That which I do, I understand

This old saying has been confirmed by a variety of different studies. The primary function of a visual image as a communication device is to serve as

a more concrete referent than the spoken word. It is said that students remember only about 20 percent of what they hear, but over 50 percent of what they see and hear. Students can learn from visual images in two ways. Firstly, by understanding the visual elements and translating these into verbal messages (which is called 'decoding'). Secondly, they can also create and use visual images as a tool to communicate effectively with others (which is called 'encoding'). Both encoding and decoding skills can only be learned by practice. The nature of the learning may vary according to a range of variables (age, cultural background, etc). Normally, younger learners prefer simple visual presentations, whereas older students and adults prefer something more complex. Nevertheless, simpler visual images tend to be more effective whatever the age group.

It is important to consider the various learning styles of the students when we are designing instructional materials. Such materials should have a good balance of textual, visual and audio elements and also facilitate practical and hands-on experience. When retrieving pictorial information from a database, the user adopts search strategies which depend upon two features : the nature of the information need and the individual user characteristics (Batley, 1988). Batley has suggested three guidelines for the design of visual information systems : i) the emphasis should be on providing a range of search options for the user, ii) care must be taken in the design of the user interface, and iii) some attempt should be made to individualise searching possibilities. Visualisation of system status and of ongoing processes as in GUIs (Graphical User Interfaces) has enhanced the user's understanding of how various computer-based tools work and can be used. Similarly, Van Nes (1986) has suggested some guidelines for the layout, the use of colours and typography on display screens, so as to create texts with optimum legibility. The aesthetic value of the pictures can effect the ability to learn. Although many aspects of aesthetic literacy are not yet well enough defined to permit empirical investigation, a field of experimental aesthetics is beginning to emerge. Jones and McFee (1986) have discussed the current approach to research on teaching aesthetics and visual arts.

Colour has been identified as one of the most effective elements for the labelling of information in visual displays (Weitzman, 1985; Christ, 1975; Hitt,

1961) when the meanings of the colours are consistent with associations that the users have previously learned. For an electronic display, the selection of appropriate colours for alphanumeric characters and their background is critical for optimum user performance. Colour may also affect learning and performance: it can be used to facilitate learning, to highlight key concepts, and to provide structure or organisation. Keister(1983) found that use of colour improved data entry performance for some types of tasks. The largest improvements occurred when the tasks were complex and when the subjects changed tasks frequently. He also found that colour reduced the boredom associated with simple tasks. McTyre and Frommer (1985) have found that, when employing an inappropriate character/ background colour combination, character recognition time may increase by more than 50 percent with an accompanying 350 percent increase in user errors. Many similar studies suggest that blue is the least acceptable colour, and should not be used except as background colour. Cyan, green, yellow, red, and magenta are all acceptable colours for alphanumeric characters, provided appropriate adjustments are made in luminance and saturation. Derefeldt et al (1984) found that a maximum of six colours improved the performance of visual search tasks. However, Smallman and Boynton(1990), from further studies, suggested that there is no limit on the number of colours that can be used for an effective colour coding in a visual search task. Most learners prefer coloured visual images over black-and-white. However, there is no significant difference in the amount of learning, except where colour is an essential part of the component to be learned(Hienich, et al, 1989).

Graphics provide an alternative to verbal communication. Many symbols are abstract or arbitrary, without obvious meaning. When these graphics are used to design an educational computer program for novices or casual users, verbal labels typically need to be attached. Graphics are better for communicating information about concrete objects. The main disadvantage of graphics is that their meanings must be learned; so, for an inexperienced user, they may be of limited value.

An 'icon' is a small graphical image used most often to represent some kind of information or file(application, document, data file, directory) in a graphical user interface. At least one study has shown that greater efficiency of search

patterns was found when users located items via icons, rather than words (Scott and Findly, 1991). The effect of both colours and graphics in retrieving information from hypertext databases is studied in this present research. The effect of computer graphics on learning and motivation is only beginning to be explored. Not many research findings have so far been published, though many projects are currently underway to test a variety of instructional uses of computer graphics (Boen, 1985). The use of computer graphics for learning and instruction should obviously be guided by a framework that is based on research findings and established heuristics, to which the present research should add.

Presentation of text on the screen depend on the type of characters used, the design of the information, the background and also the content. The character may vary with respect to font, size, lower and uppercase letters, colour and contrast to the background. Legibility of text depends on the nature and use of these characters. Knave (1983) has formulated some guidelines for the creation of characters. Studies of the effects of letter size, case and generation (dot matrix vs. letter quality) on a computer display have been carried on for some time (eg. Vartabedian, 1971). The results indicate that, for both methods of character/letter generation, upper-case letters are searched more quickly than lower-case letters, but there is a significant difference in search time with change in letter sizes. A visual display on the screen may vary with respect to organisation, such as headings, length of lines, justification of text, spacing, number of columns, number of colours on a single screen, colour coding, highlighting characters or words, and scrolling of text (Pettersson, et al, 1984). The screen background may vary with respect to colour and brightness. Most users/learners prefer dark text on light background. A text presented in a good colour combination via a visual display has been found to be easier to read than print-outs from a variety of printers (Pettersson, et al, 1984)

The goal of the present study is to explore how library and information studies (LIS) students react to the use of hypertext for education. To study this problem in an university environment, different types of experiments were conducted with LIS students in the Department of Information and Library Studies at Loughborough. The results of the experiments are reported in the

following chapters.

Chapter 1 provides an introduction to hypertext and hypermedia, to the different types of hypertext system available, the general advantages and disadvantages of hypertext systems and how hypertext has been used for teaching and training in various educational institutions and organisations. It also gives an overall account of hypertext and its advantages for teaching when compared with the other automated teaching tools.

Chapter 2 concerns the aims, objectives and models that have been employed in this study. The models are applied to users, teaching, interfaces, systems, tasks, navigation and information retrieval. The factors that might influence the students' performance in using these systems are also discussed.

Chapter 3 discusses the detailed methodology that has been used for conducting the study. Since the work was carried out in a series of stages (such as pilot, initial, and revised HyperCard teaching experiments, comparison of colour and black & white hypertext interfaces, and comparison of menu-based and hypertext interfaces), the specific methods used in each experiment are also discussed along with the general methodology.

Chapter 4 presents the pilot and initial HyperCard teaching experiment results. The main aspect of these experiments is the students' problems while using and customising HyperCard applications. They are looked at via a number of techniques.

Chapter 5 explains the revised HyperCard teaching experiment conducted in the following year, again with second-year LIS undergraduate students. The changes made from the initial HyperCard teaching experiment and the new methods used are discussed. Then the results of the initial teaching experiment are compared with the revised teaching experiment to observe any significant differences.

Chapter 6 discusses a further experiment concerned with the differences

between colour and black & white hypertext interfaces. This includes presentation of hypertext notes on-screen and use of colours in retrieving information. In another experiment, a menu-based interface was compared with a hypertext interface, both using the same database, to compare retrieval of information.

Finally, Chapter 7 presents the analysis and conclusions of this study. This includes discussion of general guidelines for designing courseware materials and of the implications of hypertext/ hypermedia for teaching in LIS.

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# **Chapter 1**

## **RESEARCH RELEVANT TO HYPERTEXT**

### **EXPERIMENTS**

#### **1. INTRODUCTION**

Even though human thinking is not sequential, when it is written, or spoken, it becomes sequential. Literature has always been recorded in sequential and linear fashion, and this practice continues. In reality, there are many cognitive links between topics and subjects, because the entire universe of knowledge is inter-linked and inter-related. Hypertext is a form of non-sequential text, which offers the possibility of representing and exploring knowledge more naturally. Hypertext is a generic term: numerous specific examples now exist.

Microcomputers have become an important instructional instrument for teaching. The software for developing the courseware is now the most important component of the system. Hypertext is one of the software forms through which one can develop courseware materials for all educational levels. A number of schools, colleges, and universities have already started using hypertext systems for designing courseware materials, presenting information and developing video-based and computer-based instructions. The main aim of the survey in this chapter is to note the strengths and weaknesses of hypertext for teaching, learning and training, and to indicate how it has been used for teaching at various levels in education.

#### **2. HISTORY OF HYPERTEXT**

Vannevar Bush, who was Science Adviser to the then President of the USA, Roosevelt, noted the problem of rapidly proliferating information in the 1940s. In 1945, he suggested the basic idea of what is now called "Hypertext" (Nelson, 1965) to store and retrieve information. He also developed a mechanical recording device, which he called 'MEMEX' to cope with his own information needs. He explained it as follows:

"the memex is a device in which an individual stores all his books, records and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory" (Bush, 1945).

Douglas C. Engelbart, a pioneer computer scientist, took the next step. He invented a number of items and concepts which are either directly or indirectly related to hypertext. Such important activities as editing text on-screen, the mouse, windows, links between chunks of information, teleconferencing, hypermedia, office automation, outline processing, etc, are his inventions. When he was working at Stanford Research Institute(SRI) in the 1960s, he designed the first hypertext system in the world, named it 'oN Line System'(NLS). When SRI was sold to a private company, McDonnell-Douglas, the name NLS (popularly known as 'Engelbart's system' in those days) was changed to AUGMENT(Text Processing Multi-user system; Engelbart 1963), and they started distributing it commercially. Though Engelbart retired in 1989 from Mc Donnell Douglas, he is still coordinating projects for SRI International.

The third pioneer of hypertext was Theodor H. Nelson, who first invented and defined the term 'hypertext' (Nelson, 1965) :

"Hypertext is the combination of natural-language text with the computer's capacities for interactive, branching or dynamic display.... of a nonlinear text ....which cannot be printed conveniently on a conventional page...."

Since then, Nelson has spent his whole life in developing and popularising this field. His book Computer Lib/Dream Machines (Nelson, 1987) was not just an ordinary book. It translated to paper all his ideas about hypertext and hypermedia. In the 1960s, he initiated a project called "Xanadu", a global literary system(Nelson, 1980; Gregory, 1983) aimed at providing an instantaneous repository and delivery system for the published works of the all humanity ( text, graphics, audio, video, etc), so that any user anywhere across the globe may rapidly access any work with automatic royalty payment (and thus no copyright permission problem). Nelson's Xanadu system is available on Sun Microsystems workstations; other versions for Macintosh, DOS/OS-2, and UNIX-based

systems are expected to be released soon. All current hypertext systems are to some extent the fruits of Nelson's anticipations in 1960s. Nelson is now working as Distinguished Fellow with Autodesk, Inc. (USA) and also as Visiting Professor at the Department of Information Science, University of Strathclyde.

Andries van Dam, a Professor of Computer Science at Brown University, has also contributed a great deal to this field. We may consider him to be the final pioneer of hypertext. He was greatly influenced by Engelbart and Nelson, and started working on the topic in the 1960s. van Dam designed FRESS, a File Retrieval and Editing System (van Dam, 1971). This was developed during the 1970s by incorporating the best ideas of Engelbart's NLS and some other features from his Hypertext Editing System. Subsequently, under his guidance, another hypermedia system "INTERMEDIA" (Meyrowitz, 1986; Yankelovich, 1988) was designed by Meyrowitz at Brown University for conducting research on use of hypertext for teaching.

From the mid-1980s, a number of people started working on various projects in different areas of hypertext. There are now more than a hundred hypertext/hypermedia systems in existence, designed by various people for specific purposes like conducting research, commercial activities, in-house use, education and training). There are about a dozen organisations/institutions/universities working full-time to develop these systems.

### **3. WHAT IS HYPERTEXT AND HYPERMEDIA ?**

Fig.1.1 shows the traditional (sequential) text of a book which is arranged linearly from page 1 to page X. At the end, there may be an index via which one can retrieve the information easily and quickly. When the same text is converted into hypertext, individual ideas, instead of following sequentially, will be linked in non-linear fashion. The information is stored in the nodal points of the hypertext system, and these, in turn, are joined through machine-generated links. Hypertext therefore consists of chunks or fragments of text, which are linked associatively (see Fig.1.2). Nodes are the basic units of information in a hypertext. Correspondingly, hypertext involves the creation and representation of links between discrete

pieces of information (text or data).

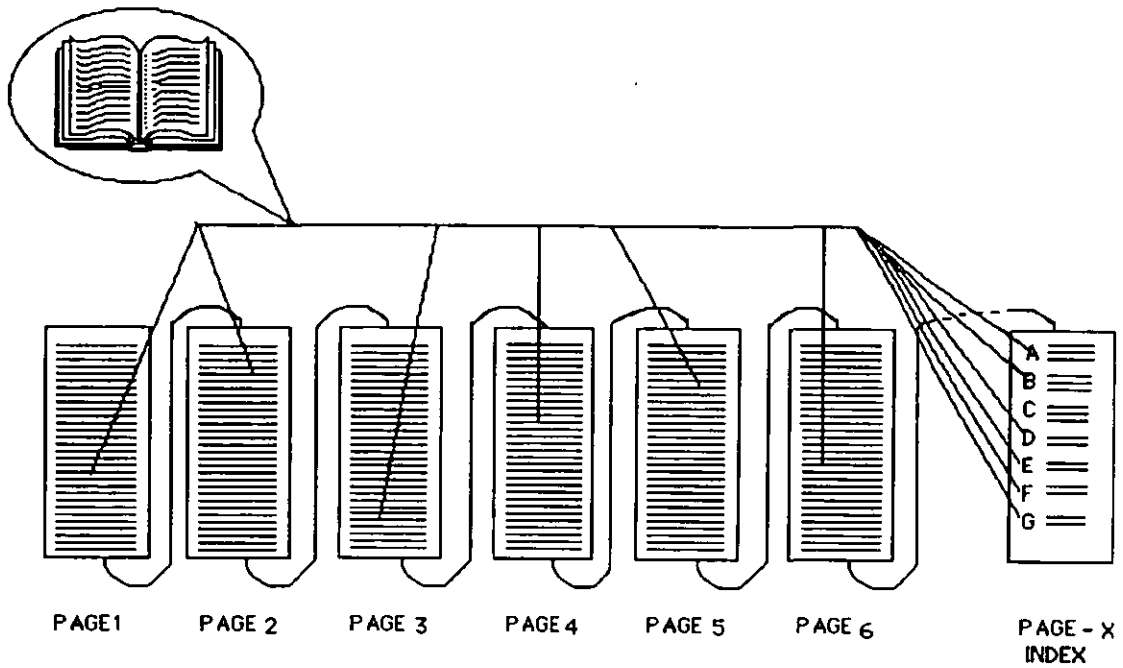


Figure 1.1. Sequential text

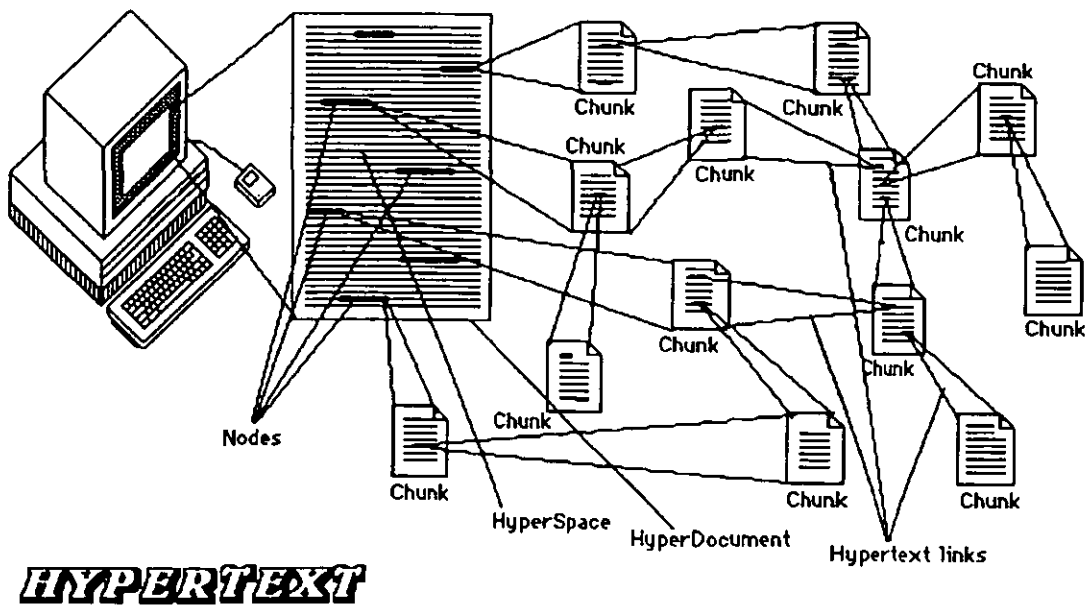
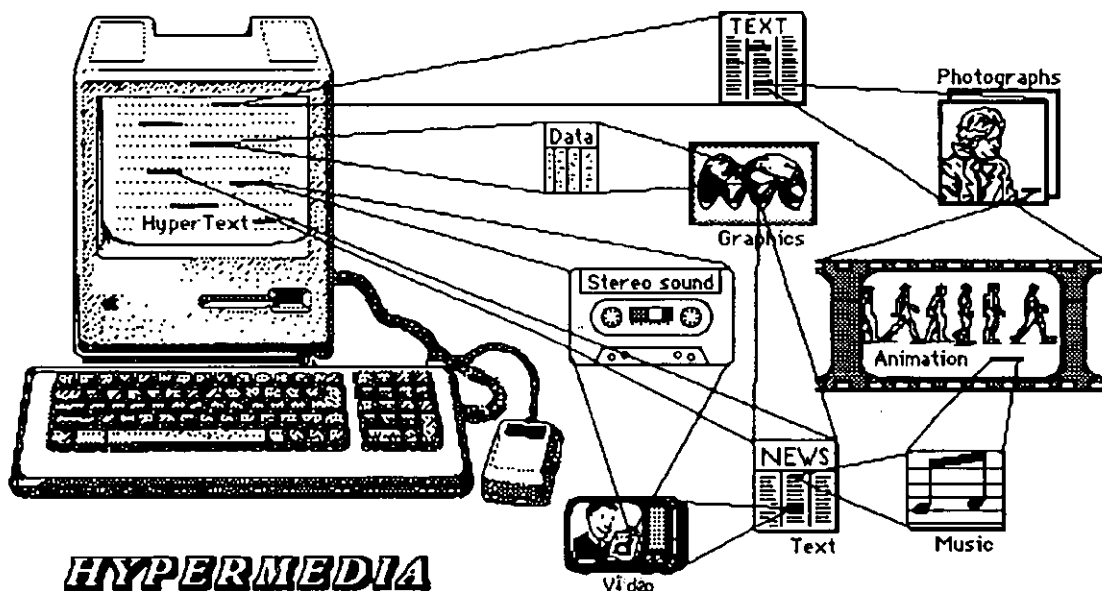


Figure 1.2. Hypertext

In hypertext, the text, instead of appearing as a continuous flow, breaks into units of information, which are linked in a non-sequential manner.

When graphics, images, sound(monaural or stereo), video, and animation are added to the hypertext, the resulting form is called "hypermedia". In hypermedia, packages, therefore, two or more media are arranged in a hypertext linking pattern (see Fig.1. 3).



**Figure 1.3. Hypermedia**

#### **4. DEFINITIONS OF HYPERTEXT AND HYPERMEDIA**

Various definitions are available, but the most important ones are :

##### **a) Hypertext**

- i) Hypertext is non-sequential writing (Nelson, 1965).
- ii) Text in electronic form that takes advantage of the interactive capabilities is called "Hypertext" (Conklin, 1987).

##### **b) Hypermedia**

Hypermedia is simply an extension of hypertext that incorporates other media elements in addition to text. With hypermedia systems,

authors can create linked corpus of materials that includes text, static graphics, animated graphics, video, sound, music, and so forth (Yankelovich, 1988).

## **5. PRINT MEDIA v. HYPERTEXT**

Easy of use, storage, reading, etc, are strong advantages of paper as a medium. With other media (such as audio, video, magnetic and optical media) we cannot yet store heterogeneous formats of information on one platform, and most possibilities would not be so convenient as print media. Hypermedia has overcome these problems to some extent, and provides multimedia on the same platform.

Hypertext systems differ from their print versions in terms of structure, organisation and functionality. Reading full text in hypertext is much slower than reading the printed version, but other advantages, such as interactiveness, browsing and navigation through a greater volume of text, must be set against this disadvantage. It is possible to create hypertext features in a printed document by creating nodes in the linear text (e.g. Hypertext on hypertext, Shneiderman and Kearsley, 1989), but it is not as effective as in the electronic form. Browsing is an important aspect of any electronic environment, especially for a hypertext system. There are a number of effective browsing techniques in hypertext, ranging from random and informal to systematic and formal (Marchionini, 1988). Hypertext/hypermedia systems allow users to browse and navigate through complex information quickly, to find explanations, references, comparisons, definitions, etc, via the nodal points created in the system.

## **6. SALIENT FEATURES OF HYPERTEXT**

1. In hypertext, knowledge (information) is represented via frames (Knowledge Management Systems - KMS), cards (HyperCard, NoteCards), nodes (geographical Issue Based Information Systems, gIBIS), PADs (HyperPAD), articles (HyperTIES), etc. Different names are used in different systems, and the information in the nodes may be in the form of paragraph, diagram, graphic, image, or combination of any of these items.

2. By inter-linking, all these small chunks/packets/fields form a hypertext

database. A chunk/packet/field can be linked with another chunk, or with many chunks, so forming a network in the hypertext database.

3. Users (i.e.both authors and readers) can rapidly navigate within a hypertext database, moving easily from one chunk to another chunk by selecting/clicking on them.

4. User can create, edit and rearrange the chunks according to their particular needs.

5. In a large hypertext database, a reader/user is able to see only a small fragment of information at any time.

6. In hypertext, there are no page boundaries as in a conventional book.

7. In hypertext systems, the user can navigate by moving rapidly in either direction between the nodes of the hypertext database.

8. In a hypertext environment, the computer brings us close to natural human knowledge processing. Even though hypertext does not incorporate an artificial intelligence(AI) element, unlike an expert system(ES), it is more useful than an expert system in enhancing human skills and knowledge effectively.

9. A hypertext system allows the user to access information by both associative and intuitive routes, without regard for the actual location of information, or for any visible database structure.

10. To a large extent, hypertext leaves the control of information in the hands of users.

11. Hypertext databases can have a changeable structure (i.e. rather like an amoeba) which keeps on altering as the author or designer adds, deletes, or edits the text, graphics, images, etc. It does not have a clear structure like a conventional book in which the length, breadth, etc. can be defined. Moreover, the arrangement of information in the hypertext

database can change depending on the nature of the user's interaction.

12. In a hypertext environment, there is no difference in terms of approach between author and reader, or teacher and student; all are equal.

13. Unlike a printed book, hypertext is multi-faceted, with many entry points via which information can be added or retrieved according to the need/requirement, level of interest and learning style of the user.

## **7. TYPES OF HYPERTEXT AND HYPERMEDIA SYSTEMS**

We can classify the hypertext and hypermedia systems in three different ways in terms of : A) a broad classification, B) their environment, and C) their generation.

### **A. Broad classification**

Conklin (1987) has classified all available hypertext systems into four types under the following broad classification.

#### **i) Macro literary systems**

These systems are related to very large 'libraries', in which all types of information on every topic can be stored and retrieved. For example, broad-based systems like MEMEX, AUGMENT, XANADU, TEXTNET were designed for a multi-user environment, which requires the storage of all types of published information. They can also be used for a range of activities, such as publishing, reading, collaborative works and criticism.

#### **ii) Problem exploration systems**

These systems are basically for the investigation of particular issues, and are designed to support high interactivity and unstructured thinking. They are typically developed to assist the members of a team in creating and structuring information. For example, Outline Processors are of this kind. They have a built-in ability to handle large unstructured chunks of information, and help the user to focus on, browse and organise concepts. These systems assist users by providing an information lenses, which filters the various levels of detail. They also permit the user to see differing views of the same information, eg. PIE, IBIS, SYNVIEW, WE, OUTLINE

## PROCESSORS.

### iii) Structured browsing systems

These systems are similar to the first type, but are smaller in size. They are being used for Computer-Aided Teaching (CAT), reference, and public information. They are always simple, and user-friendly and are intended to be easy to use, eg. KMS, INFO, HyperTIES, DE. Normally these systems are read-only, and will not allow the user to add new information. They are currently being used in museums for information displays (HyperTIES - Shneiderman et al, 1989), computerised information management systems for aircraft carrier (KMS/ZOG - McCracken and Akscyn, 1984), online computerised help systems (INFO - Stallman, 1981) and any place where well-defined information has to be provided.

### iv) General experimental systems

There are a number of systems developed for experimentation with reading, writing, collaboration, etc, such as INTERMEDIA, NOTECARDS and HYPERCARD. They are general in nature and can be used to explore most aspects of hypertext work.

## B. Types of hypertext and hypermedia system in terms of the environment.

### i) Distributed systems

Normally these systems are very powerful and are able to handle a large volume of information. Since they are multi-user systems, they allow a number of users to interact together simultaneously in doing collaborative work. Intermedia is a good example of this type : it has been used for computer-aided instruction(CAI) in Brown University's English and Biology departments for the past eight years. Other examples are Note Cards, NLS, Neptune and KMS.

### ii) PC based systems

The second type of hypertext and hypermedia system is any PC-based system which is for a single user. Such systems are comparatively small in size, and can be used to design personal hypertext applications. The most popular example of this kind of system is HyperCard; others are like Guide,

HyperTIES, HyperPAD, ToolBook and LinkWay.

### **C. Types hypertext/hypermedia Systems in terms of their generation**

Though the basic architecture of hypermedia systems is common, they have still been classified into generations(Dede, 1988). All the first-generation hypermedia systems were originally developed on mainframes, and mainly focused on text nodes and user display technologies with little or no graphics capabilities. They were developed to support team work sharing a common hypermedia network. The systems developed prior to 1980 included NLS/Augment(Engelbart and English, 1968), FRESS(van Dam, 1971) and ZOG(Akscyn and Cracken, 1985).

The systems developed after 1980 are second generation, and include various types, such as workstation-based, PC-based and research-oriented systems. The first of these categories includes NoteCards, Neptune, Intermedia, PlaneText and KMS. These systems possess advanced three-dimensional graphics interfaces, along with strong support of graphics, animation, composite multimedia nodes, sophisticated navigational displays and interface tailoring. They were basically designed for single users or a small team of workers. Subsequently, PC-based hypertext systems have emerged, such as Guide(Brown, 1987), HyperTIES (Shneiderman,1987), Link Way(Harrington 1990), HyperPAD(1989), HyperDOC etc. The limitations of first-generation systems include computational delays and poor visual representation of the structure.Second-generation systems are more powerful, and have more of the additional features users' require.

## **8. GENERAL ADVANTAGES OF HYPERTEXT AND HYPERMEDIA SYSTEMS**

The most important advantage of hypertext and hypermedia systems is to browse through a large volume of information. Here, computer-generated links between the information chunks makes the user's life easier. A user can also add personal annotations without altering the original information. The information in these systems may be viewed in varying degrees of

detail. In the case of large hypertext systems, greater economy of information storage can be achieved than in ordinary databases. In the latter, the same information may be held in more than one place. In hypertext databases, all the information is stored in basic units which are inter-linked, so eliminating the repetition of the same piece of information at more than one location. These systems, which encourage highly collaborative work environments (Smith et al,1987; Fish et al, 1988) include Augment (Engelbart,1984), Intermedia (Garrett et al 1986), KMS (Yoder 1989), Neptune(Delisle and Schwartz,1986), NoteCards (Halasz,1988) and WE(Smith et al,1987). Hyperdocuments are dynamic, and so encourage users to contribute their knowledge and ideas. Both users and authors can refine and add new information to the system at all the times, so that the information in the system is more likely to be updated than in traditional databases.

The general uses and applications of hypertext and hypermedia systems can be listed as:

- i) Technical documentation, eg. DE, Thoth II
- ii) Help systems, eg.Emacs INFO, HyperCard, Guide, askSam
- iii) Museum exhibits, eg.HyperTIES, Kings Herald's Dream, Jewish Heritage
- iv) Religious studies, eg. The Bible Library
- v) Problem solving and Idea processing, eg. IBIS
- vi) Software engineering, eg. CASE, Neptune
- vii) Authoring and designing tools, eg. HyperCard, Guide, HyperDoc
- viii) Collaborative writing, eg. Intermedia, WE
- ix) Writing aids, eg. WE, Notes
- x) Instructional aids, eg.HyperCard, HyperDoc, LSM InfoMaster,  
Project Jefferson, Persues project.
- xi) Computer-aided training/teaching, eg.CSILE Project, Palenque project,  
IRIS's Intermedia, Persues project
- xii) Presentation aids and information kiosks, eg. Boston MacWorld,  
LITA Conference information disc, Metacatalog  
(multilingual information kiosk), CHI'89 Info Booth
- xiii) Information and retrieval systems, eg. HIRS, HyperKRS, IBIS,  
Oxford English Dictionary (OED)
- xiv) Library and Information sources/services/handling  
-- Dictionaries, eg. OED, Webster's dictionary

- Encyclopaedias, eg. Grolier encyclopaedia, Compton's multimedia encyclopaedia.
- Medical text books, eg. Dynamic Medical handbook
- Product catalogues, eg. The Savings zone club disc
- Online user manuals, eg. HyperCard
- Electronic maps, eg. HyperMap, Business Class
- Travel guides, eg. Glasgow Online
- xv) Literary collections, eg. XANADU, TEXTNET
- xvi) Electronic document publishing
- xvii) Expert systems(+hypertext), eg. KnowledgePro, PLUS, HyperBridge, MacSmarts, 1st Class hypertext.

A number of libraries in developed countries and a few in developing countries are already using hypertext for providing library and information services to their users.

## **9. DRAWBACKS AND LIMITATIONS OF HYPERTEXT**

Even though the concept of hypertext was introduced in 1945, it was slow to develop compared with some other areas of information technology. It is still not in widespread use, perhaps because of the major change in user approach required. In spite of its greater power, Engelbart's NLS (possibly the most flexible of current hypertext systems) is incompatible with the use of other non-NLS applications. NoteCards, Guide, HyperCard, etc, all have their own drawbacks, in addition to their incompatibility with other systems.

Though hypertext and hypermedia systems are already quite versatile and useful, they must still be seen as suffering from : 1) 'superficial problems' - which are temporary and which should be solved in the near future, 2) 'basic problems' - which may not be solved easily because they could be inherent weaknesses of the hypertext approach.

**9.1.** The main superficial problems noted in hypertext and hypermedia systems are: a) how to structure hypertext, b) learner control, c) integrating information, d) synthesising information, e) retrieving of information, f) processing strategies of hypertext, g) retrieval of iconized nodes,

h) copyright, and i) compatibility.

## **9.2. Basic problems**

Four basic problems, over-lapping each other, have been generally discussed.

### **i) Disorientation**

Disorientation means the tendency of users to lose themselves in a hypertext database. This tendency is normally related to the size of the hypertext database: the bigger the size, the easier it is to get lost. In spite of page numbers and chapter headings, the sense of location can be lost while reading a book. In a hypertext database, where the information is not sequential, disorientation becomes easier. In multimedia environments the problem is still more severe, because each medium may have its own cycle. There are actually two aspects : not being able to find the desired information, and getting disoriented. Some hypertext systems provide aids to overcome these problems, but none have proved complete solutions. Examples are the 'Find', 'Go to' commands (in HyperCard), bookmarks, database maps, and location indicators. A good deal of research on this topic is currently under way (Fairchard, 1987; Beard and Wather, 1987; Foss, 1989).

### **ii) Cognitive overhead**

Dade(1988) has noted a number of problems relating to cognitive overhead. The problem is that while using hypertext systems, additional effort and concentration is required of the user in order to maintain several tasks or trails at one time. Psychologists have found that a normal human being can maintain at the most five to nine thoughts in their memory at one time, whereas hypertext and hypermedia systems may sometimes require more. If the information is not properly organised and linked between related chunks, then the non-linear representation leads a greater risk of potential intellectual digestion, disorientation and cognitive overhead. Consequently, the author of a hypertext system must design carefully from a human factors perspective, otherwise the usability of the system decreases as the size of the system increases.

### iii) Lack of presentation rhetoric

Landow(1987) has discussed the need for a 'rhetoric' for linking in hypermedia, based on his experience with the Intermedia system. He notes two problems: i) how to indicate the destination of a link, and ii) how to guide the user to that destination. He has formulated nine rules for creating meaningful links in a hypertext database. This has been further discussed in another study(Shirk,1991), where a set of principles for a rhetoric of hypertext is given. Simply creating links in between nodes is meaningless unless there is some logical relationship between them. Hypertext systems are useful only when there are balanced numbers of linear and non-linear links, otherwise they lead to more distortion. Normally, the number of linear or non-linear links will depend on the knowledge/information being stored, the objectives of the documentation, and the sophistication of the user population. The larger the size of a hypertext database, the more links are needed to integrate the chunks properly, but too much linkage will lead to a "nodal or linkage explosion", which is nothing but distortion. In second-generation hypertext systems, this problem has been taken care of by aggregating sub-networks into composite nodes, which chunk material at a higher level abstraction.

### iv) Construction of default paths

This problem is related to rhetoric, but is an immediate practical problem in the construction of a big hypertext database. To construct the required links takes time, whilst creating default paths requires still more time. Hence, time is a major constraint in designing a sophisticated hypermedia system.

## 10. SIGNIFICANT HYPERTEXT AND HYPERMEDIA SYSTEMS

<u>System</u>	<u>Type</u>	<u>Date of design</u>	<u>Designer</u>
MEMEX	first seminal vision	1945	V.Bush
AUGMENT	first implemented hypertext system	1968	D.C.Engelbart
XANADU	grand hypertext	1960s	T. Nelson
GUIDE	first PC based hypertext system	1982	P. J.Brown
HyperTIES	interactive encyclopaedia	1983	B.Shneiderman
KMS	commercial hypertext product	1983	Knowledge Systems

INTERMEDIA	hypermedia system	1986	N.Meyrowitz, IRIS
NEPTUNE	software engineering tool	1986	Tektronix
WE	creative writing environment	1986	J.B.Smith et al,UNC
HYPERCARD	hypertext authoring tool kit	1987	B.Atkinson
IBIS & gIBIS	issue-based hypertext systems	1987	MCC,Beegman & Conklin
NOTE CARDS	commercial hypertext system	1987	F.Halasz, Xerox PARC
Knowledge Pro	hypertext expert system	1988	Knowledge Garden,Inc.
SuperCard	hypermedia authoring tool	1989	Silicon Beach Software
LinkWay	hypermedia authoring tool	1989	IBM

## 11. TYPES OF HYPERMEDIA PRODUCTS

Two types of hypermedia product are currently available.

### i) Studio-based hypermedia products

Normally the design of this type of product requires a large number of people, sophisticated equipment and a studio environment. The products have excellent multimedia presentation and good user interaction, but their production requires a very large amount of money and manpower. They are typically large in size and require a considerable amount of storage space for holding and distributing the databases, again incurs expense.

### ii) Microcomputer-based hypermedia products

These are normally limited in size, not too expensive, easy to design, and do not require too much sophisticated equipment. They are mostly educational materials, moderately priced, which allow users to customise and building their own databases. The storage size required varies from a floppy disc (normal programs), through a compact disc(for extensive interactive applications), such as CD-ROM, CD-I, CD-V, to a video disc. For example, the Guinness Book of Records 1990 is now a hypermedia product, of about 300 Mbytes, available on a CD-ROM.

## 12. HYPERTEXT AS A TEACHING TOOL

A new era started in educational technology when videos and computers

were introduced as teaching aids/tools for work in the schools, colleges and universities. The particular value of computer-based teaching lay in its potential for a high level of interaction. In the late 1970s, expert systems began to be used as teaching tools in the education. These systems were one stage more advanced in that they incorporated both interaction and AI elements. In the 1980s, a number of new teaching tools/methods were introduced such as Interactive video disc(IVD), computer-aided learning(CAL), computer-based training(CBT), multimedia and hypertext. Since hypertext is concerned with powerful interactive methods and ease of retrieving information, many educators from schools, colleges and universities are now trying to use it as a tool in their teaching. The same is increasingly true of hypermedia. The beauty of hypertext for teaching is its ability to customise and develop personal links between the information fragments in a hypertext database. Hypertext has therefore been recognised as possessing considerable potential in developing and using courseware for students.

### **Learning, education and hypertext**

Experience with hypertext systems in education is still scarce, especially for large-scale work. Beeman (1988) has given an empirical description of the effects of the Intermedia system in education. Based upon experiences with a course on English literature in this system, Landow (1989) has developed a set of organisational rules or stylistic principles for hypertext systems.

Beeman (1987) has emphasised the variety of thinking styles, especially in university education, and the development of pluralistic, integrated thinking that is promoted by western education. He relates these to the non-linear thinking possible in the Intermedia system. A theory of hypertext/hypermedia systems in education will have to be developed on the basis of experiments with realistic educational materials, and done if possible in a realistic educational setting.

One of the most useful overviews relating hypertext and learning is that by Jonassen(1986) who presents cognitive principles based on learning theories that may make hypertext designs valid for instruction. He emphasises presentation of subject matter in networks or schemas :

modelling the structure of knowledge as webs of information and integrating new information into prior knowledge by web learning principles, involving generative learning principles that model learning as an active process of constructing knowledge. These active processes of knowledge acquisition are important for hypertext. By structuring hypertext knowledge bases according to multiple perspectives, meaning can be generated by the user who is carrying out the searching.

### **13. WHY IS HYPERTEXT REQUIRED FOR TEACHING ?**

Compared with other teaching tools, it is very easy to experiment with and reorganise information using hypertext. Research suggests that hypertext can improve a student's critical thinking, skilled reading and logical linking of related fragments of information (Beeman et al 1987). Since hypertext facilitates the making of connections between diverse information fragments, it is a good tool for students to use. Thus it is not only possible to use hypertext to present the basic information on a subject, but also to encourage analytical thinking about the presentation of that information. The capacity to allow multiple links to an individual chunk of information may also encourage the students to cultivate the habit of approaching any information fragment from several directions. Moreover, it helps the students to participate more interactively (read, think and criticise others' views) in the teaching and learning process, rather than the passive style associated with traditional teaching.

In traditional teaching, students are required to read selectively when completing their assignments or coursework. There are often problems in acquiring and understanding the reading matter. With hypertext, preparing assignments is not possible by going through the suggested reading materials attached to the assignment. This results in greater understanding of the subject by the students. Another advantage of hypertext is, that during the learning process, students can develop their authoring skills and also start contributing their own views as notes, new thoughts, arguments, comments, etc. In this case, the student may feel more involved because their contributions will be referred to by other students and by their teachers.

Hypertext has, potentially, instructional applications in all areas of the curriculum. Many instructors have already started using hypertext systems in designing courseware materials for their students in different schools, colleges and universities. Some of the more important work will be mentioned here. In the context of this study, the use of hypertext for instruction was divided into three areas : 1) Hypertext as a general instructional tool, 2) Use of hypertext for teaching undergraduate students, and 3) Use of hypertext for instruction particularly in the field of medical sciences.

### **1) Use of hypertext for instruction in general**

HyperCard has been used as an instructional tool (Rakar, 1989; Goldman and Barron, 1990; Kinnell and Richards, 1989; Lacy and Chignell, 1988; Clark, 1988; Hewett, 1989; Shalit and Boonzaier, 1990; Di Pardo and Di Pardo, 1990; Eckols and Rossett, 1989; Wilson, 1990; Geisler-Brenstein and Brenstein, 1989; Garson, 1989; Hult et al, 1990), for teaching disabled students (Higgins and Boone, 1990; Horton et al, 1990; Balajthy, 1990), for teaching arts (Clawson, 1990; Hubbard, 1989; Gregory, 1989; Carr, 1990), as a training tool (Barden, 1989; Bayne and Radar, 1990; Carr, 1988; Cortinovis, 1991; Flynn, 1988; Gall et al, 1988; Greenburg, 1991; Gregory, 1990; Maguire, 1988; Moia, 1990; Morariu, 1988; Whitmer, 1988;) for foreign language teaching (Guy and Muzen, 1989; Janus, 1990; Ashworth and Silevsky, 1989; Nakajima, 1988); in conference information systems (Bevilacqua and Lewis, 1990; Saloman, 1990); and for library instruction (Ertel and Oros, 1989; Voccaro, 1989; Bellamy et al, 1989; Bjorklund, 1989). Some of the more important work in this area will be mentioned here.

Brown University's English and Biology departments were the first to use the hypertext for teaching at the university level. It was found that the students who used these materials were not only quick to grasp the subject, but also developed more readily analytical thinking and design skills (Beeman et al, 1987). It seems that, during the teaching process, hypertext as a teaching tool interacts with students' own thinking and improves their metacognitive skills.

At Coventry Polytechnic, Alan Dyer has investigated a number of problems related to hypertext and art & design teaching. He found that the students' creative capabilities were expanded after using the hypertext courseware, both in theoretical studies and in studio design work(Dyer,1989). It was observed that several students were enthusiastic to submit their assignments (i.e. essays,theses, etc.) in the form of hypertext documents. The department is now investigating the impact both of special cognitive skills and of the educational benefits of hypertext on the students.

## **2) Use of hypertext for teaching undergraduates in universities**

HyperCard has been used for teaching in various courses, such as Archeology (Fagan and Michaels, 1992; Carr and Rahtz, 1990), Information systems (Fritz, 1991), Programming (Sametinger and Pomberger, 1992), Computer Science(Decker and Hirshfield, 1992; Hughes, 1991), Engineering (Lubkeman and Collins, 1991) Physics (Orhum and Kasli, 1991), Anatomy (Gundy,1990) and Anthropology (Crane,1991) at the undergraduate level in different universities. The more important work related to the use of hypertext to undergraduate teaching is mentioned here.

In the University of Southern California it was observed that the students of the Freshman Writing Program were experiencing difficulty in accessing information from the library for their composition class which resulted in poor quality research papers. To overcome this problem, Clark(1988) started 'Project Jefferson', using HyperCard for teaching fundamental research skills how to get information and utilise it for their academic writing. She found that hypertext ultimately had a profound impact on the students in improving their academic writing.

Kay E.Vandergriff(1988) of the State University of New Jersey selected Edna St.Vincent Millay's poem "Justice Denied in Massachusetts", as the basis for designing a HyperCard stack for teaching. Poetry is a neglected area in hypertext literature; using the poem as an example, he experimented in developing courseware with the help of HyperCard. He has suggested a

few ways in which librarians can build stackware in libraries, and can overcome the copyright problems; but he has not reported the impact of that courseware on students.

Several departments at the University of Toledo (Educational Technology, Biology, Foreign Languages, etc.) are developing their courseware in the form of computer-based instructional materials and interactive video programmes using HyperCard. The response of the students seems to be positive (Lamb, 1989).

In another experiment, it was observed that, after some exposure to HyperCard, students were able to develop stories on art education, and needed little intervention by the tutor in extending their abilities (Hubbard, 1989). They liked to submit their assignments in hypertext form, rather than traditional form.

At Wayne State University, John Camp and Mare Cogan have developed "The School of Athens" - a stackware for art students - with the help of HyperCard. These art lessons in the form of stackware have influenced the students' participation and created a greater interest in the teaching (Gregory, 1989).

"Training the Trainers", a hypertext-based training package, was designed by Philip J. Gartshore at the School of Architecture, Portsmouth Polytechnic, to study various forms of student learning. The package was designed with HyperCard software and implemented on an IVD. It was found that this training package motivated the students to use it more (Gartshore, 1989).

In 1989, Drexel University developed a HyperCard-based instructional tool, called the 'Drexel disc', for distributing day-to-day information about the University, its departments and facilities available to all the newly joined students. It was found that, comparatively, the distribution of discs was cheaper than distributing printed brochures containing the same information. It was found that the students were satisfied with the disc as a source of information, but it needed frequent updating (Hewett, 1989).

### 3) Use of hypertext for instruction in medical sciences alone

Hypertext has been used for teaching in medicine more extensively than in any other subjects. Examples of hypertext systems for medical domains can be found systems for Liver diseases (Bernstein et al, 1980); Neurology (Strong and O' Neil Strong, 1991; Stensaas and Sorenson, 1989, 1988; Reggia, 1980; Wertheim, 1989); Pathology (Henderson and Vayer, 1989; Svirbely and Smith, 1986; Thrush and Marbry, 1980); Medical knowledge base (Sorenson et al, 1988; Banks et al, 1988); Physician aid systems (Smith, 1989); Medical reference systems (Sherertz et al, 1989; Snell and Boyle, 1989; Mezrich et al, 1989); Pharmacology (Merril et al, 1989); Physiology (Harding et al, 1989); Radiology (Jaffe et al, 1989; Mezrich et al, 1989); Medical education (Greenes et al, 1989); Continuing education for medical practitioners (Narula and Diaper, 1991); Veterinary medicine (Jennings and Dambro, 1988); Medical Biochemistry (Harding et al, 1989); Primary health care (Timpka, 1988; 1989); and Clinical laboratory documentation (Svirbely and Smith, 1983). An early more important work related to this field is given here as an example.

"The Living Textbook of Pathology" is an example of an interactive hypertext system developed at university of Illinois to provide a framework for further expansion and updating of an undergraduate pathology course. The system utilises a metabase, which is a database about the databases, and contains various types of information (what type of users, where can they get and save the information etc.). A number of lessons were developed, and their use by the students was recorded, (3600 hours for all lessons). At that time they did not explore any direct impact on the undergraduate medical students because it was still in prototype form. However, it was found useful for the continuing education of practising physicians, even at the beginning of its development (Thrush and Frank, 1980).

In general, all these studies show that educational benefit can be obtained by using a hypertext approach, and that students adapt rapidly to its application.

#### **14. REASONS FOR USING HYPERTEXT AS A TEACHING/LEARNING TOOL**

1. The main reason of using hypertext for teaching is because it gives students flexibility of choice, since in hypertext the text is not presented in sequential form.
2. Normally, when browsing through a conventional printed book, most people will not read the entire book. Hypertext provides connections and relations between information fragments, so enabling the user to browse through a hypertext database effectively and quickly depending upon their requirements.
3. While reading a book or an article, it is common for the students to make marginal notes or to highlight the text. Hypertext typically allows students/readers to add their own comments.
4. Since the information in hypertext is arranged in an associative, linked form, additional information on a specific aspect can be obtained simply by activating the node(s).
5. Publications are conventionally aimed at a particular level of audience, e.g. text books are for students, articles are for researchers, and so forth. In hypertext, a single form can be made to serve the purpose of the elementary reader or the advanced researcher; depending upon the users' interaction and approach to the database.
6. In hypertext, teaching materials can be presented as a combination of graphics, animation and sound along with text in a dynamic form. This can prove more effective than the existing text-based teaching tools.
7. One of the aims of hypertext is to improve existing learning practices. So, in hypertext, the main strategy is for the learner to explore the information. Consequently, learners can move at their own pace and take independent decisions.

8. Hypertext allows individualised instruction to learners, which is difficult in traditional teaching.

9. Hypertext systems are intended to encourage the exploring of information in a database, so that students may discover ideas, facts, information, and themes on their own.

10. Collaborative writing is another feature of hypertext which is useful for education. A number of people can share ideas, works, designs, etc, in their discussion.

11. Inter-linking of ideas and concepts is a further useful aspect of hypertext for teaching. Most hypertext systems support the easy creation and inter-linking of information fragments in such a way as to allow easy navigation and browsing through hypertext databases by the students.

12. Continuous creation and updating of information is an important advantage of hypertext for teaching. This is difficult and time-consuming for books and other traditional teaching materials.

## **15. IMPACT OF HYPERTEXT ON EDUCATION**

The educational impact of hypertext is particularly in three areas: i) the replacement of traditional teaching media by dynamic media with graphics, images, sound, animation, etc., which can influence the students' learning process, ii) the need for the hypertext courseware developer to develop and present a specialised skills in areas such as HCI, graphics, designing, programming, educational psychology, cognitive studies, etc., and iii) assisting the student to develop analytical thinking via the two-way authoring and learning capabilities of hypertext. Research results suggest that, after using hypertext, students have developed their critical thinking skills comparatively more (Landow,1989). The student who had access to hypertext course materials was found to have a better grasp and understanding than those who had not.

The research on hypertext instructional design shows broadly there are four

types of issues that can effect the instruction. They are behavioural, cognitive, attitudinal and economic.

#### **i) Behavioural Issues.**

These are the effects of hypertext on learner achievement. Many educators in different fields have conducted various studies and compared the relative achievement of groups who receive similar subject matter from different media. With the advent of hypermedia, many studies have compared this medium with others, such as multimedia, interactive video, CAI, AV instruction and traditional lecturing. Each medium seems to attract its own set of advocates who make claims for improved learning and stimulate research questions that are similar to those asked about the previous medium. Media comparison studies, regardless of the media employed, tend to result in 'no significant difference' conclusions. These findings provide evidence that different media are equally effective in promoting learning in overall terms, whilst still having particular advantages and disadvantages. According to Clark (1983), the most common problems seem to be uncontrolled effects of : a) instructional method or content differences between the treatments that are compared, and (b) a novelty effect for new media, which tends to disappear over time. Evidence for each of these control effects could be found in meta-analysis studies.

The evidence of these meta-analysis studies is that it is the method of instruction, rather than the choice of medium, that leads directly and powerfully to learning. Media may not influence learning directly, but provide appropriate instruction to learners at particular levels.

#### **ii) Cognitive issues.**

This type of effect can be divided into three categories.

- a. The effects of attribute on cognitive processing and on achievement.
- b. The effects of instructional method on cognitive processing and achievement.
- c. The interactive effects of student aptitudes and instructional method on cognitive processing and achievement

The important things here are the attributes of hypertext and their influence

on the way that information is processed in learning.

### **iii) Attitudinal issues.**

These include the interactive effects of student attitudes/attributions/expectations and the instructional method or medium on cognitive processing and achievement.

### **iv) Economic Issues.**

These related to the expenditure of both time and money on the instruction; hence :

- a. The effects of hypertext on cost of instruction,
- b. The effect of hypertext on time for instruction.

Hypermedia characteristics effect learning in three ways. 1) Hypermedia offers qualitative and quantitative differences in access to information. For example, learners will have access to a large amount of information in different formats, and thus they develop skills to identify the appropriate information and use it meaningfully. 2) Hypermedia offers high levels of user control. Learners can construct their own knowledge by browsing through hypertext according to the associations provided by their own cognitive structure. 3) Hypermedia facilitates timely and reciprocal interaction with the system and with other humans.

## **16. THE DISADVANTAGES OF HYPERTEXT FOR TEACHING**

1. Disorientation of users is the main problem (i.e. getting lost in hyperspace). The user may be faced with such problems as : i) where am I in the database? ii) how can I get out ? iii) how can I reach a particular point/required information in hyperspace ?

2. Learners have to put extra effort into hypertext, as compared with books, in remembering/ concentrating on the system to maintain several tasks at a time. This strain on the learner is referred to as the 'cognitive overhead' problem.

3. Systems are incompatible due to lack of standardisation in hypertext.

Hence, a courseware package developed on one hypertext system cannot be used/exchanged on another system.

4. In terms of theoretical definitions, no fully fledged hypertext system has yet been built. It is therefore difficult to predict the entire range of advantages and disadvantages of hypertext for teaching.

5. For a new learner, it is difficult to keep control of a large hypertext database.

6. Lack of good designers and of good quality courseware is also a problem in popularising hypertext.

7. In the case of larger hypertext systems, they are neither portable nor easily accessible to all users.

8. Copyright in a designer's or author's hypertext software is not well protected as yet.

9. Reading hypertext courseware material is slower than reading books and may also cause strain on the reader.

## **17. HYPERTEXT COURSEWARE v. CAI MATERIALS**

Even though CAI (Computer-Aided Instruction) materials have some of the characteristics of hypertext, they lack some of its key concepts/ideas. CAI materials are focused mainly on new types of presentation of traditional textual materials, rather than incorporating the new concepts of hypertext. In CAI programs students do interact with the courseware, but they are not usually permitted to edit/alter the material, or to add links/connections on their own. Moreover, these materials do not allow students/readers to collaborate, or to share ideas between students and teachers. Free browsing is also not possible in CAI materials as it is for hypertext courseware. CAI readers are simply users who cannot participate in improving/ developing the materials. These differences can be listed as follows.

HYPERTEXT	CAI MATERIALS
1. Information is organised in a more natural way in non-sequential form, which is flexible for both teachers and students.	1. Information is organised in a rigid and sequential form, as in a traditional computer program.
2. Learners disorientation is possible and it increases with the size of the system.	2. There is less scope of learners' disorientation (in well-designed systems).
3. Though it is more complex for novice users, the system can soon be learnt and exploited for collaborative work.	3. Less complex to learn, but rather rigid to use. Not useful for collaborative work.
4. It is both a teaching tool, and a learning tool.	4. It is a learning tool only.
5. The control of the system is in the hands of the learner.	5. The control of the system is in the hands of the system's designer.
6. The user has the liberty to add, edit, or alter the information at any time.	6. Information cannot normally be altered, edited, or added to this system.

## 18. HYPERTEXT v. INTERACTIVE VIDEO DISC

Interactive video is another powerful training tool, but, because of the cost of hardware and software and lack of standards, it has yet to fulfil its potential in the field of education. Hypertext and interactive video each have their own advantages, but they can also be married. The resulting tool - 'HYPERMEDIA' - seems set to be a powerful teaching tool for education. For example, **WORLDVIEW** is the first interactive video atlas of this brand, developed by Fabrice Florin and Bill Atkinson (Florin, 1988). Strathclyde's 'Glasgow Online', a HyperCard-based tourist information

system, is an other example which is due, in its second phase, to employ interactive video with hypertext capabilities(Mac Morrow and Baird, 1988).

HYPERTEXT	INTERACTIVE VIDEO DISC(IVD)
1. It has not only hypertext features, but also RAM memory, so that one can write and edit information easily.	1. Since the disc has a ROM-type memory, one cannot edit or add any information to disc.
2. Information is stored non-linearly and can be accessed more quickly than for IVD. The structure of the information changes all the time with user interaction.	2. Information is displayed linearly, but random access is also available. The structure of the information is fixed, and is not changed with user interaction.
3. Text, graphics and animation can be integrated with equal emphasis.	3. Main emphasis is given to visual information .
4. Collaborative writing is one of the basic features of hypertext.	4. Collaborative writing is not possible.
5. To follow the information one has to interact with the system.	5. The learner can view the program without interaction.
6. In theory, there is no limit to the size of a hypertext system(by adding more hard discs).	6. Storage capacity is fixed according to the size of the IVD.
7. Copyright is one the unresolved problems of hypertext system.	7. Copyright can be protected easily, because duplication of a disc is expensive compared with buying a new disc.

## 19. CONCLUSIONS

Though the idea of hypertext was introduced before the development of the computer, it took a long time to popularise because people did not clearly understand its' main themes. The introduction of Apple's HyperCard made

a considerable impact on peoples' thinking, so that many educators are now using it for teaching in schools, colleges and universities throughout the world. In spite of its drawbacks, hypertext has great potential for any application in which information has to be presented and retrieved effectively to users. Since the main output is in visual form, this can readily be made familiar to the general public. The main task now is to develop good vocabulary, syntax, structure and behaviour of various forms of text in order to derive maximum benefits from it. Designers of hypertext systems are trying their best to eliminate the drawbacks and to improve their usability. During the late 1980s, the number of people involved in conducting research in this field has increased greatly. If these systems can overcome the problem of incompatibility, may well spread rapidly.

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## **Chapter 2**

# **BACKGROUND OF THE PRESENT STUDY**

### **1. INTRODUCTION**

This chapter deals with the aims, objectives, hypotheses and models that have been introduced while conducting this study. The different variables needed to form various models (oriented towards students, systems, interfaces, tasks, navigation and information retrieval) were identified and considered in this respect. The factors that might influence the students' performance on these systems and interfaces, their relations, differences and characteristics are also discussed here. Using these models, a methodology is then developed for use in the experiments described in subsequent chapters.

### **2. AIMS**

The primary aim of the present study is to examine the strengths and weaknesses of hypertext/hypermedia as a tool for teaching to university students in general, and to Library and Information Studies(LIS) students in particular. Other aims of this study are : i) to investigate the use of HyperCard in LIS teaching; ii) to identify the types of problems which might be encountered while using hypertext for the first time; and iii) to develop guidelines to design hypertext courseware materials for LIS students.

### **3. OBJECTIVES**

To achieve the main goal, this study has examined the following specific objectives in the context of LIS students with their specific backgrounds, skills and interests.

(1) What is the minimum amount of teaching and experience that students require in order to understand basic applications of a hypertext system, such

as HyperCard. How much teaching time is required to achieve such a level of understanding ?

(2) How should this teaching be provided in terms of the division between lecturing, presentation of information (via demonstrations, practicals, discussions, etc.) and hands-on experience, to equip students with such knowledge ?

(3) What are the major difficulties that students face in using hypertext (and specifically HyperCard on a Mac) for the first time?

(4) How should students be grouped in order to achieve better teaching and learning (both theoretical and practical) for hypertext teaching ?

(5) What sort of information might be included to design a hypertext introduction to a university (similar to the Drexel disc - see later), and how should the information be organised ?

(6) Which interface (hypertext/graphical or menu-based) is more useful for retrieving information from a particular kind of database ?

(7) Is the use of colours and graphics helpful and pleasing to users who are retrieving information from a hypertext database ?

(8) Which is the better way of representing the hypertext links in the courseware materials - highlighted words or icons and graphics ?

(9) Which is easier to use as a hypertext interface: text only (hypertext) or text with colours and graphics (hypermedia) ?

(10) Is the ease of teaching hypertext to students affected by the computer environment (Mac or IBM PC) ?

#### **4. HYPOTHESES**

To study the problem of hypertext for teaching, the following hypotheses were

formulated and tested in the different experiments described later. The hypotheses were divided into three groups : a) general; b) related to student background; c) related to the mode of information presentation.

a. General hypothesis

(1) Experienced users of computers will find it easier to adapt to using hypertext than naive computer users.

b. Hypotheses related to student background

2) While using hypertext systems, the number of problems encountered/errors made by the naive users can be reduced by providing appropriate theoretical knowledge before they start using the interface.

3) For optimum hypertext teaching, students should be in smaller groups which are homogeneous in respect to their prior knowledge of the domain: such grouping will lead to better understanding of the subject and more satisfaction amongst the students.

4) Students with prior knowledge of the domain being taught will use a computer system more effectively than users with little or no domain-specific knowledge.

c. Hypotheses related to the mode of information presentation

5) For computer task-oriented teaching, providing simple and clearly presented instructional hand-outs and sufficient classroom help will be more effective than providing instructions through demonstration and supplying brief hand-outs.

6) Introducing graphics and colours will help the users of hypertext systems, and also enhance their speed of retrieving information as compared with the plain text (text only without graphics and colours) provided at the same interface.

## 5. MODELS

Designing an interactive system is difficult, because it requires not only good

design and programming skills, but also skills in dealing with people and in understanding how they perceive and accomplish their tasks. One way to facilitate design is to apply different 'models' - oriented towards users, systems, interfaces, tasks and so on. In terms of the present study, it is the user model that is of most importance. The user model consists of the set of concepts that the user invents, acquires and infers in order to understand how to use the system. User models are useful in more than one way for designing a user interface. Firstly, they can be useful for providing a clear understanding of, and distinction between different aspects of a user interface. Secondly, they can support the design and implementation of an interface in a number of ways. For example, user models can provide a useful framework for structuring the design process by grouping all the necessary user requirements, and then using these various groups at different stages of the system design.

Recognition of the fact that users inevitably formulate their own model of how to operate the system is a crucial aid to the designer in designing any interactive system. In this context, the user's mental model is of particular significance to the systems programmer. As Moran (1981) remarked, it is very important to understand that "to design the user interface of a system is to design the user's model". So one of the important things that the designer needs to know before starting a software design is basic facts/information about potential users (for example, their age, sex, level of education, subject background, computer experience, job experience, training undergone, and personal interests) that might influence the system operation. The type of user model employed in the user interface design is therefore important. It is a representation of the user; used by the designer to make inferences and decisions about the design. For example, a designer often assumes either little or no knowledge (i.e. about both the computers and interfaces) on the part of the user. This assumption provides some of the criteria for the system design. In real life, such simple models may not always work successfully because in the real educational environment there are different kinds of users, and therefore different kinds of 'user models' : we need to satisfy all of them.

In interactive computer systems, human-computer interaction behaviours may

differ due to both different interfaces and differing interaction styles of the users. Here, "behaviour" means the human-computer activities during the interaction of the user with computer while a task is performed. It is based on an understanding of both the behaviour of users with the system and the behaviour of the system with users. In order to perform a function in a distinct way, there must be a corresponding underlying system structure as support. In behavioural terms, the task is to build the system to support the range of user behaviours. A behaviour model organises the system's behaviour according to user motives and the events that trigger user responses. Failure to understand the needs or motives of the user can obviously lead to poor system design. Overall, the behaviour model should produce a system that meets users' expectations, because it is designed according to their requirements. In reality, it is difficult to capture the user's needs accurately and completely and to specify them in an unambiguous way, so that developers can deliver a system that fully satisfies the users' needs.

### **5.1 User models in instructional hypertext design**

User models have been considered for applications as diverse as educational technology, software engineering (Pressman, 1987), help systems (Mason, 1986), expert systems (Sparck-Jones, 1986), computer-aided instruction (Self, 1974; Carr and Goldstein, 1977; Sleeman, 1982), instructional design (Andrews and Goodson, 1991), database systems (Tompkins, 1989; Tague et al, 1984), information retrieval systems (Agosti, 1989; Bruandet, 1989; Lucarella, 1990), hypertext systems (Frisse and Cousins, 1992; Franca Garzotto and Schwabe, 1991; Halaz and Schwartz, 1990; Futura and Stotts, 1989, 1990; Stotts and Futura, 1989; Lange, 1990; Thompson, 1990; van Dyke Parunak, 1990), browsing (Valdez and Chignell, 1988), and learning with hypertext systems (Richardson, 1988; Fischer and Mandl, 1990; Whalley, 1990). The term "user model" can, however, be used in several senses. A 'user model' may be a specific model with particular user's knowledge, or it may refer to the style of interaction that any interface engenders without reference to specific user knowledge. It can also be applied to the model that a user has specifically about a computer program. So, it is often difficult to determine the boundaries of a user model. All programs have an implicit user model, but it may have been developed to

serve the user's needs in only one situation, rather than as an integrated model designed to serve the different needs of different users in various situations. In complex user interfaces, the user models should be a collection of models rather than a single model.

For a hypertext system, a 'user model' therefore implies a knowledge/information base which contains explicit assumptions on all the aspects of the user that may be relevant to the human-computer interaction behaviour of the system. Normally, there are three types of users of hypertext systems (where the users are classified mainly by their abilities to handle the system and their frequency of use). These are naive, intermediate and expert users. In this context, an 'expert user' is one whose knowledge about the domain includes functionality of objects (an object is a collection of information : it may be a button, bit-mapped graphic, drawn graphic, field, or even text, that can be manipulated using the mouse) as well as of the mechanical process. An 'expert user' knows all the underlying basic concepts and the majority of the generalised objects contained in the knowledge base for a particular domain. A 'naive user' is one who does not know about specific objects contained in the knowledge base, nor about the underlying basic concepts. An 'intermediate user' is obviously one lying between a naive and an expert user. The user in this category has moderate knowledge of the domain, the objects and the overall system, and can operate the system with moderate speed. The level of expertise is really a continuum, with users falling at various points along this knowledge spectrum. Most users construct 'mental models' of systems based on their past experience of similar computer systems. Experienced users are more likely than naive users to have well-formed models. When users encounter a system, their initial mental model may be vague, but it will become clearer as their experience increases. It is the interface designer's responsibility to make the interface suitable for as many kinds of user models as possible.

Because so many computer/user interfaces are now being introduced, it has become a very difficult task for educators to decide which interface is better used in designing educational software. Among recent interfaces, hypertext is one which has, perhaps, had more influence than any other interface in the field of educational software design (Jonassen and Grabinger 1990;

Wright,1990). The capabilities of hypertext for teaching are numerous, but at present, only a small number of educators are using it in a restricted number of subject areas. The problem is that a large amount of time and other resources are required for developing well-designed hypertext instructional materials.

Seven possible types of model seems worth considering in the context of the present study. These are discussed in order below.

### **5.1.1 Student model**

The 'student model' relates to information about the individual student using the program. The student model must be able to indicate the abilities of a student with respect to the domain being taught, as well as student preferences for a particular method of tutoring. Normally students make frequent errors, but these may be useful in furthering the students understanding of the subject. Errors can be committed for a variety of reasons - selecting the wrong menu options, activating the wrong hypertext links, and so on.

At this stage, it is important for subsequent work to distinguish between different sorts of errors. It has been suggested that a distinction should be made between 'mistakes' and 'slips' when studying errors in the usage of a system (Norman, 1983). Users start out with some 'intention', when they attempt to use a system. If there is an error in the intention, it is suggested that this should be labelled a 'mistake'. A different error occurs when the intention is correctly formulated, but something goes amiss in the attempt to implement it. Such an error can be labelled a 'slip'. This seems a useful classification when looking at the problems of beginners. At the start, the students are carrying out intentions formulated by others; so their errors are primarily 'slips'. Later, as they begin to understand the system, they start to formulate their own intentions and so begin also to make 'mistakes'. Tests of navigation through hypertext typically involve browsing (e.g. Hendry et al, 1990). This means that subjects are formulating their own detailed intentions, so they may make both slips and mistakes. In the present guided study, the concern is rather with the slips that beginners may make in using hypertext.

Three types of student models have been formulated for use in the present study, namely :

i) Individual model

In the individual instruction model, students are individually accountable for their performance. Each student has an equal opportunity to achieve the learning objectives, regardless of the ways the student differs from other learners. To implement this technique, the slower students must be allowed more time to reach their goals, students' progress must be individually monitored to determine how well they are achieving the goals, and alternative instructional routes must be provided to suit different learners abilities and learning styles. In this model, students lose the social aspect of learning as there is no opportunity for them to learn by face-to-face discussions with each other and with their tutor.

ii) Novice-to-expert model

In contrast, the novice-to-expert model limits the amount of freedom a student has in exploring and constructing knowledge in a hypertext environment. Jonassen(1988) supported the novice-to-expert model of teaching and suggested several ways in which hypertext could be structured to reflect this. According to him, hypertext is a method for mapping an expert's understanding of a particular subject onto the learner. Learners must follow the navigational paths and links designed by the author into the system. However, one of the hypertext visionaries, Ted Nelson(1987), believes that students should go beyond the limits of novice-to-expert model. They need freedom to build their view of a subject by changing the information organisation in an open hypertext environment. Thus open-ended hypertext systems would have many optional paths that a student may or may not use. As with the individual-student model, highly motivated students/learners would explore more diverse information links and also make more meaningful connections than less motivated students.

iii) A model of learning from hand-outs

A model of how students learn to use computer systems from written instructions can also be proposed, though it is essential to remember the complex instructive character of text learning. Thus, research shows that low

ability students can particularly benefit from instructions, more than high ability students (Saloman,1979). This research indicated, indeed, that instructions are not necessarily helpful for high ability students: they may interfere with the effective processing and accessing of knowledge structures, which these students automatically carry out.

### **5.1.2 Teaching model**

The 'teaching model' considers what information can be taught to students, how that information should be conveyed, and when it is appropriate to provide such information. The model reflects the relationship of the teacher to the design of the material and to the instructional process. In some cases, the designer and tutor could be the same person. In traditional computer-aided instruction(CAI), once a learning program has started, there is no need for the designer. However, most of the programs (except commercial ones) allow the tutor to make changes without consulting the designer : so the teaching model should reflect this possibility. In principle, not only the tutor, but the students, too, can actively participate in improving/updating the system/data by adding their views to the knowledge base. In this case, learning takes place due to student involvement with all aspects of the system. Normally, teachers seek to accomplish specific objectives as quickly and as efficiently as possible; but they must also be able to decide when to let the student flounder a little, and when to interrupt and guide the student.

### **Teaching models for hypertext**

In this section, three models that seem especially relevant to hypertext teaching are examined.

#### **i) Teacher - focused teaching model**

In this model, the teacher is the focal point, and makes the decisions regarding teaching content, time, method of teaching, pattern of exercises, assessment and so on. Joyce and Weil(1980) have developed a number of "teaching models" from an analysis of psychological learning theories for training teachers. These relate to classroom applications of information processing concepts and techniques. The models used were:

- a) practical demonstration model;
- b) brief practical instructions(hand-outs) and classroom assistance model;
- c) practical instructions(hand-outs) only model.

#### ii) Student-focused teaching model

In a student-focused model, instructions (such as tutoring, computer-assisted instruction, classroom teaching and hand-outs and text book instruction) can be provided in a variety of ways to individual students. The aim is to operate different instructional models across a variety of student learning styles. These models make clear the importance of considering the different structural features of subjects and how these might influence cognitive processes.

#### iii) Group-focused teaching model

In a group-focused teaching model instructions in their various forms are provided to groups of students. Group-focused teaching models used in the present study are differentiated in terms of size :

- a) larger group model (15-20 members in a group);
- b) smaller group model (4-5 members in a group);
- c) pair model.

### 5.1.3. Interface models

Effective human-computer interaction depends critically upon the design of the computer interface which communicates information to the user. The user needs a model of the computer system that accurately represents this structure. In terms of out put, the model must ensure that information provided by the tutor is effectively presented to the student, whose responses occur in a manner intelligible to the system. Since the student's view of the domain may be significantly different from that of the expert, this can be hard to implement. Thus, the primary task of the designer is to construct an appropriate interface model, which satisfies the requirement that everything the user interacts with helps to develop a correct mental model of the system. An interface model thus provides: i) a specification of the function of the human-computer interface, ii) an allocation of functions between the human

and the computer, and iii) a relationship of users to system across domains.

In a hypertext environment, computers are always used interactively so that the exchanges between computer and student resemble a conversation. In traditional CAL programs, the student has to formulate queries, or select appropriate menu options on screen. Because of the hierarchical structural organisation of both information and menus it usually takes some time to obtain the required information. However, a student using a hypertext instructional program need neither remember the different commands and their syntax, nor select values of parameters for inputting. Commands are implemented by simply activating the appropriate links, either through clicking a mouse or pressing a key. The browsing aspect of hypertext makes the student's life more comfortable in moving through a greater depth of knowledge quickly and easily. Hypertext promotes restructuring of already acquired knowledge, so a hypertext interface may make students change their existing pattern of accessing information.

Students may interact with hypertext systems in a variety of ways. For example, the system may drive the interaction by leading a student through a series of options. When designing a hypertext system for teaching, three learning processes seem best supported by hypertext - information seeking, knowledge acquisition, and problem solving. The tutor's goal is for the student to acquire the skills and knowledge necessary to perform tasks in the domain successfully. The method adopted by the hypertext systems for achieving this goal is to induce the student a model of the domain and match it with the hypertext system's model. The information in a hypertext system should satisfy all types of student models (i.e. naive, expert and intermediate users) of the domain by incorporating multi-user model characteristics. The present study therefore differentiates between :

- i) hypertext interface model;
- ii) menu-based interface model.

#### **5.1.4. System models**

When users are using a system, they form a mental model of that particular

system. This is a 'system model' (Penta,1973; Tuckman and Edwards,1973). It differs from user to user because the way computer systems are actually used varies with each user. People use computer systems for different purposes (word processing, spread sheets, databases, programming, teaching, learning and so on); in each case the task of the user is also different. Virtually no users (including the system programmer) will possess a model of the system as a whole. Each user selects a part of the totality of tasks for modelling. In this study, the 'system model' is the model formed by the each student while using a particular system.

#### **5.1.5. Task models**

From a broader perspective, an interest in structural models is characteristic of most research programs that focus on the nature of teaching/learning in classrooms. Of particular importance are the models based on the concepts of tasks and activity. These models drive from various fields, especially in psychology and sociology. According to the nature of the problem, task structure can be divided into two types: i) well-structured tasks, where data and methods are known; and ii) unstructured tasks, where the task can only be defined approximately. In this study, all the tasks were well-structured they can, in turn, be classified into three categories.

a) Simple tasks, such as finding factual information from the hypertext database. Tasks are typically perceived in terms of the number of steps that they require: simple tasks require few steps. In the present study, simple tasks required students to seek straightforward answers to questions given to them on worksheets.

b) Complex tasks, which both require many steps for their solution and also need a high level of user control of the system. This category requires student decision-making in completing the tasks. At this level, the students must decide which information is appropriate or inappropriate in the given context, what they expect from the system, some concepts of the design, information organisation and overall improvement of the system and so on.

c) Designing tasks, where a small number of tasks are combined together to

provide a complete work activity. In the present study, this was a 'stack design exercise'. Students were asked to design a HyperCard stack with the help of instructions provided in their hand-outs.

Although tasks and environments are inherently linked, it is worthwhile to define two characteristics of environments that have an impact on tasks and on the modelling of human-computer systems. Time and resources are two of the important factors that can influence the system's design, usually as a form of constraint. For example, there may be a dead-line by which users need to complete the tasks. This has a psychological impact on the user and demands special attention by designers. Equally, limited resources require decisions as to how to allocate functions. For example, users need to take decisions on how to act when computer responses are slow.

While designing, tasks variety is desirable; otherwise the user becomes bored. At the same time, task complexity must match the user's personal ability; hence, the capabilities of the user have to be considered while designing the tasks. The tasks may be very stimulating, but they will be of little use if they are beyond the capabilities of the user. So a balance needs to be maintained between task structure/formation and user abilities, so that users get the encouragement to develop new skills and widen their experience with the system. When the tasks are beyond the user's abilities, it will result in frustration.

#### **5.1.6. Navigational models**

Since hypertext is a new paradigm, many users (especially naive users of hypertext) have not yet developed the skills to navigate, structure, synthesise and integrate information within its scope. Novice users browse the system rather than using the hypertext links. The most frequently used link is typically the 'next screen'. It was found in one study that college students quickly adapted, and developed sophisticated browsing, search strategies, computing information, and solving problems (Jonassen and Grabinger, 1990). Users vary in the extent to which they develop these habits. The effect of hypertext on the students may change according to the subject matter, kind of authoring system used, type of computer and size and kind of terminal.

The kind of navigational models in hypertext systems that can be adopted by students are of two types.

i) Sequential viewing of documents model

In this model, users go through the system screen-by-screen. This is more common for a menu-based interface, but can be provided as part of a hypertext interface, if the user or designer wishes.

ii) Non-sequential viewing of documents model

The power of computers to store, retrieve, and process information helps the students to browse through the vast amount of information quickly and accurately. The linking feature of the hypertext interface helps the learner to go through the hypertext system quickly and easily and view the documents in non-sequential manner.

### 5.1.7. Information retrieval models

Browsing is an important feature of hypertext. It does not require computing skills to retrieve information from a hypertext database, so it is a simple method of retrieving information for naive users of computers. There are four types of information retrieval model which are worth describing here.

i) Browsing model

The commonest and most natural mode of retrieving information from a hypertext system is through browsing (though some educators think that browsing is not a form of learning they should encourage).

ii) Menu-oriented information retrieval model

This is one of the best known methods (apart from Boolean searching), and is extensively used in traditional computer training materials. Even though it may be time-consuming, because of its sequential linking of screens, the user may feel more comfortable in retrieving information this way. It is a fairly simple and unambiguous method for the naive user.

### iii) Boolean searching information retrieval model

This method is the oldest and commonest form of information retrieval from a large database. This involves specifying the operations to be performed on sets that have been defined by relationship statements or previous set operations. AND, OR and NOT are the Boolean operators which used for junctioning and disjunctioning of the terms in the searching. The information searching methods used in various courseware materials are generally simpler, but they may, in some cases, be similar to Boolean searching.

### iv) Non-Boolean retrieval model

This is may be a simple kind of search pattern for a small database, or a sophisticated approach for a large database. For example, the user types in a keyword and looks for the related information in a database. For naive users, this kind of retrieval model can be easier to operate, and it can certainly help retrieve adequate information. The development and evaluation of keyword-based computer information retrieval systems has been reviewed by Salton and McGill(1983) and van Rijsbergen (1981). OPACs and commercial bibliographical databases available on CD-ROMs are common examples which use keyword searching extensively. In one study(Henri Dou et al, 1990) it was found that searching patents information from online databases is very easy using non-Boolean concepts.

Hancock-Beaulieu (1992) found that menu-driven interfaces, Boolean searching and document representation can be identified as major barriers for users' interaction with OPACs. She noted that user friendly interfaces cannot be developed independently without developments in the functionality of the search software and enhancements of the raw databases. Boolean search systems only retrieve the information/keywords which match the query exactly. Normally, online catalogue users tend to reformulate searches by generating new terms, rather than reusing the existing ones. She found that, even after providing help facilities/online instructions about Boolean operation to the users of online catalogues, these users could not use such operations effectively searches. To overcome this problem, Online Keyword Access for Public Information (OKAPI) and LIBERTAS (a system modelled on OKAPI) have been developed as a viable alternative to Boolean retrieval. The OKAPI system was specifically designed for novice users of online

catalogues. In this environment, the user simply types the query in natural language and need not think about the keywords or standard terms. Then the system assigns weights to the user's query terms, depending on how frequently the term occurs in the databases. Here the system has the ability to differentiate between good matches, less good matches, or partial matches; it seems to be a more effective and useful way of retrieving the information than Boolean searches.

## 6. TESTING MODELS

The preceding discussion of models highlights the types of parameters that must be input when applying them. This section lists the input parameters chosen for measurement in the present study.

### 6.1. Teaching hypertext

#### a) Subjects

The subjects used in these teaching experiments were second year Library & Information Studies (LIS) and Information & Computing Studies (ICS) undergraduate students.

#### b) Grouping pattern of the subjects

The students were grouped in different ways for HyperCard teaching, employing varying group size and composition. The basic parameters involved were :

- i) Nature of the group (heterogeneous/homogeneous student groupings in terms of background);
- ii) Variable - sized groups (15-20; 3-5; pairs; individuals).

#### c) Teaching patterns used

Different kinds of teaching patterns were used in this study. The corresponding parameters were :

- i) Size of the group(pairs; individuals);
- ii) Order in which the students were taught  
(teaching followed practicals; practicals followed teaching;

instructional material-based teaching;  
 brief instructional materials and more classroom help-based teaching);

- iii) the way in which the students were monitored/supervised (group-focused teaching; group monitor-based teaching; pair-focused teaching; individual-focused teaching).

d) Courseware materials used

The courseware materials used in these experiments involved :

- i) retrieval of factual information (using the Drexel disc);
- ii) customisation of a task (using HyperCard).

## 6.2. Comparing hypertext and menu-based interfaces

a) Subjects

The different levels of students used in comparing these interfaces were :

- i) LIS undergraduate students;
- ii) LIS postgraduate students;
- iii) LIS research students.

b) Teaching patterns used

Both systems were user-friendly and sufficient online instructions were provided for users to follow a self-learning approach. Their progress was monitored, and help provided where essential.

c) Types of interfaces used

The two software interfaces used in this experiment were :

- i) hypertext (HyperCard) interface;
- ii) menu-based (dBase III+) interface.

d) Courseware materials used

The courseware material used in this study was the software catalogue of the CTILIS Centre in both hypertext and menu-based forms. The data provided in both the catalogues were the same - only the presentation was different.

- i) Software catalogue designed with HyperCard;
- ii) Software catalogue designed with dBase III+.

e) Navigation patterns

The different navigational patterns followed by the students while doing the task exercises were divided into :

- i) non-sequential navigation;
- ii) sequential (screen-by-screen) navigation.

f) Information retrieval patterns

This was divided according to the ways in which the students retrieved information from the databases.

- i) browsing;
- ii) menu-based searching;
- iii) Boolean searching;
- iv) non-Boolean searching.

### **6.3. Comparing colours/graphics and black & white hypertext interfaces**

a) Subjects

The subjects used in this experiment were LIS and ICS second-year undergraduate students.

b) Teaching patterns

Before the start, the basic operations of both systems were explained to the students. During this experiment, students were asked to work on their own, only asking for help if it was essential.

c) Courseware materials used

The courseware materials used in this experiment were:

- i) Hypertext:hands-on (HHO) [a text book in hypertext form];
- ii) Innovation and Technology Transfer(ITT) [a bulletin in hypertext form].

d) Navigation patterns

The navigational patterns followed by the students to go through the databases were :

- i) menu-oriented navigation;

ii) hypertext-oriented navigation.

e) Information retrieval patterns

The different kinds of search patterns required of the students in this experiment were :

- i) browsing;
- ii) menu-based search;

These variables will be discussed further in subsequent chapters, as the three experimental studies are described in detail.

## **7. BACKGROUND**

### **7.1. Background to hypertext teaching**

In view of the continually increasing range of information technology that needs to be taught to undergraduate students, a recurring question is how much teaching (and of what sort) is required for a satisfactory basic introduction to any new topic. This is particularly the case for library and information studies students, who need to be exposed to a very wide range of computer packages.

The need to introduce a new short course on hypertext to undergraduate students in library and information studies at Loughborough was used as an opportunity to examine the basic teaching requirements involved . The results are reported here. It was decided to use HyperCard as the basic hypertext tool in the course. HyperCard is a widely distributed and well-documented package (Eckols and Rossett, 1989), and is likely to be encountered by library and information studies personnel in their subsequent careers.

### **7.2. Background to comparison of hypertext and menu-based interfaces**

Individual differences in the time to complete a computer information searching task largely arise from differences in making and recovering from errors. Vincente, Hayes and Williges (1987) trained 'people to use a screen-

based Browser for searching hierarchically arranged pieces of text. They found that spatial ability was most the influential predictor which influenced the task performance of the users. The subjects of low spatial ability took twice as long to perform the task with high spatial ability. Interestingly, experience alone does not predict task performance. A comparison of the frequency of command usage between subjects with high and low spatial ability were getting lost in the hierarchical file structure. A study of college students using online library catalogue (Janosky, Smith and Hildreth, 1986) shows how errors effect the actual information search task. In that study, students had to enter a sequence of several commands to carry out a library catalogue search correctly. The average minimum/ maximum search time ratio was 23:1 and only 49 percent correct on very first command of the sequences.

In another study, Borgman (1986) studied the use of an online catalogue by the undergraduate students at Stanford University. She found that more than one quarter of the undergraduates who had been through a training programme in how to use the catalogue could not pass an elementary 'benchmark test' at the end of the training. Although prior computer experience was controlled, students passing the test were more likely to be Science and Engineering subjects while those failing the test were mostly Humanities and Social sciences subjects. Even the students of frequent library use also had problems in learning to use the online catalogue. In this case study, the computer user interface used to design the online catalogue hindered library access for exactly those people who needed it the most.

The user difference in information search times tends to be largely due to slips (user formulated the intentions correctly but something goes amiss in the attempt to implement it) formulated by the naive user of the system. Individual difference in the performance of computer users are not only large and systematic but they are also modifiable. Patterns of performance differences would change depending on the design of human computer interfaces and on training in the use of interface.

The acquired knowledge, skills and experience during job(s) might effect the use of a computer system, as compared with users who have little or no

domain knowledge. For example a good typist would be expected to do well with word processing and text editing. In the same way a person with more subject knowledge and experience would search the database effectively in his or her field. Normally acquiring experience with a computer interface is predicted by a set of characteristics of users such as aptitude to learn, age etc. Domain knowledge would effect the performance of the users only after acquiring some experience with the computer interface. Even though users may have a great deal of skills in a task domain, they may not be able to apply it until they have completely understood/learned about computer interface and that requires different kinds of skills. For example, Egan and Gomez(1985) found that users begin to do their text editing performance only after they had acquired some experience with the text editing system. In another study, Gomez, et al. (1983) found that the users typing skills connected negatively with initial editing performance on a text editing system.

Mayor(1976,1981) proved that the students who had studied a training manual before were later able to perform better on both programming and recall tasks. In another study, Halasz and Moran (1982) taught students how to use a calculator, using either step-by-step action sequence to do standard calculations or instructions which included a verbal model of how the internal registers, windows and stacks worked. They found that performance on standard tasks was identical for the two groups, but that the group who learned the model performed better on novel tasks.

### **7.3. Background to colour and black & white hypertext interfaces**

It is possible to provide good quality hypertext materials with a monochrome system, but the addition of colour and graphics features, if they are used correctly, may be able to improve the effectiveness of learning. However, it should be noted that some studies (Pattersson 1989) suggest, basically, that colours are used : i) to make the screen easier to read, ii) to identify different objects on the screen, and iii) to add emphasis. The screen is made up of a background and a foreground which can be differentiated by using different colours. The preferred colours for the background layer have typically been black, white and green, because these are seen as restful to the eye. The

preferred foreground colours for these three backgrounds, in terms of good contrast, are :

<u>Background colour</u>	<u>Foreground colour</u>
Black	Yellow, green, grey, white
White	Black, green, blue
Green	Yellow, white, black

Colours can be used to highlight important information on the screen for bringing the attention of the learner. However, too many colours can affect a student's concentration: a few consistently used colour codes can provide an affective display. Shontz et al (1971) investigated the visual search performance of the users with both the colour-coded and uncoded information location in a task experiment. It was found that colour served as a particular redundant code for information location. However, it is effective when the categories of information can be coded, and the number of objects per category is kept reasonably small. Colour can also be used to identify different windows by changing the background and/or foreground combination as the user moves from one to another.

A image/graphic should be usually be in colour but not in unrealistic colours. Even though we can produce several millions of colours, our eye can distinguish about 10,000 different colours only. Colour is capable of enhancing communication, adding clarity and impact to message. People of different cultures, different socioeconomic groups use colours in different ways and with different meanings. Some times colour enhances learning but in many cases black-and-white would be better(Pettersson,1989). However, from many experiments it is quite clear that people usually prefer colour in visuals. Use of colour does not necessarily improve the students achievement of learning objectives(Dwyer, 1971). Katzman and Nyenhuis(1972) found that the addition of colour to an audio-visual presentation improved learning of pictorial material that might be considered peripheral or irrelevant; but it did not lead to a much improved learning of central material.

Tollivier(1976) examined the extent to which college students were affected by and remembered, colour information in instructional materials. It was

found that higher scores were achieved with highly codifiable coloured stimuli than with low. Differences appear to exist between colours as they interact in instructional materials. Tullis (1981) evaluated structured, black-and-white graphics and coloured graphics computer displays in the context of a computer-based telephone line testing system. It was found that accuracy did not vary significantly with format, but speed did. The response time for graphic formats were considerably shorter than those for the narrative formats. However, there was no significant difference between response time for the black-and-white and colour graphic formats.

### **7.3.1 Graphics and Icons**

Graphical interfaces have also been called 'direct manipulation interfaces' (Shneiderman, 1987). The main advantage of a direct manipulation interaction style is that it reduces typing errors and helps the user in reducing memory and learning loads. In this style, users can directly manipulate the items on a screen. Common features of graphical interfaces are the icons, point-and-do facilities, windows and pull-down menus. Adding icons to a poorly designed interface does not improve its usability, rather it may create more problems for users. Icons play a major role, along with other features, in a graphical interface, but not all icon-based interfaces are equally well-designed or more efficient than command-driven interfaces (Whiteside, et al 1985).

Currently, an expressive visual language is lacking - although the basic ingredients are clear; i.e. typography, symbolism, colour, layout and sequencing (Marcus, 1984). Easterby (1969, 70, 72) feels that the initial guessing of symbol meanings is less important and relevant than the speed and accuracy of recall after suitable training. According to him, there are three psychological factors to consider as regards icons: i) a strong element of user stereotyping in symbol perception, ii) attributes of meaningfulness, simplicity, pleasantness and familiarity, and iii) pictorial quality - how much the symbol is like its referent.

Basically icons are useful in two ways to the user: i) they decrease the burden on the user's memory by making visible everything relevant to a task, and ii)

the real model of an icon on the computer screen helps the user understand them in terms of their visual characteristics. So, by displaying the appropriate graphic, the user can learn to use the system easily and quickly. When the software does not conform closely enough to the real world, and commands and menus often do not, users need more intermediary instruction; they cannot find things out so easily by experience (Smith,1977).

Icons should look like the action or object they represent, and should be readily recognisable to all levels of users (Heines,1984; Krull,1985; Seeing,1985). One solution to icon ambiguity is to adding labels, which helps the users in reduce interpretation errors. Bewley et al (1983) found that users made 25 percent fewer errors when they saw icons with accompanied labels for the first time, than when they saw the icons alone. It was also found that the labelled icons produced a more rapid and accurate visual search of computer menus than the icons alone were presented (Palmer, 1986; Krunell, 1988; Lansdale et al, 1990). Krull(1988) has suggested four points to remember when using the icons in an interactive system in the following contexts: i) icons are better used for objects than for actions, ii) labels should be added to reduce the ambiguity, iii) icons should not be used for abstract topics, and iv) icons cannot sustain an interface by themselves.

It is generally believed that icons make the interpretation of information on a display more direct, and, therefore, easier to learn and use. However, experimental results shows that the careful design of the interface determines its ease of use more than interface style. Whiteside(1985) compared seven user interfaces: two iconic systems, one menu-based system and four command systems. The results showed that naive users performed better on the command and menu-based systems than they did on the iconic systems. Similarly, Potosnak(1988) has concluded that icons leave much of the work up to the user, who has to struggle trying to figure out what to do.

## **8. ENVIRONMENTAL CONDITIONS**

Environmental factors include all those physical sensory elements, such as lighting, computers, noise levels, space, furniture and so on, that characterise

the place in which a student is expected to work. All the teaching experiments and practicals should be planned to have minimum stress and maximum effectiveness. The physical layout should accommodate the scheduled activities, allowing for peoples sense of personal space and promoting desirable patterns of social interaction and communication.

The main environmental factors that can effect the students' considered in this study are :

### **8.1. Seating**

Proper seating is an important factor in determining a students relative comfort and effectiveness as a user, learner and processor of information. Different et al (1974) have made some useful recommendations on the seating arrangements for students of computer-aided teaching based on their research. So far as possible, these were taken into account in the present study.

### **8.2. Room size & seating configuration**

Restrictions on the use of equipment and timetable limitations of the students are common in the LIS teaching, so it seemed appropriate to carry out experiments in groups. During the year 1990, three to five places were provided to each Mac. The students found this too crowded. So, in the second teaching experiment, one or two places were provided to each Mac. The students found this satisfactory.

### **8.3. Acoustics/noise level**

Overall, there was no problem regarding acoustics during these experiments: all the rooms were satisfactory from this viewpoint. The noise level during all the experiments and practicals was minimal, and there was no complaint from the students.

### **8.4. Illumination**

Glare has recently been identified as a major problem in environments that employ computers, TV monitors, and other visual display units. Glare brings about discomfort and/or a reduction in visual accuracy. It is caused either by an unduly bright source of light in the visual field or by reflection from a

specular surface (Kaufman, 1981). The lighting condition in all the teaching and computing rooms was satisfactory, and students reported that they had no problems due to illumination and glare in these experiments.

#### **8.5. Other factors**

The department was centrally heated, and the atmosphere in the rooms properly maintained. There were no complaints about heating or humidity from the students. In terms of scheduling the hands-on work, the gaps between classes created some problems with a few students in the second teaching experiment. Apart from this, no one reported problems regarding timings in their comments.

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## **Chapter 3**

# **METHODOLOGY**

### **1. INTRODUCTION**

This chapter deals with the overall methodology employed in this study and the specific methods used in the four different experiments. The methodology related to HyperCard teaching was carried out in different ways with different groups. To test the hypotheses mentioned in the previous chapter, different types of models for students, teaching, tasks, navigation, information retrieval and interface were chosen. Four different experiments were designed in order to examine one basic problem from different angles.

The HyperCard application programs used as courseware for the experiments were the 'Drexel disc' an introductory disc about the Drexel university, HyperCard, and a HyperCard Software Catalogue (i.e. the CTILIS Software Resource Guide). This catalogue was used to compare the ease of use and speed of information retrieval in the hypertext interface with another menu-based database designed for the same CTILIS database, but using dBase III+ software. The other courseware materials used were a hypertext textbook "Hypertext : hands-on" (HHO) designed using the HyperTIES system and a hypertext bulletin "Innovation & Technology Transfer" (ITT), designed using the ToolBook system. Both the Drexel disc and HyperCard software database were Mac-based hypertext systems; whereas the other two systems were PC-based hypertext systems. Firstly, the students evaluated the Drexel disc in terms of its ease of use, speed of information retrieval, and the problems encountered while they were using it for the first time. Secondly, they were asked to compare the hypertext interface with the menu-based interface with respect to the ease of use and speed of information retrieval. Finally, they compared the coloured and graphical hypertext interfaces with the plain text hypertext interface. The outcome of each evaluation was assessed by observing subjects performing the tasks and by questioning them, through questionnaires and worksheets,

on their attitudes to the particular part of the interface that was being tested and the effect they thought it would have on the whole. The tests involving asking the subjects to perform simple tasks, such as locating information to answer questions posed in their worksheets. Their observations, comments and performances were recorded as they invoked different aspects of the hypertext interface.

## **2. FACTORS THAT MIGHT INFLUENCE INSTRUCTIONAL HYPERTEXT**

Research into instructional media can be classified according to the main independent and dependent variables studied. In the area of hypertext instructional design, there are four types of dependent variables of interest to researchers. These are : performance outcomes, cognitive processing, efficiency/costs of the media and equality of access to instruction. Although there are many possible independent variables, three are particularly relevant to the present study. These are : characteristics of hypermedia (including type of medium, specific attributes of a medium, symbol system available within a medium), student characteristics (including general ability, attributes, preferences and prior knowledge) and instructional method.

An exhaustive literature search was carried out of sources in the field of designing the user interfaces for instructional hypertext in order to determine which factors needed attention in the present study (Potosnak, 1985; Gropper, 1991). To establish relationships between them and to get systematic representation of the spectrum of all the user characteristics, a pattern of user and interface factors was developed. Keeping these factors in mind, various hypertext teaching models were constructed. The variables that appeared to be most important, and were therefore used to construct models in the present experiments, are given in Table 3.1.

All the student variables are quantitative/independent variables, whereas all the interface variables are qualitative/dependent variables. In case of teaching variables, there are both qualitative and quantitative/ independent variables. The rest, (such as performance, task, navigation and information retrieval variables) are dependent variables.

Once an adequate sampling model has been adopted, the next step is how

to observe or measure the sampling units.

Table 3.1. Types of models and variables used in this study

<u>Type of model</u>	<u>Variable</u>
Student	Age
	Sex
	Course
	Group
	Sub-group
	Subject background
	General computer experience
Teaching	Size of the group
	Teaching methods
	Courseware materials
Performance	Speed of information retrieval
	Number of questions attempted
	Number of questions correctly answered
	Number of questions incorrectly answered
	Number of questions not attempted
Task	Simple enquiries
	Complex enquiries
	Designing tasks
Navigation	Sequential viewing
	Non- sequential viewing
Information retrieval	Browsing pattern
	Boolean search pattern
Interface	Ease of use
	User-friendliness
	Well laid out
	Easy to understand
	Easy to learn
	Presentation of information
	Error frequency

To quote Mueller and Schuessler(1961): 'Any object or event which can vary in successive observations either in quantity or quality may be called as a variable'. For our present purpose, a variable is any characteristic in terms of which individuals or group differ. Variables could be classified into two types - independent and dependent variables. For example, students may be taught hypertext in different ways, and may correspondingly, differ in how much hypertext they learn. In such an experiment, teaching method would be the independent variable, a presumed cause. The amount of hypertext learned would be the dependent variables. A 'quantitative' variable can be used to represent a concept that may take on various measurable values (usually discrete); these would include age, number of students in a class, time taken for a task, and so on.

Variables that differ in degree, rather than in quantity, are called 'qualitative' variables. For example, user views about an interface (i.e. bad, good, very good), appearance of graphics, screen design, etc. are qualitative in their nature. They can be converted to a pseudo-qualitative form by equating opinions to a numerical scale. During this study, both qualitative and quantitative variables were used to evaluate hypertext interfaces.

For the experiments discussed here, the variables were classified into seven types. They are :

**2.1. Student variables.** The variables used in the student models were age, sex, class, group, sub-group, subject background, general computer experience, and Mac experience. In more detail :

i) Age

There was a considerable range of ages amongst the students involved in these experiments : the ages of the students varied from 19 to 47 years. The students were therefore grouped together for analysis purposes in different age groups. Most of the students were under 19-20 years and the rest were spread from 21-47 years. So, the age groupings were made on the basis of five years difference in age. The resulting groups were 21-25, 26-30, 31-35, 36-40, and 41- above.

## ii) Sex

Researchers have reported differences between the sexes in the performance of tasks relating to computer use, but consistency has been low. In this study, sex was therefore included as a student variable. The majority of the students involved were females; but the groupings of student subjects were designed to allow any male/female difference in activity to be detected.

## iii) Course

The students came from different courses, namely : i) first-year ICS students, ii) second-year ICS students, iii) second-year LIS students, iv) postgraduate taught-course students, and v) research students. Their course background obviously affected a number of important parameters, such as their knowledge of computers.

## iv) Group

Students working together in one group on a particular task could differ with other groups in the same class. This is because of students differed in each group. For the purposes, of these experiments it proved convenient to specify fairly large groups (of 15-20 students) which were then divided into sub-groups.

## v) Sub-groups

A Sub-group was the basic teaching unit used in these experiments. Each sub-group had 1-5 students, depending upon the experiment. Sub-groups were classified as either a homogeneous or heterogeneous, depending on the mix of student backgrounds.

## vi) Subject background

This relates to the subjects which the students had read, or were reading in their courses. Broadly speaking, students were classified into three categories according to their subject background: i) Science students, ii) Social Science students, and iii) Humanities students.

## vii) General computer experience

Most of the students had some experience of computers, but the degree of

experience varied from student to student. It is expected that experience with all kinds of computers (such as mainframe, minis, and PCs) could affect the performance of a student using an interface or system. Correspondingly, users were classified into three types: i) students who had not encountered computers at all, ii) students with two years or less computer experience, and iii) students who had more than two years computer experience. In this last group, there are students who had up to ten years computing experience in previous jobs.

#### viii) Mac experience

This concerned a student's prior Mac experience before starting the experiments. About half of the students had not encountered Macs before so there was fairly even division into two groups : i) those with prior Mac experience, and ii) those with no prior Mac experience.

User characteristics depend upon perceptual skills, attention, memory, problem solving, and motor skills. Discussions of individual differences among the users have been given by Ulich (1987) and Vicente et al (1987). Broadly speaking, these imply that user characteristics may be grouped into three types :

#### i) Knowledge characteristics

Knowledge of a system is usually complex, involving such aspects as the task domain, in terms of both semantic and syntactic knowledge. Users vary not only in the amount of their knowledge about a system, but also in terms of their type of knowledge about the system. An important distinction has been made between ideal and non-ideal components of the user's knowledge of a system (Barnard et al,1989). Ideal knowledge contains information about how to perform the tasks correctly and how the system works, whereas non-ideal knowledge covers information that may lead to errors or wrong actions in performance.

#### ii) Cognitive characteristics

Users vary in their ability to perform a task, to solve a problem, or to make a decision. Sternberg(1977) has described the user's assessment of information-processing capabilities and their relationship to performance.

Different tasks involve different abilities in varying degrees; so an analysis of the particular cognitive components involved is useful in terms of system design and user training.

### iii) Skill characteristics

Users vary in their ability to type, draw graphics, or point to objects on the screen (eg. with mouse). These characteristics are particularly important in utilising interfaces. Again, an analysis of the particular skills required by an interface is useful in system design and user training.

## **2.2. Teaching variables**

### i) Group size

Researchers have found that a small group size results in a higher student satisfaction, more participation in the task exercise and greater achievement. In this study, different student group sizes were chosen to try and find the optimal group size to support better learning in hypertext teaching.

### ii) Teaching methods

The experiments are aimed at determining which teaching method is likely to achieve best student satisfaction. In this case, different teaching methods were used depending on size of groups, order of teaching items and method of monitoring work.

### iii) Courseware materials

Courseware materials were evaluated in terms of their information contents, structure, organisation, system design and the user interface. Different types of courseware materials were used with the students in order to test their relative values for teaching.

## **2.3. Interface variables**

The interface is not merely a topographical boundary through which information travels. It is also an intersection of display and transformation functions to, and from, the operator. In the case of instructional hypertext, the following interface variables were chosen :

i) Ease of use

This concerns how easy the interface is to use for an inexperienced user. This is typically a relative assessment by comparison with the systems users had experienced before. The assessment is essentially subjective and depends on the user's background, environment, training, etc.

ii) User-friendliness

A naive user with little knowledge of computing, should be able to work readily with a user-friendly system. Even though it is difficult to achieve complete user-friendliness, students perceive relative degrees of this attribute for different systems.

ii) Well laid out

The look of the information should be visually appealing to the users. The colour, graphics and other elements used on the screen should be attractive and easy to understand and remember by naive users.

iii) Ease of learning

How easy are the interface commands and functions to learn? The time required to learn how to do a set of tasks is one measure of this.

iv) Presentation of information

The elements of information should be clear and effectively presented in order to be easily understood. Both the structure and layout of the information are important for good screen design.

v) Error frequency

This refers to the number of errors committed and/or the time taken to correct these errors. Errors include mistakes and slips, as explained in the previous chapter.

**2.4. System variables.** The variables which seemed important, in this case, for a system model were :

i) Speed of information retrieval

This relates to the question of how easily and quickly the information can be

retrieved from a hypertext system. This may depend upon many aspects of the system (such as users' system knowledge, users' mental abilities and skills, ease of system operation, etc.).

ii) Number of questions attempted

This refers to the number of tasks a student attempted to complete within the time provided. Since there is a time limitation (i.e. one hour for each class), the number of questions attempted varied from sub-group/student to sub-group/student.

iii) Number of correct answers

The number of questions correctly answered out of the total questions attempted in the given time was determined. This varied with the sub-group/student concerned.

iv) Number of incorrect answers

This obviously follows from the previous measurement

v) Number of unattempted questions

Due to time limitations and the unfamiliarity of the interface and system, many students could not finish all the questions within the time provided. Students were asked to comment on this and other problems in their final questionnaire.

**2.5. Task variables.** The task structure can be classified into three types according to the nature of the problem :

i) Simple inquiries

Where the students are asked to find factual, unambiguous information from the hypertext database.

ii) Complex inquiries

Here the students have to think about the task and make their own judgments concerning the answers. Consequently, the answers may vary from person to person.

### iii) Design tasks

In this case, students were asked to design a HyperCard application program with the help of the instructional hand-outs. The number of tasks completed in the design task exercise could be measured, and all the students were given the same fixed time in which to complete their task.

## **2.6. Navigational variables**

Broadly speaking, users navigate through hypertext systems in two ways: i) sequentially and ii) non-sequentially.

### i) Sequential viewing of documents

In this case, users mostly use fixed links to go either to the next or the previous screens to the current viewing screen. These links are common in menu-based systems, but are also provided in hypertext systems, as some users wish to view documents sequentially.

### ii) Non-sequential viewing of documents

Here users can explore the hypertext system through hypertext links in a variety of directions. It is a quick way of moving through the hypertext database for all types of users.

## **2.7. Information retrieval variables**

In hypertext systems, users can find the information in different ways, but two are particularly common - browsing and Boolean searching.

### i) Browsing

Here, the user simply follows the hypertext links and can reach the information required in a variety of ways. It can be a time-consuming process.

### ii) Boolean search

Even though this approach is not as effective as for relational databases, hypertext system designers typically provide this facility to satisfy the people who are familiar with this type of information search.

### iii) Non-Boolean search

This is similar to a keyword searching method which is widely seen in OPACs, small bibliographical databases and so on.

## 2.8 Summary

The characteristics of students in a learning environment have been identified in several studies (Brewer, 1985; Dehning, Essig and Mass, 1981; van der Veer and van de Wolde, 1983). One can assess the usefulness of an interface by studying its negative and positive attributes through qualitative and quantitative tests. Qualitative variables such as ease of use, user-friendliness, ease of understanding and learning, help identify the overall impressions of students. Quantitative variables can be used to crosscheck the results obtained from qualitative tests. Hence, in this study both the qualitative and quantitative variables have been selected.

## 3. **METHODOLOGY**

### 3.1. Methodology for the pilot study

The general approach to methodology has been described in this Chapter before. This pilot survey employed an eight-hour training programme, at the rate of two hours per week for a continuous period of four weeks. Since it was intended to be an introductory training course, the basic elements of HyperCard, and technical terms in HyperCard and hypertext were explained. In each two-hour class, ninety minutes were allocated to teaching and demonstration, and thirty minutes to practice with the software. Guidance was provided to the students during that period as it was needed. At the beginning of every class, any problems from the previous class were discussed. Hand-outs were provided for all classes, and the students were asked to practice out of the class.

In general terms, the elements taught consists of the following. In the first week, the basics of the Macintosh computer were taught, along with a brief description of hypertext and its features. HyperCard software was demonstrated as an example. In the second week, HyperCard's Painting tools were explained and demonstrated. The basics of stack design together with the building of an example stack were covered in the third

week. Lastly, in the fourth week, problems encountered by students were discussed, the questionnaires were completed and 'My To Do' stack (a sort of diary stack as an assignment: details about this were given later) which was demonstrated before in the class was designed by the students on their own.

In more detail, each painting tool was explained and demonstrated in the second week along with their enhancements and shortcuts. Since there are 15 painting tools, it would have taken more than the time allocated just for explanation only. So a hand-out describing enhancements and shortcuts using painting tools was supplied to all the students, and they were asked to practice them after the class.

In the third week, a stack design was demonstrated by taking a simple example - in this case, a weekly diary entitled "My To Do" stack. A hand-out describing the steps to be followed in designing this stack was given to the students for their guidance. The 'My To Do' stack was a simple personal diary in which seven cards were to be provided, one for each day of the week, in a form that might be used for planning personal activities. This required them both to create a new stack, and also to make various modifications to the text and graphics. Their activities therefore ranged from erasing and inserting patterns, selecting an appropriate type face, creating, organising and linking buttons and cards to linking the stack finally to the home card.

In the last week of training, the entire course was reviewed briefly. Students were asked to complete a questionnaire designed to examine their use of the software and their opinions on the speed and duration of the course. Finally, students were asked to design the 'My To Do' stack which was demonstrated its design in the week three. They were given a detailed hand-out and also provided with classroom help while designing the stack.

As this suggests, most aspects of HyperCard ( the basic elements, painting tools and stack design) were covered. Programming was mentioned very briefly, but not demonstrated practically.

To assist in evaluating students' work, a coursework performance sheet was designed and used for the evaluation of their stacks.

### **3.2. Methodology for the initial hypertext teaching experiment**

The first five objectives mentioned in Chapter 2 were examined via the following methodology. The minimum acceptable level of acquaintance of students with hypertext can be expressed in terms of two activities. The first is the use of existing hypertext packages to retrieve information: the second is construction of a simple application of hypertext for one's own use. It was decided therefore to introduce students to both these activities. Six contact hours (spread over six weeks of term) were set aside for this teaching, as this seemed likely to be near the minimum required to meet the objectives. Feedback from the students would determine whether or not this assumption was correct.

The subjects for this study were second-year undergraduate students at Loughborough University, who were taking either single or joint honours degrees in Library and Information Studies. There were 36 students in this class, none of whom had previously encountered hypertext. In addition, there were six students taking a degree in Information and Computing Studies who had had an introductory course on hypertext in their first year. These students were used to monitor the progress of the other students on the course. All the LIS students had similar computing knowledge, though some had different levels of prior computer experience. Keeping the ICS students aside, all the LIS students were randomly divided into two groups; so the groups had students of heterogeneous backgrounds in respect of age, sex, subject background and level of general computing and Mac experience. These two groups were further divided into 4-5 sub-groups each one of which had 3-4 members. Each sub-group was provided with an ICS 'monitor', and given a Mac to carry out their practical exercises.

Stodolsky(1984) has described five types of peer work-groups. They are - completely cooperative, cooperative, helping obligatory, helping permitted and peer tutoring. i) In a completely cooperative grouping, the groups have independence with regard to both means and ends. All the members share

all aspects of the group activities and work towards a common end. Students are expected to discuss, debate, evaluate and come to a cooperative conclusion. ii) The second type of peer-work-group is cooperative. The difference between this group and the completely cooperative group is that the tasks and activities are divided to some extent, but students still work towards a common goal. iii) In helping obligatory groups, each student is supported to work on their own and complete the assignment or task, and evaluation is on an individual basis. However, students are expected to help each other in their work, so that help flows from one student to another. iv) Helping permitted is like the helping obligatory type, but there is no pressure for students to help each other. v) Finally, in peer grouping, students do not work towards a common goal or task. Within any group, one student is expected to be more expert than the others and helps them complete the task. This classification seems to be clearer than others currently available (such as Sharan and Hertz-Lazrowitz, 1980; Slavin, 1980; Bar-Tal and Geser, 1980; and Sharan, 1980). It has been kept in mind when devising the group structures described below.

The distribution of students sets and sub-sets was partly dependent on timetabling constraints. However, a fairly regular pattern was imposed of three or four members (including the student from ICS who worked as a group monitor).

Table 3.2 . Distribution of students among the sub-groups

<u>Set</u>	<u>Sub-set</u>	<u>Number of students</u>
<b>A</b>	A1	4
	A2	3
	A3	4
	A4	4
	A5	4
Total number of students in set A :		19
<b>B</b>	B1	4
	B2	3
	B3	4
	B4	3
	B5	3
Total number of students in set B :		17

Each student was exposed to one hour of hypertext learning/teaching for six successive weeks. All students attended an hour of introductory demonstration and discussion of hypertext and were then provided with a comprehensive folder of hand-out material. These hand-outs included an overview of hypertext and Macintosh computers, together with background reading, as well as a detailed introduction to all those aspects of HyperCard that students would be using subsequently. Group A spent the next two class hours carrying out projects. They then returned for two hours of classroom discussion and for further demonstrations. Group B had the latter two hours first: then they did the project work. Finally, all students came together for a general discussion of hypertext and how its use should be taught.

Whilst the Library and Information Studies students in groups A and B were carrying out their project work, the Information and Computing Studies students were monitoring their activities. For example, the first exercise involved measuring how long it took to answer a series of questions. The Information and Computing Studies students were asked to observe and measure these times independently, and their estimates compared with the times measured by the group members. More generally, the Information and Computing Studies students were asked to help (or call for assistance) if it became clear that a group had completely lost its way. Before doing so, however, they had to record what the problem was that the group had encountered.

The first exercise the students were required to carry out was to look at a hypertext disc produced by Drexel University in the USA, and to answer questions based on its contents. In this case, all the students were asked to note their answers, the time taken for each task and the problems they encountered while using the disc on a specially prepared worksheet.

### **DREXEL DISC**

The Drexel disc was designed for naive or relatively inexperienced students attending Drexel University in the United States during the first few months of contact with computers. (DLIS at Loughborough was given permission to

make use of this material.) After an initial animation sequence, the screen switches to a copyright notice, which also offers an option to learn mouse usage for naive Mac users. It then takes the user to the main menu of the Drexel disc.

**Main menu.** The main menu (Fig.3.1 ) offers six choices, (each of which has graphics along with labels). These choices are : i) Drexel University Macro Facilities, ii) Rights and responsibilities, iii) Drexel disc index, iv) Shortcuts & Tips, v) Miscellaneous, and vi) Something else.

**i) Micro Facilities.** This leads to another screen(Fig.3.2) which offers eight choices, representing the various types of microcomputer facilities on campus (such as printers, micro classrooms, repair, hotline, access clusters, consulting, database searching). Each choice gives information about the support services that the university provides. For example, when the user selects the 'database searching' choice box, the screen shows the campus map and the location of those facilities on it. On the campus map, each building is numbered and can be highlighted. At the bottom of the screen, the name of the building along with its number and the indication to click to have further information is displayed. The other seven boxes provide corresponding information to users.

**ii) Shortcuts & Tips.** The 'Shortcuts & Tips' box on the main menu leads the user to another screen which offers nine choices (such as 'Space & storage', 'Apple Jargon', 'MacWrite', 'Nifty things', 'Printing', 'Hardware', 'Spreadsheets', 'File Maker' and 'HyperCard'). These choices provide helpful hints on how to use the computer as a tool in instructional computing, ranging from very basic information about the mouse to explanations of various Macintosh software.

**iii) Rights & Responsibilities.** This screen provides four more choices (such as computer access, copyright, warranties, and truth & consequences). These options offer information about relevant policy matters, particularly university policy on software written by students and faculty.

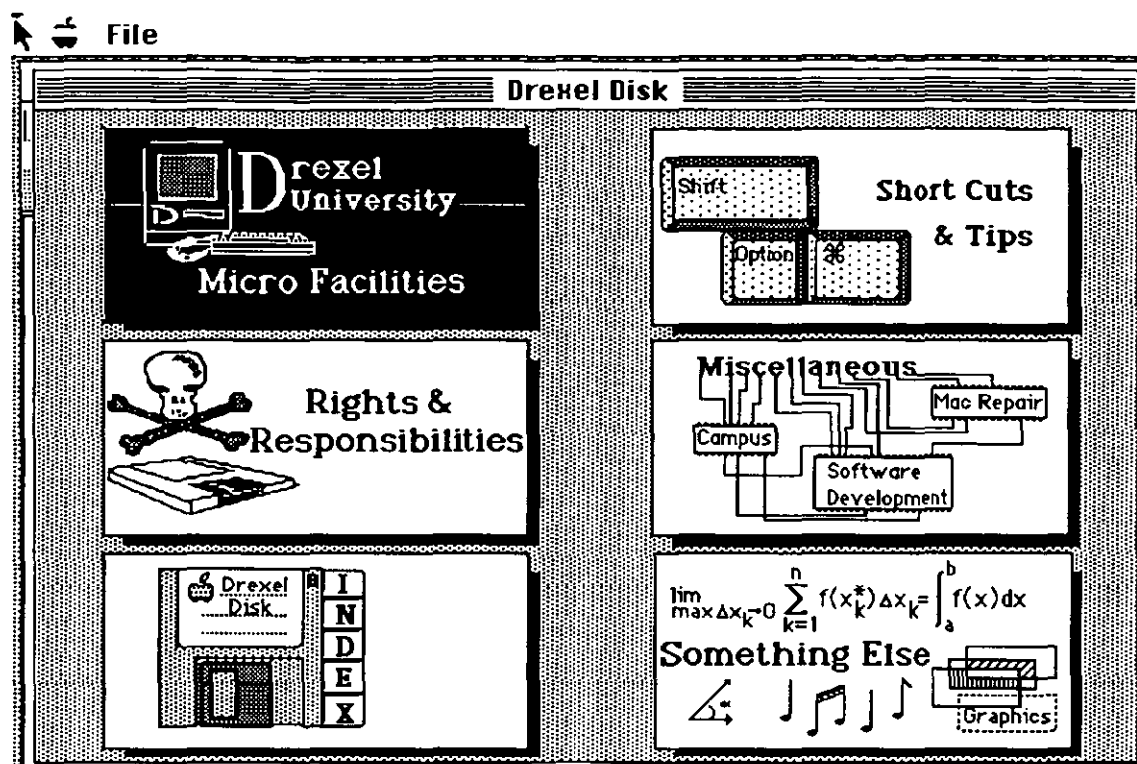


Figure 3.1. Drexel disc - home card

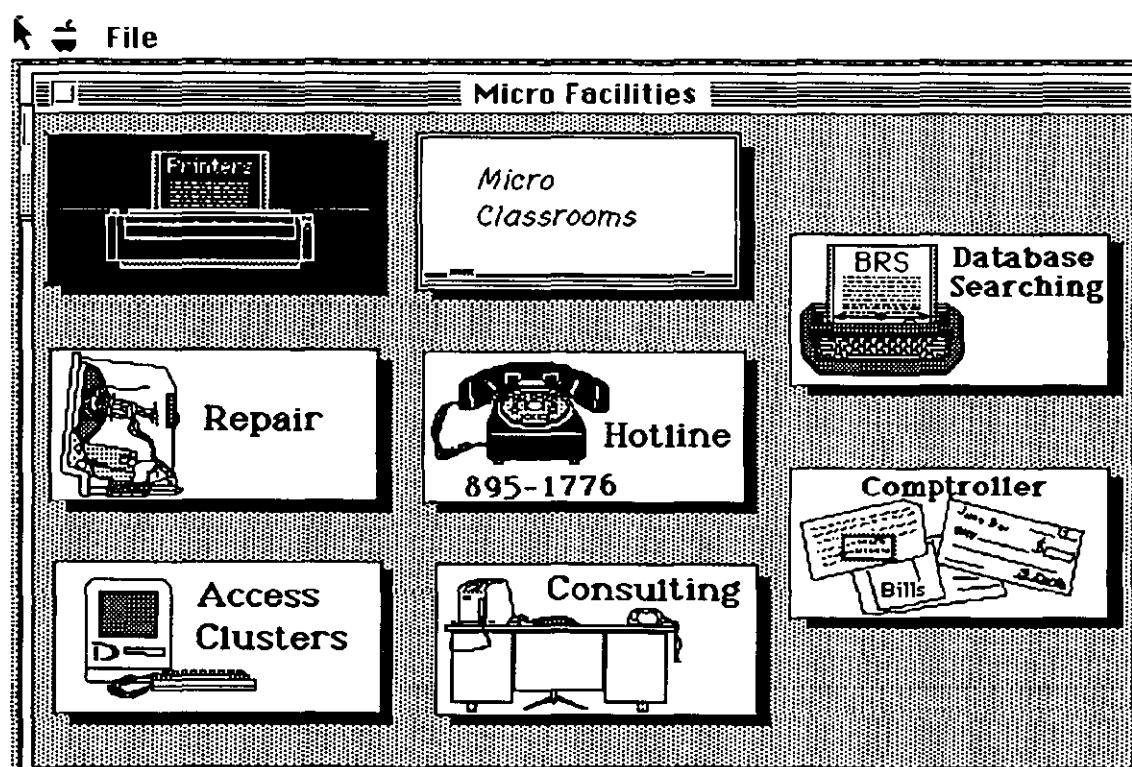


Figure 3.2. Drexel disc - MicroFacilities

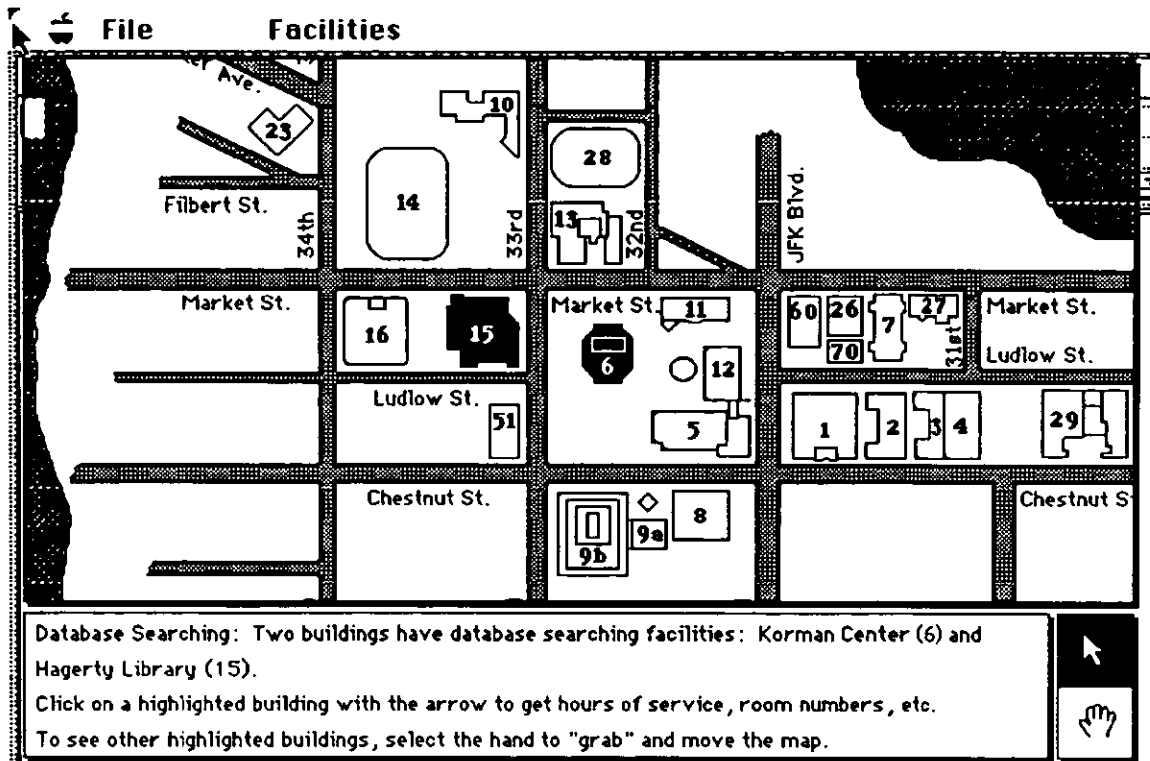


Figure 3.3. Drexel university - campus map

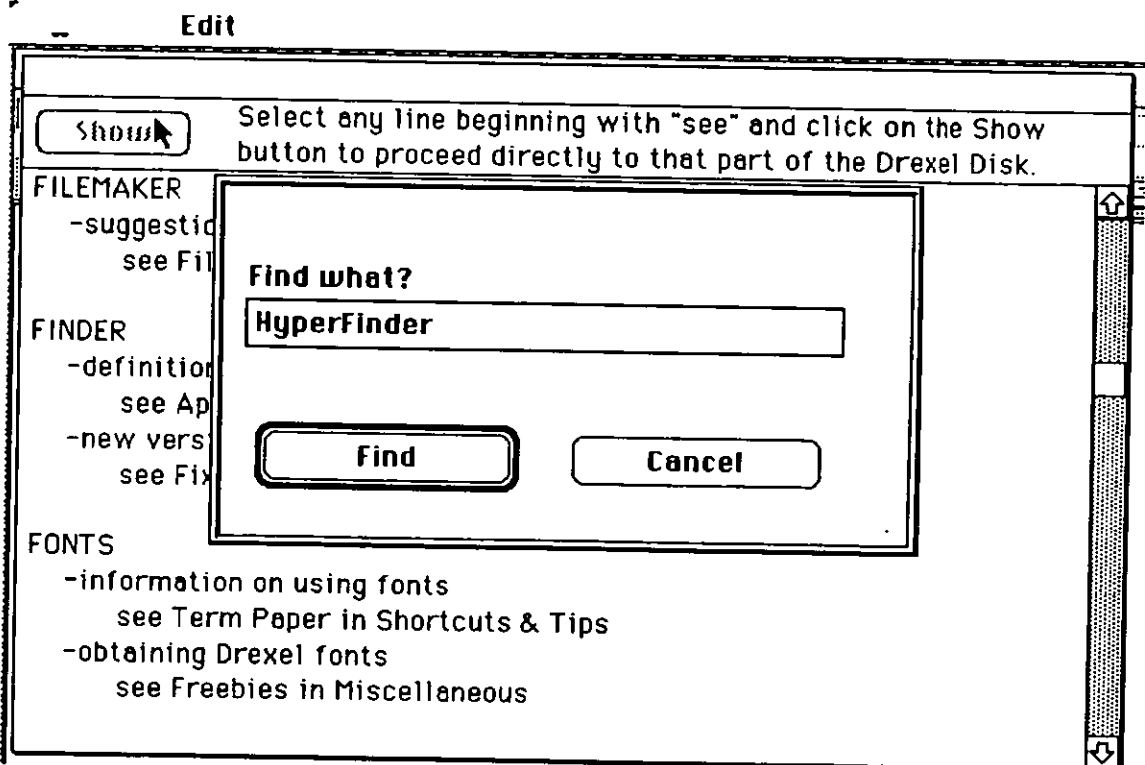


Figure 3.4. Drexel disc - index

**iv) Miscellaneous.** The 'Miscellaneous' box leads to another screen dealing with campus buildings, freebies for sale, fixes and upgrades. Telecommunications and Mac prices are provided. The campus building option moves back to the campus map (Fig.3.3) on which further information can be given about each building (eg. name of the building, facilities available, hours of opening). There is a search facility (Fig.3.4) on the menu that offers a list of academic departments, and can lead to further information about the department (such as the name of the head of the department, telephone number, location of the office, and some information about the undergraduate courses offered by the department).

**v) Index.** The fifth choice on the main menu leads to a keyword index. When the user activates the index choice box, a window appears with a hypertext index of almost all the disc contents (Fig.3.4). The user can select any of the words with a mouse click and can use the 'show' button to show the related information on that word. Alternatively, there is a search facility on the menu which can be used for searching information in the database.

**vi) Something Else.** The final choice on the main menu of the Drexel disc is 'Something Else'. Clicking on this box takes the user directly into one of the six demonstration modules of the courseware materials. The selection of module is random and all the modules run one after another. These are the modules of courseware that are in use at Drexel University in various departments.

Overall the Drexel disc is a fairly simple, attractive and well-designed program. It is a hypertext guidebook which can be used with little or no Mac experience. This simplicity and the interest (for comparison purposed) of American university activities were the main reasons the Drexel disc was chosen as courseware material for this study.

After using the Drexel disc, the students were asked to evaluate the disc with regard to its contents and organisation of information. The questions asked were: 1) How easy to use did they find this disc ? ; 2) How informative did they find it ?; 3) How well-organised did they find the material ?; 4) Were there any features (eg. the campus map) that they especially liked ? If so

what were they?; 5) Were there any features that they especially disliked ? If so what were they ?; 6) If a similar disc was to be made for Loughborough, what are the changes they would like (giving examples) in: a) the way the information is presented?; b) the type of contents included? ; 7) Any other comments about the disc?

### **CUSTOMISATION**

The second exercise was to implement a simple customisation of a weekly diary using HyperCard. (The details of the stack design are given in Chapter 4). While doing the customisation exercise, the students were asked to record the problems they encountered. At the end of the course, all the students were asked to submit an essay on both the tasks they had been set (Drexel disc and customisation) together with their assessment of the problems facing the teaching of hypertext. They were also asked to specify the main problems they had encountered in their own use of HyperCard. Finally, a questionnaire(see Appendix-V) was distributed to all the students(both LIS and ICS) to find out the use of hypertext(HyperCard) for teaching. The data gathered in this experiment through worksheets, questionnaires and essays are analysed and discussed in the analysis Chapter 4.

### **3.3. Methodology for the final hypertext teaching experiment**

The results obtained using heterogeneous groupings of students in the initial study suggests that the experiment should be repeated using:i)homogeneous groupings of students, and ii) fewer members students per group.

#### **i) Size of the group**

This depends on a balance of factors : too many students can retard individual learning, but too few can lead to a limited understanding. Thus, with a bigger group size, students have less individual computer experience, but more group discussion; whereas, with smaller groups, they have more personal computer experience, but less group discussion. For the revised experiment, the size of the group was reduced to pairs of students and to individuals.

In this revised experiment, there were 45 students altogether, of whom 34 were from LIS and 11 were from ICS. The LIS students were divided into three groups, labelled 'A', 'B', and 'C', whilst the ICS students became group 'D'. These main groups were further divided into sub-groups consisting either of pairs, or of individuals. In this new set of second-year students, the ICS members had not been exposed to hypertext previously; so they were used as subjects, rather than monitors.

The distribution of students into groups/sub-groups is shown in the table below.

Table 3.3. Distribution of students in various groups

	<u>Number of sub-groups</u>	<u>Students per sub-group</u>	<u>Total no. of students</u>	<u>Student's background in the sub-group</u>
<u>Group A:</u>				
				All female members.
<b>Pairs</b>	4	2	= 8	All had used a Mac before.
<b>Individuals</b>	5	1	= 5	All were of a similar age.
			----- 13 -----	
<u>Group B:</u>				
				All female members.
<b>Pairs</b>	4	2	= 8	None had used a Mac before.
<b>Individuals</b>	3	1	= 3	Covered a range of ages.
			----- 11 -----	
<u>Group C:</u>				
				Mainly male (apart from two sub-groups).
<b>Pairs</b>	3	2	= 6	
<b>Individuals</b>	4	1	= 4	None had used a Mac before
			----- 10 -----	All were of a similar age.
<u>Group D:</u>				
				Mix of male and female members.
<b>Pairs</b>	3	2	= 6	All experienced computer users.
<b>Individuals</b>	5	1	= 5	Covered a range of ages.
			----- 11 -----	

As the table indicates, the intention behind these groupings was to mix the various user characteristics (variables) such as age, sex, level of computer experience, experience with Macs and HyperCard. Users of similar characteristics were grouped together and formed sub-groups. For example, Group A was divided into eight sub-groups: these sub-groups were built up in the following way.

Table 3.4. Distribution of students in Group A

**Group A :**

**Pairs**

<u>Sub-group</u>	<u>Ages</u>	<u>Sex</u>	<u>Computer experience</u>	<u>Experience with Macs</u>	<u>Experience with HyperCard</u>
A1	19/19	females	normal	used	Nil
A2	19/19	females	advanced	used	Nil
A3	32/36	females	normal/advanced	not used	Nil
A3	19/19	females	advanced	not used	Nil

**Individuals**

A5	47	female	normal	used	Nil
A6	34	female	advanced	used	Basic knowledge
A7	20	female	advanced	used	Basic knowledge
A8	20	female	advanced	used	Nil

[normal : students of one year or less computer experience; advanced: students of more than one year computer experience]

The B, C and D groups were divided into sub-groups in the same way. Group B had 4 pairs and 3 individuals, Group C had 3 pairs and 4 individuals and Group D had 3 pairs and 5 individuals.

**ii) Composition of the group**

In this revised experiment, each student attended five one-hour sessions. The first and last weeks were lecture-cum-demonstrations, whilst the other three were practical with two weeks gap between each class. This approach had to be taken due to the reduced sizes of the sub-groups compared with the Macs available for teaching. The results from the first year had indicated that six hours was just acceptable for teaching hypertext. In the revised approach it was hoped to determine whether smaller groups allowed an even lower minimum. First, all the groups combined for an introduction to HyperCard/hypertext. At the end of the course, all the students assembled

for a further class to discuss the problems they had encountered. Of their three hours practical time, one was allocated for the Drexel disc exercise and the other two for the customisation exercise. As before, they were asked to find answers to tasks given in a worksheet. In this Drexel disc exercise, all the courseware materials and worksheets provided were the same for all the groups. For the 'Document catalogue design' exercise (a revised customisation exercise), two types of hand-out were prepared. One was a 'normal hand-out', in which detailed instructions were given in a step-by-step form(see Appendix-XVI). In the other hand-out, the instructions were given in a much briefer form(see Appendix-XV). The A and D groups were given 'normal hand-outs', and groups C and B were given 'brief hand-outs'. However, these latter groups had available much more classroom help while they were doing the practicals.

For the Drexel disc exercise, students were supplied with three types of worksheets - a Task worksheet(see Appendix-VII), a Drexel disc evaluation form, and a Problems recording form(see Appendix-VIII). For the customisation exercise, they were provided with two types of worksheet - an Exercise progress form (see Appendix-IX)and a Problems recording form(see Appendix-VIII). After completing the course, all the students were given a final questionnaire(see Appendix-X) to ascertain, as before what their overall view of the course was. Finally, they were asked to submit an essay on the problems and pleasures of using HyperCard. The data obtained from all these worksheets and essays were subsequently analysed and are discussed in Chapter 5.

### **3.4. Comparison of hypertext and menu-based interfaces**

The database used in this study was a catalogue of teaching software prepared by the Computers in Teaching Initiative Centre for Library and Information Studies(CTILIS) which is situated in the department at Loughborough. The CTILIS Software Catalogue originally appeared in a printed version. The two automated versions were designed to compare a hypertext interface with a menu-based interface in terms of use and ease of retrieving the information from a database. After the study reported here, copies of the software were provided free of cost to LIS teachers and professionals on request. This is small catalogue (containing 40 entries), but

each entry may need to be retrieved under a range of headings. Altogether there are 11 aspects for each software entry in terms of which retrieval might be necessary (eg. who uses the software for teaching, what sort of teaching is involved, how much the software costs.). This database has the advantage of being of interest to library and information students, and they have the additional motivation that they can expect to encounter dbms and hypertext systems in their subsequent careers.

The HyperCard and dBase III+ interfaces to the database were designed specifically for this experiment. (The dBase III+ interface was designed by a fellow research student.) The intention in each case was to provide an interface which was acceptable to relative beginners in the art of information retrieval, but which also exploited the particular advantages of each type of interface for efficient information retrieval. Both versions were pretested with students and staff from Loughborough and elsewhere. Modifications were made, where necessary, in the light of this pretesting.

The CTILIS catalogue consists of basically four stacks : i) the introduction to the Software Catalogue, ii) a list of CTI Centres, iii) a list of LIS Departments, and iv) a list of LIS - oriented software. The catalogue's home card (Fig.3.5) is in the "Software Catalogue" stack, which is the opening stack to this catalogue. It provides an introduction to CTI, the CTI Centre for LIS, its objectives, functions, who are the people concerned, its services, etc. It has a 'help' section (Fig.3.6), which provides information about the catalogue, the project, the icons used, complete information about the stacks and the organisation of information in the form of a 'Stack Map' (Fig.3.7). As shown in the figures, every box in this map is interactive and takes the user to the corresponding part of the database.

The CTI Centres stack gives all the CTI centres' addresses and also contact persons at all the CTI centres in various disciplines (Fig.3.8). The LIS Departments stack covers all the LIS Departments and schools in the country (Fig.3.9). Finally, the CTILIS Software stack is the main stack: it covers all the basic information (Fig.3.10), such as the name of the software, designer's address, price, hardware required, availability, supplier and teaching uses.

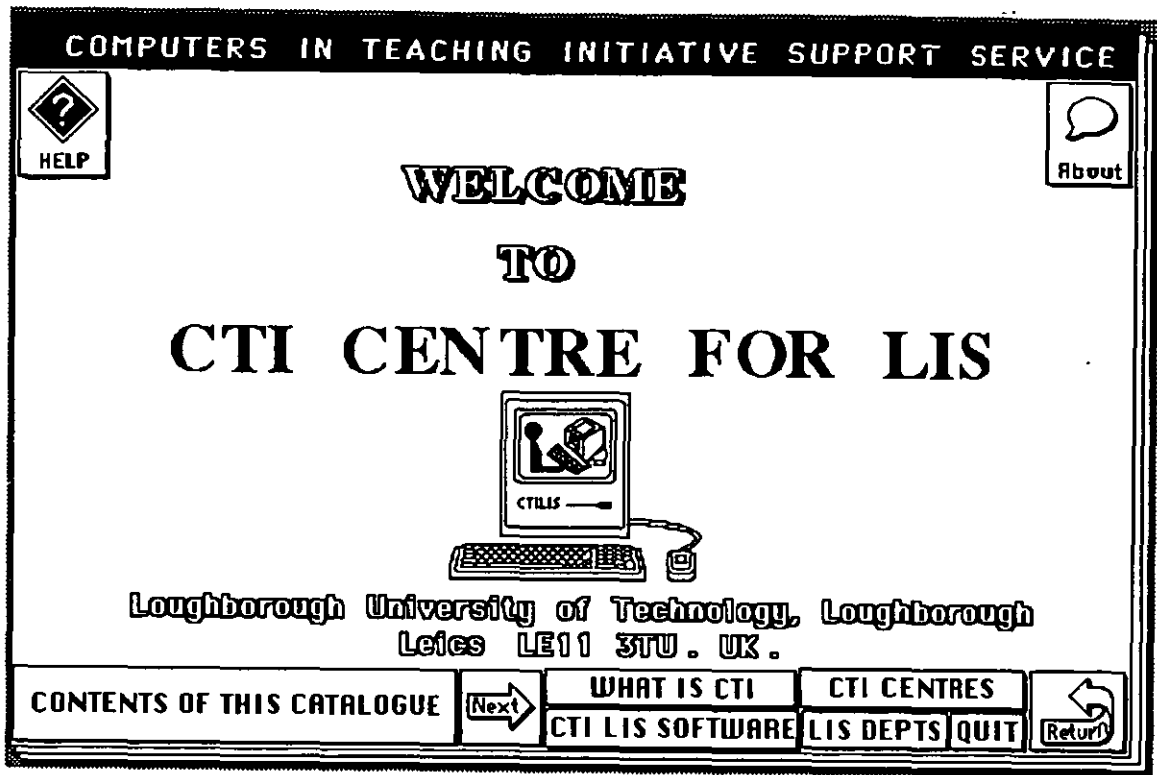


Figure 3.5. CTILIS Software Catalogue - home card

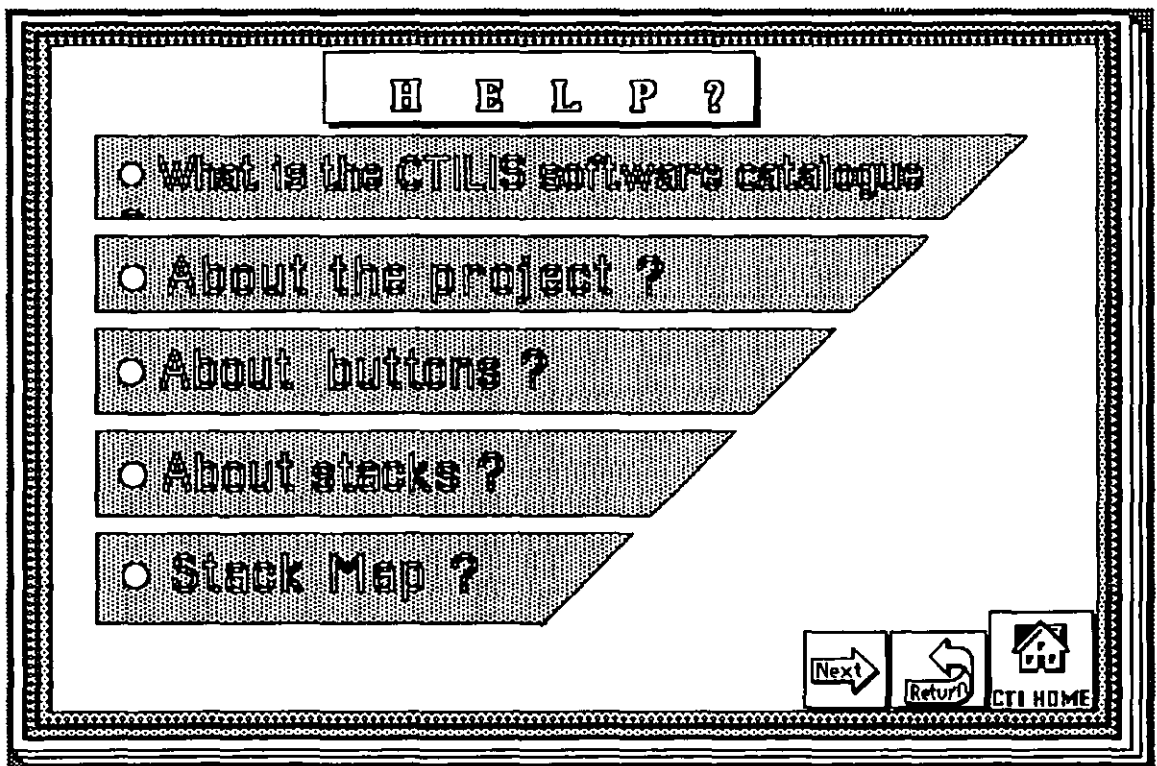


Figure 3.6. CTILIS Software Catalogue - help

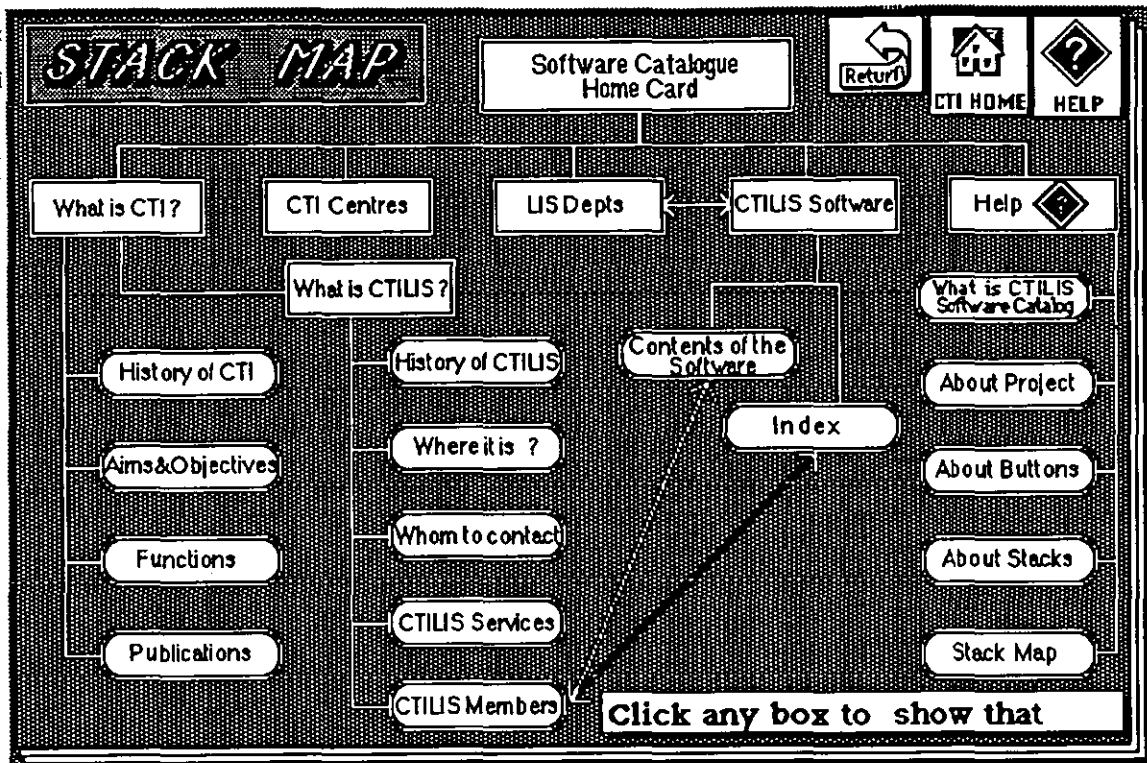


Figure 3.7. CTILIS Software Catalogue - stack map

<b>Field :</b>	CTISS (Computers in Teaching Initiative Support Service)
<b>CTI Centre :</b>	University of Oxford 13 Banbury Road Oxford OX2 6NN
<b>Date :</b>	1986
<b>Contact Person:</b>	Joyce Lewin Email : CTISS@ox.vax Tel : 0865 273273

FIND CENTRE Prev Next

Return

Figure 3.8. CTI Centres - sample card

LIS DEPARTMENTS ADDRESSES	
Name & address of the Dept. :	15 of 16
	Department of Information Science,
	University of Strathclyde,
	Livingstone Tower,
	26 Richmond Street, Glasgow G1 1XH.
	Telephone 041-552 4400 ext. 3700
	Telex 77472 UNSLIBT G
	Telecom Gold 79: GOW 006 ALANET ALA1158 JANET FG@UK.AC.STRATH.CS
User/Developer of the software:	Apple Computers (USA)
Name of software:	Hypercard
CTILIS SOFTWARE         Find ?	

Figure 3.9. LIS Departments - sample card

Software		BOOKSHELF	8 of 65
Type	Library management and housekeeping		Price see supplier
Author	Specialist Computer Systems and Software Ltd.		User ↓
Addresses	Specialist Computer Systems and Software Ltd., Goodson Building, Goodson Street, Hanley, Stoke on Trent ST1 2AT; telephone (0782) 279110; fax (0782) 202267	Hilary Dyer Department of Information and Library Studies, Loughborough University of Technology, Loughborough, Leicestershire LE11 3TU Telephone (0509) 223068 Fax (0509) 223053 Telex 34319 JANET H.J.Dyer@uk.ac.lut Department of Library and Information Studies	
	Package: Bookshelf		
Hardware	Teaching Uses of Bookshelf		
Availability	Bookshelf is a library management system, designed for use in a real library setting but capable of running on relatively inexpensive hardware. It is used in a substantial number of libraries of colleges of further education, in a number of medical libraries and in some of the smaller public library systems. It provides cataloguing, thesaurus, circulation, acquisitions and serials control modules. The bibliographic database created by the cataloguing module is at		
Supplier			
Uses			
		FIND A KEYWORD         CONTENTS    INDEX	

Figure 3.10 CTILIS Software Catalogue - sample card

## Sample

Volunteers to evaluate this catalogue were obtained from amongst undergraduate and postgraduate students in the Department of Information and Library Studies. Altogether 40 students participated, nine of whom were postgraduate research students, 22 - postgraduate master's course students and nine - undergraduate students. They were asked to answer a series of questions concerning the contents of the database using successively the

HyperCard/Mac and dBase/PC combinations. To allow for transfer effects (i.e. experience from the first trial affecting the results of the second), the participants were divided into two groups - hereinafter labelled 'Group A and B' - each consisting of 20 members. Members of Group A used the HyperCard/Mac combination first, whilst members of Group B used the dBase/PC combination first.

Group A consisted of 14 females and 6 males, whereas Group B contained 6 females and 14 males. The spread of ages of the two groups was similar, with a mean of 31.3 years for Group A and 33.0 years for Group B (with standard deviations of 7.7 and 5.9, respectively). In each group, 18 members had had previous training on computers (mainly microcomputers), whilst two had not. Previous training had mainly been on IBM-compatibles, with word-processing as the most popular activity. Of Group A members, 13 had previous experience with the Macintosh, as compared with 9 members of Group B. Previous acquaintance with HyperCard and dBase III+ was similar between the two groups, as indicated in the Table below.

Table 3.5. Students' prior domain experience

	<u>Group A</u>		<u>Group B</u>	
	<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>
Previous experience with HyperCard	3	15	5	13
Previous experience with dBaseIII+	8	18	11	7

The participants consisted of a mix of 20 overseas students and 20 UK-based students. It was important to get a balance between the two groups, since overseas students differ systematically from home-based students in a number of factors (average age, previous computer experience, etc.). Each

group was therefore made up of 10 overseas and 10 home-based students.

The evaluation exercises were carried out with one member of Group A and one of Group B participating simultaneously. So far as possible, each pair of participants were matched (e.g. if the Group A participant was an older overseas student, so would be the Group B participant). This was intended to compensate for any changes in the environment (time of day, external noise, etc.) as the evaluation exercises proceeded.

Students were set a series of 12 questions(Appendix - XI). Finding the answers entailed accessing different parts of the database, starting each time from the initial screen. Examples of these questions are: Who is the supplier of CEA software?; What is the price of QUESTION MARK software?; Which software is both a hypertext system and an expert system? The time taken to find an answer to each question was recorded by an observer, together with the number of steps required to answer the question. (A 'step' here is defined as any input by the user to the system, e.g. a command to move from one screenful of information to another.) The most efficient routes for answering the questions had been worked out beforehand. The number of steps taken by a participant was compared with this predetermined figure: any excess was recorded under the heading 'extra steps'. Finally, all the students were distributed a questionnaire(Appendix - XII) to ascertain their opinions about both the interfaces and the computers (IBM PC or Mac) as aids for teaching hypertext to university students.

The data obtained from the questionnaires and worksheets were analysed, and the results are presented in Chapter 6.

### **3.5. Comparison of colour/graphics v. black & white hypertext interfaces**

#### **3.5.1. Hypertext Hands-on (HHO)**

The black and white hypertext system used in this study is an electronic version of a basic textbook designed using HyperTIES and was developed at Maryland University. It is available along with the hardcopy version 'Hypertext Hands-on' (HHO) written by a well-known researcher in user

interfaces, Prof. Ben Shneiderman. It provides some graphics and colours, but was converted to a black & white plain-text hypertext system for these experiments by being installed on a IBMPC/XT with monochrome monitor. The final system was black-and-white with highlighted words as hypertext links: these could be activated by using keyboard arrow keys. The system could also be used with a mouse to activate the hypertext links : this input was not provided as the intention was to compare it with a mouse-based hypertext system.

The main features of the system and illustrative screen prints are given here. HHO has a root document which is the preface to the disc. It provides different choices (such as 'Table of contents', 'Index', 'History' and 'Search facility') to proceed further. The table of contents was organised by topics selected via the arrow keys. To find titles/keywords, there is a 'turn to' option at the bottom of the index screen; either typing the first letter of the keyword or using the forward arrow key allows the user to select the appropriate keywords under that letter. Moving the cursor to the required keyword with arrow keys and pressing return then shows the required article. The user can obtain online help by simply typing a question mark(?) or control-H.

## 5.2. Innovation & Technology Transfer (ITT)

In contrast to HHO, 'Innovation & Technology Transfer' (ITT) is a hypertext bulletin (Fig.3.11) developed by using another hypertext system, called 'ToolBook', which operates in a Microsoft Windows 3.0 environment. The first issue of this bulletin was sent for evaluation to a group of academics who already used the printed version. It uses colours extensively along with graphics, icons and animation(Fig.3.12). It was installed on a IBMPC/AT compatible with a super VGA colour monitor and a mouse-driven environment, so providing a colour hypertext system with a graphical interface.

ITT covers scientific and technological research information relevant to the EC. It contains in-depth articles about all aspects of DGXIII, but especially the policies, strategies and strategic thinking which underpin the work of the Director General. The main purpose of DGIII programme, and therefore of the bulletin is to disseminate relevant information to EC community members.

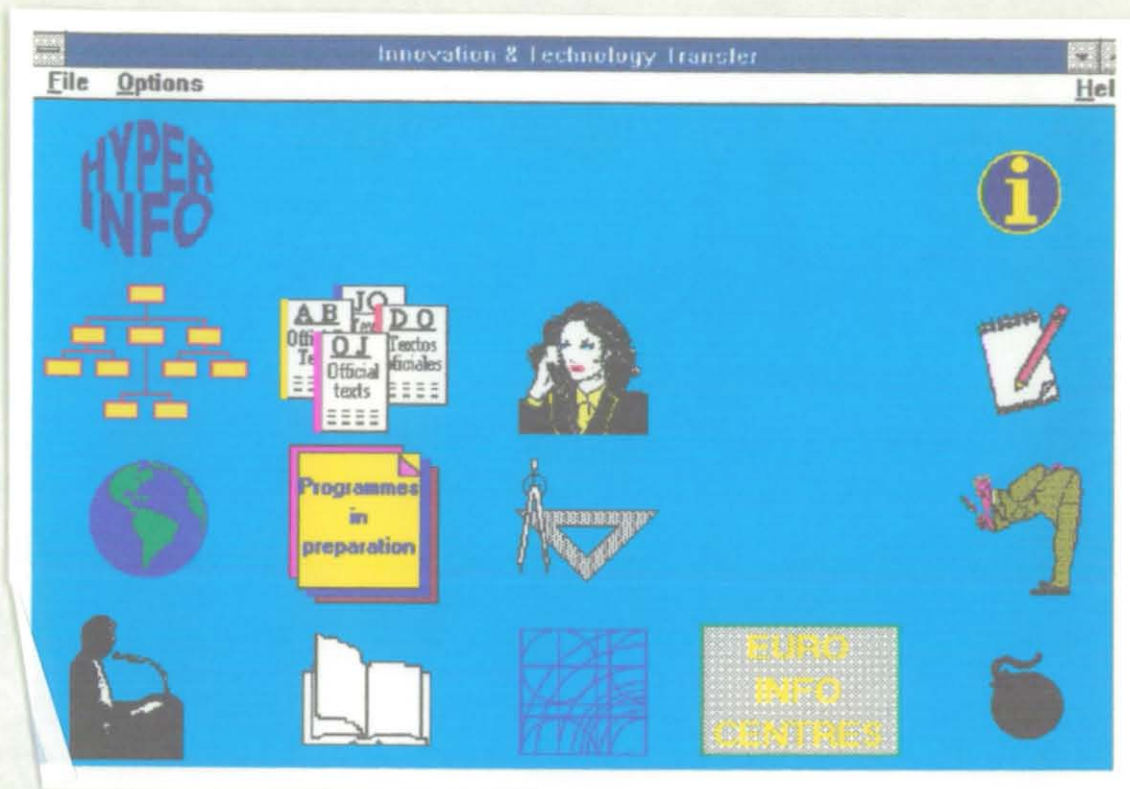


Figure 3.11. ITT - main menu

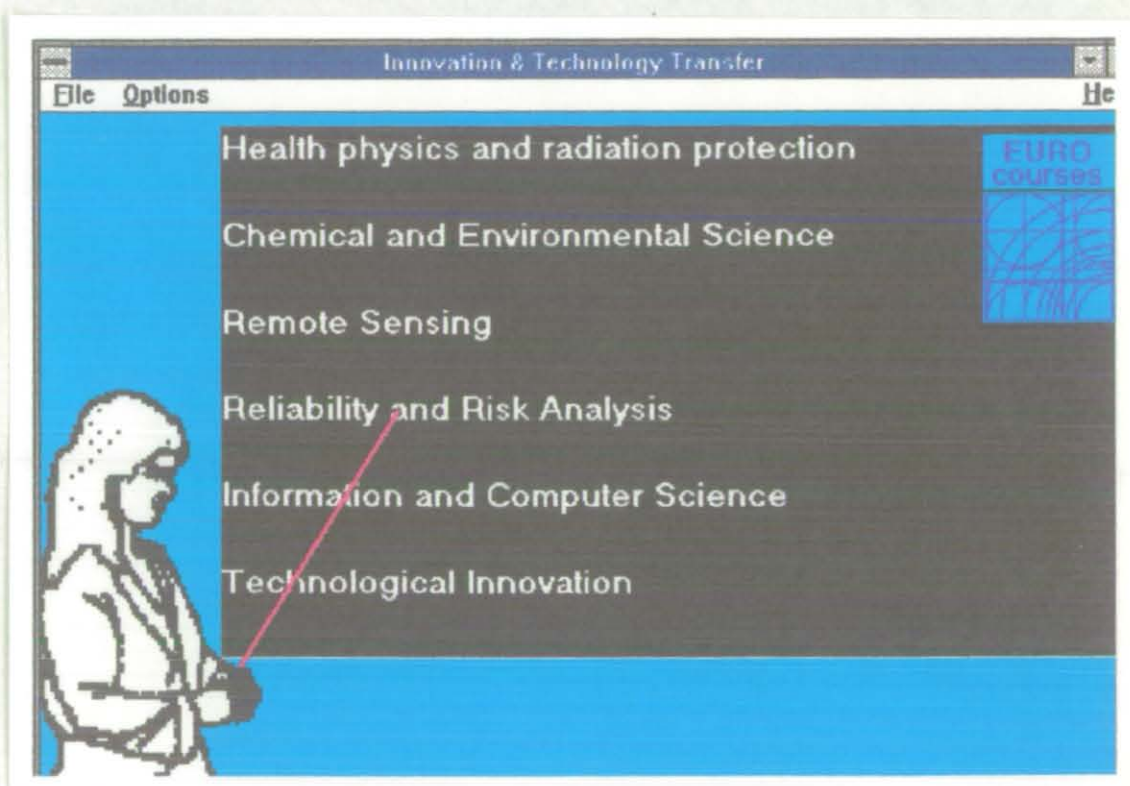


Figure 3.12. ITT - programs

The first issue of the ITT was launched in April 1990. It was intended to publish quarterly diskettes, but the possibility of using electronic mail was also being investigated. The text is multilingual, but, currently, only an English-language version is being produced. Eventually, it will be available in English, French, Dutch, Spanish and Italian.

Though there is an obvious difference in subject matters between the two hypertext pieces, both are likely to interest LIS students.

The subjects for this study were second-year undergraduate students of the Department of Information and Library Studies at Loughborough University : the same group which also participated in the revised HyperCard teaching experiment. Details of their backgrounds has been given previously; hence, it is not repeated here. All the students were asked to select a time slot during a period of one month to carry out this exercise. Before starting the exercise, the tutor explained to each student the basic procedures involved (eg. how to start the system, what facilities were available through the system). Under the supervision of the tutor, the students were asked to use each system in sequence for 30 minutes to find the answers to the queries in the worksheet (Appendix-XIII). They were also advised to do the exercise at their own pace and complete as many questions as they could within 30 minutes. The time taken for each task and the problems they had while using these systems were also recorded on the worksheets. At the end, the students were asked to choose the interface and computer environment they would prefer for teaching purposes.

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## **Chapter 4**

# **HYPERCARD PILOT STUDY AND INITIAL HYPERTEXT TEACHING EXPERIMENT**

### **1. INTRODUCTION TO PILOT SURVEY**

Before moving to a full-scale investigation of hypertext teaching, a pilot study was carried out to confirm that the chosen methodology was appropriate.

The sample population for this pilot survey consists of first-year Information and Computing Studies(ICS) students of the Department of Information and Library Studies at Loughborough University of Technology, Loughborough. The class started with five students, but a sixth student joined mid-way through. They were essentially naive users of both Apple machines and Hypertext software.

### **2. RESULTS OF PILOT SURVEY**

Of the six students, two had some microcomputer experience (but not on Apple computers) and the rest of them had no experience. None of them had used training software before. The time they took to grasp the basics of HyperCard ranged from 1-5 hours. Three of them thought that the tuition provided was sufficient to achieve a basic understanding of the software, but the other three students considered it was inadequate. All the students required some classroom help from the tutor while using the HyperCard system. In terms of ratings the HyperCard's tutorial software, opinions varied from poor to very good. Equally, in terms of the time required to complete the tutorial material, rating ranged from unsatisfactory to satisfactory. The majority judgment on the material was that it was comprehensive, quite easy to use and was not taken an excessive amount of time to complete.

It became clear during this pilot that students were often unwilling to ask questions even when they were stuck. This is not uncommon, but note was

taken of it for the main investigation. However, the main problems they faced were that (1) they did not understand the Apple computers, and (2) they remained uncertain as to the range of possible uses of Hypertext. It was concluded that more time (say a week or more) could have been given to explaining the basics of Macs and the concept and uses of hypertext before starting the course.

One other point that came through was that the students found it difficult to see ways in which hypertext could be applied to topics that interested them (though it was suggested that it might help with ergonomics teaching).

The students generally thought that the training provided for them was enough for the elementary use of HyperCard, but more hands-on practical time would be needed for a thorough understanding. It was evident that any attempt to teach the HyperTalk programming language in depth would take at least another eight hours.

All the students liked HyperCard, because of its user-friendliness, ease of use and attractive presentation. It was clear from their comments that mistakes made whilst developing a stack often proved hard to correct. There was some confusion, too, in differentiating between the different layers of a card. The general problems of hypertext, (like getting lost) also appeared in some of the drawbacks of the HyperCard that they reported.

After completion of the training, half of the students were unable to develop a stack easily. Even though they were theoretically clear about the stack design, their understanding was limited by their lack of practical experience. This applied both to HyperCard, itself, and to the Mac environment.

One lesson drawn from this pilot was that more effort should be put into teaching about the Mac (eg. how to use the mouse). Some aspects that might have been thought to be 'transparent' (eg. the icon approach characteristics) actually proved problematic. It seemed likely from this pilot that, if the various difficulties could be resolved, then a basic understanding of hypertext could be instilled into a majority of students on the basis of six hours teaching plus private practice.

### 3. INTRODUCTION TO INITIAL STUDY

On the basis of the pilot study, an initial HyperCard teaching experiment was conducted during the year 1990 using LIS undergraduate students at the Department of Information and Library Studies as the subjects. Seven student variables ( age, sex, class, group, sub-group, general computer experience, and Mac experience) were identified as potentially significant. Student performance with hypertext systems was tested to find whether these variables affected the results. The problems encountered and errors made by the students while using HyperCard and its application program were identified. The data collected during their task exercises and questionnaires (obtained during and after the teaching) were analysed, and the results are presented here.

### 4. BACKGROUND

The subjects for this study were second-year undergraduate students at Loughborough University, who were taking either single or joint honours degrees in LIS. There were 36 students in this class, none of whom had previously encountered hypertext. In addition, there were 6 students taking a degree in ICS who had had an introductory course on hypertext in their first year. These latter students were used to monitor the progress of the other students on the course, and are not included in the main body of the discussion here.

**Table 4.1. Background Information of the Subjects**

	<u>Age group</u>	<u>No. of students</u>
1. Age	19-20	29
	21-25	4
	26-30	3
	31-35	3
	36-40	1
	> - 46	1

[Minimum age : 19; Maximum age : 49; Mean age of the sample :22.3; SD of the sample:6.43]

2. Sex	<u>No. of students</u>
Male	7
Female	34

3. Subject Background	<u>No. of students</u>
Science	8
Social science	20
Humanities	13

Prior to taking the course, the students were asked to complete a questionnaire relating to their background (see Appendix - I). Two-thirds of the sample had entered university directly from school: the remainder had work experience before coming to university (half of them in libraries). Corresponding to this, there was some spread of ages, as indicated in Table 4.1. The class was predominantly (four-fifths) female. Educational backgrounds were generally comparable, with 95% of the sample having standard British university entrance (A-level) qualifications.

As it seemed possible that hypertext might prove less interesting to those with traditional library orientation, students were also asked about their information interests. Only 10% saw themselves as primarily concerned with library work: the remainder were either equally concerned with library and information work, or more concerned with the latter. The students were also asked about their previous computing experience. Some 90% had made significant use of computers before. Nearly 90% of these users had been primarily or entirely involved in using microcomputers, whilst the remainder had made greater use of mainframe computers. For the most part, this usage represented previous experience at work or at home. A third of the sample had previous experience of Macintosh computers (on which HyperCard was to be run), but no one in the class had encountered HyperCard before.

## 5. DATA ANALYSIS

### 5.1. THE DREXEL DISC

### 5.1.1. Retrieval of information in the Drexel disc with group A and B.

As described in the methodology chapter, the students were divided into two sets, and these subdivided into groups. Observation of the student responses to the questions(see Appendix - II) given in the worksheets showed that variations in retrieval time were linked primarily to errors in arriving at the correct screen. Hence, the significant comparison is between the average time taken by each group to answer each question. The results, averaged over the five groups in sets A and B, are given in Table 4. 2.

**Table 4.2. Set v. mean time taken for a question**

<u>Set</u>	<u>Average time for each answer(minutes)</u>	<u>Number of questions answered</u>	<u>Number of correct answers</u>
A	3.6	8.7	7.9
B	4.9	7.2	6.7

The obvious difference between the two sets in Table 4.2 lies in the average time required to answer a question. (The difference in the number of questions answered stems from this.) A t-test suggests that there is a significant difference (at the 0.01 level) between the two sets. However, this appears to be entirely due to one group in set B, who took 7.4 minutes on average to answer a question. If this group is eliminated the difference in time between the two sets does not reach the 0.05 significance level. In addition, there is no significant difference between the two sets in terms of the proportion of questions answered correctly. (It should be noted that the times recorded do not include the time taken for discussion beforehand by members of the group.)

It was decided, for the purpose of analysing responses from 36 students, that the significance level set at 0.05. In some cases, the results warranted investigation at the 0.01 level. The significance level is indicated at the end of each table.

Research suggests that age is a factor to be taken into account when subjects are learning to use complex computer systems. Egan and Gomez(1985) found that older people have great difficulty generating syntactically complicated commands. In a component task simulation of line

editing, age was found to be a significant factor for each component involved in the command generation process. If the users wrote out editing changes in longhand, age had little effect on performance. In another study (Greene, Gomez and Devlin, 1986), age made a substantial contribution to predicting errors in an information search. The correlation between age and errors obtained in this study across four interface conditions was 0.57. However, two studies relating to programming show that constricting relationships between age and performance is not necessarily straightforward. Chryster (1978) found that older users were more productive (but the age range was restricted and strongly affected by system experience). These studies highlight two difficulties. The first is that the range of user ages is often restricted, and age may be strongly correlated with experience directly relevant to the task being assessed. The second difficulty is that there is no clear basis for understanding why age affects performance. As task complexity increases, the effect of age becomes larger (Cirella, Poon and Williams, 1980), but the reasons for this is not clear. The decline in performance might, in principle, result from age-related characteristics, rather than from age itself.

**Table 4.3. Age v. mean time taken for a question**

Year	Age groups	Total no. of students	Number of Students						Minimum time taken for a question	Maximum time taken for a question	Mean time taken for a question	SD
			correctly answered		incorrectly answered		not attempted					
			No.	%	No.	%	No.	%				
1990	19-20	29	18	63.5	1	3.2	10	33.4	74.1	486.7	237.2	133.6
	21-25	4	3	75	0.2	4.2	0.8	20.8	123.2	306.3	198.9	106.0
	26-30	3	1.6	52.8	-	-	1.4	47.2	176.8	472.6	320.5	171.8
	31-35	3	2.2	72.2	0.1	2.8	0.8	25	120.4	300	182.6	103.7
	36-40	1	0.7	66.7	-	-	0.3	33.3	266.3	266.3	266.3	-
	46 ->	1	0.3	33.3	-	-	0.7	66.7	172.5	187.5	172.5	-
	21-47	12	2.0	67.4	0.1	2.6	1	30.1	151.9	333.1	228.7	125.1

The statistical difference in the mean time taken for each question between 19-20 and 21-47 age groups is : 1.016

df : 29+12-2=39

P = 0.05

Table 4.3 compares students age with the mean time required to answer a

question. For the purpose of statistical comparison, the 19-20 group was compared with a merged age group (21-47 years). It was found that there was no significant difference in the mean time taken to answer a question between these two age groups. In the same way, the percentage of correct answers, etc, essentially the same. Hence, it can be claimed that age was not a factor in this hypertext-teaching exercise.

**Table - 4.4. Sex v. answers and time taken**

Year	Sex	Total	Number of Students						Minimum time taken for a question	Maximum time taken for a question	Mean time taken for a question	SD
			no. of		correctly		incorrectly					
			students		answered		answered					
							not attempted					
			No.	%	No.	%	No.	%				
1990	Female	34	21.8	64.2	1	2.9	11.2	32.8	66.8	571.3	221.6	140.1
	Male	7	4.3	61.9	0.2	2.4	2.5	35.7	86.1	227.8	162.7	65.4

The statistical difference in the mean time taken for each question between male and female students is : 1.71

df : 34+7-2=39

P : 0.05

The results in Table 4.4 show that there was no significant difference between male and female students in the mean time taken to answer each question. One of the problems in this comparison was that the female population was almost five times larger than the male population, so making the detection any such difference more difficult.

**Table - 4.5. Class v. answers and time taken for a question.**

Year	Class	Total	Number of Students						Minimum time taken for a question	Maximum time taken for a question	Mean time taken for a question	SD	
			no. of		correctly		incorrectly						not attempted
			students		answered		answered						
			No.	%	No.	%	No.	%					
1990	ICS	6	4.8	79.2	-	-	1.3	20.8	109.5	295.8	191.6	81.6	
	LIS	35	21.4	61.2	1.2	3.3	12.4	34.5	69.3	561.2	244.3	146.4	

The statistical difference in the mean time taken for each question between ICS and LIS is : 1.271

df : 6+35-2=39

P : 0.05

Table 4.5 indicates no significant differences relating to the degree course taken by the students. Again, there is a statistical problem due to the small number of ICS students.

**Table - 4.6. Subject v. answers and time taken for a Question.**

Year	Subject	Total back- ground	Number of Students						Minimum time taken for a question	Maximum time taken for a question	Mean time taken for a question	SD
			correctly answered		incorrectly answered		not attempted questions					
			No.	%	No.	%	No.	%				
1990	Sc.	8	5.4	69.2	0.1	1.1	2.3	29.8	92.3	419.1	204.2	119.4
	S.Sc.	20	11.3	58.4	0.7	3.5	7.3	38.1	92.5	476.6	239.9	134.5
	Hum	13	7.8	63.9	0.4	3.4	4	32.7	85.4	505.9	260.9	156.6

[Sc.=Sciences; S.Sc.=Social sciences; Hum=Humanities]

The statistical difference in the mean time taken for each question between Science and Social sciences students is : 0.688

df :  $8+20-2=26$

P :0.05

The statistical difference in the mean time taken for each question between Science and Humanities students is : 0.936

df :  $8+13-2=19$

P :0.05

The statistical difference in the mean time taken for each question between Social science and Humanities students is : 0.398

df :  $20+13-2=31$

P : 0.05

The results in Table 4.6 indicates that the differing subject backgrounds of the students did not lead to any significant difference in response rate.

Previous studies have indicated that user performance with a system can depend upon prior experience. Differences in such experience have been controlled for in a range of different studies, eg. Curtis(1981), Gould(1975), and Grant and Sackman(1967).

**Table 4.7. Used computer v. answers and time taken**

Year	Used computer	Total no. of students	Number of Students						Minimum time taken for a question	Maximum time taken for a question	Mean time taken for a question	SD
			correctly answered		incorrectly answered		not attempted					
			No.	%	No.	%	No.	%				
1990	Yes	38	24.7	65.1	0.9	2.4	12.3	32.5	108.1	433.1	235.4	141.3
	No	3	1.5	50	0.2	5.6	1.3	44.4	132	363	211.5	39.4

The statistical difference in the mean time taken each question between computer experienced and no computer experienced students in 1990 is : 0.739

df: 38+3-2=39

P :0.05

The results in Table 4.7 show that the students with appreciable prior computer experience do not seem to perform better during their task exercise than students with less experience. A t-test suggests that there is no significant difference between the average time taken for answering a question between computer experienced and inexperienced students. A possible interpretation is that HyperCard has been designed in such a way that naive users do not require much training in order to use it, as compared with other commonly used systems (such as word processing and spread sheets).

**Table 4.8. Used Mac v. answers and time taken**

Year	Used Mac	Total no. of students	Number of Students						Minimum time taken for a question	Maximum time taken for a question	Mean time taken for a question	SD
			correctly answered		incorrectly answered		not attempted					
			No.	%	No.	%	No.	%				
1990	Yes	15	9.9	66.1	0.3	1.7	4.8	32.2	77.0	424.4	224.7	117.2
	No	26	16.3	62.5	0.9	3.5	8.8	34	77.9	541.6	256.1	154.3

The statistical difference in the mean time taken for each question between Mac-experienced and inexperienced students is : 0.735

df: 15+26-2=39

P :0.05

Table 4.8 shows that the average time taken to answer a question by the

Mac-experienced students and the students who have not used Macs before. A t-test shows that there is no significant difference between these two groups. So, even prior Mac experience did not play any important role in the quick retrieval of information from a hypertext database.

### **5.1.2. Evaluation of the Drexel Disc**

The students were next asked for their evaluation of the Drexel disc (see Appendix -III). It was first established that the disc was suitable for absolute beginners: 95% thought it could be used by such people, and virtually all thought that the material was organised in a fashion that a beginner could follow. Only three-quarters of the students found the information on the disc generally interesting. However, in view of the US orientation of the material, this represents a satisfactorily high level of interest.

When asked to pinpoint features that reflected the particular value of hypertext for this kind of application, three-quarters mentioned the campus map. (This could be used interactively to find what facilities were available where, and at what times.) More generally, a third mentioned the multi-media presentation of text, graphics and sound.

In terms of information content, a wide range of features (such as campus map, index, graphics, ease of use) was applauded: altogether two-thirds of the students commented favourably on these. Somewhat less than a third especially appreciated the option for obtaining tips on how to use the computer. The other features liked by the students were flexibility, the glossary and working with a system that was interesting to use.

Fewer students - about a third - found significant drawbacks to the system. Their complaints mainly concerned lack of information - for example, approaching a third commented that a detailed index would be useful. About a third found that the terminology used in the system was difficult to understand, and would like to have seen the computer jargon replaced by simpler words which a naive user could understand. About 20% of the students thought that the disc layout was too graphics-oriented, and the graphics were not properly representative of the information content. A few

students commented adversely on other features, such as too much text on the screen, incomplete glossary, lack of colours and restricted movement between the screens.

In terms of teaching, about a third felt that the hour time provided for the evaluation of the Drexel disc was not sufficient that some more time should be provided. In general terms, they felt that more time was needed to evaluate the disc and additional assistance (either online or a hand-out with explanations) was required to help teach easy navigation through the package.

### **5.1.3.Changes suggested by the students for a Loughborough disc**

Further points appeared when the students were asked what changes they would like to see if a similar disc were to be produced at Loughborough. One item, mentioned in one form or another by some 20%, was the need to mix graphics and text on each screen, rather than to separate them (as sometimes occurred on the Drexel disc). Another was the need to provide better information retrieval and online help, especially when rectifying mistakes. A majority of the students noted that the disc would be more useful if its contents covered leisure, as well as work activities. About a fifth of the students felt that details about other departments and courses, faculty member's names and telephone numbers, course contents, reading lists, etc., could be added. Among the prominent topics to be covered under leisure activities were campus sports facilities, entertainment facilities, transport information, banks, post-offices, medical facilities, local libraries, accommodation, etc.

Even though the campus map was attractive to many of them, a sixth of the students felt that interacting with the campus map on the screen was difficult, especially for first-time users. (The icons used for switching between the movement mode and interactive mode were not labelled, and the purpose of the icons on the campus map was not obvious to naive users. Students also felt that the map could be more informative.) The information on the map should be indexed with, if possible, an index of buildings and departments provided on the map itself.

About a fifth of the students felt that the information on a Loughborough disc could be organised in the same way as for the US disc; but a third suggested modifications to the existing presentation of information. Most of their points related to a need to organise and present information in a logical, coherent and simpler way. A quarter of the students felt that a help system would aid this.

About half of the students felt that one hour was not enough for the evaluation of Drexel disc, especially when this was done immediately after seeing the disc for the first time. Most of their time was spent on finding the answers to the questions in the work sheet, so leaving little time to evaluate the properties of the package.

#### **5.1.4. Problems of the students while using the Drexel disc**

The most likely problems for novice users had been identified in the pilot study described previously. In the 1990 teaching experiment, these problems were broadly categorised into five types, which were used as the basis for preparing a hypertext practical worksheet to record the problems students encountered while using and customising the HyperCard stacks. The students were asked to record any difficulties they encountered on the worksheet(see Appendix-IV) under the five headings: (1) mechanical problems (e.g. difficulties in directing the pointer with the mouse); (2) on-screen problems(e.g. difficulty in understanding the information displayed by the screen); (3) between-screen problems(basically relating to navigation through the system); (4) problems in making changes (e.g. failure to transfer material between cards); (5)other problems (including conceptual difficulties).

In the first hypertext practical class, students were asked to use the 'Drexel disc', as has been described. The main activity in this exercise was to find the answers to the tasks provided in the worksheet (see Appendix-II). Altogether, students in set A mentioned 113 problems that they had encountered, whilst students in set B mentioned 84. The major problems (based on the five categories outlined above) were as follows.

### **1) Mouse problems.**

This was the most common type of problem. Of the total 197 problems encountered by sets A and B while using the Drexel disc, the mouse problems alone accounted for slightly more than a quarter (27.4%). Even the C set students, with greater computer experience, reported the same that one-third of their problems were due to the mouse. Almost all the students had initial problems with clicking and double-clicking. Many of the students (about 80%) from both the sets did not know precisely when and where to single click or double-click. While clicking, either they clicked the mouse button too slowly, or too many times. One of the C set students acting as a monitor reported of his group that "at the beginning double-clicking was not quick enough and they were quite lost initially".

About a quarter of the students had problems in directing and coordinating the mouse pointer on the screen. For example, they failed to take the cursor to the corners of the screen because the mouse ran out of space on the mouse pad. Since the mouse was connected to the right-hand side of the keyboard, two left-handed students in the class had difficulties in operating it. They did not realise it could be connected to the left-hand side, so the problem continued until they mentioned it to the tutor.

### **2) On-screen problems**

About a quarter of the students had problems in identifying the clickable points (buttons) on the screen. As a result, they tended to click at random. A few of them felt that the information presented on the screen did not help them move around the system. They also had difficulties in getting out of a file as there was no 'exit' indication on the screen. The other on-screen problems encountered were failure to get online help, selecting the home card, identifying the right screen, deciding which information was relevant, not sure what was happening on the screen, and need to break out of a pattern to start again. The number of problems reported by both the groups was more or less the same in this category.

Some problems related to the actual exercise itself. Clicking on some of the graphics led to the appearance of a 'time bomb icon' (for about 10 seconds only), followed by exit from the system. This happened because of system

software incompatibility with the Drexel disc( discussed later).

### **3) Between screen problems**

About one-third of the students had problems in escaping from wrong screens. One-fifth of the students felt uncertainty regarding their position in the database. A few students had problems in returning to previous screens they had visited. Overall, the number of between-screen problems mentioned by the set B students was almost twice those mentioned by set A.

About one-sixth of the students from both groups noted that there were no card numbers on each screen and that this caused problems in perceiving their position in the database. It was difficult to know how much information was contained in the system and whether there was more relevant information in the database apart from that already found. At times, students encountered difficulties in deciding where and how to go to a particular piece of information.

### **4) Problems of changing materials/screens**

Since the main activity of the students required only finding answers from the Drexel disc, many of them did not encounter this category problems. However, one-fifth of the students had difficulties in identifying their progress in the task they were working on. The designers of the Drexel disc created a considerable rigidity in the movement of the users between the screens; so a few students encountered problems in moving freely around the system. For example, when using the campus map, some students kept going into the same loop again and again, and were unable to come out of it.

### **5) Menu problems**

About a quarter of the students felt that the menu options were confusing and sometimes ambiguous. For example, the students were not clear when to use the 'restart' and 'resume' options in the 'Something Else' section of the Drexel disc.

Some menu options (and sub-menu options) were not clear, with the result that students arrived at the wrong information or place. Often different fields had similar sub-headings, which caused confusion and resulted in the wrong

information being chosen. Some of the students encountered problems while using the 'exit', 'close', and 'quit' options. Thus, they used the 'quit' option for closing a file, but this actually led them to quit the program. One of the students from set C monitoring students in set A commented of the menu problems that "there are difficulties in understanding the information displayed on the 'File menu', for example they could not exit from the Macro Facilities screen". While doing the exercise, about one-sixth of the students did not realise that only highlighted menu options could be used - not the dim(inactive) menu options. A few (about 10%) of the students felt that the size of the print in the menu options was too small to read (particularly for students working as a member of a group and therefore further away from the screen).

#### **6) Online/system help**

About one-third of the students from both the sets felt that there was not much online help in the system. For example, there was no introduction to the disc, the purpose of icons, the organisation of information, retrieving of information from the disc, and meanings of the technical terms used. This affected both retrieval and navigating in the database. More online help might have eliminated some of the problems of this type.

#### **7) Campus map**

Even though many students liked the campus map, there were a few drawbacks which could have been eliminated to make it a better system. For example, a quarter of the students from both sets had problems in switching between "interactive mode" and "movement mode". In 'interactive mode'; each button on the map could be clicked to obtain further information, but the user could only access the portion of the map on the screen. The invisible area outside the screen could not be accessed in this mode. On the contrary, in the 'movement mode', the map could be moved in any direction on the screen so as to see the total map. But in this mode, none of the objects(buttons) on the map were interactive. Here the main problem was that most of the students did not realise one of the icons could be used for changing the modes of the campus map. The icon was not accompanied by its title, and there were no online instructions for using the campus map.

### **8) Problems with Icons/graphics**

Though the graphics were attractive to look at, some students noted that a few were not representative of their contents. One-tenth of the students pointed that the various graphics and icons were not always labelled properly. A 'closed palm' shaped icon (which could be used for changing the modes of the campus map) caused many problems. The students remarked that the icons could be confusing: though they were easy to remember once they had been learnt, their meaning was not always immediately evident.

Lansdale (1988) has found that iconic representation of information does not automatically result in a high level of user performance. The meaningfulness of the icon, or the association between the icon and the idea it represents, has an impact on the effectiveness of the icon. Abstract shapes do not perform as well as shapes that have some representational meaning. Icons should be meaningful, easy to understand and must be accompanied by titles to avoid confusion amongst students. The icons in this system did not always satisfy these criteria.

### **9) Overall navigational problems**

'Getting lost' is a common problem in hypertext systems. Getting lost in a hypertext system means that the user does not have a clear conception of the relationships within the system, and finds it difficult to decide where to go next. Because of its non-linear organisation of information and its dynamic information structure these problems occur with most users of hypertext, but they are especially important for naive users. To overcome these problems, the designers have provided various aids to the users ( maps, location indicators, navigational maps, etc). For example, in an electronic book designed for use by nuclear power plant operators, this problem was overcome by providing a facility to generate a 'subroutine map'. This helps the operator to recover past actions up to the current point, and aids in retracing his/her steps(Elm & Woods, 1985). In HyperCard, a 'recent' facility is provided to help trace back the last forty cards recently seen. By simply clicking on any of those 40 card pictures on the recent card, the user reaches the actual card in that stack. About a sixth of the students lost track in the Drexel database while looking for information. They also had difficulties in tracking back to the places they had visited.

**10) Information Retrieval problems**

One-fifth of the students had difficulties in locating the required information from the title options on the cards. There was no general search facility for the database and only a few sections of the database had a 'find' facility for retrieving information. The students were therefore not sure whether there was any more relevant information in other parts of the database. In addition, the index was inadequate.

**11) Jargon problems**

About a fifth of the students from both the sets had difficulties with the technical terms used in the disc. For example, information about HyperFinder could not be found by many of the students in the database because its meaning was not clear to them. They felt that HyperCard contains a lot of jargon that is fairly meaningless to a beginner.

**12) Hardware and Software problems**

There were no major problems related to hardware, but a few students had initial difficulties in switching on the Mac. A student monitor of set C remarked about the hardware that "I found that some of the LIS students using the system had never used a Mac before and were unsure of how to insert discs, turn the machine on or connect the mouse. Therefore it is useful to teach students how to use the hardware". The incompatibility of the Mac system software with the Drexel disc also caused a problem for some of the students. The Drexel disc was designed under the old Mac operating system (version 6.0). When it was running under later versions (version 6.1 or 7.0), the 'Something Else' section caused problems: the system issued a 'time bomb icon dialog box' with 'restart' and 'resume' options. Here 'resume' mean to continue the task, whereas 'restart' first closed the Drexel disc and then loaded the program again. But, due to bugs in the programming, it actually led to quitting the program and not restarting again. This obviously caused confusion.

**13) Other problems**

Some students encountered problems not covered by the above categories, namely: i) need for more practical time, and ii) group size. One of the

students of set C who was monitoring the set B students commented about the groups that "the problem with having groups is that there is always one person who is better than the rest. This person seemed to do most of the exercises because the others were slower". Even though it is a drawback with group teaching, the benefits like group discussions, backing their ideas while doing the exercise, quickly learning the subject, etc. outweighs its drawbacks. This problem was rectified in the next experiment by making singles or pair as groups and providing a Mac for each group.

## **5.2. THE CUSTOMISATION EXERCISE**

As the second part of their hypertext learning activities, students were asked to build a new HyperCard stack from existing stacks in the HyperCard software. They were required to construct a stack of seven cards, one for each day of the week, which might be used for planning a personal diary. This entailed not only creating a new stack, but also carrying out various modifications to the text and graphics. Their activities therefore ranged from erasing and inserting patterns, and selecting an appropriate type face and size, to organising buttons and linking buttons and cards. They were given detailed hand-outs on how to tackle these tasks. They were also asked to record any difficulties they encountered on the worksheet provided.

### **5.2.1. Problems of students while designing/customising HyperCard stacks**

Set A students mentioned 75 problems that were encountered while designing the diary stack, and Set B mentioned 105. These were spread over all five categories previously defined, but concentrated especially on matters relating to (4) -- painting tools, erasing graphics, etc. It is difficult to estimate whether the difference in the number of problems identified between the two groups is significant. However, it may be noted that the problems encountered in using the Drexel disc reversed this order, so it seems unlikely that these were any systematic differences in response between the two sets. (However, see the next paragraph.)

### **Problems of students with the Diary stack design exercise**

As described in the methodology chapter the LIS students were divided into two sets A and B and the ICS students were kept in a set C. All the sets attended an introductory session. B and C sets then went to the Mac lab to carry out their project work. Set A attended two theoretical classes first and then did their practical work. It will be noted that set B, which carried out the practical sessions before attending the theoretical classes, encountered a greater number of problems.

After their theoretical classes and practicals, all the students (sets A, B, and C) were asked to come to a final discussion class to examine any problems. In that class, the students' general problems were first discussed, followed by individual problems. This class was not only useful in clarifying their personal problems, but also gave the opportunity to listen to other problems faced by their peers. After completing the course, all the students could claim a similar level of exposure to hypertext, but the method of teaching used to achieve this had been different for sets A and B. The overall result was that there were slightly more problems with set B (which had had theoretical classes after the practicals), but the ultimate level of learning in both groups appeared to be much the same. The problems encountered by both sets were analysed in terms of the following sub-headings, as before.

#### **1) Mouse problems**

Though set B encountered almost twice as many problems (13) as set A (6), the kind of problems encountered by both sets was the same. Since all students had had an hour's practical experience of both the Macs and HyperCard in their previous class, the number of mouse problems encountered during the customisation exercise was only about one-third of the number encountered in the Drexel disc exercise by the same students. This indicates that only a short exposure to a mouse is necessary for students to have markedly fewer problems in using it. This deduction was confirmed by the set C students who were observing the set A and B student's problems. As one mentioned: "initially there was some problem of controlling the movement of the pointer, but they got used to it quite fast". Only a few (about 10%) continued to have difficulties with mouse operation, mainly clicking and

double-clicking. However, about a fifth of the students still had problems in directing and controlling the mouse on the screen. For example, selecting the commands from the menu options, taking the cursor to the corner of the screen and dragging objects on the screen all led to difficulties for this group. Most of them felt that many of these mouse problems would disappear as their hands-on experience increased.

## **2) On-screen problems**

There was not much difference in the number of on-screen problems encountered using the Drexel disc exercise and the customising exercise(14:11). Since these exercises were different in nature, the kind of problem encountered was also slightly different. About a sixth of the students had on-screen difficulties in remembering how many new cards had been created and how far they had reached in a particular task. They were not always sure what was happening on the screen, and there was a lot of unnecessary clicking.

## **3) Problems of changing materials/screens**

About one-fifth of the students from both sets had difficulties in transferring the graphics from the background domain to the card domain. A few students could not get back to their stack once they had left it. When they tried to build another stack with the same name, the system responded that a stack with that name already existed, but the students still failed to locate it. Normally, when a new stack is created, the system keeps it in the folder from which the new stack copied the background. If the background is new, and not copied from any of the existing stacks, then this created stack would be in the HyperCard folder. Since the students copied the background from the 'Address stack', their created stack was in the 'HyperCard Stacks Folder' (which is in the 'HyperCard Folder'). Many students did not realise this, and looked for their stack directly in the HyperCard folder. Eventually, the tutor had to intervene and explain the solution. This indicates a conceptual difficulty of the HyperCard approach.

## **4) Online help**

Most students mentioned no problem here, but a few (about 10%) had minor problems. HyperCard has a good online help system, but the problem lay in

locating it.

### **5) Menu problems**

Overall, about a quarter of the students from both groups experienced difficulties with the menus, especially with the 'background option' in the 'Edit menu'. Sometimes the menu options were not highlighted and they then had problems in accessing the inactive/dimmed menu options. the difficulty is that HyperCard will highlight the menu options only when a particular task/operation related to those menu options is occurring. For example, the 'copy', 'cut', and 'paste' options in the 'Edit menu' will not usually be highlighted unless some text or graphics is being selected, or copied, or cut. This is a particular problem for a naive user of HyperCard, and again suggests a deficiency in the software. A few students also had difficulties in selecting menu options : they were clicking on them, instead of highlighting, to execute the action. The menu problems were reduced to half in the second practice class when compared to the first practice class.

### **6) Keyboard problems**

About a quarter of the students from both groups had difficulties in identifying the various keys (eg. the command key) on the keyboard. Since these keys are different from the IBM PC keyboard, all the students had difficulties in identifying them at first. They also had occasional problems in remembering to use the shift, option and command keys together to execute commands.

### **7) Problems with paint tools**

In the total of 180 problems reported by both sets, problems relating to paint tools alone amounted to 72(40%). About a quarter of the students from both groups had problems in identifying the various tools available in the paint toolbox. Many of the icons do not resemble their names; for example, the 'eraser tool', 'selection tool', etc., were confused by first-time users. One of the student monitors of set C mentioned that "my group does not understand what all the various pictures in the tools menu mean. A demonstration or explanation should be given before they are ready to select the right tools". Some students had problems with the 'selection tool' in copying, transferring, and changing the size of an object on the screen. A set C monitor commented about this tool that a "terrible problem was using the 'selection

tool', they did not understand which part of the card to select. They found it very hard to drag the image to increase the size of card. A very long time was spent to increase the size of the card, it would have been quicker to erase the whole of the card and draw it again". Many students had problems with the 'eraser tool'. Firstly, it proved difficult to identify this tool and, secondly, it was very easy to erase everything on the screen with a double-click. Several students commented that a steady hand was required to use many of these tools, particularly the 'eraser tool'. About one-fifth of them failed, when tearing off the paint tools palette from the menu bar, to fix it at a convenient place on the screen. A few of the students also experienced difficulties while editing graphics in 'FatBits mode' with the 'Pencil tool'. More than half (56%) of the students had problems while using the 'eraser tool'. A few had problems in moving the mouse continuously in a straight line to erase a straight line. Set C monitors noted that students did not read the instructions in the hand-outs carefully, where it had been explained that they should press the shift key when erasing a straight line to avoid this problem.

#### **8) Home card**

More than one-third of the students had problems with the home card in the customisation exercise. This included (13) in set B, but fewer (5) in set A. All these students had difficulties in reaching the home card at the beginning of the exercise. It had previously been explained in the first class, but students had forgotten the procedure. Since there were many stacks and folders in the HyperCard folder, they were not sure which stack to click on in order to reach the home card. In one case, the home stack was accidentally deleted. In another, the 'address' stack was deleted, which led to problems in accessing the address stack for their stack design. It can clearly be seen that one of the drawbacks of HyperCard is the possibility of accidental deleting stacks.

#### **9) Hand-outs/worksheets**

About a quarter of the students had difficulties with the hand-outs; sometimes the instructions were inadequate for completing the task (especially erasing graphics in the background). One-fifth of the students also had occasional difficulties in understanding the instructions. In particular, it sometimes proved difficult to explain some of the graphical concepts using only words. One of the set C students mentioned that "my group of students did not follow the

instructions on the hand-out closely, they have often unaware of what stage they had reached in their task. Perhaps they were too nervous to see the details in the hand-out". It was decided, for future testing, that use of diagrams based on screen dumps might improve the comprehensibility of the hand-outs.

#### **10) Other problems**

Some students encountered other problems, more especially : i) confusion between card and background domains (about 5%); ii) insufficient time for practice (about 20%). One of the LIS students commented that "as most learning comes through practice, more time should be spent in practicals rather than lectures. More practice time with staff assistance or help in using the system would be more beneficial". This underlined the clear need for future provision of more practical sessions/time, if students were really to get to the grips with hypertext. Another student remarked that "the introductory lectures were good to provide information on the basic ideas of hypertext, but it would have been better if four double periods (two-hour) practical sessions were time-tabled individually, or pairs could have been allocated a Mac to get meaningful teaching".

Overall, no-one completed the entire stack design within the time provided for this exercise. However, the majority of students from both sets A and B completed most (about 90%) of the stack design. The number of problems encountered by the students in both sets while studying the Drexel disc and stack design (customisation exercise) are given in the table below. The problems recorded by the student monitors of set C for each of set A and B are also given in the same table. Remembering that the monitors were asked to record problems that required assistance, it is evident that most problems were low-level and could often be solved by the students themselves.

**Table 4.9. Number of problems encountered by students**

	<u>Drexel disc</u>	<u>Customisation exercise</u>
Set A	113	75
Set B	84	105

**Number of problems recorded for both sets by the set C monitors**

	<u>Drexel disc</u>	<u>Customisation exercise</u>
Set A	29	28
Set B	48	34

**6. ASSESSMENT OF HYPERCARD TEACHING**

In computer-assisted teaching, instructions must be neither too difficult, nor too easy for the student. If too difficult, the student may give up the task altogether; if too easy, the student will become bored, losing interest or motivation. So, individual differences must be evaluated and difficulty levels must be set appropriately. Choosing inappropriate instructional design or inappropriate characteristics can lead to unsuccessful instruction (Steinberg, 1977). The HyperCard teaching and task exercises were designed to seem reasonably straightforward and useful to average second-year LIS student. Tables 4.10 and 4.11 suggest that this objective was fairly well achieved.

**Table 4.10. Easy to learn to use HyperCard**

I) Hard	-	nil
II) Fairly hard	-	2 (5 %)
III) Reasonable	-	20 (49 %)
IV) Fairly easy	-	18 (44 %)
V) Easy	-	1 (2 %)

**Table 4.11. Interesting to use HyperCard**

I) Not interesting	-	nil
II) Moderately interesting	-	27(66 %)
III) Very interesting	-	17(34 %)

**Table 12. Helpful the different hand-outs supplied**

I)	Very useful	-	8 (20 %)
II)	Fairly useful	-	27 (66 %)
III)	Not very useful	-	6 (14 %)
IV)	Useless	-	nil

In providing their final assessment of the course(see Appendix - V), three-quarters of the students thought that the teaching they had received was sufficient to give them an elementary understanding of hypertext. However, most of these, as well as the remaining quarter of the students (who thought they needed more tuition), said that the emphasis, even for conceptual learning, should be on hands-on practice, rather than on classroom demonstration and discussion. A majority also commented that groups consisting of 3-4 members were too big: two members would be better. (A small minority would have preferred to work on their own, but most respondents found it useful to carry out projects, and discuss concepts, with fellow-students.) An important proviso was that the fellow-student in any pairing must have a similar background in computing, whether this was limited or extensive. One of the students commented of the teaching in their assignments that "structured lessons, in which clear, easy to understand hand-outs could be provided to the students, make far more profitable sessions than letting students play about on the system without guidance".

The students' interest was especially captured by the user-friendly layout (particularly the graphics) of hypertext, and they appreciated the different way in which hypertext organised information as compared with the other database management systems they had encountered. Once understood, they found the iconic representation easy to remember, and they liked the ability to move rapidly between screenful's of information and stacks. (This was the first time most of the students had used a mouse, and they soon learn to appreciate the flexibility it gave.)

In terms of benefits from hypertext teaching, four-fifths of the students said that it had improved their knowledge of computer usage; over a half that it had improved their ability to handle practical projects; a third that it had advanced

their design skills; a quarter that it had widened their thinking about information retrieval. Over half of the students thought that hypertext could be usefully applied in other library and information courses they had taken, especially for information retrieval and cataloguing. A student commented of its applications that "it is very useful for many inexperienced users who may be less daunted by the sight of a mouse. No typing skills are required or any finger ability which may be impossible for some elderly users. People with spelling difficulties are also less likely to be put off by the sight of a hypertext terminal". They also felt that it should be taught as a regular course in their curriculum. In terms of whereabouts it should come in their degree course, three-quarters felt the second year was appropriate (the remainder preferred the first year). They felt that, by the time students reach the second year, their analytical thinking skills have become better developed. They are therefore better able to evaluate critically hypertext systems and compared them with other systems studied in their first year courses. One student remarked that "I feel that hypertext was introduced at the right time because our knowledge of computers has grown during the first year, it would probably have been too much to take in all at one go, especially as some of us were totally new to computers ..... learning hypertext in the final year might be leaving it a little late, and would not be good idea, because we would be busy with revision, exams and job applications". A similar comment from another student was that "hypertext should be a regular feature of the LIS course, being a good introduction to the field and with a genuine possibility of future relevance. It also provides a good introduction to the practical aspects of design on computers, and offers basic computer concepts that LIS students may not be aware of, i.e. icons, use of mouse, etc."

## 7. ANALYSIS OF RESULTS

The overall response to the Drexel disc proved to be similar to that found for the actual students at Drexel University. Comparable comments were made by the latter : 'users consider the disc to be well organised, informative, and easy to use. They particularly like the graphics, the campus map features...'. The major complaint of users is that too much of the information is provided as text' (Hewett, 1989). The major difference lay in the lower interest of British students in the contents. Hence, it appears that a disc of this sort, geared for

the local audience, provides a good entry point to the use of hypertext. However, it is clear from the comments by both British and American students that what they really want is hypermedia, not hypertext (Ramaiah and Meadows, 1993).

As has been noted before (Chapter 2), it seems appropriate for our purposes to draw a distinction between 'slips' and 'mistakes'. In the present guided study, the concern was firstly with the slips that beginners may make in using hypertext. The commonest of these from the work reported here fall into two categories. The first relates not to hypertext as such, but to the use of a mouse. Two types of slip in using mice were particularly evident - at the start, an inability to position the mouse accurately, and then a failure to distinguish between clicking and double-clicking. The second category related to misinterpretation of menu headings, the significance of icons, etc. The sources of both types of slips lie ultimately in the system. However, the present study suggests that errors in both these categories can be minimised by provision beforehand of sufficiently informative handouts. (For example, students commented approvingly on the use of screen print-outs to illustrate points about menus.)

## 8. CONCLUSIONS

This initial study provided suggestions on how hypertext teaching might be implemented, given limitations on staff/student contact, etc. In the first place, it underlined the need to concentrate on hands-on experience when teaching hypertext to undergraduates. Combined with informative handouts, this appears to provide an adequate conceptual, as well as practical background. One question, however, concerned the level of detail required in hand-outs, since a number of students appeared to operate quite happily with fairly brief instructions. Six hours seems to be about the minimum time needed for an elementary introduction. Given the choice, students believed that they would prefer to work in pairs, partners being matched in terms of their computing experience. The course, they felt, is best given in the middle of an undergraduate degree, when most students have sufficient knowledge of information technology to recognise the conceptual differences of hypertext and the practical differences of the Macintosh computer, but whilst they still

have time to exploit this new area of skill further. The next stage was to implement changes along these lines to see whether this did, indeed, lead to improved student learning. This second stage is discussed in the next chapter.

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## **Chapter 5**

# **REVISED HYPERCARD TEACHING**

# **EXPERIMENT**

### **1. INTRODUCTION**

This chapter explains the alterations made as a result of the HyperCard teaching experiment conducted in 1990 and examines their effects. Like the 1990 HyperCard teaching experiment, it was conducted with second-year LIS undergraduate students at DILS. The results obtained in 1990 HyperCard teaching experiment are compared with the results of the 1991 experiment to see whether the changed method of teaching produces any significant difference. As in the first teaching experiment, the effect of various student characteristics on their performance with the HyperCard system were studied, and are discussed below.

### **2. BACKGROUND**

The subjects for this study were second-year undergraduate students of the Department of Information and Library Studies at Loughborough University, who were taking single or joint honours degrees in ICS and LIS. Altogether there were 45 students, none of whom had previously encountered Hypertext. Prior to taking the course, the students were asked to complete a questionnaire (see Appendix - VI) relating to their background. More than half (53 percent) of the sample were aged between 19-20 years, whilst the rest spread over 21 to 47 years. About one-sixth of the class consisted of mature students with ages between 30 to 47 years, who had been working in various non-library organisations. Two-thirds of the sample were female. About half of the sample had entered university directly from the school; the remainder had work experience before coming to the university (of these, 18% had been working in libraries and 31% in non-library organisations). Three-quarters possessed standard British University entrance (A-Levels)

qualifications, while the rest had other qualifications (equivalent to A-Levels).

**Table 5.1. Background information of the subjects**

	<u>Age group</u>	<u>No. of students</u>
1. Age	19-20	24
	21-25	12
	26-30	2
	31-35	2
	36-40	2
	41 - 47	3

[Minimum age : 19; Maximum age : 47; Mean age of the sample :23.7; SD of the sample:7.8]

2. Sex	<u>No. of students</u>
Male	15
Female	30

3. Subject Background	<u>No. of students</u>
Science	14
Social science	15
Humanities	16

Of these 45 students, 11 (24%) were ICS students, who are more exposed to computers in their day-to-day courses, both theoretically and practically, as compared with the remaining 76% of LIS students (both single & joint honours degrees). When they were asked to mention their interests, however, only about 4% of the students were found to be library-oriented; 34% of them were information-oriented; the majority (62%) were equally interested in information and libraries. The students were also asked about their level of previous computer experience. Some 93% had made significant use of computers before. The type of computers they used had been mainly PCs and mainframes, though a very small percentage had also used minis. Some 71% had used computers for two years or more (some for more than 5 years); 22% had used them for less than a year; a minority (7%) had never used computers. Overall, most of the students had had reasonable exposure to computer usage before doing this HyperCard exercise. The main activities for which they had used computers were : Word processing(80%); Course

work(80%); Databases (51%); Spread sheets(40%); Programming (29%); Games (24%); Library work (24%); Miscellaneous works (24%); DTP(16%); Graphics design (13%); E-mail (4%). The majority, 84 % had already used a mouse, and more than half (53%) had also had exposure to Apple Macs. Most (42%) of these had one year or less experience on Macs, but a small percentage (11%) had 2-3 years experience. A small percentage of the sample(13%), had had experience with HyperCard before doing this course.

### **3. DATA ANALYSIS**

#### **3.1. THE DREXEL DISC**

For this experiment, the worksheet prepared in the 1990 teaching experiment was slightly re-organised, but without changing the total number and contents of the questions(Appendix-VII). The preliminary investigation in 1990 suggested that 12 was the maximum number of questions likely to be answered in an hour. The students in the 1990 teaching experiment felt that some of the questions at the beginning were too hard to answer. In this repeat experiment, all 12 questions were therefore reorganised in ascending order of difficulty. The questions are basically of two types - those asking for information about the university and its computing facilities, and those asking for information related to computer software. (An example of the former was a question about what database searching facilities were available in the university and where they were. An example of the latter was a question about by whom and when the Drexel disc was designed.)

Observations of the student responses to these questions in the earlier trial showed that variations in retrieval time were primarily because of errors in arriving at the correct screen and of problems in using and understanding the system. Hypertext sets a new paradigm (which is slightly different from the traditional menu-based database) for the students. They do not necessarily understand the ideas behind each concept. More especially, the previous work indicated they had problems with buttons (i.e. hypertext links). The icons and graphics which represent the buttons led to difficulties in moving quickly through the database to retrieve the information. As before, a comparison was made between the average time taken by each set to answer each question. The results were averaged over 9 sub-sets in set A; 7 sub-sets in

sets B and C; and 8 sub-sets in set D.

### 3.1.1 Analysis of results

**Table 5.2. Overall comparison of retrieval time for a question in 1991 and 1990**

Year	Total no. of students	Number of Students						Minimum time taken for a question	Maximum time taken for a question	Mean time taken for a question	SD
		correctly answered		incorrectly answered		not attempted questions					
		No.	%	No.	%	No.	%				
1991	45	34	72.4	0.9	2.0	12	25.6	37.8	654.5	209.9	154.4
1990	41	26	63.8	1.2	2.9	14	33.3	61.3	554.2	222.0	146.4

The statistical difference in the mean time taken for each question between 1991 and 1990 HyperCard teaching experiments is : 0.373

df : 45+41-2=84

P : 0.05 level

There is a small difference between the two sets in Table 5.2 in the average time required to answer a question. However, the application of a t-test shows that this difference is not significant at the 5 % level.

The mean time taken for a question was then tested against other variables, such as the student's age, sex, group, subject background, prior computer experience and experience with Macs. The results are discussed below.

**Table 5.3. Age groups v. time taken for a question**

Year	Age groups	Total no. of students	Number of Students						Minimum time taken for a question	Maximum time taken for a question	Mean time taken for a question	SD
			correctly answered		incorrectly answered		not attempted questions					
			No.	%	No.	%	No.	%				
1991	19-20	24	18	73.6	0.6	2.4	5.8	24	48.0	550	209.2	147.2
	21-25	12	9.1	75.7	-	-	2.9	24.3	49.8	534.5	192.7	139.5
	26-30	2	1.1	54.2	0.3	12.5	0.7	33.3	95.6	215.6	156.8	86.7
	31-35	2	1.8	91.7	-	-	0.2	8.3	141.8	261.8	201.8	101.7
	36-40	2	1.2	58.3	-	-	0.8	41.7	205.7	351.4	278.6	111.6
	46 >	3	1.8	59.5	0.1	2.7	1.2	37.8	140.9	365.2	240.9	135.5
	21-47	21	6.8	77.1	0.1	0.4	2.0	22.5	90.8	436.5	205.2	127.6

1990	19-20	29	18.4	63.5	0.9	3.2	9.7	33.4	74.2	486.7	237.2	133.6
	21-25	4	3.0	75	0.2	4.2	0.8	20.8	123.2	306.3	199.0	106.0
	26-30	3	1.6	52.8	-	-	1.4	47.2	176.8	472.6	320.5	171.8
	31-35	3	2.2	72.2	0.1	2.8	0.8	25	120.4	300	182.6	103.7
	36-40	1	0.7	66.7	-	-	0.3	33.3	266.3	266.3	266.3	-
	46 >	1	0.3	33.3	-	-	0.7	66.7	172.5	187.5	172.5	-
	21-47	12	2.0	67.4	0.1	2.6	0.9	30.0	151.9	333.1	228.7	125.1

The statistical difference in the mean time taken for each question between 19-20 and 21-47 age groups in 1991 is : 0.098

df :  $24+21-2=43$

P : 0.05

The statistical difference in the mean time taken for each question between 19-20 and 21-47 age groups in 1990 is : 1.016

df :  $29+12-2=39$

P : 0.05

The statistical difference in the mean time taken for each question between 1991 and 1990 in 19-20 years age group is : 0.515

df :  $24+29-2=53$

P : 0.05

The statistical difference in the mean time taken for each question between 1991 and 1990 in 21-47 years age group is : 0.515

df :  $21+12-2=31$

P : 0.05

Two age groupings (19-20 and 21-47) were used in the analysis and the results are listed in Table 5.3. According to a t-test, there was no significant difference in the average time taken to answer a question between these two groups. Similarly, when a t-test was conducted between the mean times taken for each question in 1991 and compared with the results for 1991, no significant difference was found.

The mean time taken for each question by the 19-20 years age group students in both the experiments(i.e. 1990 and 1991) were then combined and a t-test carried out using the combined mean time of the age groups from both the experiments. Even then it was found that there was no significant difference between the two age groups.

**Table 5.4. Sex v. answers and time taken for a question**

Year	Sex	Total no. of students	Number of Students						Minimum time taken for a question	Maximum time taken for a question	Mean time taken for a question	SD
			correctly answered		incorrectly answered		not attempted questions					
			No.	%	No.	%	No.	%				
1991	Female	30	22.3	74.2	0.8	2.8	6.9	23.1	47.4	613.5	219.8	157.2
	Male	15	10.3	68.9	0.1	0.6	4.6	30.6	50.1	455.8	180.8	124.3
1990	Female	34	21.8	64.2	1	2.9	11.2	32.8	66.8	571.3	221.6	140.1
	Male	7	4.3	61.9	0.2	2.4	2.5	35.7	86.1	227.8	162.7	65.4

The statistical difference in the mean time taken for each question between 1991 and 1990 with females is :0.048

df : 30+34-2=62

P : 0.05

The statistical difference in the mean time taken for each question between 1991 and 1990 with males is : 0.448

df : 15+7-2=20

P : 0.05

The statistical difference in the mean time taken for each question between males and females in 1991 is : 0.906

df : 30+15-2=43

P : 0.05

The statistical difference in the mean time taken for each question between males and females in 1990 is : 1.71

df : 30+7-2=39

P : 0.05

Table 5.4 shows the average time taken for answering each question by male and female students. Again, a t-test indicated no significant difference in the mean time to answer a question between males and females. When the results from 1991 were compared with the 1990 experimental results, it was also found that there was no significant difference in their mean time to answer a question. Combining 1990 and 1991 results still indicated that the combined mean time of the male students was not significantly different from the female students' combined mean time.

**Table 5.5. Class v. answers and time taken for a question**

Year	Class	Total no. of students	Number of Students						Minimum time taken for a question	Maximum time taken for a question	Mean time taken for a question	SD
			correctly answered		incorrectly answered		not attempted questions					
			No.	%	No.	%	No.	%				
1991	ICS	11	8.8	79.5	0.2	1.5	2.1	18.9	49.5	369.8	155.2	102.1
	LIS	34	24.2	70.4	0.8	2.2	9.4	27.4	38.3	654.9	226.0	164.1
1990	ICS	6	4.8	79.2	-	-	1.3	20.8	109.5	295.8	191.6	81.6
	LIS	35	21.4	61.2	1.2	3.3	12.4	34.5	69.3	561.2	244.3	146.4

The statistical difference in the mean time taken for each question between ICS and LIS students in 1991 is : 1.697

df:  $11+34-2=43$

P : 0.05

The statistical difference in the mean time taken for each question between ICS and LIS students in 1990 is : 1.271

df:  $6+35-2=39$

P : 0.05

The statistical difference in the mean time taken for each question between 1991 and 1990 with ICS students is : 0.801

df:  $11+6-2=15$

P : 0.05

The statistical difference in the mean time taken for each question between 1991 and 1990 with LIS students is : 0.488

df:  $34+35-2=67$

P : 0.05

The two types of student (ICS or LIS) along with the mean time taken to answer a question are shown in Table 5.5. (The students of single and joint honours courses in LIS were grouped together because of their similar level of computer experience.) Despite the differences in computing background, it was found that there was no significant difference between these two classes. This was also true of differences between the 1990 and 1991 experiments, and of the combined results.

**Table 5.6. Combined mean time of ICS and LIS students in 1990 and 1991 experiments**

<u>Class</u>	<u>No. of Students</u>	<u>Mean time</u>	<u>SD</u>
ICS	17	346.8	183.8
LIS	69	470.4	310.6

The statistical difference in the mean time taken for each question between ICS and LIS students after combining both 1990 & 1991 years experimental results is : 2.124

df : 17+69-2 =84

P =0.05 level

On this occasion, since the ICS and LIS backgrounds differed in the same way in both the 1990 and 1991 experiments, the results were combined and a difference test was carried out against the combined mean time of students from both the experiments. It was found that there is a significant difference (2.124) in the mean time taken between the ICS students and LIS students at the 0.05 level (df:84; t:1.998), but not at the 0.01 level (df:84; t:2.617).

**Table 5.7. Group v. answers and time taken for a question**

Year	Group	Total	Number of Students						Minimum time taken for a question	Maximum time taken for a question	Mean time taken for a question	SD
			no. of correctly students answered		incorrectly answered		not attempted questions					
			No.	%	No.	%	No.	%				
1991	A	13	10	75.5	0.8	6.3	2.4	18.2	75.5	437.5	196.6	120.6
	B	11	7.9	72.0	0.2	1.5	2.9	26.5	76.3	583.6	238.6	184.7
	C	10	5.9	59.2	-	-	4.1	40.8	102.3	560.3	258.2	164.2
	D	11	8.8	79.6	0.2	1.5	2.1	18.9	49.5	369.8	155.2	102.1
1990	A	19	11.7	61.4	0.7	3.5	6.7	35.1	79.5	487.3	253.3	86.4
	B	16	9.8	60.9	0.5	3.1	5.8	35.9	78.2	493.3	229.1	85.2
	C	6	4.8	79.2	-	-	1.3	20.8	116.8	321.1	191.6	49.8

The statistical difference in the mean time taken for each question between Group A & B in 1991 is : 0.647

df : 10+11-2=19

P :0.05

The statistical difference in the mean time taken for each question between Group C & D in 1991 is : 1.706

df :  $10+11-2=19$

P :0.05

The statistical difference in the mean time taken for each question between Group A & D in 1991 is : 0.909

df :  $13+11-2=22$

P :0.05

The statistical difference in the mean time taken for each question between Group B & C in 1991 is : 0.258

df :  $11+10-2=19$

P :0.05

The statistical difference in the mean time taken for each question between Group A & C in 1990 is : 2.175

df :  $19+6-2=23$

P :0.05

The statistical difference in the mean time taken for each question between Group B & C in 1990 is : 1.274

df :  $16+6-2=20$

P :0.05

The statistical difference in the mean time taken for each question between Group A & B in 1990 is : 0.834

df :  $19+16-2=33$

P :0.05

The statistical difference in the mean time taken for each question between Group A & C in 1990 is : 1.032

df :  $13+19-2=30$

P :0.05

The statistical difference in the mean time taken for each question between Group A & C in 1990 is : 0.159

df :  $11+16-2=25$

P :0.05

The statistical difference in the mean time taken for each question between Group A & C in 1990 is : 0.986

df :  $11+6-2=15$

P :0.05

The mean time taken for each question for each group is shown in Table 5.7. In the previous year, students suggested that 3-4 students per computer leads not only too many problems in retrieving information, but also to less hands-on experience and learning. In 1991, students were allocated to computers either individually, or as matched pairs, to investigate whether this led to greater student satisfaction and better results. Hence, the LIS students were divided into three sets and the ICS students were kept in a fourth set. A t-test suggests that there is no significant difference at 0.05 level between these four sets. However, it is worth noting that the order in 1991 runs in the order of computer experience of the group, with set D first, followed by set A, and the two least-experienced groups(B and C) last.

In the 1990 HyperCard teaching experiment, students were grouped randomly (i.e. heterogeneous grouping), whereas in the second HyperCard teaching experiment grouping was in terms of similar student background (i.e. homogeneous grouping). When the results of the sets in 1990 were compared with those in 1991, it was found that there was no significant difference.

**Table 5.8. Subject v. answers and time taken for a question**

Year	Subject back- ground	Total no. of students	Number of Students						Minimum time taken for a question	Maximum time taken for a question	Mean time taken for a question	SD
			correctly answered		incorrectly answered		not attempted questions					
			No.	%	No.	%	No.	%				
1991	Sc.	14	11.3	81.0	0.3	2.4	2.3	16.7	48.8	434.1	172.7	118.1
	S.Sc.	15	10.5	70.0	0.5	3.3	4	26.7	84.5	592.1	215.8	166.9
	Hum.	16	10.7	67.0	0.1	0.5	5.2	32.5	65.8	578.4	235.4	161.1
1990	Sc.	8	5.4	69.2	0.1	1.1	2.3	29.8	923	419.1	204.2	119.4
	S Sc.	20	11.3	58.4	0.7	3.5	7.3	38.1	92.5	476.6	239.9	134.5
	Hum.	13	7.8	64.0	0.4	3.4	4	32.7	85.4	505.9	260.9	156.6

[Sc. = Sciences ; S.Sc. = Social sciences; Hum. = Humanities]

The statistical difference in the mean time taken for each question between Sciences and Social sciences background students in 1991 is : 0.807

df: 14+15-2=27

P :0.05

The statistical difference in the mean time taken for each question between Social sciences and Humanities background students in 1991 is : 0.332

df :  $15+16-2=29$

P : 0.05

The statistical difference in the mean time taken for each question between Sciences and Humanities background students in 1991 is : 1.225

df :  $14+16-2=28$

P : 0.05

The statistical difference in the mean time taken for each question between Sciences and Social sciences background students in 1990 is : 0.688

df :  $8+20-2=26$

P : 0.05

The statistical difference in the mean time taken for each question between Sciences and Humanities background students in 1990 is : 0.936

df :  $8+13-2=19$

P : 0.05

The statistical difference in the mean time taken for each question between Social sciences and Humanities background students in 1990 is : 0.398

df :  $20+13-2=31$

P : 0.05

The statistical difference in the mean time taken for each question between 1991 and 1990 Science background students in 1990 is : 0.597

df :  $14+8-2=20$

P : 0.05

The statistical difference in the mean time taken for each question between 1991 and 1990 Social science background students in 1990 is : 0.457

df :  $15+20-2=33$

P : 0.05

The statistical difference in the mean time taken for each question between 1991 and 1990 Humanities background students in 1990 is : 0.43

df :  $16+13-2=27$

P : 0.05

Table 5.8 shows the mean time taken for answering the question against the subject background of the student. On average, the students with a Science subject background took the shortest time, whilst students with a Humanities subject background took most time. However, in terms of a t-test, it was found that there was no significant difference. When the 1991 results were

compared with the 1990 results, it was found that there was no significant difference. Nevertheless, it is worth noting that the students with a science background took least time and students with a Humanities background took most time in both years. It must be added that combining the 1990 and 1991 still failed to arrive at a significant difference.

**Table 5.9. Used computer v. answers and time taken for a question.**

Year	Used computer	Total no. of students	Number of Students						Minimum time taken for a question	Maximum time taken for a question	Mean time taken for a question	SD
			correctly answered		incorrectly answered		not attempted questions					
			No.	%	No.	%	No.	%				
1991	Yes	42	31.6	75.2	0.9	2.2	9.5	22.6	38.6	622.1	200.9	147.8
	No	3	1	33.3	-	-	2	66.6	212.5	602.5	402.5	224.2
1990	Yes	38	24.7	65.1	0.9	2.4	12.3	32.5	108.1	433.1	235.4	141.3
	No	3	1.5	50	0.2	5.6	1.3	44.4	132	363	211.5	39.4

The statistical difference in the mean time taken for each question between computer experienced and no computer experienced students in 1991 is : 1.534

$$df: 42+3-2=43$$

$$P:0.05$$

The statistical difference in the mean time taken for each question between computer experienced and no computer experienced students in 1990 is : 0.739

$$df: 38+3-2=39$$

$$P:0.05$$

The statistical difference in the mean time taken for each question between 1991 and 1990 with computer experienced students is : 1.064

$$df: 42+38-2=78$$

$$P:0.05$$

The statistical difference in the mean time taken for each question between 1991 and 1990 with no computer experienced students is : 1.453

$$df: 3+3-2=4$$

$$P:0.05$$

It is normally expected that the students with more computer experience will perform better when using complicated systems than students who have never used computers before. The difference in time taken by experienced and non-experienced users was high (201.0 and 402.4 seconds in 1991 and

1990, respectively), but it was still at the limit of significant difference. The problem lies in the small number of students lacking computer experience. Correspondingly, the combination of data from 1990 and 1991 did not greatly improve the statistical data.

**Table 5.10. Used Mac v. answers and time taken for a question**

Year	Used Mac	Total no. of students	Number of Students						Minimum time taken for a question	Maximum time taken for a question	Mean time taken for a question	SD
			correctly answered		incorrectly answered		not attempted questions					
			No.	%	No.	%	No.	%				
1991	Yes	24	18.9	78.8	0.8	3.5	4.3	17.7	47.0	379.0	161.9	97.2
	No	21	13.7	65.1	0.1	0.4	7.3	34.5	64.7	624.5	273.7	190.4
1990	Yes	15	9.9	66.1	0.3	1.7	4.8	32.2	77.0	424.4	224.7	117.2
	No	26	16.3	62.5	0.9	3.5	8.8	34	77.91	541.6	256.1	154.3

The statistical difference in the mean time taken for each question between Mac experienced and no-Mac-experienced students in 1991 is : 2.427

df:  $24+15-2=47$

P :0.05

The statistical difference in the mean time taken for each question between Mac experienced and no-Mac-experienced students in 1990 is : 0.735

df:  $15+26-2=39$

P :0.05

The statistical difference in the mean time taken for each question between 1991 and 1990 with Mac-experienced students is : 1.735

df:  $24+15-2=37$

P :0.05

The statistical difference in the mean time taken for each question between 1991 and 1990 with no-Mac experienced students is : 0.342

df:  $21+26-2=45$

P :0.05

Finally, Table 5.10 shows the difference in the mean time taken for a question between students experienced and inexperienced in using Macs. The number of students in each category is about the same. It was found that there is a significant difference (2.427) between these two groups at 0.05 level(df:47; t:2.0).

A comparison of 1991 results with 1990 results shows no significant difference in the earlier year. In 1990 the random formation of groups may have affected the mean time, whereas in 1991 all the students with a similar background and computer experience were grouped together. The existence of a significant difference between those with Mac experience and those without was confirmed when data for 1990 were combined with the 1991 data.

### **3.1.2. Evaluation of the Drexel disc**

After the exercise, students were asked for their evaluation of the Drexel disc. Nearly all the students (97.8%) considered that the disc was reasonably easy to use and was suitable for absolute beginners. A similar proportion (95.6%) of the students felt that the disc was acceptably organised. Almost three-quarters of the students found the information on the disc was generally interesting. However, some felt that the materials on the disc were too American-oriented.

When asked to pinpoint features reflecting the particular value of hypertext for this kind of application, two-thirds of the students mentioned the campus map as the feature they liked most. This was because the campus map could be used interactively to find building numbers and their names, facilities, timings, etc. Moreover, the layout was very clear and all the buildings were clearly designed. Besides the campus map, about 40% of the students found the index useful and helpful in retrieving information easily and quickly. About one-third of the students liked the graphics and felt that multi-media presentation of text, graphics and sound made them more interesting. A quarter liked the information content on the disc and felt that it would be useful for their day-to-day needs. A small percentage of the students also liked other features of the disc (such as icons, menus, navigation and the method of retrieving information).

The disliked features of the disc were also, interestingly enough, the campus map (22%), icons(15%) and the index (11%). Even though the majority liked the campus map, a few commented on problems they had experienced while using it. In particular, they had not understood the switching modes on the

campus map, so they were unable to see portions of the campus map which lay outside the screen. In the same way some of the information searching of the index proved inadequate: a more comprehensive index was needed. Several had difficulty in understanding the meaning and purpose of the icons: this applied to especially to the 'closed hand' icon, which could be used to switch between interactive and movement modes on the campus map. Other features, such as windows without 'close boxes', rigid navigation, moving between the screens, lack of colours and too long chunks of text on the screen, were each disliked by a few students.

### **3.1.3 Changes suggested by the students for a Loughborough disc**

Students were asked what changes they would like to see if a similar disc were to be produced at Loughborough. They suggested changing the way the information was presented (especially the campus map), the graphics, the organisation of information and the system interaction. Most of the information on the campus map was not indexed, and moving the map on the screen also caused problems to a few students, as noted above. It was advocated that all the information on the campus map and other parts of the disc should be indexed and made easily available without taking too many steps. At the same time, it was proposed that the map should be modified to allow scrolling and the facility of zooming to parts of the campus map for greater detail should be added. The textual information should be linked to the photographs of the buildings, graphics, etc. Information should be presented in smaller chunks with a balance of graphics on the screen. Big text chunks and graphics alone without text were considered to be unattractive to naive users : a balanced provision of text, graphics and sounds would encourage students to use the system more. Some students felt that there was no online screen help : this should be included along with a few screens of introductory information about the disc. Some of the icons/graphics were presented without a title which confused the students. It was proposed that the titles of the icons/graphics should be added beneath them.

The students would naturally prefer to have English spellings and

phraseology, rather than American (which caused a few of them difficulty). Eventually, the contents would need to be adapted to UK practice in a number of areas, eg. OPACs, Inter-Library loan, reservations, computing facilities, on-campus travel and entertainment facilities, carrier information, clubs and societies, local information and libraries, and a comprehensive index to retrieve all the information quickly. A majority of the students noted that the disc would be more useful if the contents could cover leisure as well as work activities.

Overall, the majority of the students liked the disc with a few modifications and additions to its contents. Their analysis suggests that a Loughborough disc could be designed in a similar way, and that many students would find it useful.

#### **3.1.4. Student's problems with the Drexel disc**

Common problems and errors that a novice user might make while using HyperCard applications were identified in the 1990 hypertext teaching experiment and categorised into the following types: 1) Mouse problems (eg. difficulties in directing the cursor when using the mouse, confusing clicking and double-clicking, controlling the mouse, difficulty in selecting the commands); 2) Icon problems (eg. difficulty in understanding what they represent, what will happen when you click on them); 3) On-screen problems (eg. failure to move materials about on the screen; difficulty in understanding information displayed and what it means); 4) Problems in moving between screens (selecting the wrong screen; failure to escape from the wrong screen; uncertainty regarding position in the database); 5) Problems of changing material (eg. failure to transfer material between cards; difficulty in identifying what stage a user had reached in the task); 6) Navigational problems (eg. not being able to move freely in the database, difficulty in finding a particular piece of information; losing control of the database); 7) Information retrieval problems (eg. identifying relevant information in a database, difficulty in searching the information); 8) Problems with Paint tools (eg. failure to identify which tool is for what purpose, difficulty in using the tools); 9) Menu problems (eg. difficulty in understanding the menu options, manipulating the menus, difficulty in reading the menus due to small print

size); 10) Problems with graphics (eg. difficulties in identifying the graphics titles, what activity they represent); 11) Hardware & software problems (eg. failure/ inability to operate Macs, to enter HyperCard); and 12) Other problems (in case they came across new types of problems not covered in the above list).

The students were asked to record all the problems they encountered during the practical sessions in the appropriate parts of the worksheets(see Appendix-VIII) provided. They were also asked to make a note each time a problem occurred, even it was for the same reason, so that the most common problems of novice users of hypertext(HyperCard) could be identified. In each session, a worksheet was provided to the students, so they could record their problems while doing the hypertext practicals. For the Drexel disc experiment, the type of hand-outs and worksheets provided to all the students of the different sets were the same. For practical purposes sets A and D were grouped together, and their problems compared with those encountered by sets B and C. The earlier study had shown that most of the problems encountered are the same, whether the students are novices or experienced computer users. However, the number of problems encountered could vary as between novices and experienced users. Since none had encountered hypertext before, though the number of problems was liable to change with computer experience, the kind of the problems encountered were likely to remain more or less same. The range of problems uncovered are described under the successive categories below.

### **1) Problems with the mouse**

Even though both sets A and D had some initial problems with the mouse, they were soon solved. In set A, some of the students lost control of the cursor on the screen while selecting commands from the menus; they also sometimes ran out of space to operate the mouse. Some were not sure where to click, or how many times they should click to select an object. Though set D also had problems with the mouse, they were mainly in selecting and resizing the fields and buttons. Initially, some members of the group accidentally resized the fields and buttons because of inaccuracy in using the mouse. Overall both groups felt that a steady hand is required to control the mouse, but it could be achieved given adequate Mac experience.

By way of contrast, sets B and C had more basic problems with the mouse (such as differentiating between a single-click and a double-click). As first time users, some were holding the mouse too tightly and pressing the mouse button too hard, so that the cursor failed to move on the screen. These two sets also had problems in controlling the mouse, altering objects accidentally and running out of space for the mouse more frequently than the first two sets. All levels of users therefore had problems with the mouse, but the type and number were more with sets B and C who had less computing experience. As one of the students commented about the mouse, "I had a number of mouse problems and sometimes found it hard to drag the fields and buttons and had to repeat the process a number of times before I got it right". Given experience, some students noted felt that it was easier to move around the system using a mouse rather than a keyboard : they could keep their eyes on the screen all the time, instead of looking down at the keyboard to initiate the commands. Another student said that 'I enjoyed the idea of using the mouse for virtually every function in HyperCard. It meant there was no necessity for complicated instruction on what keys to press, and when, as in many computer-based-exercises'.

## **2) Problems with icons**

In general, most of the students (about 90%) experienced, in one way or another, problems with icons. For novice users of HyperCard and its applications, the icons seemed to be difficult to understand, though once they had been learnt, they were fairly easy to use. Sets A and D had slightly fewer problems (12) than sets B and C (19). One of the students from set A commented on the icons that : "to a first-time user it is not always obvious what the symbolic icons represent and the type of information which can be retrieved when selected, time was wasted in clicking on wrong icons". Because of this uncertainty, many students used the icons by trial and error, so leading to an appreciable waste of time. Hence, when designing any HyperCard application, it is important to choose appropriate, popular and easily understandable icons, accompanying them with their titles, if these kinds of problem are to be eliminated.

### **3) On-screen problems**

The commonest on-screen problems encountered by students were difficulty in understanding the information displayed on the screen, especially the icons/graphics. Slightly less than one-fifth of the students had problems in understanding the meaning and the purpose of the 'closed hand symbol' (browse tool) on the campus map. They also remarked that the information displayed on the screen could be either too long, or too brief. About one-sixth of the students had difficulties in scrolling the campus map. Other on-screen problems included failure to find the system's online help, difficulty in extracting answers to questions, no information or very little information about the icons and understanding the textual information displayed on the screen. Overall, there was not much difference in the number of problems encountered under this heading for sets B and C and A and D.

### **4) Problems in moving between screens**

While using the Drexel disc, about half of the students (from all sets) selected the wrong screens and experienced difficulties in escaping from them. They had problems in knowing their exact position in the database: one-sixth of the students failed to appreciate this and ultimately lost control of the database. They felt that 'there was no indication of what particular screen they were on'. The menu options used for moving between the screens created some problems. For example, when the menu option 'exit' was selected, instead of 'close', the application quitted the program; so that it was necessary to start again from the beginning. There was also some confusion between the lower-level icon options and the main screen icon options, because of their similarity in nature and look. A few students also became confused while trying to find screens/information which had been found previously. They could not remember where that information was in the database.

### **5) Problems of changing material**

One-sixth of the students had difficulties in identifying their position in the database. They said that it was hard to know how much information was still available, besides that already found. These problems were found to a similar extent in all four sets.

### **6) Navigational problems**

About half of the students had either minor or major problems while navigating through the Drexel disc. The number was slightly greater for sets B and C, but students in all sets lost control of the database at some time or other. The designer of the disc had to some extent constrained the movement of the user. As a consequence, one-fifth of the students said they could not move as freely in the database as they wished. In consequence, a few lost their way. Despite the existence of an index, about an eighth of the students had difficulties in finding particular pieces of information in the database.

### **7) Information retrieval problems**

Almost two-thirds of the students experienced difficulties in retrieving information from the database. All the sets encountered almost the same number and level of problems while looking for the answers to their tasks. About a quarter of the students had trouble in identifying the relevant item from the topic and sub-topic options on the screen. This led to clicking on different topics to look for those relevant to their task. It also meant that they were unsure whether there was any additional information existing at any other point in the database. The existing index only covers some parts of the database; and there is no general search facility for the whole of the database. Since there was no online help system, a few students ran out of ideas and did not know how to look for the next piece of required information. Some even had difficulties in identifying information on the screen, if there was too much text at one point. The number of problems encountered under this heading was similar for all the sets.

### **8) Problems with Paint tools**

The only paint tool used in the Drexel disc was the "Browse tool". About a sixth of the students had difficulty in identifying its purpose to begin with, and also in using it with the map. Since it was not labelled, many of these students did not realise that the icon could be used for seeing the rest of the map beyond the screen size of the computer. The other icon on the map was a left-inclined arrow, which was used for selecting the 'interactive(normal) mode' of the campus map. Some of the students also had difficulties in switching between the campus map's 'movement mode' (in which the map

could be moved up & down and right & left, but the buttons in this mode are not interactive) and the 'interactive mode' (in which all the images, buttons and layouts of the buildings on the campus map are interactive, but the map cannot be inspected beyond the screen size). Though there were two icons to be used for switching between these two modes, students did not realise what they were meant to do. Moreover, there was no online help on the campus map to aid access when a novice user was stuck.

### **9) Menus problems**

Overall, one-fifth of the students had difficulties in understanding the menu options, though they had no problems in using them. Some of the menu options were single words and, to understand their actions, some of the students used trial and error. A few felt that the print size of the menu options was too small to be read easily, and, in addition, did not describe the contents properly.

### **10) Problems with graphics**

Most of the students liked the graphics, but a quarter of them did not understand their meanings. Neither the icons, nor the graphics used in the system were self-explanatory and many were poorly labelled. Because of unfamiliarity, many students had problems, particularly on the 'campus map' and 'short cuts & tips' sections.

### **11) Hardware and software problems**

Apart from connecting the mouse to the key board and switching on the Macs (especially the Mac LC) the students did not find any major difficulties with the Macs and HyperCard. A few had initial difficulties in entering the HyperCard software, but on the whole, problems were few. Because of a system software incompatibility, the system crashed three times without giving any prior response : this was not serious, as it had been anticipated beforehand. It occurred because the Drexel disc was designed under system software 6.0 (an old version), whereas the current running system software under which Drexel disc was used, was version 7.0. Incompatibility of some of the files between these two versions caused the problems; this had been checked out with the Apple's software technicians, before starting the experiments, but nothing could be done to help the situation.

Since Mac LCs have got separate power switches on both the system and the monitor, the students became confused, while switching on, on what order should be followed for correct operation. A few switched on the monitor first, and kept the system switch in the off position. Others first switched on the system, but kept the monitor switch in the off position (with the result that they did not get a picture on the screen). Since these switches are on the rear of the monitor and the system, students could not see them while doing these operations, so they frequently operated the switches wrongly. Once the correct procedure had been demonstrated, this problem disappeared quickly. The Mac SE has the power switch on the rear left of the the Mac, but did not present a problem, because the system and monitor are, in this case combined together and provided with a single power switch.

### **3.2. THE CUSTOMISATION EXERCISE**

In this exercise, students were asked to design a 'Document Catalogue' stack. A Document catalogue stack is simply an electronic version of a manual card catalogue (such as libraries used to have). Each card in the stack had nine fields, namely :1)Class number, 2) Accession number, 3) Author, 4) Title, 5) Publisher, 6) Place of publication, 7)Date of publication, 8) Keywords, and 9) Notes. The main objective of this stack design was to test students' understanding of the techniques for using HyperCard which had been taught in the classes. At the same time, this type of application may be useful in their later work. The exercise required them not only to create a new stack but also to carry out other activities such as using the graphic tools and transferring buttons from the HyperCard's home stack to their stack. The main activities were creating a new stack, background, buttons and fields, using paint tools, transferring buttons, typing scripts to the buttons and testing the stacks' real operation.

During the 1990 customisation exercise, students were asked to construct a personal diary, which required using most of the paint tools. While designing the diary stack, many students had problems not only in identifying the icons belonging to the paint tool box, but also in using them in the stack design (Ramaiah and Meadows, 1993). To avoid these problems in the 1991

customisation exercise, the students were asked to use the paint tools at a very minimum level so that they could carry out this exercise quickly without many problems. They were also supplied with a hand-out which described all the icons, images and their functions. Among the four sets, sets B and C were provided with similar types of hand-outs which contain a 'condensed form of instructions'(see Appendix - XV). These two sets did not have much experience either on computers or on Macs, but they were provided with classroom-help while designing the DC stack. On the other hand, sets A and D had advanced computing experience and were given a recipe(see Appendix - XVI) contains step-by-step instructions. However, these two latter sets were not provided with any kind of classroom help (except on a few occasions, where they were totally stuck and could not go further). All the sets were given a total of two hours time to complete this exercise - an hour in one week followed by another hour two weeks later. All the students were asked to record the difficulties they encountered while designing the 'Document Catalogue' under the headings mentioned in the previous section (i.e. the Drexel disc exercise).

In all, students in sets A and D mentioned 93 problems that were encountered while carrying out the customisation exercise, whilst sets B and C mentioned 104. These spread over the following categories : i)Moving between the screens, ii)Transferring the materials between stacks, iii) Domain, iv) Instructions, v) Fields, vi)Button, vii)Icons, viii) Screen size, ix)Mouse, x)Cognitive, and xi)Hand-out problems. The main problems were found to relate particularly to the categories number 1,2,4,5 and 6. Further details of the problems encountered in the customisation exercise are discussed below.

### **3.2.1. Students' problems with the Document Catalogue(DC) stack design**

As described in the methodology chapter, for the DC stack design the students were grouped into (1) sets B and C and (2) sets A and D. This was in order to study the different problems the students encountered while designing a stack in comparison with their level of computer experience on both PCs and Macs. The two groups (sets A and D and B and C) were also

given different types of hand-outs to emphasise the possible impact of these differences in background. Sets A and D were provided with a detailed hand-out in which step-by-step instructions were provided, whilst sets B and C were provided with a condensed hand-out.

Set D contained ICS students who had fairly extensive computer experience, including some exposure to Macs (9 out of 11), whilst set A contained LIS students who had been similarly computer-literate and also had prior Mac experience. These students were provided with step-by-step instructions to see whether such experienced computer users could work independently on their own without further classroom help. Sets B and C contained LIS students who were less computer-literate and who had made little use of Macs. They were grouped together and provided with brief instructions to help to carry out their tasks. At the same time, they were provided with maximum classroom help while designing the DC stack. Whereas the intention for sets A and D was to see what was the minimum level of classroom help required, for sets B and C it was to see what was the maximum level of help required. All the students were asked to record the problems they encountered while designing the DC stack, so that the level of the problems encountered in both the groups could be compared. This should cast light on the type of hand-outs they required, the amount of classroom help needed by a novice user, the kind of instructions needed and the appropriate methods of instruction to achieve optimum satisfaction for the students.

The problems encountered by the students were analysed within the following broad categories.

### **1) Mouse problems**

The number of mouse problems encountered was similar in the two groups, but the level proved to be different. In sets B and C, the mouse problems were basic in nature, whereas for sets A and D the problems were slightly different. A quarter of (B and C) students had difficulties in knowing where to click and double-click. One-sixth of them had initial difficulties in selecting the objects on the screen and controlling the mouse. subsequently, several encountered problems in resizing the fields and buttons.

Only a few of the (A and D) students had problems with clicking and double-clicking, but a third of them had difficulties in changing the size of the fields, buttons and windows with the mouse. While moving the buttons and fields on the screen, they frequently sized them by accident. They found that it was hard to position the cursor accurately on the button or field, and that it needed a lot of practice to overcome this problem. Despite these problems, almost all the students in both the groups preferred the mouse over the keyboard while using HyperCard applications.

## **2) Icon problems**

About two-thirds of the students (from B & C) had difficulties in understanding the meanings and functions of the icons in HyperCard. However, when the icons had titles underneath, they experienced may fewer difficulties in understanding and using them. Many of them used trial and error methods which took a lot of their time, eg. when using the of the paint tools, especially the 'lasso tool'. Since it was not obvious which icon/graphic was clickable on the screen, there was also much uncertainty concerning the buttons to be used.

In comparison, half of the (A & D) students had difficulties with understanding icons, mainly with the paint tool box. There was uncertainty in knowing what they were or what information might be contained in them. Students felt that 'it was really difficult to understand all the icons without using the help of the hand-outs provided'.

## **3) On-screen problems**

About one-sixth of the (B & C) students had difficulties in differentiating between the card and the background domains. Due to this confusion they were sometimes working in one domain when they thought they were in the other domain, so wasting considerable time. A few had problems in understanding the information displayed on the screen.

Half of the (A & D) students had encountered on-screen problems, but these were mainly minor. The most important one was resizing and organising the fields and buttons on the screen. A few also accidentally altered the position

and size of the fields and were not sure how to fix the fields on the card. When they created fields accidentally, they were not sure how they could be deleted. However, it was clear, overall, that the level of problems encountered by this group was different from that of the other group.

#### **4) Problems in moving between the screens**

A quarter of the (B & C ) students had difficulties in coming back from the home card to their stack, but they soon learned how to correct this. A few also had difficulties in ascertaining their position in the hypertext database.

Even the (A & D ) students experienced difficulties in returning to their stack from the home card, using the 'command and escape' keys on the keyboard. The hand-outs supplied to both groups of students mentioned clearly that while copying the buttons they should not go to any other cards or stacks. However, some from both groups still made mistakes. In this case, both groups encountered problems similar in number and level.

#### **5) Problem of changing materials**

A quarter of the (B & C ) students had difficulties in moving material between their stacks and the home card. While transferring buttons the home stack to their stack, the students failed to come back to their stack and wandered into different stacks/cards in a loop. A few copied the buttons onto the card layer instead of its background layer, and also did not know what stage they had reached in their task. Consequently, they felt that creating buttons was much easier than copying them. Some of the students had difficulties in selecting and resizing the fields and buttons whether created, or copied. Students in the (A & D ) group experienced similar problems.

It was found that the Mac SEs offered particular problems in this exercise because of their small screen size. Three quarters of the students working with Mac SEs encountered this difficulty because, while creating the stack, they opted for a card size which was slightly bigger than the Mac SE screen size. Consequently, some portion of the card disappeared.

#### **6) Navigational problems**

With this design exercise, the students did not need to move about much in

the HyperCard software. As a consequence, in both groups there was no major navigational problem.

#### **7) Information retrieval problems**

There were no tasks in this exercise which required information retrieval while designing the stack. Hence, neither group encountered more than trivial problems.

#### **8) Problems with paint tools**

More than half of the (B & C) students had difficulties in understanding the paint tools. One of these students mentioned that, "at first I had problems with identifying tools, then in remembering to change to the correct tool option, depending on whether I wanted to type text, create boxes, or buttons". Even though a hand-out explaining the functions of the 'paint tools' was provided beforehand to assist them, still the functions of several icons were difficult to understand for many of them. A few failed to move the tools palette from the menu bar to a convenient part of the screen to have easy access to all the tools. Many of the students noted that one needs a steady hand to use the paint tools.

About one-third of the (A & D) students had similar difficulties with the paint tools. A typical comment was that with, 'Paint tools it was not obvious to a first time user which tool was meant for what purpose, however they became clear with experience and also by taking help from the hand-outs supplied'.

Overall, both groups of students felt that the paint tools were difficult to understand, especially when they were using them for the first time. Even though they were asked to use only a small number of the paint tools for the design of the Document Catalogue stack, the students encountered problems, suggesting that there are inherent difficulties in this aspect of the HyperCard software.

#### **9) Menu problems**

Neither group encountered major problems with the menus. The only exception, for both groups, was the 'Go menu', where they did not understand the options properly (eg. home, recent, etc.). On the whole, the HyperCard

menus were easy to understand and the size of the print was satisfactory to the majority of the students.

#### **10) Hardware and software problems**

Few in either group had major difficulties with the hardware and software. The only problem was in entering HyperCard. As there were many stacks or folders with similar names - such as HyperCard, HyperCard stacks, HyperCard help, and HyperCard Tour - a few students were not sure where to start. All students were shown how to reach the HyperCard software in their introductory session. Nevertheless, a number of students felt it was important to repeat this in the hand-outs.

#### **11) Other problems**

There was a general feeling in both groups that the time allowed for this exercise was not long enough and that two weeks gap in between each lecture was too long. As one of the students said, "I felt that the time allocated to do the HyperCard exercise was not quite long enough, as I felt that just as I had got used to the features of the system, it was time to leave for another lecture".

### **3.2.2 Time to complete the DC stack design**

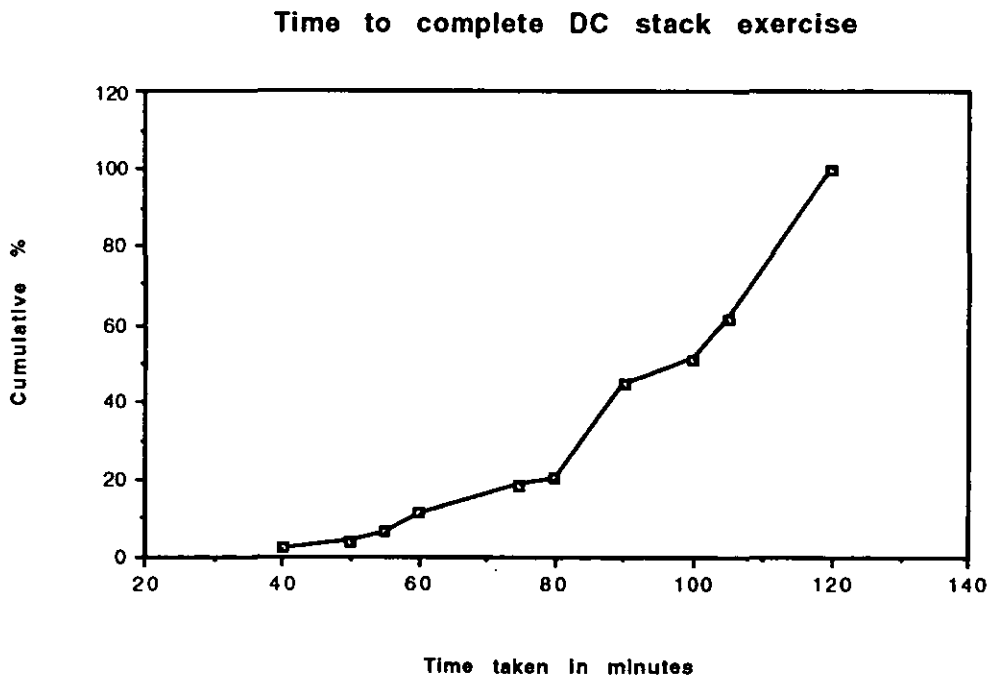
At the end of the customisation exercise, all students were asked to fill in a DC exercise 'progress sheet'(see Appendix-IX), which was divided into five stages. Each stage corresponded to the completion of a particular task, as follows. Stage 1 - creating a new stack; stage 2 - creating the background; stage 3 - adding the background fields; stage 4 - adding the background buttons; stage 5- completing the total design of the stack and testing its performance. It was found that 87% of the students successfully completed these exercises well within the time limit. Among the six students who failed to complete, four had completed up to stage 4 and the other two had only completed up to stage 3. When these students' computer experience was checked, it was found that three of them had no prior computer experience and the other two had only limited classroom experience in their first-year course work. The reasons given by these students for not completing their exercise were : i) insufficient time; ii) problems with hand-outs; iii) confusion

between background and card domains; iv) inexperience in using a mouse and a Mac.

It was found that most (91%) of set D students and over a third (39%) of set A students completed the customisation exercise within 90 minutes. In comparison, 24% of students from sets B and C completed the exercise 90 minutes. The details are given in Table 5.11 and Fig. 5.1

**Table 5.11. Time taken to complete the customisation exercise**

<u>Time taken</u> <u>in Minutes</u>	<u>No of Students</u> <u>&amp; percentage</u>	
40 -	1 (2%)	} 11 %
50 -	1(2%)	
55 -	1(2%)	
60 -	2(5%)	
75 -	3(7%)	} 33 %
80 -	1(2%)	
90 -	11(24%)	
100 -	3(7%)	} 56 %
105 -	7(16%)	
120 -	15(33%)	



**Fig. 5.1. Time to complete DC stack exercise**

The least time taken for this exercise in the entire class was 40 minutes by a student who had six years computer experience on both PCs and mainframes and a year on Macs. Among the ICS students, five of them finished their exercise within an hour.

#### **4. ASSESSMENT OF HYPERCARD TEACHING**

In providing their final assessment of the course, 60% of the students thought that the teaching they had received was sufficient to give them an elementary understanding of hypertext. Most of these students felt that more teaching time and practice was required for a full understanding and sufficient hands-on experience. Half of the students felt that the hand-outs for 'designing the DC' needed to be updated. Just before starting this hypertext teaching experiment, the HyperCard software on all the Macs in the Mac lab was updated from version 1.2.2 to 2.0. With the result, all the customisation exercise hand-outs prepared beforehand needed updating again with the newer version features. Through this was done, one or two points were not presented as fully as the students wanted. Apart from the updating of the hand-outs, there were no major problems in hand-outs. On the other hand, in sets B and C who were given a condensed version of the hand-out one-third of the students encountered problems in understanding the instructions in the hand-outs. Even though they were provided with constant classroom help while doing the exercise, they were not satisfied with the condensed version of the hand-out and reported that they needed more written guidance.

The attractive features of HyperCard for a majority of the students were especially the paint tools, ease of movement in the database, flexibility, use of the mouse, graphics and buttons for linking different cards. The provision of graphical tools to design their own graphics and the existence of different user levels to provide the instruction at their level was also appreciated.

The negative side was that a quarter of the students felt that navigation in HyperCard was a difficult. Many students felt that, once the meaning of the icons was understood, they were easy to use and provided rapid access to great amounts of information.. Some of the icons, especially in the paint tool

box, caused confusion in terms of their meaning and purpose of use. A few students also disliked other HyperCard features, such as menus, mouse, transfer of materials between stacks, differentiation between card and background domains, accidental alteration of the objects, information retrieval, too many hypertext links, fixed card size in a stack, lack of colours, inability to select multiple objects at a time and poor system response.

**Table 5.12. How easy is it to learn to use HyperCard ?**

I) Hard	-	1 (2 %)
II) Fairly hard	-	5 (11 %)
III) Reasonable	-	20 (44 %)
IV) Fairly easy	-	15 (33 %)
V) Easy	-	4 ( 9 %)

**Table 5.13. How interesting it is to use HyperCard**

I) Not interesting	-	1(2 %)
II) Moderately interesting	-	27(60 %)
III) Very interesting	-	17(38%)

It will be remembered that two sets of hand-outs were devised - one detailed and and other abbreviated. Table 5.14 shows that the former proved marginally more acceptable than the latter, but the difference seems unexpectedly small.

**Table 5.14. How helpful were the hand-outs supplied ?**

		<u>Students with</u> <u>detailed hand-outs</u>	<u>Students with</u> <u>condensed hand-outs</u>
I) Very useful	-	8(18 %)	2(4 %)
II) Fairly useful	-	13(29 %)	13(29%)
III) Not very useful	-	2(4 %)	7(16 %)
IV) Useless	-	-	-

Table 5.12 shows that more than two-thirds(87 %)of the students decided that HyperCard is reasonably easy to learn and almost all of them felt that it was moderately interesting. About 80% agreed that the hand-outs supplied were reasonably useful. About one-third of the students from sets B and C (more than three times the percentage of students from sets A and D) had problems with the condensed version of the hand-outs.

Overall, more than three-quarters of the students felt that the course materials provided were about right: 13 % felt they were too elementary and 9% felt they were too advanced. In terms of benefits from the hypertext teaching, four-fifths of the students said that it had improved their computer knowledge; most of them (over 90 %) thought it had improved their practical ability to handle information retrieval problems; a quarter thought they had advanced their design skills. About all the students thought that hypertext could be usefully applied for teaching in other LIS courses (such as Applications of Information Technology, Data analysis & presentation, System analysis, Information handling, Human information processing, Human management, Foreign languages, Classification, Cataloguing, Training programmes). Some even felt that it could be used for any course.

## **5. CONCLUSIONS**

Most of the students were satisfied with the teaching pattern and coverage of the revised course. Among their suggestions, increasing practical and teaching time was the prime requirement, along with a need for a shorter gap between the classes. Computer experience made a difference in some aspects of using HyperCard, but not in others. Classroom assistance could not replace the requirement for detailed written assistance.

**Reference**

Ramaiah, C. K and Meadows, A.J., 1993. A study of Hypertext teaching to undergraduate students in Library and Information Studies. *Information Processing & Management*, 29(2), pp.257-262.

## Chapter 6

# COMPARISON OF HYPERTEXT v. MENU-BASED AND COLOUR v. BLACK & WHITE HYPERTEXT INTERFACES

### **1. INTRODUCTION TO HYPERTEXT AND MENU-BASED INTERFACES**

This experiment was carried out to compare student reaction to hypertext and menu-based interfaces. A database was designed which could be accessed via both interfaces. A set of tasks was then designed as an exercise for students to carry out during their free time. The performance data of the individual student for each interface was examined for any significant difference with interface. The time required to complete a task was again chosen as a basic measure of the performance. Other measures were - number of correct and incorrect answers, not attempted tasks and extra steps taken for a task. Overall, this experiment tried to identify the student characteristics that may influence individual task completion for each interface.

### **2. RESULTS FROM THE PERFORMANCE TESTS**

As in the previous experiments, performance results were compared with a range of student characteristics, ranging from age to computer experience. These are discussed below.

Table 6.1 shows the grouping of students along with their age, number of correct answers, average time and extra steps taken for a question in both HyperCard and dBase systems. A t-test was conducted to find the difference between age groups using both systems in terms of correct answers, time taken and extra steps taken for a question. It was found that there is a significant difference in the mean time taken for a question between the 20-25 and 26-31 years age groups with the HyperCard system( $t=2.186$ ;  $df=18$ ) and

20-25 and 32-37 years age group also with HyperCard ( $t=2.572$ ;  $df=14$ ) at the 5% level, but not with the dBase system. Both these sets were not significantly different at 1% level. However, there is a significant difference in the mean time taken for a question between the 20-25 and >-38 years age groups in both the HyperCard system( $t=4.913$ ;  $df=39$ ) and the dBase system( $t=2.512$ ;  $df=16$ ) at 5% level. Whereas at the 1% level there is significant difference with the HyperCard system, but not with the dBase system. For the purpose of statistical comparison, the 20-31 years group (a merged age group of 20-25 and 26-31 years) was compared with a merged age group (32-48 years). It was found that there is no significant difference in the number of correct answers, time and extra steps taken for a question in both HyperCard and dBase. Apart from these age groups combinations there was no significant difference with all other combinations of the age groups in the mean time for both the systems. It was also found that there was no significant difference in both correct answers and extra steps taken for a question between these two systems. These results show that age is one of the student's characteristics which plays an important role in the performance of interface tasks.

**Table 6.1 . Age v. time taken for a question**

Age group	No. of students	HyperCard			dBase III+		
		Correct answers	Time taken for a question	Extra steps taken for a question	Correct answers	Time taken for a question	Extra steps taken for a question
20-25	7	10.8	157.1	5.0	12.0	71	1.3
26-31	13	10.3	132.4	6.8	11.5	115	1.7
32-37	9	9.2	154.8	6.8	11.7	122	2.9
38->	11	10.5	140.4	5.8	11.4	108	1.9
<b>20-31</b>	<b>20</b>	<b>10.5</b>	<b>116</b>	<b>6.2</b>	<b>11.6</b>	<b>99.6</b>	<b>1.5</b>
<b>32-&gt;</b>	<b>20</b>	<b>10</b>	<b>147</b>	<b>6.3</b>	<b>11.5</b>	<b>114.4</b>	<b>2.1</b>

The statistical difference in the mean time taken for each question between 20-25 and 26-31 years age groups in HyperCard is : 2.186

$df: 7+13-2=18$

$P = 0.05$

The statistical difference in the mean time taken for each question between 20-25 and 26-31 years age groups in dBase is : 2.028

$df: 7+13-2=18$

$P = 0.05$

The statistical difference in the mean time taken for each question between 20-25 and 32-37 years age groups in HyperCard is : 2.572

df :  $7+9-2=14$

P= 0.05

The statistical difference in the mean time taken for each question between 20-25 and 32-37 years age groups in dBase is : 2.130

df :  $7+9-2=14$

P= 0.05

The statistical difference in the mean time taken for each question between 20-25 and 38-> years age groups in HyperCard is : 4.913

df :  $7+11-2=16$

P= 0.05

The statistical difference in the mean time taken for each question between 20-25 and 38-> years age groups in dBase is : 2.512

df :  $7+11-2=16$

P= 0.05

The statistical difference in the mean time taken for each question between 26-31 and 32-37 years age groups in HyperCard is : 0.805

df :  $13+19-2=30$

P= 0.05

The statistical difference in the mean time taken for each question between 26-31 and 32-37 years age groups in dBase is : 0.362

df :  $13+19-2=30$

P= 0.05

The statistical difference in the mean time taken for each question between 32-37 and 38-> years age groups in HyperCard is : 0.505

df :  $9+11-2=18$

P= 0.05

The statistical difference in the mean time taken for each question between 32-37 and 38-> years age groups in dBase is : 0.541

df :  $9+11-2=18$

P= 0.05

The statistical difference in the mean time taken for each question between 20-31 and 32-48 years age groups in HyperCard is : 1.629

df :  $20+20-2=38$

P = 0.05

The statistical difference in the mean time taken for each question between

20-31 and 32-48 years age groups in dBase is : 0.636

df : 20+20-2=38

P= 0.05

The number of correct answers, average time and extra steps taken for a question in both HyperCard and dBase systems are shown against sex in Table 6.2. It appears that males differ significantly from females in the mean time taken for a question in both the HyperCard and the dBase systems at the 5% significance level. In both cases, the males take less time. There was no significant difference for the other measures.

**Table 6.2. Sex v. time taken for a question**

Sex	No. of students	HyperCard			dBase III+		
		Correct answers	Time taken for a question	Extra steps taken for a question	Correct answers	Time taken for a question	Extra steps taken for a question
Male	20	10.7	110.9	5.6	11.7	8.7	1.9
Female	20	9.8	152	6.9	11.4	12.7	1.9

The statistical difference in the mean time taken for each question between male and female students in HyperCard is : 2.222

df : 20+20-2=38

P= 0.05

The statistical difference in the mean time taken for each question between male and female students in dBase is : 2.289

df : 20+20-2=38

P= 0.05

Table 6.3 lists the results in terms of student status (i.e. research student, postgraduate course, undergraduate course). Research students differ from undergraduate students at the 5% level for both the HyperCard and the dBase; the difference reached the 1 % level for the HyperCard.

**Table 6.3. Class v. time taken for a question**

Class	No. of students	HyperCard			dBase III+		
		Correct answers	Time taken for a question	Extra steps taken for a question	Correct answers	Time taken for a question	Extra steps taken for a question
Research	9	9.2	174.3	5.8	11.4	131	1.7
PG	22	10.6	126.7	6	11.7	106	2.1
UG	9	10.3	99.8	6	11.2	86	1.6

[Research =Postgraduate research students; PG= Postgraduate students; UG= Undergraduate students]

The statistical difference in the mean time taken for each question between Research students and PG students in HyperCard is : 1.604

$$df : 9+29-2=36$$

$$P= 0.05$$

The statistical difference in the mean time taken for each question between Research students and UG students in HyperCard is : 3.913

$$df : 22+9-2=29$$

$$P= 0.05$$

The statistical difference in the mean time taken for each question between Research students and UG students in dBase is : 2.339

$$df : 9+9-2=16$$

$$P= 0.05$$

The statistical difference in the mean time taken for each question between PG students and UG students in HyperCard is : 1.842

$$df : 22+9-2=29$$

$$P= 0.05$$

The statistical difference in the mean time taken for each question between PG students and UG students in dBase is : 1.132

$$df : 22+9-2=29$$

$$P= 0.05$$

The statistical difference in the mean time taken for each question between Research students and PG students in HyperCard is : 1.604

$$df : 9+22-2=29$$

$$P= 0.05$$

The statistical difference in the mean time taken for each question between Research students and PG students in dBase is : 1.146

$$df : 9+22-2=29$$

$$P= 0.05$$

Groups A and B tested the two systems in the opposite order to each other. Table 6.4 indicates that the times and number of extra steps taken are essentially the same for the two groups; hence it can be deduced that no significant transfer effect occurs between uses of the systems.

**Table 6.4. A comparison of retrieval (Group A v. Group B)**

	<u>Number in</u> <u>group</u>	<u>Time taken for</u> <u>HyperCard</u>	<u>Time taken for</u> <u>dBase III+</u>	<u>Extra steps for</u> <u>HyperCard</u>	<u>Extra steps for</u> <u>dBase III+</u>
Group A	20	136	104	6.4	1.8
Group B	20	126	110	5.9	2.0

The statistical difference in the mean time taken for each question between Group A and Group B with HyperCard is : 0.534

Df =  $20+20-2=38$                       P = 0.05 level

The statistical difference in the mean time taken for each question between Group A and Group B with dBase is : 0.322

Df =  $20+20-2=38$                       P = 0.05 level

The statistical difference in the mean time taken for each question between HyperCard and dBase with Group A is : 1.561

Df =  $20+20-2=38$                       P = 0.05 level

The statistical difference in the mean time taken for each question between HyperCard and dBase with Group B is : 0.93

Df =  $20+20-2=38$                       P = 0.05 level

The statistical difference in the extra steps taken for each question between HyperCard and dBase with Group A is : 2.964

Df =  $20+20-2=38$                       P = 0.01 level

The statistical difference in the extra steps taken for each question between HyperCard and dBase with Group B is : 7.352

Df =  $20+20-2=38$                       P = 0.01 level

However, both groups show a systematic difference between the HyperCard and the dBase in both time taken and extra steps required. Both differences are significant at the 1 % level.

An alternative breakdown of the data provides additional information. Table 6.5 shows the time and extra steps taken by overseas and home-based students, respectively. There is a significant difference at the 1 % level between the HyperCard and the dBase in times for the two groups. The overseas students clearly have greater problems in rapid retrieval than home-based students. There was, however, no significant difference in the number of extra steps taken.

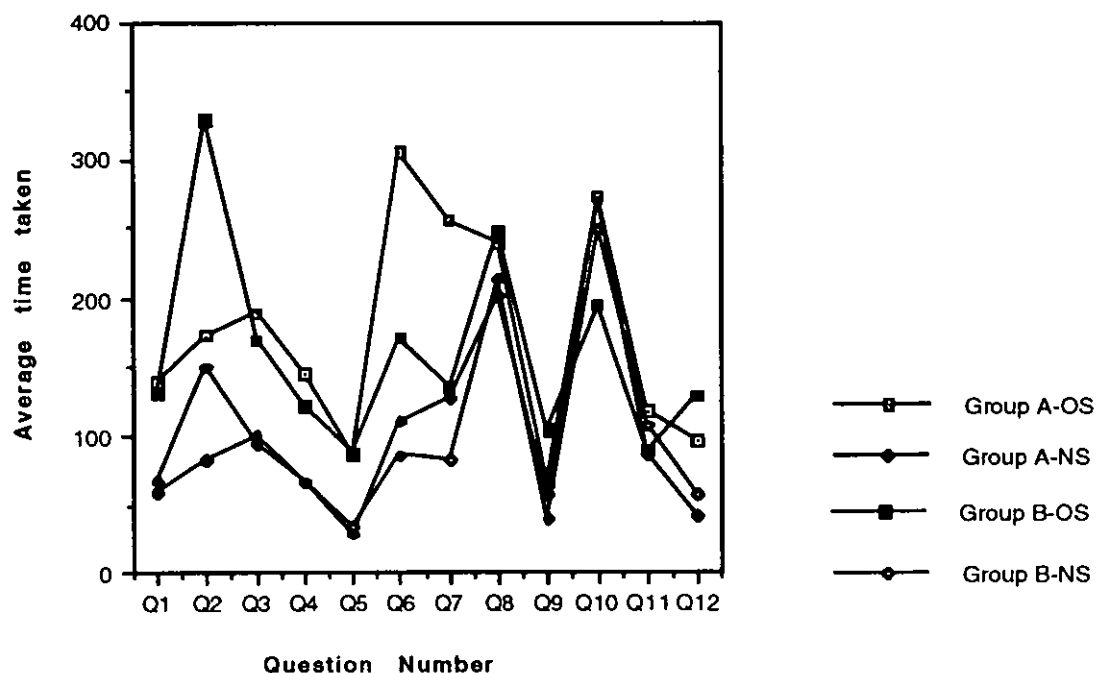


Fig. 6.1. Group v. Time taken for a question

**Table 6.5. A comparison for retrieval (overseas students v. home-based students)**

	Number in group	Time taken for HyperCard	Time taken for dBase III+	Extra steps for HyperCard	Extra steps for dBase III+
Overseas	20	165	137	6.7	2.3
Home-based	20	98	77	5.7	1.5

The statistical difference in the mean time taken for each question between Overseas and home-based with HyperCard is : 4.075

Df = 20+20-2=38                      P = 0.01 level

The statistical difference in the mean time taken for each question between Overseas and home-based with dBase is : 3.76

Df = 20+20-2=38                      P = 0.01 level

The statistical difference in the extra steps taken for each question between Overseas and home-based with HyperCard is : 0.666

$$Df = 20+20-2=38$$

$$P = 0.01 \text{ level}$$

The statistical difference in the extra steps taken for each question between Overseas and home-based with dBase is : 1.649

$$Df = 20+20-2=38$$

$$P = 0.01 \text{ level}$$

**Table 6.6. A comparison of retrieval (computer users v. non-users)**

	<u>Number in</u> <u>group</u>	<u>Time taken for</u> <u>HyperCard</u>	<u>Time taken for</u> <u>dBase III+</u>	<u>Extra steps for</u> <u>HyperCard</u>	<u>Extra steps for</u> <u>dBase III+</u>
Used computers previously	36	124	125	6.5	1.4
Not used computers previously	4	201	159	3.5	2.2

The statistical difference in the mean time taken for each question between computer experienced and not used computer previously with HyperCard system is : 2.971

$$Df = 36+4-2=38$$

$$P = 0.01 \text{ level}$$

The statistical difference in the mean time taken for each question between computer experienced and not used computer previously with dBase system is : 2.775

$$Df = 36+4-2=38$$

$$P = 0.01 \text{ level}$$

The statistical difference in the extra steps taken for each question between computer experienced and not used computer previously with HyperCard system is : 2.665

$$Df = 36+4-2=38$$

$$P = 0.01 \text{ level}$$

The statistical difference in the extra steps taken for each question between computer experienced and not used computer previously with dBase system is : 0.066

$$Df = 36+4-2=38$$

$$P = 0.01 \text{ level}$$

The statistical difference in the number of correct answers between computer experienced and not used computer previously with HyperCard system is : 2.64

$$Df = 36+4-2=38 \quad P = 0.01 \text{ level}$$

The statistical difference in the number of correct answers between computer experienced and not used computer previously with dBase system is : 4.09

$$Df = 36+4-2=38 \quad P = 0.01 \text{ level}$$

As Table 6.6 shows, only a few students were without prior computer experience. This raises problems for a satisfactory statistical analysis. However, there appeared to be a significant difference for HyperCard at the 1 % level for the time taken and number of extra steps. Whereas, for dBase there is a significant difference for the time taken and number of correct answers but not for extra steps.

The value of prior acquaintance with the system for rapid retrieval can be examined by looking at the results for students who had used a Mac previously, as compared with those who had not. (Since most of the students had a prior acquaintance with PCs, this factor could not be examined separately.) As Table 6.7 shows, prior experience with a Mac significantly affected the ease of extracting information via HyperCard (at 1% level), but not the number of extra steps taken. This could be partly due to mechanical skills - the ability to manoeuvre a mouse rapidly - but the difference in the number of steps taken indicates that there were also differences relating to on-screen manipulation. It will be noted that the average times recorded for Mac users retrieving information via HyperCard were similar to the average times recorded in Table 6.4 for retrieval by all users via dBase III+.

**Table 6.7. A comparison of retrieval (Mac users v. non-users)**

	<u>Number in</u> <u>group</u>	<u>Time taken for</u> <u>HyperCard</u>	<u>Correct</u> <u>Answers</u>	<u>Extra steps for</u> <u>HyperCard</u>
Used Mac previously	22	105	10.7	5.4
Not used Mac previously	18	164	9.7	7.1

The statistical difference in the mean time taken for each question between Mac experienced and not used Mac previously with HyperCard is : 3.2

Df =  $22+18-2=38$       P = 0.01 level

The statistical difference in the extra steps taken for each question between Mac experienced and not used Mac previously with HyperCard is : 1.23

Df =  $22+18-2=38$       P = 0.01 level

Some interfaces/systems enable users to capitalise on their domain knowledge quickly, so that they do not need much by way of prior experience or skills in order to perform a given task. Other systems enable the users to exploit domain knowledge by changing the nature of the task to be accomplished. For example, hypertext systems allow a much richer kind of information search than is possible with ordinary books and catalogues. It might be expected that previous experience with a specific piece of software would help in its subsequent evaluation. However, as Table 6.8 shows, there is no significant difference in retrieval times between those who had not used HyperCard before, and those who had. (Though the number of students who had used it previously was small.) Almost half of the students had used dBase III+ before. Table 6.9 suggests some difference in retrieval speed by the two groups, but it is not significant at the 1% level.

**Table 6.8. A comparison of retrieval (HyperCard users v. non-users)**

	<u>Number in</u> <u>group</u>	<u>Time taken for</u> <u>HyperCard</u>	<u>Extra steps for</u> <u>HyperCard</u>
Previous experience of HyperCard	8	124	6.1
No previous experience	32	133	6.3

The statistical difference in the mean time taken for each question between HyperCard- experienced students and no-HyperCard-experienced students is : 0.43

Df =  $8+32-2=38$       P = 0.01 level

The statistical difference in the extra steps taken for each question between HyperCard- experienced students and no-HyperCard-experienced students is

: 0.113

Df = 8+32-2=38

P = 0.01 level

Table 6.9 shows the number of correct answers, the mean time taken for a question and the number of extra steps taken by the students with prior dBase III+ experience and no experience. In a t- test, it was found that students with prior dBase III+ experience were not significantly different from those with no dBase experience in the number of correct answers, the mean time taken and the number of extra steps taken for a question.

**Table 6.9. A comparison of retrieval (dBase III+ users v. non-users)**

	<u>Number in</u> <u>group</u>	<u>Correct</u> <u>Answers</u>	<u>Time taken for</u> <u>dBase III+</u>	<u>Extra steps for</u> <u>dBase III+</u>
Previous experience of dBase III+	19	11.8	97	1.6
No previous experience	21	11.4	116	2.1

The statistical difference in the mean time taken for each question between dBase III+ experienced students and no-dBase III+ experienced students is : 1.07

Df = 19+21-2=38

P = 0.01 level

The statistical difference in the extra steps taken for each question between dBase III+ experienced students and no-dBase III+ experienced students is : 1.012

Df = 19+21-2=38

P = 0.01 level

### 3. RESULTS FROM THE USER RATINGS

At the end of the exercises on the Mac/HyperCard and PC/dBase system, participants were asked to complete a questionnaire recording their subjective assessment of the two interfaces. In the first place, they were asked with which interface they found it easier to retrieve information from rapidly. The responses -- contained in Table 6.10 -- indicate a strong preference amongst both overseas and home-based students for dBase III+. This accords with the picture derived from the timings in Table 6.4; a point worth noting, since some

evidence exists for supposing that users are not always able to recognise which is the fastest interface (Hayes, 1989). There was much less agreement concerning which was the more flexible interface for seeking information. Table 6.11 suggests a fairly even division of opinion, but that conceals an appreciable difference between overseas and home-based students. The latter were appreciably more in favour of HyperCard, and the former in favour of dBase III+.

The participants were next asked about the appearance of the information on the screen and how well they could absorb it. As Table 6.12 indicates, both interfaces proved to be generally acceptable in this respect. The main difference was that some users found the HyperCard screen too full of different types of information for a beginner to disentangle easily. A typical comment was that dBase III+ was easier to read, but not as attractive as HyperCard. (Overseas and home-based students agreed on this.)

**Table 6.10. Which system permitted more rapid retrieval ?**

	<u>Total</u>	<u>Overseas</u>	<u>Home-based</u>
HyperCard	8	5	3
dBase III+	28	13	15
Equal	4	2	2

When the students were asked about the speed of retrieving information from the two systems, about two-thirds of them felt that a menu-based system was quicker. Most of the remainder felt that the hypertext system is quicker, whilst a few of them felt that both were equal. Overseas and home-based students divided similarly on this question.

In terms of the flexibility of the systems, there was a slight bias in favour of HyperCard for home-based students, but not for overseas students (see Table 6.11).

**Table 6.11. Which system was more flexible?**

	<u>Total</u>	<u>Overseas</u>	<u>Home-based</u>
HyperCard	22	9	13
dBase III+	18	11	7

**Table 6.12. Relative assessments of presentation**

<u>User grading</u>	<u>HyperCard</u>	<u>dBase III+</u>
Poor	2	0
Acceptable	15	11
Good	23	29

As regards presentation of information on the screen, both systems seem to be acceptable to the students. However, the menu-based system was seen as slightly simpler and easier to understand than the HyperCard system. Correspondingly, students found it more different to move between screens in HyperCard than in dBase.

**Table 6.13. Relative assessment of movement between screens**

<u>User grading</u>	<u>HyperCard</u>	<u>dBase III+</u>
Hard	3	2
Fairly hard	10	2
Fairly easy	14	16
Easy	13	22

**Table 6.14. Relative assessment of organisation for rapid retrieval**

<u>User grading</u>	<u>HyperCard</u>	<u>dBase III+</u>
Poor	8	0
Acceptable	19	11
Good	13	29

This point was taken up in a further question, which asked participants to assess how well-organised the information was for rapid retrieval via the two interfaces. Their responses (Table 6.14) clearly favour dBase III+, in agreement both with observation of their retrieval activities and of the measured times.

**Table 6.15. Which hardware/software system is more user-friendly ?**

	<u>Total</u>	<u>Overseas</u>	<u>Home-based</u>
i) Mac & Hypertext	13	7	6
ii) PC & dBase database	27	13	14

After completing the exercises with both the systems, the students were asked to chose one of the computer environments as more user-friendly. About two-thirds of the students felt that PC and dBase was a more user-friendly.

#### **4. COMMENTS BY STUDENTS ON THE TWO SYSTEMS**

In conclusion, some idea of the points raised by students can be gained from the following selection of their contents.

**Table 6.16. Student's comments about both the systems**

	<u>Hypertext</u>	<u>dBase III+</u>
<u>User- friendliness</u>	<p>'Very user-friendly and quick in finding information'</p> <p>'Hypertext looks more user-friendly, but use of the mouse is not familiar'</p> <p>'Both are user-friendly but Mac &amp; hypertext are somewhat easier than dBase'</p>	<p>'Menu-oriented system is user-friendly and simple to navigate'</p>
<u>Easy to use</u>	<p>'More online help to use the system'</p> <p>'After using hypertext system, the dBase felt heavy and cumbersome'</p> <p>'dBase database is complicated whereas</p>	<p>'Hypertext is user-friendly but I prefer dBase due to mouse problems'</p> <p>'Need not have any background to use the system'</p> <p>'Less confusing and</p>

hypertext is straight forward'      more simple'

**Easy to Understand**

'Had some problems due to lack of understanding of the system'  
 'Hypertext sometimes not very clear, dBase easier to read although not attractive'

'Easy to pickup information and instructions'  
 'Better working interface and more user-friendly system'

**Flexibility**

'More flexible in finding information'  
 'Hypertext would take longer to get to know but it is more flexible for an inexperienced user'

'Necessary to go through many steps linearly'

**Information Presentation**

'More clearly presented'  
 'Sometimes screens were too cluttered'  
 'Too much information on the screen at once'  
 'Much information on the screen that can confuse the beginner'

'Screens are not cluttered up, simple straight forward text not so dazzling'  
 'Logical layout of dBase is more similar to word processor than hypertext'  
 'While hypertext you have to keep pressing next button'  
 'Logical sequence of information may lead to answers easily'

**Interesting to use**

'Hypertext seems to be quite challenging, though it is interesting to use'  
 'Hypertext is interesting compared to monotonous dBase database'

---

**More time  
needed to use**

'Hypertext needs much time to move through the menus'  
 'Tend to look at other interesting information while searching for something'

'Directions are too much to read'

**Cognitive/  
Distortion  
Problems**

'Not used to different names and terms, difficult to remember'  
 'I got lost somewhere but can't remember where'  
 'Problem of the logical tie between the various steps'

'Forgotten what I have read on the dBase database screen'

**Searching of  
Information**

'Use of mouse is quicker in retrieving information compared to dBase'  
 'Use of mouse and retrieving of information is quicker compared to dBase'  
 'Finding answers is difficult'  
 'Hypertext showed one answer at a time'

'Need not type keywords only a number or letters is enough'

'Difficulty in finding the information on some screens'

**Designing**

'Not used to the layout'

'Too many headings on the screen'

'Titles are not explanatory enough to their contents'

**4.1. Navigation issues in menu-based system and hypertext systems**

Even though menu-based systems are easy to use, navigation can become difficult due to their size, or because there are too many options available from which to choose. McCracken & Akscyn(1984), in their work with ZOG, have

noted that users often have a feeling of being lost in menu systems. Menu navigational paths are often quite inflexible. To reach a particular part of the database, users can proceed in one direction only, which limits both their freedom and their skill in navigating. At the same time, designers have tried to provide aids which help users see the navigational paths they have chosen.

As for menu-based systems, users of hypertext systems must be able to distinguish the options available and select the appropriate one. In this case, unlike a menu-based system, users have many options and ways to navigate or to find information in the database. In this case, too much flexibility can create problems. Successful users need to understand the nature of the objects, such as icons, pictures and other graphical objects.

#### 4.2. Hypertext v. menu-based systems

The advantages and disadvantages of the two sort of interfaces can compared in tabular form, as follows.

**Table 6.17. Advantages and disadvantages of menu-based and hypertext systems:**

	<u>Advantages</u>	<u>Disadvantages</u>
Menu-based systems	1. Menus have to be organised so that users can understand or recognise the options.	1. Menu systems require structures that can limit the user's flexibility.
	2. Menus guide the users step by step, suggesting appropriate options.	2. Menu systems take more space and also require the user to navigate through several screens.
	3. Menus are easier to use for beginners.	3. Access via a sequence of menus may be irritating.
	4. Little training required, and an easy structure for decision-making	

Hypertext systems	1. Hypertext provides free browsing and need not to be too specific in identifying the options.	1. Because of too many options in the hypertext database, users can get disoriented easily.
	2. Hypertext is highly flexible and permits the user to move quickly in the database.	2. As the size of the database increases, hypertext causes cognitive overhead problems to users.
	3. Hypertext requires relatively little space and avoids the duplication of information in the database.	
	4. Hypertext can be accessed by less literate users.	

## 5. INTRODUCTION TO COLOUR AND BLACK & WHITE HYPERTEXT INTERFACES

As noted earlier in Chapter 2, since the experiments reported so far were purely in black and white, it seemed appropriate to see whether colour introduced any difference. HyperTIES and ToolBook applications were chosen as the black-and-white and colour hypertext interfaces for this comparative study. More generally, the students were asked to compare the Mac + HyperCard environment with the PC + HyperTIES and ToolBook environments.

## 6. RESULTS FROM THE PERFORMANCE TESTS

To compare ease of retrieving the information a menu-based interface with a hypertext interface, a database was designed in both hypertext and menu-based interfaces without any changes in their contents. The description about these databases were given in Chapter 3. Observations of the student's responses to the tasks given in the worksheets showed that variations in retrieval time in these two systems. The mean time taken for a question in both

the systems were given below Table 6.18. The results listed in Table 6.18 suggest that the ITT is less easy to use than the HHO. However, it should be noted that the difference in average response rate is not significant at the 5% level.

**Table 6.18. A comparison of retrieval times (HHO v. ITT)**

Hypertext Package	Average time taken for each answer (in seconds)	SD	Minimum/maximum time taken for each answer	% of correct answers	% of incorrect answers	% of not attempted questions
HHO	204.9	130.7	28.3/558.4	92.6	2.6	4.8
ITT	227.5	147.9	40.4/618.6	80.7	7.0	11.9

The statistical difference in the mean time taken for each question between HHO and ITT is :0.767

df : 45+45-2=43

P : 0.05

Table 6.19 relates to possible differences with age group. Since more than half of the students are between 19-20, this group was compared with rest of the age group, 21-47 years. There is no significant difference in the average time taken for each answer between the two age groups in either of the systems. The remaining results similarly show no significant differences between the two age groups.

**Table 6.19 . Age v. Average time taken for a question.**

Package	Age groups	No. of students	Average time taken for each answer (in seconds)	SD	% of correct answers	% of not attempted questions
<b>HHO</b>	<b>19-20</b>	<b>24</b>	<b>204</b>	<b>110</b>	<b>97</b>	<b>99</b>
	21-25	12	197.6	146.2	90.3	93.1
	26-30	2	108.0	50.9	83.3	83.3
	31-35	2	321.7	82.5	100	100
	36-40	2	237.3	127.3	83.5	97.7
	40>	3	248.0	143.0	77.8	83.3
	<b>21-47</b>	<b>21</b>	<b>211</b>	<b>129</b>	<b>87</b>	<b>90</b>

<b>ITT</b>	<b>19-20</b>	<b>24</b>	<b>232</b>	<b>141</b>	<b>86</b>	<b>94</b>
	21-25	12	200.1	155.5	77.8	86.1
	26-30	2	176.3	90.2	66.7	66.7
	31-35	2	204.0	50.9	75.0	83.3
	36-40	2	315.0	53.0	66.7	66.7
	40->	3	282.9	161.9	61.1	77.8
	<b>21-47</b>	<b>21</b>	<b>222</b>	<b>131</b>	<b>70</b>	<b>76</b>

The statistical difference in the mean time taken for each question between 19-20 and 21-47 years age groups in HHO is :0.204

df : 24+21-2=43

P = 0.05

The statistical difference in the mean time taken for each question between 19-20 and 21-47 years age groups in ITT is : 0.253

df : 24+21-2=43

P : 0.05

The statistical difference in the mean time taken for each question between HHO and ITT in 19-20 years age group is : 0.768

df : 24+24-2=46

P : 0.05

The statistical difference in the mean time taken for each question between HHO and ITT in 21-47 years age group is : 0.515

df : 21+21-2=40

P : 0.05

Table 6.20 suggests that males tended to respond more quickly to both systems than females. However, the results are not significant at the 5% level.

**Table 6.20. Sex v. Average time taken for a question.**

Sex	No. of Students	Average time taken for each answer in HHO (in seconds)	SD in HHO	Average time taken for each answer in ITT (in seconds)	SD in ITT	% of correct answers in HHO	% of correct answers in ITT
Male	15	173.1	107.1	184.4	150.3	93.3	86.7
Female	30	221.2	135.9	251.0	142.5	92.2	77.8

The statistical difference in the mean time taken for each question between male and female students in HHO is : 1.293

df : 30+15-2=43

P : 0.05

The statistical difference in the mean time taken for each question between male and female students in ITT is : 1.426

df :  $30+15-2=43$

P : 0.05

The statistical difference in the mean time taken for each question between HHO & ITT with male students is : 0.236

df :  $15+15-2=28$

P : 0.05

The statistical difference in the mean time taken for each question between HHO & ITT with female students is : 0.83

df :  $30+30-2=58$

P : 0.05

Table 6.21 shows that there was no significant link with the degree course taken, whilst Table 6.22 indicates that the same is true of their subject background (though the Social Science students perhaps encountered more problems).

**Table 6.21. Class v. Average time taken for a question**

Class	No. of Students	Average time taken for each answer in HHO (in seconds)	SD in HHO	Average time taken for each answer in ITT (in seconds)	SD in ITT	% of correct answers in HHO	% of correct answers in ITT
ICS	11	189.8	102.3	184.0	154.1	95.5	89.4
LIS	34	210.2	136.0	243.4	142.0	91.7	78.0

The statistical difference in the mean time taken for each question between ICS and LIS students in HHO is : 0.525

df :  $34+11-2=43$

P : 0.05

The statistical difference in the mean time taken for each question between ICS and LIS students in ITT is : 1.13

df :  $30+15-2=43$

P : 0.05

The statistical difference in the mean time taken for each question between

HHO & ITT with ICS students is : 0.105

df :  $11+11-2=20$

P : 0.05

The statistical difference in the mean time taken for each question between HHO & ITT with LIS students is : 0.981

df :  $34+34-2=66$

P : 0.05

Table 6.22 shows the mean time taken for answering the question against the subject background of the student in HHO and ITT. On average, the students with a Humanities subject background took the shortest time, while those with Social sciences subject background took most time. However, in terms of statistical difference, it was found that there was no significant difference between the students for the three subject backgrounds.

**Table 6.22. Student's subject background v. Average time taken for a question.**

Subject back-ground	No. of Students	Average time taken for each answer in HHO (in seconds)	SD in HHO	Average time taken for each answer in ITT (in seconds)	SD in ITT	% of correct answers in HHO	% of correct answers in ITT
Sciences	14	197.9	126.9	184.3	138.3	95.2	86.9
S.Sciences	15	216.8	134.5	278.7	159.5	90.0	71.1
Humanities	16	199.8	114.1	223.3	135.7	92.7	84.4

The statistical difference in the mean time taken for each question between HHO and ITT with Sciences background students is : 0.272

df :  $14+14-2=26$

P : 0.05

The statistical difference in the mean time taken for each question between HHO and ITT Social sciences background students is : 1.149

df :  $15+15-2=28$

P : 0.05

The statistical difference in the mean time taken for each question between HHO & ITT with Humanities background students is : 0.53

df :  $16+16-2=30$

P : 0.05

The statistical difference in the mean time taken for each question between Science & Social sciences background students with HHO is : 0.389

df :  $14+15-2=27$

P : 0.05

The statistical difference in the mean time taken for each question between Social sciences & Humanities background students with HHO is : 0.379

df :  $15+16-2=29$

P : 0.05

The statistical difference in the mean time taken for each question between Science & Humanities background students with HHO is : 0.37

df :  $14+16-2=28$

P : 0.05

The statistical difference in the mean time taken for each question between Science & Social sciences background students with ITT is : 1.706

df :  $14+15-2=27$

P : 0.05

The statistical difference in the mean time taken for each question between Social sciences & Humanities background students with ITT is : 1.039

df :  $15+16-2=29$

P : 0.05

The statistical difference in the mean time taken for each question between Science & Humanities background students with ITT is : 0.776

df :  $14+16-2=28$

P : 0.05

Table 6.23 shows the difference in the mean time taken for a question between computer experienced and inexperienced students. The number of inexperienced students in this experiment is very small, hence it is difficult to generalise the results. However, it was found that there is no significant difference between these two groups.

**Table 6.23. Computer Experience v. Average time taken for a question.**

Prior Computer experience	No. of Students	Average time taken for each answer in HHO (in seconds)	SD in HHO	Average time taken for each answer in ITT (in seconds)	SD in ITT	% of correct answers in HHO	% of correct answers in ITT
Yes	42	203.0	128.4	226.6	146.6	95.6	82.1
No	3	247.5	124.1	247.5	163.9	50	61.1

The statistical difference in the mean time taken for each question between Computer- experience & no-computer-experienced students with HHO is : 0.583

df : 42+3-2=43

P : 0.05

The statistical difference in the mean time taken for each question between Computer- experience & no-computer-experienced students with ITT is : 0.215

df : 42+3-2=43

P : 0.05

The statistical difference in the mean time taken for each question between HHO & ITT with Computer-experienced students is : 0.785

df : 42+42-2=82

P : 0.05

The statistical difference in the mean time taken for each question between HHO & ITT with no-Computer-experienced students is : 0 (Zero)

**Table 6.24. Computer experience v. Tasks performance**

Prior computer experience	No. of students	% of attempted questions		% of correct answers		% of incorrect answers	
		HHO	ITT	HHO	ITT	HHO	ITT
Yes	42	97.2	89.7	95.6	82.1	1.6	7.6
No	3	66.7	66.7	50.0	601	16.7	5.6

The number of students with no experience of computing was too small for a

meaningful comparison to be carried out (Table 6.23). However, Table 6.24 confirms what was noted in laboratory sessions - namely that such students found answering questions accurately much more difficult than the remainder did. This slight link with computer experience is also reflected in Table 6.25.

An alternative breakdown of the computer experience data provides additional illumination. Table 6.25 shows the difference in time taken for each answer against level of computer experience. Apart from three cases (2,3 and 5 years computer experience), the students average time taken for each question was inversely proportional to the level of computer experience in years. When the background of the two years computer experience subjects was checked, it was found that all were females and taking LIS. They are between 19-34 years old and mostly from Social sciences with a few from Humanities.

**Table 6.25. Years of computer experience v. Tasks performance**

Level of Computer experience	No. of Students	Average time taken for each answer in HHO (in seconds)	SD in HHO	Average time taken for each answer in ITT (in seconds)	SD in ITT	% of correct answers in HHO	% of correct answers in ITT
Not used Computer	3	247.5	162.1	247.5	163.9	50	61.1
Less than 2 a year		230.2	153.2	246.0	135.8	100	83.3
1 year	8	187.5	106.7	227.7	101.9	97.9	83.3
2 years	9	232.5	137.9	260.5	152.6	96.3	77.8
<b>≤2 years</b>	<b>19</b>	<b>213.3</b>	<b>126.4</b>	<b>245.1</b>	<b>129.5</b>	<b>97.4</b>	<b>80.7</b>
3 years	9	199.4	132.2	183.9	122.9	85.2	77.8
5 years	5	241	147.4	261.1	190.5	100	86.7
More than 9 five years		164.8	72.2	213.5	141.3	100	87.0
<b>≥3 years</b>	<b>23</b>	<b>194.9</b>	<b>112.0</b>	<b>212.1</b>	<b>144.8</b>	<b>94.2</b>	<b>83.3</b>

The statistical difference in the mean time taken for each question between ( $\leq 1-2$ ) & ( $3-\geq$ ) years computer experience with HHO is : 0.494

df :  $19+23-2=40$

P : 0.05

The statistical difference in the mean time taken for each question between ( $\leq 1-2$ ) & ( $3-\geq$ ) years computer experience with ITT is : 0.780

df :  $42+42-2=82$

P : 0.05

2-tailed probability : 2.021

The statistical difference in the mean time taken for each question between HHO & ITT with ( $\leq 1-2$ ) years computer experience is : 0.494

df :  $19+19-2=36$

P : 0.05

The statistical difference in the mean time taken for each question between HHO & ITT with ( $3-\geq$ ) years computer experience is : 0.45

df :  $23+23-2=44$

P : 0.05

The percentage of incorrect answers is more for ITT than for HHO. All levels were then combined into two major groups: less than one year to one year in one group, and two years or more in another group. In a t-test, it was found that there is no significant difference (at the 0.05 level) even between these groups.

## **7. RESULTS FROM THE USER RATINGS**

### **7.1. Students general comments about HHO & ITT systems**

When they were asked to evaluate the two systems, two-thirds of the students preferred HHO to ITT. A small percentage evaluated both as the same. This was despite the fact that HHO has no colour and graphics: the frequency was clearly due to ease of use. The main reasons they mentioned for selecting this system were user-friendliness, ease of use, less confusing, well-presented information, easy movement in the database, more online/system help, easier to recognise and use highlighted words, rather than icons, as hypertext links. A small number of students liked ITT because of its colourful nature, pleasant screen appearance and graphical, mouse-driven environment. But of 45

students, only nine liked ITT. The reasons why many students did not like ITT were because of its unfamiliar graphics and icons, lack of user-friendliness, very slow and restricted movement between the screens, poor information retrieval, no online/system help, and also difficulty in handling the mouse in this system. This difference in appreciation of the two systems was reflected in their handling of the questions they were set.

**Table 6.26. Student's general comments about the HHO and ITT systems**

<u>System</u>	<u>Liked because of</u>	<u>Disliked because of</u>
<b><u>HHO</u></b>	'Easier to use, because of the system simplicity' 'Easier to use arrow keys than the mouse' 'Text is easier to use than graphics as it is more explanatory' 'Easier to find answers, icons are not clear' 'Easier to go around' 'Easier to use because sequential order seemed more logical' 'HHO is more user-friendly' 'Less confusing' 'I found information a lot more quickly than with ITT' 'Searching and retrieving is easier and quicker' 'Highlighted words give prompts for further information' 'More online help is available' 'More helpful and easier to use'	'The text-based system is less direct than coloured and graphic system'
<b><u>ITT</u></b>	'IBM-based system is easy to browse and retrieve information' 'More graphical interface' 'Information is presented in a much	'Coloured screens hurts my eyes' 'ITT is difficult, because do not understand the icons'

more obvious fashion'	'Icons on ITT were too small'
'Screen layout is more colourful and informative'	'ITT icons did not represent the meaning, so they are more confusing'
'Screen design is more pleasant for viewing'	'Did not understand the use of icons'
'Pleasant to the eyes with coloured graphics'	'Icons did not explain themselves'
	'Difficulty in relating icons to their functions'
'More attractive system'	'Use of icons is awkward'
'Presentation of information was better and colourful'	'Icons, though attractive, can be very confusing'
	'ITT was awkward when dealing with contents and icons'
	'Graphics and icons difficult to understand'
	'Not easier to move around'
	'ITT was very confusing'
	'Scrolling information is too slow'
	'ITT takes a long time to find information'
	'Search facility of ITT seemed difficult to use'

When they were asked to compare the colour with the black-and-white screen layout, 91 percent (41 out of 45) preferred colour because of its better screen appearance, but they realised that they were not really influenced in grasping the contents quickly by its presence. All the students complained about the icons in the ITT. Some 82 percent of the students preferred highlighted words to icons as hypertext links. Somewhat less than half of the students felt that graphics and colours could help them to retrieve information more easily. Some 42 percent preferred text only and a small percentage (11%) felt both are the same.

## 7.2. Mac v. IBM PC environments

**Table 6.27. Comparison of the Mac and IBM PC environments**

'Generally the Mac is a better-looking and more user-friendly interface'

'IBM systems possibly slower in retrieving the information'

'Easier to browse via a Mac and obtain the information in less time, no need of typing, Easier to move between various screens quickly with a Mac'

'The Mac-based system used more meaningful icons and was lot quicker in retrieving the information. You could also use a mouse. Scrolling was easier and moving about the level was also easier. I found it is easier to tell what level I was in on the Mac,

'Easier to use the mouse rather than keying in the commands. ITT is difficult to use because we do not understand the icons'

'Macs are much faster to use and the search is a lot quicker'

'Hypertext Hands-on was user-friendly and ITT was very confusing, but I just feel more comfortable with the Mac'

'The Mac does not scare away the user (user-friendly) compared to IBM systems'

'The Mac seems faster at scrolling the information than IBM (ITT) and more facilities seem to be available on-screen. The text-based system is less direct than both the graphical and icons-based systems'

'Macs layout/information display is more attractive. On the other side, the students who liked IBM PCs did so because of its familiarity over a long time, and due to problems with the mouse'

## 8. CONCLUSIONS

In terms of the objective of this exercise, it was found that the students felt colours are pleasing from an aesthetical point of view, but did not helped them in retrieving information from hypertext databases. When graphics and colours were mixed with text, the representation were not always easy to understand and meaningful. Highlighted words proved easier to use because they were distinct on a black-and-white screen(Ramaiah, Sulaiman and Meadows, 1993). Students liked the black-and-white menu-based hypertext interface more because of its simple, clear, easy to use, understandable screen design

and information organisation, as compared with the colourful, complicated, graphical hypertext interface. Finally, the Mac was chosen overwhelmingly for classroom teaching, rather than IBM PCs, also because of its ease of use.

Overall, for retrieving information, a menu-based interface seems to be more acceptable to many students than a hypertext interface. However, the flexibility, visually appealing and user-friendly nature of hypertext systems was also liked by many students. Both their opinions and their comments about the systems underline that a simple and easy-to-use system matters more than the particular interface for inexperienced users. For experienced users of any system, other factors come into play.

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## **Chapter 7**

# **DISCUSSION AND CONCLUSIONS**

### **1. INTRODUCTION**

The results obtained in the various experiments of this study are discussed in this Chapter in the light of the original objectives. The problems naive users have with hypertext are identified and presented. The important variables for grouping students for hypertext teaching and which affect the students' performance with hypertext systems are also considered. The implications for hypertext/hypermedia teaching in LIS and the overall conclusions of this study are presented.

### **2. DISCUSSION**

#### **2.1. HYPERTEXT TEACHING**

The results of both the initial and the revised hypertext teaching experiments suggest that six hours seems to be about the minimum time required to teach hypertext (more especially for an elementary introduction to HyperCard). For these six hours, the best form of organisation seems to be: (1) an hour for an introductory lecture, followed by (2) an hour's demonstration of HyperCard and other hypertext applications. Then (3) three hours of practicals, including an exercise and a stack design, with hand-outs and classroom help. Finally, a last hour for discussing the doubts and problems students have encountered during their course. The minimum time required for teaching obviously depends on the course content. Thus teaching programming extends the time considerably (Nielsen et al, 1991).

Student feedback indicates that the appropriate time to teach this course is in the second year. By then, students have had some exposure to information technology, which is essential to understand the hypertext concept and the Mac environment. The amount of personal help needed by students, as compared with using printed instructions, was investigated in some detail - since it is significant in determining the teaching load - and will be discussed below.

### **2.1.1. Students problems with hypertext**

The common errors that novice users make, and the problems they encounter while using and customising HyperCard applications, have been identified from both the initial and the revised HyperCard teaching experiments. The common errors so identified are given below.

#### **Errors**

It is common for all categories of users (naive to experts) to make errors when using computer systems. Experienced people take this as a matter of course, but a naive user tends to emphasise errors. It seems that errors may be categorised into two types : 1) mode errors, and 2) descriptive errors.

Normally, 'mode errors' occur when the user believes the system is in one mode, when it is actually in another. The user does the correct operations for one mode, but in the other mode. This is a common problem with HyperCard software, especially for naive users. HyperCard has a 'background mode' and a 'card mode' : the distinction between these two modes is a 'dotted menu bar' at the top of the screen. Apart from this, there is no other system feedback for users to know which mode they are in. In both the teaching experiments (i.e. initial and revised), students made mode errors during the customisation exercise. While drawing and editing the graphics, or adding buttons and fields, many students found that they were in 'background mode' when they should have been working in the card mode. Due to this mode error, they spent a lot of time either transferring their materials from one mode to another, or creating them again freshly, since their material had either been lost or transferred elsewhere. Mode errors clearly occur due to inadequate feedback relating to the state of the system. This error is basically due to a flaw in the HyperCard system, which could be eliminated by improving its design.

When a user's intentions and mode of operation is correct, but the actions are performed on the wrong item, the resulting error may be called a 'descriptive error'. For example, in HyperCard, the paint tool box is confusing because of similar-looking paint tools. Thus students may intend to use the 'selection tool' to choose a graphic for copying, but, instead, use

the eraser tool, with the result that the graphics are erased instead of being selected. About a third of the students in the initial teaching experiment, and two-thirds of the students in the revised teaching experiment, made errors of this kind while using the paint tools. Such errors normally occur where there is an insufficient specification of the action. Since the tools in the paint-tool palette are not labelled, there is uncertainty in identifying the correct tools, so leading to a descriptive error.

### **Students problems**

Common problems that have been encountered by the students while using and customising HyperCard applications in both the initial and revised HyperCard teaching experiments are given below in Table 1.

#### **1. Mouse**

Difficulties in using a mouse for the first time (as in clicking, directing and coordinating) were common with most of the students. Almost all students had initial problems in distinguishing clicking and double-clicking. However, this problem soon disappeared. Students, in both the experiments, felt that a steady hand is required to use a mouse. Consequently, it was found essential to provide a hand-out explaining how to use the mouse to all the students before they first handled one(Appendix-XIV).

#### **2. Icons**

In the revised teaching experiment, 62 % of the students had difficulties with icons, especially in identifying their functions. They were not sure which icon on the screen was clickable and what information would be contained in it. However, the students had no problems with the icons on the home card as they were properly labelled. Students noted that icons were easy to remember, once learnt, but their meanings were not always immediately evident (eg. in the Drexel disc). All categories of students had almost the same type of problem with the icons. Their reactions to labelled and unlabelled icons indicates that, for satisfactory use, all the icons must be labelled properly.

Table 1. Number of problems encountered while using and customising HyperCard in both the initial and the revised teaching experiments(the

figures represent number of problems divided by number of students).

Problem	<u>INITIAL TEACHING EXPERIMENT</u>		<u>REVISED TEACHING EXPERIMENT</u>	
	Drexel disc	Customisation	Drexel disc	Customisation
Mouse	1/4	1/10	only initial problems	1/6 (B&C) 1/3 (A&D)
Icons	2/3	-	9/10	2/3 (B&C) 1/2 (A&D)
On screen	1/4	1/6	1/5	1/6 (B&C) 1/2 (A&D)
Moving between the screens	$\geq 1/2$	1/20	1/6	1/4 (B&C) 1/6 (A&D)
Changing materials	1/5	1/5	1/6	1/4 (B&C) 3/4 (A&D)
Navigational	1/6	nil	1/2	nil
Information retrieval	1/5	nil	2/3	nil
Paint tools	1/4	$\geq 1/2$	1/5	$\geq 1/2$ (B&C) 1/3 (A&D)
Menus	1/4	1/4	1/5	minor
Graphics	1/10	nil	1/4	a few for all groups
HW & SW	a few	1/4	a few	a few

[HW= Hardware; SW=Software ;A&D = Groups supplied elaborated hand-outs; B&C= Groups supplied condensed hand-outs]

### 3. On-screen problems

It appeared to be better if the system issued a dialog box and asked the user to choose the required characteristics of the card to be created. The user then immediately knows the number of cards created. (It is not obvious to a novice user that it is necessary to go to the objects menu and check for stack information in order to know how many cards he/she has created.) Differentiation between card and background domain is another feature of HyperCard which created some confusion in the beginning to many of the novice users. Though there is an indicator (a dotted title bar in the background domain), it was not very evident to beginners.

#### **4. Moving between screens**

Somewhat less than a quarter of the students also had difficulties in moving between the screens and in altering objects accidentally. The frequency of such difficulties suggests that the system (eg. Drexel disc) is not entirely well designed.

#### **5. Changing materials**

In both the experiments, about one-fifth of the students had problems in changing materials (such as graphics, buttons, fields, cards, text) during their customisation exercise. This again suggests greater need in HyperCard for helping novices.

#### **6. Navigation**

About a quarter of the students in both the experiments had problems in navigating through the Drexel disc. These problems mainly occurred due to problems with non-sequential movement and rather inflexible structure of the Drexel disc. Such problems could be eliminated by providing a simpler and more flexible design and sufficient online help to guide the user.

#### **7. Information Retrieval**

Information retrieval problems were encountered by about a quarter of the students in both the teaching experiments. This was particularly the case with the Drexel disc exercise : there was no major problem in the customisation exercise. The design change required here is for different types of search facilities to find the required information.

#### **8. Paint tools**

Slightly less than half of the students had problems with customisation exercises in both experiments. For example, students failed to identify the right tool in the paint tools palette. In the same way, a quarter of the students had problems in identifying the 'hand tool' when changing the modes on the campus map of Drexel disc. However, the same students had no problems when using icons accompanied with labels on the home card. Hence, it appears again that icons should be labelled properly to avoid these problems.

## **9. Menus**

Less than a quarter of the students encountered menu problems. Of these, most were on the Drexel disc menus. For example, 'quit', 'close' and 'exit' options in the 'File menu' created much confusion among the students. This kind of problem could be eliminated by providing simple, clear and easy-to-understand menus.

## **10. Graphics**

Most of the students liked the presentation of information through graphics. However, the graphics and icons are sometimes ambiguous and not easy to understand (eg. Drexel disc, icons in paint tools palette). This again reflects the need for proper labelling.

## **11. Hardware and software**

There were no major problems with hardware and software. Some minor problems with the keyboard (such as identifying the command key) were encountered. In terms of software problems, there was a small programming bug in the Drexel disc. As a result, it was not compatible with System 7.0; this led to it issuing a time bomb dialog box.

## **12. Hand-outs**

The students clearly attached a good deal of weight to detailed hand-outs. The experiments showed that even when given maximum classroom-help, students still wanted detailed hand-outs in place of condensed ones. Students from different backgrounds felt that minimum assumptions of prior knowledge should be made. From a teaching viewpoint, there is an important point here : given really detailed hand-outs, the students were willing to receive less direct classroom assistance.

A fifth of the students felt that they would prefer more teaching time, especially to allow more exploration of HyperCard application programs as applied to library and information work. Some preferred to have personal instructions given in the class, rather than via general lecturing/demonstrating.

The important thing the table reveals, however, is that there is no immediately obvious difference between the number of problems record in each group of experiments. The numbers are generally similar for the pilot and main experiments and for students with either condensed or detailed hand-outs.

### **2.1.2. Grouping of students for hypertext instruction**

As noted earlier in this thesis, various pieces of research have shown the importance of instructional grouping practices (eg. Bosserts and Barnett, 1981; Filby, Barnett and Bosserts, 1982). Grouping is essentially a coordinative mechanism by which teachers organise students for specific tasks during teaching. As part of the present study, students were grouped in different ways to try and find the best method of grouping students for computer-assisted teaching. The experimental results indicate that grouping into pairs seems to be the most suitable and useful grouping for hypertext teaching. It must be remembered that grouping can be related to subject studied; so this result must be generalised with caution.

As noted previously, Johnson and Johnson at the University of Minnesota (Johnson and Johnson, 1976) developed a 'learning together model' of cooperative learning. In this model, 4-5 students, with heterogeneous backgrounds, worked on their computer-based assignments together. On the basis of this model the present study initially grouped together 3-5 students for teaching and learning. Many of the students found that this group size was too big and was not helpful to them in terms of computer learning. In the revised teaching experiment, the group size was reduced to homogeneous pairs and individuals. It seems that the differences may relate to a more project-based approach to teaching in the US experiment.

There is some indication in the literature (Colbaoun and Cockerton-Turner, 1990) that working in pairs on HyperCard improves learning, as compared with working individually. In the present experiments, some 60 % of the students preferred to work in pairs, rather than working individually with a computer. More than one third of the students felt that working in pairs allowed fruitful discussion when stuck with a problem. For example, one member can read the instructions from the hand-out, whilst the other

operates the computer. Some students felt that it is more interesting and enjoyable to work in a pair rather than working alone and it allows tasks to be completed more quickly. On the negative side, a quarter of the students felt that the practical time was divided between them, resulting in less hands-on experience on the system. Moreover, if the partner does not have the same level of computer experience, both may suffer from the slowing down or speeding up of the learning process. If one partner dominates the other, there is an uneven level of instruction.

#### Homogeneous v. heterogeneous

University students differ in their working experience, social, economic and cultural contexts. Especially when the teaching has to be conducted through computers, relative homogeneity of the students can have a significant effect on the teaching and learning process. When teaching a homogeneous class, it is comparatively easy for teachers to operate effectively in a way that seems to be appropriate to all students(Halffman, 1959).

The division of a class into smaller groups usually has the aim of achieving instructional homogeneity, as does also ability grouping in the class. The dilemma in grouping students is to balance orderliness and structure against human diversity and curriculum variety. In general, it has been found that homogeneous groups are more cohesive in training activities than heterogeneous groups, but they are not always more effective in performance. Under certain conditions, groups that are heterogeneous with respect to attitude or prior computer experience might be more effective than homogeneous groups. For example, Hoffman(1959) found that heterogeneous groups of college students showed better performance in working on a problem that required multiple perceptions and cognitive reorganisation.

In the present study, students were grouped by combining the different student characteristics such as age, sex and computer experience (especially experience with Macs and HyperCard). In the first teaching experiment, several groups were heterogeneous, whereas in the second they were homogeneous. It is noticeable that, though the second type of grouping was preferred by the students, it led to few significant

improvements in actual performance, which perhaps supports Hoffman's observations.

### **2.1.3. Information required to design the UK equivalent of a Drexel disc**

Though students liked most of the information presented in the Drexel disc, they suggested some modification and additions to the existing information for use in the UK.

#### Changes suggested

1. All the information (including information on the campus map) should be indexed.
2. Changing between modes on the campus map is not clear and needs to be provided with sufficient online help.
3. Zooming to parts of the campus map for greater detail should be provided.
4. Graphics should be balanced with text on each screen. Big text chunks or graphics alone should be avoided.
5. More online help is needed to such topics as the introduction to the disc, icons/graphics used, organisation of information, etc.
6. English phraseology and spellings should be used in place of American.
7. Information on OPACs, library facilities, campus computing, travel, entertainment, clubs, societies, local information and libraries could be added.

### **3. COMPARISON OF HYPERTEXT AND MENU-BASED INTERFACES**

Along with the hands-on tests and the questionnaires, student participants were asked to write short essays on their opinions of the two systems they had used. Data from all three sources have been used here in assessing the results: agreement between them seems to be good.

A majority of the students felt that a menu-based interface is better than a hypertext interface. This seems surprising in view of the many claims that have been made for hypertext systems. It is therefore necessary to consider the factors involved. In menu-based systems, users are provided with a list of category descriptions on each screen in order to find the required information. Users must select one of these options. The choices are typically arranged in a hierarchy, so that choices at one level lead to a refinement of the selected category. Such systems are more useful for inexperienced users, because the user need not remember the commands and search patterns. The position of more experienced computer users is different. They are more likely to be irritated by the need to go through all the options hierarchically in order to reach the appropriate information. Moreover, all kinds of information are not all equally amenable to hierarchical organisation : the search and access routes typically depend on a rigid and partly arbitrary organisation imposed by the system designers. In order to use a menu system successfully, users must be able to predict correctly the contents of the categories available on the screen - which they cannot always do.

It is clear, that dBase III+ and HyperCard provide good examples of Shneiderman's 'menu selection' and 'direct manipulation' styles, respectively. As he suggests, menu selection is easier because it divides a complex interaction into a series of small steps, which provides structure for decision making to the user. However, it may slow down the frequent user with a knowledge of the domain because it goes through all the steps sequentially. Direct manipulation leads to relatively rapid learning with high retention over time and high user satisfaction. However, for navigation, the latter style is relatively more difficult (Shneiderman, 1991). In practice, the relative importance of the advantages and disadvantages he lists depends on the type of interface, as much as on the style (i.e. the way in which the user interacts with a computer). In this case, the initial problems of handling a Mac computer compounded the problems of handling a hypertext interface for the first time. A typical comment was: 'HyperCard looks more user-friendly, but the use of a mouse is not as familiar to me as using a keyboard; so I prefer dBase III+'.

However, ultimate judgment of an interface must depend on its suitability for carrying out the kind of task that immediately concerns the user. For library and information students, the typical requirement for this kind of database is rapid retrieval. As the results show, experienced Mac users were only retrieving information via the HyperCard interface at about the same rate as average users of dBase III+. This disadvantage outweighed the advantages of HyperCard for many students. As one of them commented: 'I thought that PC/dBase III+ was clearly laid out, uncluttered and could get the required information without resorting to "gimmicks". The Mac/HyperCard combination is more fun to use, but, if information finding is the main prerequisite, then PC/dBase III+ wins'.

Overseas students were even more strongly in favour of dBase III+ than home-based students. (For example, home-based students agreed with the implication of Shneiderman's classification that HyperCard was a more flexible interface: this was less accepted by overseas students.) Here, it seems from the responses that their greater domain knowledge over other students is at work. The dBase III+ interface resembles more closely the cataloguing approach with which most overseas students are well acquainted, and they therefore find it easier to accept.

The implications for teaching are twofold. Firstly, new forms of interface (in this case, hypertext) may best be presented initially in terms of their special capabilities, rather than as an alternative for standard activities which may fit better -- from a students' viewpoint -- into another framework (and so a different interface). Secondly, the greater the knowledge students have of a particular domain, the more likely they are to prefer an interface that fits their conceptual framework.

#### **4. COMPARISON OF THE COLOUR AND BLACK & WHITE HYPERTEXT INTERFACES**

Students felt that colours are pleasing from an aesthetical point of view, but colour did not help them in retrieving information from hypertext databases. Research findings indicate that colour does not increase the effectiveness of

instruction, except when it is an essential feature of what must be learned (Schramm,1977). When graphics and colours were mixed with text, the representations were less easy to understand. In consequence, the speed of information retrieval was poor. Hypertext links consisting of highlighted words were easier to use because they were more readily distinguishable even on a black-and-white screen. In general, students preferred black-and-white menu-based hypertext interface because of its simple, clear, easy to use screen design and information organisation - as compared with the colourful, but complicated, graphical hypertext interface. Finally, the Mac computer was chosen overwhelmingly for use in the class, when compared with IBM PCs, mainly because of its ease and flexibility.

## 5. STUDENT VARIABLES AND HYPERTEXT TEACHING

Table 2. Student variables - significant difference in various experiments

Variable	Initial teaching experiment	Revised teaching experiment	Comparison of hypertext and menu-based interfaces	Comparison of colour and black & white hypertext interfaces
Age	NSD	NSD	SD	NSD
Sex	NSD	NSD	SD	NSD
Class	NSD	NSD (but 1990+1991=SD)	SD	NSD
Group	SD	NSD	SD	NSD
Subject background	NSD	NSD	-	NSD
Computer experience	NSD	NSD	SD	NSD
Mac experience	NSD	SD	SD	NSD
OS/HS	-	-	SD	-

[ NSD=No significant difference; SD = Significant difference; OS=Overseas students; HS=Home-based Students]

### **5.1. Age**

The age of the students was one of the factors that determined the group to which each was allocated for instructional purposes. The ability of students may vary with age, but differences due to past experience are likely to be much more important. Performance may reflect differing combinations of work skills and special ability. In the present study, students of different age groups varied significantly in the time they took to retrieve information from hypertext and menu-based interfaces in only one of the four experiments. So, age is a significant variable for task-oriented teaching specifically.

### **5.2. Sex**

Various studies have suggested that females and males differ significantly in terms of their results when taking standardised achievement measures (Evans, 1970; Hauck, 1970). However, it was found that males and females took a significantly different time to retrieve information from hypertext and menu-based interfaces in only one of the four experiments. This leaves open the question whether sex is a variable which should be considered for grouping students for hypertext teaching.

### **5.3. Grouping**

In computer-assisted task-oriented teaching and learning, groups usually produce more and better solutions to problems than do individuals working alone. Group judgment is also better for tasks where errors are likely to occur. It was found in the present study that group work is particularly effective for solving simple tasks (such as finding answers to questions on the Drexel disc). Complex tasks (such as stack design) appear to be better done individually or in pairs, since students need to interact closely whilst taking a series of complex decisions.

Peer work groups as a method of teaching has been less common in university teaching. Teacher-led groups are more common. However, the present investigation suggests group-led hands-on study by students can be effective. The results obtained from both the teaching experiments provide guidelines concerning the various student grouping patterns, teaching methods, courseware materials to be used for study. Homogeneous groupings of students seem to be easier for achieving closer cooperation

and providing more student satisfaction. In terms of the size of the group, pairs seem to be most suitable for computer-assisted teaching, especially for hypertext teaching. In the context of grouping for hypertext teaching, prior domain knowledge and system (software) experience affects the performance of the students on each task. But the other characteristics of the students - such as age, sex and subject background - do not normally play an important part.

#### **5.4. Computer experience**

Computer experience is another student factor that seemed to determined the performance of students with different hypertext systems. In this study, in two out of four experiments the students with prior computer experience (i.e. general computer experience and Mac experience) performed better than the students who had no experience. These seems to fit well with the results of some recent US studies of hypertext(Leggett et al, 1989).

### **6. IMPLICATION FOR HYPERTEXT TEACHING IN LIS**

Hypertext teaching in LIS might be used, according to the students, for a wide range of topics : Classification, Cataloguing, Information retrieval, Applications of information technology, Human management, Human information processing, Information handling, System analysis, Data analysis & presentation and general training programs. It could also be used to design front-end applications for training students about online databases and to provide self-study tools for different software available in the department. Particularly, hypertext can be used to develop library and information systems/service applications and also as a research tool in various areas (such as library information services, teaching, training, designing courseware materials, etc.).

The most promising application for hypertext is in structuring access to a large number of closely related documents. At university level, students need to deal with a large number of documents which have relation to one another. This is especially true of LIS students who will be acquiring, organising, storing and retrieving the information in their jobs. Hypertext/hypermedia systems can be useful in dealing with such situations

because they permit the assembly of a large collection of discrete materials composed in different media (such as text, graphics, sound, animation), linking them together in a variety of ways, without destroying the integrity of the individual components, the nodes of the system. In a hypertext environment, students are less limited than in most CAL/CAT situations.

### **Hypertext instructional environment**

#### **i) Position of the instructor in a hypertext instructional environment**

Hypermedia redefines the role of the instructor by transferring some of the power and authority to students. The teacher becomes more a helper/guide/coach than a lecturer. Hypermedia systems have great a deal to offer to teachers in all kinds of institutions of higher education, but the biggest problem in developing courseware materials with hypermedia is that it takes a long time.

#### **ii) Position of the student in a hypertext instructional environment**

Since making connections is one of the main characteristics of hypertext, it provides an efficient means of accustomising students to making connections between the items of information they encounter. The adaptive nature of hypertext provides students a with way of working up to their abilities by providing access to a range of materials from elementary to advanced level. The reader-centred and controlled feature of hypertext offers students a means of shaping, and hence controlling, major portions of what they read. In addition, students can contribute documents and links to the system and thus gain the experience of contributing to the coursework.

#### **iii) Types of assignment and method of evaluation**

The most important use of hypertext is to allow students to adopt the most appropriate learning strategy for their task. Instructors must therefore create assignments that emphasise those qualities and features of hypertext that furnish the greatest educational advantages. Readers retain less of the information they encounter while reading text on the screen than while reading a printed page. Teachers need to keep these particular interface problems in mind when devising exercises, especially for beginners.

## **7. GUIDELINES FOR DESIGNING HYPERTEXT COURSEWARE MATERIALS**

The experiments with LIS students at Loughborough suggest that the following points should be kept in mind.

- 1) System design should be simple, clear and there should be only a restricted number of menu options on a single screen.
- 2) There should be adequate online help, which should explain the information organisation, graphics and icons used, and search patterns provided in the systems.
- 3) Movement of the user through the system should be flexible, but there should also be navigational aids on the screen to help the user.
- 4) Colours are pleasing from an aesthetical point of view, but they should be used only when they are essential.
- 5) Graphics and icons should be balanced with text on each screen. Big text chunks or graphics alone should be avoided.
- 6) All graphics and icons must be labelled properly.
- 7) Highlighted words are easier to use and more acceptable as hypertext links than graphics and icons to students.
- 8) The Mac is a good computer environment for teaching hypertext to undergraduate students.

## **8. CONCLUSIONS**

1. Six hours seems to be about the minimum time required for introductory teaching of hypertext using a hands-on, student-mediated approach.
2. The main problems encountered by students who are naive users are

with : 1) mouse; 2) icons; and 3) graphics.

3. Homogeneous grouping leads to more student satisfaction : teaching in matched pairs appears to be optimal from this viewpoint. This does not necessarily lead, however, to more efficient or effective results.

4. For naive computer users, menu-based interfaces are easier to use than hypertext interfaces for the retrieval of information.

5. Colours and graphics are pleasing to look at, but do not necessarily help in retrieving information quickly. Indeed, too many, or inappropriate, colours/ graphics can create more problems than they solve for the user.

6. Highlighted words are a good way of presenting hypertext links in a simple database.

7. Even though hypertext is easier to use than hypermedia, students preferred hypermedia because of its attractive graphics and sounds.

The experiments suggest that all the hypotheses (except the hypothesis relating to the mode of information presentation, no.6) formulated in Chapter 2 are acceptable within the limits of the present experiments. Namely :

a) General hypothesis

(1) Experienced users of computers will find it easier to adapt to using hypertext than naive computer users.

b) Hypotheses related to student background

2) While using hypertext systems, the number of problems encountered/errors made by the naive users can be reduced by providing appropriate theoretical knowledge before they start using the interface.

3) For optimum hypertext teaching, students should be in smaller groups which are homogeneous in respect to their prior knowledge of the domain: such grouping will lead to better understanding of the subject and more satisfaction amongst the students.

4) Students with prior knowledge of the domain being taught will use a computer system more effectively than users with little or no domain-specific knowledge.

c) Hypotheses related to the mode of information presentation

5) For computer task-oriented teaching, providing simple and clearly presented instructional hand-outs and sufficient classroom help will be more effective than providing instructions through demonstration and supplying brief hand-outs.

6) Introducing graphics and colours will help the users of hypertext systems, and also enhance their speed of retrieving information as compared with the plain text (text only without graphics and colours) provided at the same interface.

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## APPENDICES

**BACKGROUND QUESTIONNAIRE**

(To be completed and returned at the beginning of the course)

1. Personal record :

a) Name :

b) Age :

c) Sex :

d) Qualifications (eg.A-levels) :

d) What were you doing before joining this course(eg.school, work, etc.) ?

e) Would you regard your interests as :

i) More 'library' oriented ( )

ii) More 'information' oriented ( )

iii) Equal interest ( )

2. Have you used any computer or had computer training before ?

Yes ( ) No ( ) → Questionnaire is now complete.

↓

a) Which type of computer did you used ?

i) Micro ( ) ii) Mini ( )

iii) Mainframe ( ) iv) Don't know ( )

b) What did you use the computer(s) for ?

c) Have you used a Macintosh computer before ?

Yes ( ) No ( )

1. What information can you find concerning copyright in software in Pennsylvania ? [ ]
2. What database searching facilities are available in Drexel University? Where are they ? [ ]
3. Find out where the Department of Humanities/Communications is located. [ ]
4. Find out the Hugerty Library's working hours and its location on the university campus. [ ]
5. What is the HyperFinder stack ? [ ]
6. How do you prevent data loss from the disc ? [ ]

7. What is the price of the Mac ImageWriter II cable ? [            ]

8. What are Error messages ? If there is one, what should you do ? [            ]

9. Who designed the Drexel disc ? when ? [            ]

10. What are the debugging features of HyperCard ? [            ]

11. Where are the Micro Classrooms ? What facilities are available there for teaching computers ? [            ]

12. What is NuBus ? [            ]

**DATA ANALYSIS AND PRESENTATION II****The Drexel disc**

Name of the student :

Class :

Group :

Date :

After you have worked your way of through the material on the disc, please answer the questions below (by circling your answers, where appropriate).

1. How easy to use did you find this disc ?

Hard      Fairly hard      Reasonable      Fairly easy      Easy

2. How informative did you find it ?

Highly      Fairly      Nothing special      Fairly      Highly  
informative      informative           uninformative      uninformative

3. How well-organised did you find the material ?

Very poorly      Poorly      Acceptable      Quite well      Very well  
organised      organised      organised      organised      organised

4. Were there any features (eg. the campus map) that you especially liked ?

If so list them here:

5. Were there any features that you especially disliked ?

If so list them here:

6. If a similar disc were to be made for Loughborough, would like to see an changes in the following (giving examples):

a) the way the information is presented?

b) the type of contents included?

7. Have you any other comments on this disc?

DATA ANALYSIS AND PRESENTATION IIHypertext Practical

Name of the student :  
Class :  
Date :  
Group number :

**PRACTICAL PROBLEMS**

Please record below any problems encountered during one group session on the Mac. The problems have been put into categories, but these may not be suitable for all the problems. If so, you should note the problem at the end of this sheet. Please record each time a problem occurs, even if it is for the same reason as an earlier occurrence.

---

**1. Mechanical problems :**

(eg. difficulties in directing the pointer when using the mouse; confusing 'clicking' ; mechanical problems with the Mac)

**2. On-screen problems :**

(eg. failure to move material about on the screen; difficulty in understanding what information the screen is displaying and what it means)

**3. Between - screen problems :**

(eg. selecting the wrong screen; failure to escape from the wrong screen; uncertainty regarding position in the database)

4. Problems of changing materials :

(eg. failure to transfer material between cards; difficulty in identifying what stage you have reached in your task)

5. Other problems

USE OF HYPERTEXT FOR TEACHING

## 1. Personal background:

- a. Name :
- b. Class :
- c. Group number :

## 2. Do you think the teaching you have received is sufficient for an elementary use of HyperCard ?

Yes [     ]

No [     ]

If 'No' , what further assistance would you need ?

## 3. List any characteristics of HyperCard that you found particularly attractive.

## 4. List any characteristics of HyperCard that you disliked, or found confusing.

## 5. What major difficulties did you encounter whilst using HyperCard ? (List in order of importance, so that the difficulty you encountered most frequently is listed "1".)

6. How easy was it to learn to use HyperCard ?

- I) Hard [     ]
- II) Fairly hard [     ]
- III) Reasonable [     ]
- IV) Fairly easy [     ]
- V) Easy [     ]

7. How interesting did you find it to use HyperCard ?

- I) Not interesting [     ]
- II) Moderately interesting [     ]
- III) Very interesting [     ]

8. How helpful did you find the different hand-outs supplied to you ?

Indicate briefly any difficulties you had with the hand-outs.

- I) Very useful [     ]
- II) Fairly useful [     ]
- III) Not very useful [     ]
- IV) Useless [     ]

9. How useful did you find the teaching sessions using the OHP ?

10. Indicate briefly any difficulties you encountered in the teaching.

11. Would you have preferred to work on you own, rather than in a group ? What advantages and disadvantages did you find in group working ?

i) Advantages :

ii) Disadvantages :

12. Have you used the Macs at other times during these weeks, apart from your scheduled HyperCard sessions ?

Yes [     ]

No [     ]

If 'Yes' : For what purpose and for how long (approximately) ?

13. How would you assess the level of course materials and teaching provided ?

a) too elementary [     ]

b) about right [     ]

c) too advanced [     ]

14. Overall, what benefits, if any, do you think you have obtained from learning HyperCard ?  
(Tick as many as you wish)

- |                                    |         |
|------------------------------------|---------|
| i) improved computer knowledge     | [     ] |
| ii) improved practical skills      | [     ] |
| iii) improved thinking skills      | [     ] |
| iv) improved designing skills      | [     ] |
| v) others, if any (please specify) | [     ] |

15. Do you think that HyperCard might be used to help in the teaching of any of the other library and information courses you have attended?

Yes [     ]

No [     ]

If 'Yes' : Which courses (please list them below)

16. Do you have any other comments not covered by the preceding questions?

**Appendix - VI****BACKGROUND QUESTIONNAIRE**

(To be completed and returned at the beginning of the course)

**1. Personal record:**

- a) Name :
- b) Age :
- c) Sex :
- d) Group No. :

(This will be given by us later on)

- e) Qualifications (eg. A-levels or others if any and the subjects studied) :

- f) What were you doing before joining this course (eg.school, work, etc.) ?

- g) Would you regard your interests as:

- i) More library oriented ( )
- ii) More 'information' oriented ( )
- iii) Equal interest ( )

**2. Have you used any computer, or had computer training before ?**

Yes ( ☐ )      No ( ☐ ) → Questionnaire is now complete.

↓

- a) Which type of computer did you use ?

- i) Micro (      )      ii) Mini (      )
- iii) Mainframe (      )      iv) Don't know (      )

- b) How long have you been using a computer ?

c) What have you used computer (s) for ?

d) Have you used a mouse before with any computer ?

Yes (   )      No(   )

3. Have you used a Macintosh computer before?

Yes (   )   No(   )

If Yes:

i) What did you use the Mac for?

ii) How long have you been using the Mac ?

a) Did you used or had any training on the HyperCard before ?

Yes (   )   No(   )

If yes:

i) What level of experience/exposure you had with the HyperCard ?

- A) Basic                    (       )
- B) Intermediate        (       )
- C) Advanced            (       )

DATA ANALYSIS AND PRESENTATION IID R E X E L   D I S C

Name :  
Class :  
Date :  
Group Number :

[Drexel University is a relatively small university in Philadelphia. It supplies its undergraduates with copies of this disc to answer their questions about the university.]

Your task is to use the disc to find the answers to the questions given below. Fill in your answers in the spaces provided after each question. Fill in also the time taken for each question in the boxes provided.

1. Find out where the Department of Humanities/Communications is located. [      ]

2. Find out the Hugerty Library's working hours and its location on the university campus. [      ]

3. What database searching facilities are available in Drexel University ? Where are they ? [      ]

4. What is the price of a Mac ImageWriter II cable ? [      ]

5. Who designed the Drexel disc ? When ? [      ]

6. Where are the Micro Classrooms ? What facilities are available there for teaching computers? [      ]

7. What information can you find concerning copyright in software in Pennsylvania ? [      ]

8. How do you prevent data loss from the disc ? [      ]

9. What are the debugging features of HyperCard ? [      ]

10. What are Error messages ? If there is one, what should you do ? [      ]

11. What is the HyperFinder stack ? [      ]

12. What is NuBus ? [      ]

DATA ANALYSIS AND PRESENTATION IIHypertext Practical

Name of the student :  
Date :  
Class :  
Group Number :

---

Practical Problems :

Please record below any problems encountered during your group sessions on the Mac. The problems have been put into categories, but these may not be suitable for all of those you encounter. If so, you should note special problems at the end of this sheet. Please record each time a problem occurs, even if it is for the same reason as an earlier occurrence.

---

1. Mouse problems :

(eg. difficulties in directing the pointer[cursor] when using the mouse, confusing clicking and double-clicking, controlling the mouse, difficulty in selecting the commands, etc.)

2. Icons problems :

(eg. difficulty in understanding what they represent, what will happen when you click on them, etc.)

3. On-screen problems :

(eg. failure to move materials about on the screen; difficulty in understanding information displayed and what it means)

4. Problems in moving between screens :

(selecting the wrong screen; failure to escape from the wrong screen; uncertainty regarding position in the database)

5. Problems of changing material :

(eg. failure to transfer material between cards; difficulty in identifying what stage you have reached in your task)

6. Navigational problems :

(eg. not being able to move freely in the database, difficulty in finding to a particular piece of information; losing control of the database, etc.)

7. Information retrieval problems :

(eg. identifying relevant information in a database, difficulty in searching the information, etc.)

8. Problems with Paint tools :

(eg. failure to identify which tool is for what purpose, difficulty in using the tools, etc.)

9. Menu problems :

(eg. difficulty in understanding the menu options, manipulating the menus, difficulty in reading the menus due to small print size, etc.)

10. Problems with graphics :

(eg. difficulties in identifying the graphics titles, what activity they represent, etc.)

11. Hardware & software problems :

(eg. failure/unable to work Macs, to enter HyperCard, etc.)

12. Other problems (if any, please specify here)

DATA ANALYSIS AND PRESENTATION IIHypertext PracticalDOCUMENT CATALOGUE EXERCISE

Name of student :  
 Class :  
 Date :  
 Group Number :

Please record below the progress of your exercise and the problems encountered while designing the 'Document catalogue'. The time taken to complete the whole exercise should also be noted at the end of this sheet.

---

1. Did you complete the 'Document Catalogue' design exercise ?

Yes ( ) No ( )

If Yes:

a) Did you encounter any problems while designing the 'Document Catalogue' ?

Yes ( ) No ( )

If Yes : what were they ? (explain clearly)

If No:

a) How far did you get in the exercise ?

- i) Created new stack ( )
- ii) Created new stack + Created background ( )
- iii) Created new stack + Created background +  
Added background fields ( )
- iv) Created new stack + Created background +  
Added background fields + Added background  
buttons ( )
- v) Everything completed ( )

b) Why were you unable to complete the exercise ? (specify here )

2. How much time did you spend in designing this catalogue ?  
(give the approximate time)

USE OF HYPERTEXT FOR TEACHING

1. Personal background :

a. Name :

b. Class :

c. Group number :

---

2. Do you think the teaching you have received is sufficient for an elementary use of HyperCard ?

Yes [     ]

No [     ]

If 'No' , what further assistance would you need ?

3. List any characteristics of HyperCard that you found particularly attractive.

4. List any characteristics of HyperCard that you disliked, or found confusing.

5. What major difficulties did you encounter whilst using HyperCard ? (List in order of importance, so that the difficulty you encountered most frequently is listed "1".)

6. How easy was it to learn to use HyperCard ?

- I) Hard [     ]
- II) Fairly hard [     ]
- III) Reasonable [     ]
- IV) Fairly easy [     ]
- V) Easy [     ]

7. How interesting did you find it to use HyperCard ?

- I) Not interesting [     ]
- II) Moderately interesting [     ]
- III) Very interesting [     ]

8. How helpful did you find the different hand-outs supplied to you ?

- I) Very useful [     ]
- II) Fairly useful [     ]
- III) Not very useful [     ]
- IV) Useless [     ]

Indicate briefly any difficulties you had with the hand-outs.

9. Did you encounter any difficulties with the teaching ? If so, please comment on them briefly below.

10. Would you have preferred to work on you own, or as a member of a pair ?

What advantages and disadvantages did you find in working by yourself/as a member of a pair (whichever is relevant to you) ?

i) Advantages :

ii) Disadvantages :

11. Have you used the Macs at other times during these weeks, apart from your scheduled HyperCard sessions ?

Yes     [     ]

No      [     ]

If 'Yes' : For what purpose and for how long (approximately) ?

12. How would you assess the level of course materials and teaching provided ?

- a) too elementary            [     ]
- b) about right                [     ]
- c) too advanced              [     ]

13. Overall, what benefits, if any, do you think you have obtained from learning HyperCard ?

(Tick as many as you wish)

- i) improved computer knowledge            [     ]
- ii) improved practical skills                   [     ]
- iii) improved thinking skills                   [     ]
- iv) improved designing skills                  [     ]
- v) others, if any (please specify)            [     ]

14. Do you think that HyperCard might be used to help in the teaching of any of the other library and information courses you have attended?

- Yes        [     ]
- No         [     ]

If 'Yes' : Which courses (please list them below)

15. Do you have any other comments not covered by the preceding questions?

**Appendix - XI****Comparison of Hypertext & dBase Databases****Worksheet**

Your task is to use the database to find the answers to the questions given below. Fill in your answers in the spaces provided after each question. Fill in also the time for each question in the boxes provided.

Name :

Course :

Group :

---

1. Where is the CTI(Computers in Teaching Initiative) Centre for Physics ? [       ]

[Give the complete address]

2. What people are associated with the CTI Centre for Library and Information Studies ?

[       ]

3. Who originally developed 'HyperTIES' ? [       ]

4. Who is the supplier of 'CEA' software ? [       ]

5. What is the price of 'QCIP' software ? [       ]

6. Which LIS Departments in the UK use HyperCard ? [       ]

7. Which software is both a Hypertext system and an Expert system ? [       ]

8. What software is available for running on a PRIME [mainframe] system ? [       ]

9. Who is the supplier of 'Bibliometrics Toolbox' ? {       }

10. Which software is freely available ? [       ]

11. What software has been developed by the Department of Information Studies at the University of Sheffield ? [       ]

12. Who is using the 'Softop' software ? [       ]

**Appendix - XII****Comparative study of Hypertext and dBase III databases**(Please tick against the appropriate response)

-----oOo-----

1. Name :

2. Course :

3. How well-organised did you find the information in the database ?

	<u>Hypertext database</u>	<u>dBase database</u>
i) Very poor	[      ]	[      ]
ii) Poor	[      ]	[      ]
iii) Acceptable	[      ]	[      ]
iv) Quite well	[      ]	[      ]
v) Very well	[      ]	[      ]

4. How acceptable was the appearance of the material on the screen ?

	<u>Hypertext database</u>	<u>dBase database</u>
i) Very poor	[      ]	[      ]
ii) Poor	[      ]	[      ]
iii) Acceptable	[      ]	[      ]
iv) Fairly good	[      ]	[      ]
v) Very good	[      ]	[      ]

Note briefly here any major defects

5. Which system did you feel enabled you to retrieve information most quickly ?

i) Hypertext	[      ]
ii) dBase	[      ]
iii) Both equal	[      ]

6. Which system did you find was the more flexible for seeking information ?

- i) Hypertext [       ]  
 ii) dBase [       ]

7. How easy did you find it to move from one screen to another ?

- |                  | <u>Hypertext database</u> | <u>dBase database</u> |
|------------------|---------------------------|-----------------------|
| i) Hard          | [       ]                 | [       ]             |
| ii) Fairly hard  | [       ]                 | [       ]             |
| iii) Fairly easy | [       ]                 | [       ]             |
| v) Easy          | [       ]                 | [       ]             |

8. Did you encounter any navigational problems while using this catalogue ?

- Yes [       ]  
 No [       ]

If your answer is 'Yes', note briefly what they were below

1. Hypertext database

2. dBase database

9. Did you encounter any other problems in retrieving the information ?

- Yes [       ]  
 No [       ]

If 'Yes', please note the sort of problem briefly

10. Which hardware/software system did you feel was more user-friendly ?

i) Mac & Hypertext [       ]

ii) PC & dBase database [       ]

a) Can you explain briefly why ?

**HYPERTEXT PRACTICAL - COLOUR COMPARISON**

Name :

Group number :

**INTRODUCTION:**

Your task is to use these packages to find the answers to the questions given below. Fill in your answers in the spaces provided after each question. Fill in also the time taken for each question in the boxes provided.

**WORK SHEET FOR HYPERTEXT HANDS-ON**

1. Who has designed the HyperTIES hypertext system ? [                      ]
  
2. What is Memex ? [                      ]
  
3. Who has created "Hypertext on Hypertext", a HyperCard version ? [                      ]
  
4. Find an example of a Hypertext system which can be used as the 'Help system'.  
[                      ]
  
5. What is a 'node' ? [                      ]
  
6. What is the admission fee to the San Diego Zoo ? [                      ]

**WORKSHEET FOR INNOVATION & TECHNOLOGY TRANSFER (ITT)**

1. In what languages is 'Innovation & Technology Transfer(ITT)', an electronic information bulletin, available ? [            ]

2. When was the first issue of ITT launched ? [            ]

3. When and where was the Sprint Link 1991 conference held ? [            ]

4. Who is the contact person at Rostock Euro Information centre ? [            ]

5. Can you find an address for getting more information about patents ? [            ]

6. What is CORDIS ? [            ]

**Comparison of colour and black-and-white hypertext**

Please circle the appropriate answers to the questions below.

**Colour v. Black & White:**

How do you feel colour compares with black & white between these two packages in terms of the attractiveness of the presentation.

Better with  
colour

the same

Worse with  
colour

**Icons v. Hot spots (highlighted words) :**

Do you find the use of icons more helpful than highlighted words ?

Better with  
icons

same  
with both

Better with  
highlighted words

**Graphics v. Text :**

Do you find it easier to move about, and to retrieve information with mixed graphics and text, or with text only ?

Better with  
text and graphics

the same

Better with  
text only

**Ease of use :**

Which package did you find it pleasanter to use.

Hypertext Hands-on: [       ]

ITT : [       ]

Both the same: [       ]

Why ?

**Mac v. IBM :**

Comparing the two computer environments you have used for hypertext, which do you prefer?

Mac-based systems [       ]

IBM-based systems [       ]

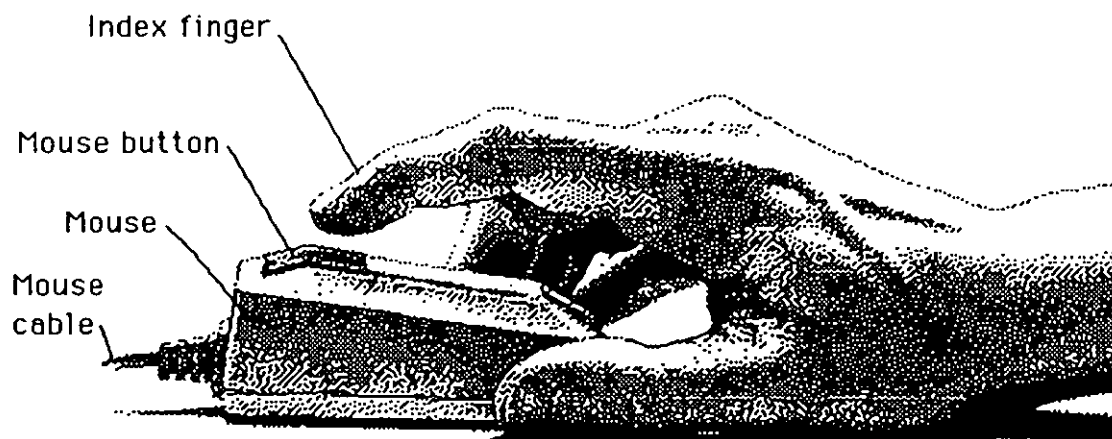
No difference [       ]

If you see a difference, what is it ?

**THANK YOU FOR COMPLETING THIS QUESTIONNAIRE**

LOUGHBOROUGH UNIVERSITY OF TECHNOLOGYDepartment of Information and Library StudiesMouse Familiarity

- (1) Switch on the Mac at the rear left of the SE30's, LC and on the keyboard of the Mac II.
- (2) Plug in the mouse at the side of the keyboard, on the side opposite the keyboard cable. People wishing to use the mouse in the left hand may wish to swap sides with the keyboard cable. Note the corresponding symbol on the mouse plug and the socket: line them up with each other.
- (3) Move the cursor (arrow) by holding the mouse loosely in the right or left hand, with the index or middle finger resting on the button. Move the mouse in a rough circle on the table, and note the movement of the cursor on the screen. Note that if you lift the mouse and relocate it, the cursor will not move. In this way you can prevent 'running out of table'.

Correct way of holding and clicking the mouse

People who are unused to using a mouse often hold it too tightly and do not pick it up often enough.

- (4) When the computer first starts up, you should see a 'hard disc icon' on the top right of the screen, and a 'menu bar' across the top of the screen. Move the cursor to the icon, so that it points on the icon itself, and not the lettering beneath. Click once. The icon will change colour showing that it has been 'selected'. To open up the hard disc and see what is on it you will need to 'double click' (ie. click twice, rapidly).
- (5) Beginners, and many others, find double clicking difficult. If you are tense and move the mouse, you may find that you have effectively selected and move the icon instead of opening it. This does not matter. Try it again.
- (6) Once open, the hard disc will reveal many 'folder icons' as well as possibly some document or program (application) icons. The Mac arranges its files so that they are collected in folders which may be opened by double clicking to reveal more folders or other icons.
- (7) Find any icon. Move the cursor over this icon and press and keep down the mouse button. Still with the button depressed, move the mouse about an inch, and release. Notice that the icon has moved. This is called dragging.
- (8) Place the cursor on any of the menus on the menubar at the top of the screen. Press and hold the mouse button. This shows the items on the menu. When you release the mouse button, the menu will disappear.
- (9) All the menus contain commands to allow you to carry out activities. To select a command, place the cursor on any command on a menu. Press the mouse button and the command will be highlighted (change colour). Release the button and the command will be executed.
- (10) To finish a Mac session, close any folder you may be in by clicking on the square in the top left corner of the window. When no folders are open, click on the menu item 'Special', and drag down to the word 'Shutdown', and release.

**LOUGHBOROUGH UNIVERSITY OF TECHNOLOGY****Department of Information and Library Studies****Designing a Document Catalogue stack**  
**(Condensed Version)**

A Document Catalogue stack is simply an electronic version of the manual card catalogue (such as the ones that libraries used to have). Each card should contain the following nine fields: 1) Class Number, 2) Accession Number, 3) Author, 4) Title, 5) Publisher, 6) Place of publication, 7) Date of publication, 8) Keywords, and 9) Notes. The main objective of designing this stack is to test your understanding of the techniques and use of HyperCard. At the same time, the application is one that you may find useful in your later work.

**INSTRUCTIONS:**

You are given below a brief recipe for creating your catalogue. This will test your ability to use HyperCard. But make sure that, at the same time, you understand what you are doing.

1. **Creating a new stack** : Create a new stack with the name "My Catalogue" by choosing the 'New stack' from the 'File Menu'.
2. **Creating the background** : Choose 'Background' from 'Edit Menu'. Then go to the 'Tool Menu' and select the 'Text tool'. Finally, enter the title graphics (shown in the figure given below) on the background.

<b>Class No :</b>	<b>Acc.No :</b>
<b>Author :</b>	
<b>Title :</b>	
<b>Publisher :</b>	
<b>Place of publ :</b>	<b>Date of publ :</b>
<b>Key words :</b>	
<b>Notes :</b>	

3. **Adding background fields :** Create a new field with 'Shadow' field style and place it again: 'Class No:'. In the same way, create a field for each of the following - Acc No:, Author, Title, Publisher, Place of publication, and Date of publication. Create two more new fields with 'Scrolling' field style and place them against Keywords and Notes graphics.

<b>Class No:</b>	<input type="text"/>	<b>Acc.No:</b>	<input type="text"/>
<b>Author :</b>	<input type="text"/>		
<b>Title:</b>	<input type="text"/>		
<b>Publisher:</b>	<input type="text"/>		
<b>Place of publ:</b>	<input type="text"/>	<b>Date of publ :</b>	<input type="text"/>
<b>Keywords:</b>	<input type="text"/>		
<b>Notes:</b>	<input type="text"/>		

4. **Adding buttons to the Background :**

a) **Creating new buttons:** i) New Card, and ii) Delete Card. Create a new button and name it 'New Card'. Double-click on it; a 'Button Info dialog box' will be displayed. Click on 'Script' button, a 'Script dialog box' will appear which contains:

```
on mouseUp
```

```
end mouseUp
```

Type 'domenu "New card" '(exactly like this without any changes) in between these lines and click on the 'OK' button. Place this button at the bottom of the background as shown below. In the same way, create another button and name it 'Delete card'. Open the 'Script dialog box' and type 'domenu "Delete card" '. Place it next to the 'New card' button on the background.

b) **Copying the buttons from the 'Home stack' :** Copy the 'Previous card', 'Next card', 'Find', and 'Sort' buttons from the 'Card 3' of 'Home' stack to your stack's background and place them at the bottom as shown in the figure.

<b>Class No.:</b>	<input type="text"/>	<b>Acc.No.:</b>	<input type="text"/>
<b>Author :</b>	<input type="text"/>		
<b>Title :</b>	<input type="text"/>		
<b>Publisher :</b>	<input type="text"/>		
<b>Place of publ.:</b>	<input type="text"/>	<b>Date of publ. :</b>	<input type="text"/>
<b>Keywords:</b>	<input type="text"/>		<input type="button" value="v"/>
<b>Notes:</b>	<input type="text"/>		<input type="button" value="v"/>
<input type="button" value="New Card"/> <input type="button" value="DeleteCard"/> <input type="button" value="Prev. Card"/> <input type="button" value="Next Card"/> <input type="button" value="Find"/> <input type="button" value="Sort"/>			

Come out of the background domain, click on the 'New card' button; a new card will be added to your stack. The 'Delete card' button will delete a card. The 'Previous' and 'Next' buttons will take you to the previous and next cards respectively. The 'Find' button is useful for searching the text in the catalogue. Finally, the 'Sort' button will sort all the cards alphabetically both by 'author' and by 'title' when they are selected.

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Oct, 1991.

**LOUGHBOROUGH UNIVERSITY OF TECHNOLOGY****Department of Information and Library Studies****Designing a Document Catalogue stack**

A Document Catalogue stack is simply an electronic version of the manual card catalogue (such as the ones that libraries used to have). Each card should contain the following nine fields: 1) Class Number, 2) Accession Number, 3) Author, 4) Title, 5) Publisher, 6) Place of publication, 7) Date of publication, 8) Keywords, and 9) Notes. The main objective of designing this stack is to test your understanding of the techniques and use of HyperCard. At the same time, the application is one that you may find useful in your later work.

**INSTRUCTIONS:**

You are given below a recipe for creating your catalogue. This will test your ability to use HyperCard. But make sure that, at the same time, you understand what you are doing.

**1. Creating a new stack:**

- i) Irrespective of your position in the Hypercard software, choose the 'New Stack' from the "File Menu"
- ii) The system will display a dialog box and will ask you to type the name of the new stack you are creating. Type "My Catalogue" in the new stack name box. Then you click on the rectangular box with a cross against the 'Copy current background', at the bottom of the 'New stack dialog box'. The cross will disappear: then click on the "New" button.
- iii) A new stack with the name "My Catalogue" has now been created. You need to think next about the card background.

**2) Creating the background:**

- i) Go to the 'Edit Menu' and choose "Background"; the normal menu bar will turn into a dotted line both on the upper and lower side of the title bar. Fig.1 shows you the difference between the normal title bar and the dotted title bar. The appearance of the latter confirms that you are in the 'Background domain' of the card.

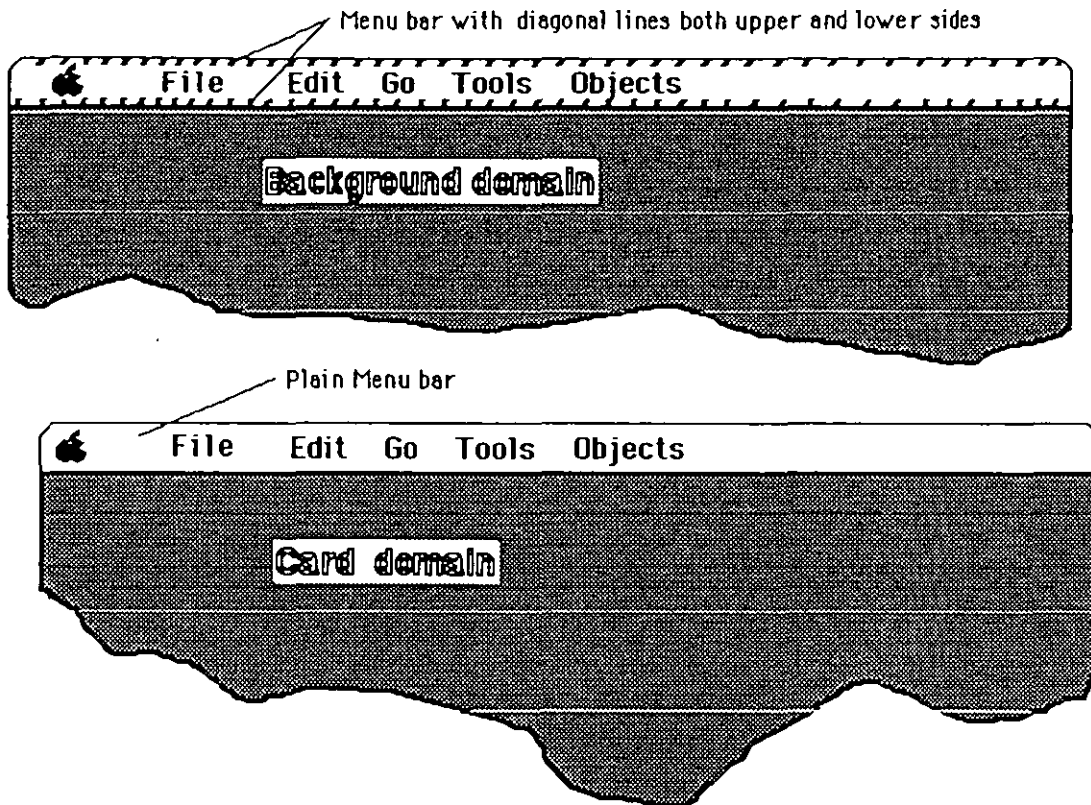
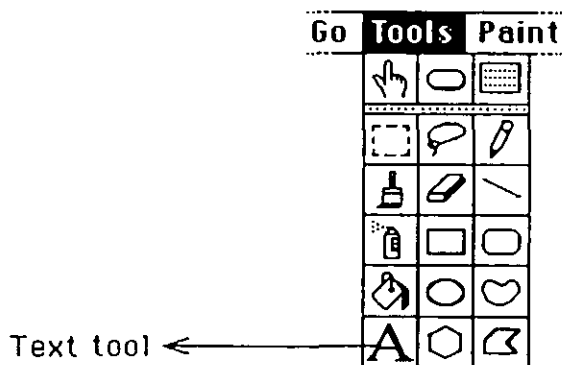


Fig.1. Difference between the 'Background domain' and the 'Card domain'

ii) Go to the 'Tools Menu' and select the 'Text tool' (which is in the bottom left-hand corner of the 'Tools Palette' with the 'A' symbol). The cursor will change into a vertical line "I". Keep this cursor on the left-hand top corner of the background and click it. It will stick there. Press the return to leave that line and to go to the next line.



iii) Type "Class No" as shown in Fig.2. Leave some space (about 15 spaces) and type "Acc. No".

iv) Then go to the 'Edit Menu' and choose 'Text style'. This leads to the display of a dialog box. Select 'bold' from the 'Text style'. (You are already in 'Geneva font' and 'size 12', which is the default 'Text style' option for Hypercard.)

v) The letters you have typed will become bold and the size will also increase slightly.

Class No.:  Acc.No.:

Author :

Title:

Publisher:

Place of publ:  Date of publ :

Keywords:

Notes:

Fig.2. A sample Card of the Book catalogue

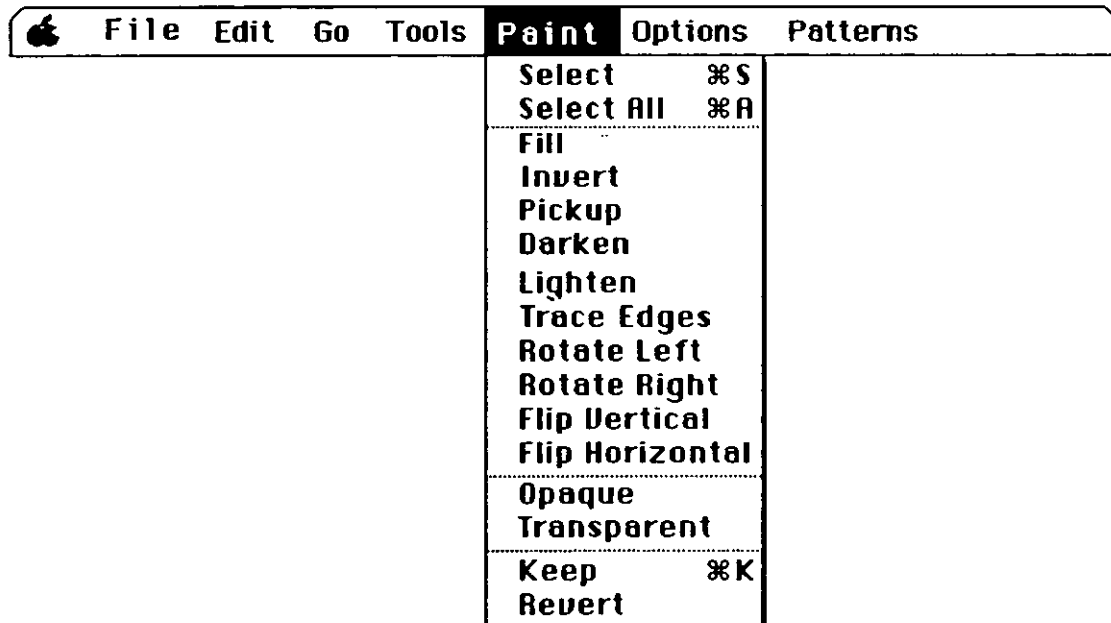
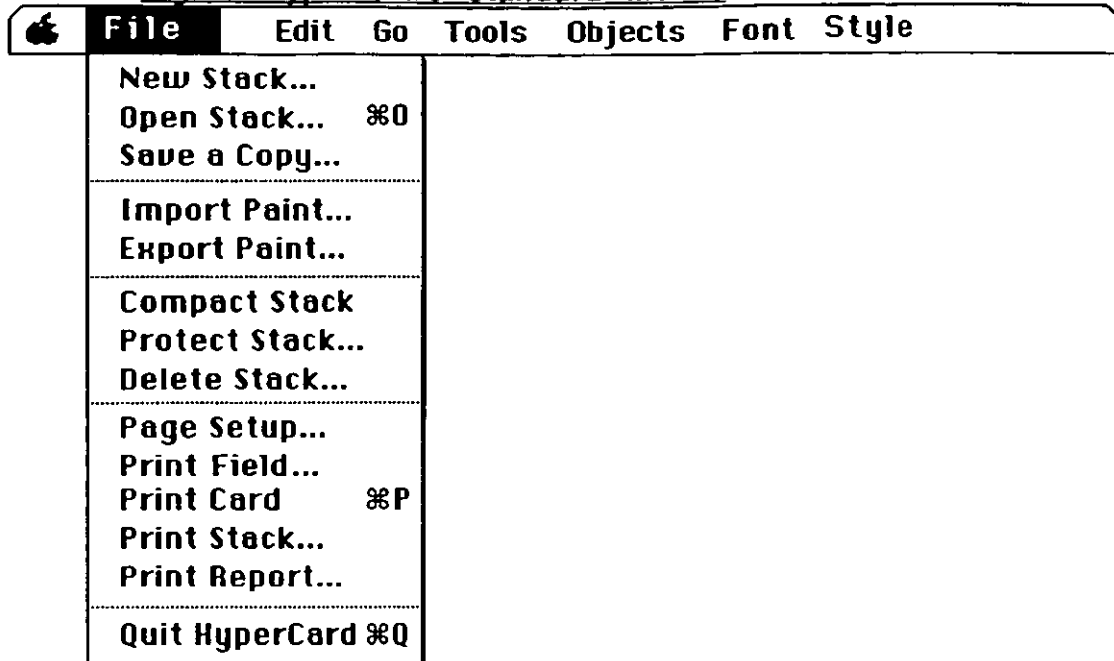
vi) Press the 'Return' twice to leave a space between the two fields you are creating. Type 'Author' and press 'Return' twice to leave one line for author and another for the space between the fields. Now type 'Title' and press 'Return' three times, to leave two lines for the title and one for the space between the fields. Type 'Publisher' and press the return three times. Type 'Place of publ' [publication], leave about 15 spaces and then type 'Date of publ'[publication]. Leave the rest of the space in that line empty. Press 'Return' twice, type "Keywords", and press 'Return' three times. This leaves two lines for future entries and one for the space between the fields. Then type the last field title, 'Notes', and leave the rest of the space empty.

**Note:** When creating these titles, do not press the mouse button anywhere on the card except on the 'menu options'. Otherwise the spacing between the lines will be disturbed, and the card design will look less attractive.

### 3. Adding background fields :

(It is assumed that you are still in the 'background domain'. If you have come out, follow the procedure in 2(i) to return to the 'Background' .)

i) Go to the 'Tools Menu' and select the 'Field tool' (top right-hand corner box in the 'Tools palette'). A new 'Objects Menu' will be added to the menu bar.

**Fig. 3 HyperCard's Standard Menus****Fig. 4 HyperCard's Paint Menus**

ii) Go to the 'Objects Menu' and choose the 'New Field'. A new field will appear on the 'Background'. Place the cursor on top of it, and press the mouse button. Drag the field to a place between 'Class No' and 'Acc No'. Then double-click on it: a 'field info dialog box' will be opened. Type 'Class No' in the new fields' name box and click on 'shadow' in the fields' 'Style' options. Then click on the 'OK' button at the bottom of the dialog box.

iii) A new field for 'Class No' has now been created. Click anywhere to insert that field onto the background.

iv) Follow the same procedure to create another 'new field'. Type 'Acc No' in its name box. Select the 'shadow' again from the fields' 'style' options, and click on the 'OK' button. Drag the field to a place beside the title 'Acc.No:'. To resize the fields, put the cursor at the bottom right-hand corner of the field. Press the mouse button, and drag diagonally down to increase the size (or up to reduce the size) of the field. After resizing and placing it in its proper place, click anywhere to insert it onto the background.

v) In the same way, create a new field and name it 'Author'. Place it against the 'author' title and resize it to a one-line height and width up to the right-hand edge of the 'background' (see Fig.2).

vi) Create a new field for 'Title' and resize it to a two-lines height and a width as far as the right-hand edge of the 'background'.

vii) Create a new field for 'Publisher' and resize it to a two-lines height and width up to right-hand edge of the 'background'.

viii) Create a new field, in the same way, and name it 'Place of publication'. Place it against its title and resize accordingly.

ix) Create a new field for 'Date of publication'. Place it against its title and resize accordingly.

x) Create a new field for 'Keywords' and select its style as 'scrolling type'. Place it against its title, and resize it to a two-lines height and width to the right-hand edge of the 'background'.

xi) Finally, create a new scrolling field in the same way and name it 'Notes'. Place it against its title and resize it to a three-lines height and width to the right-hand edge of the 'background'.

You have now finished creating the nine background fields for each title on the background of the catalogue card.

#### 4. Adding buttons to the background :

##### A. Creating new buttons :

Now we need to create two new buttons: i) New Card, and ii) Delete Card.

i) Go to the 'Edit Menu' and select 'Background', so that you are in the 'background' domain

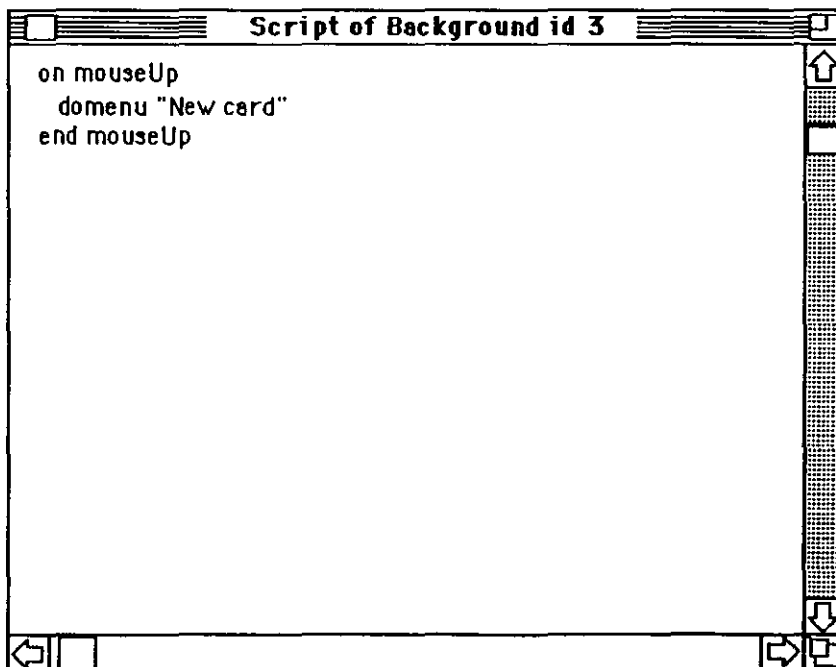
ii) To create a new button, go to the 'Tools Menu' and select the 'Button tool'(the middle box of the top row in the 'Tools palette'). A new 'Objects Menu' will be added to the menu bar.

iii) Go to the 'Objects Menu' and select 'new button'.

iv) A new button will appear on the 'background'. Double-click on it; a 'button info dialog box' will be displayed. Press the 'delete' key to delete the existing title of the button ('new button'). Then type 'New Card' in the button's name box. Next click on the 'Script' button (bottom left-hand corner of the button info dialog box). A 'script dialog box' will appear which contains two lines:

```
'on mouseUp
```

```
end mouseUp'
```



**Fig. 5 Background button Script editor window**

Type 'domenu "New card" ' (exactly as indicated, without any changes) between these two lines and click on the 'OK' button. Now place the cursor on the screen button, press the mouse button and drag the words to the bottom left-hand corner of the background. Align it with both of the edges, and click anywhere outside the button to stick the words onto the background.

v) In the same way, create another button and name it "Delete Card". Now click on the 'script' button; a 'script dialog box' will be opened. Type 'domenu "Delete card" ' as before between the two lines and click on 'OK' button. Drag this button in the same way, and place it adjacent to the 'New card' button at the bottom of the background.

#### B. Copying the buttons from the "Home stack":

Now we need to copy four buttons from the 'Home stack' of the Hypercard. They are: i) 'Previous card', ii) 'Next card', iii) 'Find', and iv) 'Sort'.

i) To copy these buttons from the 'Home stack', you first select 'Home' from the 'Go Menu'. Then click on the 'card 3' icon at the bottom of the Home card. It will take you to 'card 3', which contains all the four buttons you need to copy and paste on your stack.

ii) Now select the 'Button Tool' (top-row middle box of the 'Tools palette') from the 'Tools Menu'. All the buttons on the viewing card will be high-lighted. Click on the 'Previous card' button; its border will be high-lighted with dotted lines. Choose the 'Copy button' from the 'Edit Menu'; the selected button will be copied. Now choose the 'Browse Tool' (top left-hand corner box of the 'Tools palette').



Fig. 6 Buttons before and after selecting

iii) Hold the Command key down and press the 'ESC' (Escape) key slowly till you get back to your 'Document Catalogue stack' (or choose 'Back' from the 'Go Menu' to go back to your stack). After reaching your stack, select 'Background' from the 'Edit Menu'.

iv) Continue with the 'Edit Menu' and choose the 'Paste button'. The 'Previous card' button you have just copied will be pasted on this background. Place the cursor on it and press the mouse button. Drag the button to the bottom line of the background and place it after the 'Delete card' button. Adjust it properly and click anywhere on the card to stick that button on the background.

v) In the same way, copy the 'Next card' button from the 'card 3' of the 'Home stack'. Paste it after the 'Previous card' button on the bottom line of the background of your stack.

vi) Follow the same procedure to copy the 'Find' and 'Sort' buttons. Paste them in order after the 'Next card' button on the background of your stack.

You have now created a basic card catalogue. The catalogue you have created is good enough for your day-to-day work. When you click on the first button, 'New card', a new card will be created and added to your stack, which allows you to build up your catalogue by adding new titles. The next button, 'Delete card', will be useful in deleting old entries or cards.

The button, 'Previous card', will take you to the card before the currently viewed card. Similarly, 'Next card' will take you to the card after the currently viewed card. When you click on the 'Find' button, it will provide a dialog box with 'Find " ...." ', in which you need to type the keyword(s) to be searched in the catalogue. After typing the keyword(s), press 'Return'; you will be shown where the word(s) appear both on the card and in the entire stack.

The 'Sort' button can be used to sort all the cards alphabetically, both in terms of title and author. When you click on the 'sort' button, it will provide a dialog box with 'Author', 'Title', and 'Cancel' options. Click on the 'Author' button, and the catalogue will sort all the cards alphabetically according to author. In the same way, when you click on 'Title', it will sort all the cards alphabetically by title.

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Oct, 1991.

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