A comparative study of concept-based and procedural teaching methods in user instruction of the OPAC at the M L Sultan Technikon.

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Declaration

I, the undersigned hereby declare that this thesis is my own original work and has not previously in part or in its entirety been submitted at any university for a degree.

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Dedication

This work is dedicated to my husband Dass Raju, who gave me every support and encouragement and who made it his main priority to help me complete this thesis in every way that he could.

Abstract

The purpose of this research was firstly to compare the differences in online performance between two groups trained to use the Online Public Access Catalogue at the M L Sultan Technikon using two different types of instruction, namely the teaching methods of concept-based and procedural instruction. Secondly, the objective of the research was to compare these two teaching methods in relation to first year students at the M L Sultan Technikon with differing levels of library experience, computer experience and English language experience.

To meet the objectives of the research, literature was reviewed and analysed from various sources. Original research was conducted using the method of a quasi-experiment. A random sample of 120 students were split between two teaching conditions, with sixty participants in a concept-based teaching condition and sixty participants in a procedural teaching condition. Research instruments used were a background questionnaire to collect demographic information, a pre-and post test to evaluate significant differences between the teaching methods, an evaluation questionnaire to collect affective responses, direct observation, and transaction log monitoring of the searches conducted. In a one-hour lecture the concept-based group were taught general search concepts using model-based instruction techniques and the procedural lecture demonstrated methods of searching in a step-by-step fashion. Data analysis made use of Microsoft Access 97 and Excell 97 software to code and verify the data, and the Statistical Package for the Social Sciences (SPSS), v9.0 to conduct statistical analysis.

The research found that first year students were generally inexperienced in the use of the online information retrieval system. The majority of the participants in the study did not have any computer experience, and made use of English as a second language. Others, although not in the majority were found to have low levels of library experience. Performance on pre-tests were generally low for these participants while those who had experience in the use of libraries, computers and who regarded English as a first language were able to make fair use of the system for simple tasks such as author and title. This suggested that prerequisite competencies needed for online searching were, library literacy, computer literacy and some proficiency in the use of English. Performance on search tasks found no significant differences on simple tasks between the teaching conditions. However, variances in performance as a result of individual differences were found. On difficult tasks participants fared better with concept-based instruction resulting in significant differences in performance.

The findings of this research supported the need for online instruction to novice end-users, taking cognisance of the need for suitable venues equipped with adequate hardware, provision of staff, and allocation of sufficient time for such instruction. The research proposes that model-based teaching be encouraged, especially for difficult tasks. In the decisions made however, instruction must take note of the background of participants. Further proposals for instruction and other related aspects are discussed in the research.

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List of Abbreviations and Acronyms

AACR2	Anglo-American Cataloguing Rules II
BI	Bibliographic Instruction
BRS	Bibliographic Retrieval Services
CAI	Computer- Aided Instruction
CAS	Chemical Abstracts Service
CD-ROM	Compact Disc-Read Only Memory
CLR	Council on Library Resources
CSIAS	Cognitive Style Inventory for African Students
DF	Degrees of Freedom
DOS	Disk Operating System
DDC	Dewey Decimal Classification Scheme
ERIC	Educational Resources Information Centre
esAL	Eastern Seaboard Association of Libraries
FRELICO	Free State Library and Information Science Co-operative
FTP	File Transfer Protocol
GEFT	Group Embedded Figures Test
GRE	Graduate Record Examination
GUI	Graphical User Interface
HTML	Hypertext Markup Language
HTTP	Hyper Text Transfer Protocol
IEE	The Institute of Electrical Engineers
LC MARC	Library of Congress Machine Readable Cataloguing
LC	Library of Congress Classification Scheme
LCSH	Library of Congress Subject headings
LIASA	Library and Information Association of South Africa
LISA	Library and Information Science Abstracts
MARC	Machine Readable Cataloguing
MEDLINE	Medical Literature Analysis and Retrieval System Online

MESH	Medical Subject Headings
NAEP	National Assessment of Educational Progress
NLM	National Library of Medicine
OCLC	Online Computer Library Center
OPAC	Online Public Access Catalogue
PTA	Preferential Trade Area
RLIN	Research Libraries Information Network
SA MARC	South African Machine Readable Cataloguing
SABINET	South African Bibliographic Information Network
SAILIS	South African Institute for Librarianship and Information Science
SADC	Southern Africa Development Community
SDC	System Development Corporation
SEALS	South Eastern Academic Libraries System
SPSS	Statistical Package for the Social Sciences
TCP/IP	Transmission Control Protocol/Internet Protocol
UK MARC	United Kingdom Machine Readable Cataloguing
UNIMARC	Universal Machine Readable Cataloguing
URL	Uniform Resource Locator
UTLAS	The University of Toronto Library Automation Systems
UWC	University of the Western Cape
WLN	Washington Library Network
WWW	World-Wide Web

Chapter 1

Introduction

1.1 Background to the study

The provision of instructional programmes to students in the use of research and reference tools has been a traditional practice in academic libraries (Mellon 1988). These programmes, commonly referred to as bibliographic instruction (BI) or user education, have increasingly come under review recently as a result of the increased use of computer online technologies (Caren 1989; King and Baker 1987; Shill 1987; Borgman 1986a). This is because online technologies have brought peculiar problems not experienced in the use of printed bibliographic systems and services. Online technologies refer to bibliographic information tools such as Compact Disc-Read Only Memory (CD-ROM), external database services, and Online Public Access Catalogues (OPAC).

The growth in the use of online technologies in academic libraries has been a world-wide phenomenon (Armstrong 1991; De Klerk and Euster 1989). Evidence of this growth has been found namely in industrialized countries such as the United States, and in countries in Europe, and to a lesser extent, in some countries in Africa, including South Africa (Laribee and Lorber 1994; Abifarin 1993; Lancaster and Warner 1993;

Ovens 1994; Chisenga 1995; Enyia 1991; Moodley 1988 ; Musiker 1985). For the most part, this growth has been influenced by the capacity of online technologies to improve the management and retrieval of information. At the same time however, they have also made the searching and retrieval of information more complex (King and Baker 1987). Some of the reasons for this include:

i) The evolutionary nature of online systems, in respect of hardware, software, and processes.

ii) The complexities involved in the retrieval of information, such as the knowledge required of databases; semantic application of search terminology; technical applications with respect to connecting to systems, namely the use of keyboards and terminals (Caren 1989; Borgman 1986b).

iii) The lack of standardization between multiple systems sharing the same content (Katz 1992 v.1; Harter 1986).

Converging with the growth in online technologies, has also been the advance in technology and telecommunications which has introduced concepts such as remote access and end-user searching (Lancaster and Warner 1993; van Brakel 1989). As a result of these developments, the retrieval of information from online systems has shifted from the hands of the information specialist, to also include end-user searching. End-user searching refers to the retrieval of information from online systems by persons other than intermediaries or trained information specialists as was the norm in the early days of online searching (van Brakel 1989). End-users include both novice and inexperienced searchers, as well as those with advanced and intermediate online searching experience. Therefore the systems are, or should be, designed in such a way that they serve both specialist and nonspecialists.

Research undertaken in North America has reported that novice or inexperienced searchers have great difficulty in retrieving information from online resources (Connaway, Budd and Kochtanek 1994; Thorne and Whitlatch 1994; Popa, Metzger and Singleton 1988). The difficulties experienced by students as end-users are depicted as problems of techno-phobia, which is a fear of computers, to difficulties in selecting databases, selecting appropriate terminology for searching, keyword searching, subject searching, and using features such as Boolean logic and truncation. Most end-users are reported to be lacking the contextual understanding necessary for online problem solving (Huston1989a). The undergraduate student in particular, has been described as being overwhelmed by the flexibility of the online system and the volume of information that can be generated when searching (Baker, Huston and Pastine 1991).

This growth of both online systems and number of end-users has created new challenges for librarians involved with BI. In response it has been advocated that traditional BI programmes must be revisited to effectively accommodate the idiosyncrasies of the online environment (Caren 1989; Shill 1987), and also to address problems experienced by the end-user (Hunter 1991). The importance of providing effective teaching underscored by the acknowledgement that without the ability to negotiate online systems, library users will increasingly be at a disadvantage in access to information (Huston 1989a).

To this end the teaching methodologies of procedural and concept-based teaching have been weighed as the two possible approaches in the provision of online instruction (Cherry, Yuan and Clinton 1994; Borgman 1984a). Procedural teaching is described as the step-by-step instruction focussing on the mechanics of operating the system at hand, and on system-dependent skills. In contrast, concept-based teaching has been described as presenting a conceptual model of a system which includes how the system and others of its type work, and system-independent skills (Cherry *et al.* 1994). For the most part, literature emanating mainly from studies conducted in North America have pointed to the method of concept-based teaching as the most effective method of the two (Cherry *et al.* 1994; Dimitroff 1990; Borgman 1984a). The academic profile of the participants in these studies have ranged from undergraduate students up to doctoral level (Dimitroff 1990). Borgman's study (1984a) was based on students recruited from Stanford University, an institution which is classed as an Ivy League institution in America, that has earned a reputation for its enrolment of students in high academic standing. The participants also had some level of experience in the use of computers. For example, the criteria to determine computer experience in Borgman's research was the number of courses a student had in computing concepts and Pascal programming. In research by Cherry and Clinton (1991:9), at least "...35.8% of the participants owned computers, 56.6% played video games, 62.3% used word processors, and others used

CD-ROM databases, database management systems, and electronic spreadsheets." The general finding of this research was that those who received concept-based instruction were more successful on performance on search tasks than those who received no instruction.

Cherry *et al.* (1994:361) have described the benefits of concept-based teaching in three categories. Namely:

i) Improved user performance where users will perform better on advanced or non-routine tasks; will have less trouble extricating themselves from errors; will be more able to make inferences and predictions; will be more able to structure searches and interpret search results.

ii) Learning transfer where users will be able to apply their knowledge to new situations; more able to move from one vendor's system to another; and more able to use other related systems.

iii) Judgement, where users will understand the limitations of the system.

Based on theories of mental models stemming from cognitive psychology, King and Baker (1987) and Borgman (1984c) have argued that training for online systems could be achieved through the development of sound mental models. The argument presented is that if librarians do not provide conceptual models, users will develop their own mental understanding of the technology which may prove erroneous, and incomplete, leading to misconceptions, poor interaction and ineffective searching. On the other hand based on a literature review Wesley (1991) concluded that students, comprising the largest segment of academic library users have a preference for a brief, basic summary of the technical details. This is unlike patrons who use the system frequently, who must use the system in their jobs, and who have advanced information needs, strongly preferring a conceptual orientation. Based on findings from OPAC studies related to naive computer users it was concluded that users want to find procedural directions for a specific task at the time of need rather than learn a broader, conceptual approach (Wesley 1991).

The arguments in favour of concept-based teaching see the value of this teaching method as its ability to convey a framework of the concepts which underlie the effective retrieval of information. This suggests that in order to be able to search online systems effectively, certain pre-requisite skills pertaining to information literacy are necessary. Hence, when one has an understanding of procedures alone it does not necessarily lead to effective searching. In the provision of such instruction, it is apparent that access to resources such as computer terminals is also important for the teaching to be effective.

In support of arguments favouring either procedural or concept-based teaching a review of the available literature, mostly international, revealed only three related studies on the topic. In a further review of the South African literature, no evidence to support either teaching method could be found. The possibility of generalising the findings from the studies conducted in North America was not certain. The reasons are, firstly, the contrasting profiles of subjects recruited in the overseas studies and students attending higher education institutions in South Africa. Compared to the high level of academic and computer experience reported of subjects participating in the North American studies conducted by Cherry *et al.* (1994), Dimitroff (1990), and Borgman (1984a), reports in the South African literature for example, Zondi (1992), Suttie (1990) and Bell (1990), provided accounts of the under-preparedness of students to cope with tertiary education. Cuthbertson (1992) described South African students becoming overwhelmed in the face of library technology. Others like Dalton (1989) and van Zijl (1986) highlight issues of literacy, social and economic developments in Third World countries which have served to slow down academic and technological developments. Research conducted in the Western Cape in South Africa by Sayed (1998) did an audit of students' information literacy abilities and needs finding that at least a third of all students express reading and writing difficulties. He concluded that across the region training was required for basic information needs. September (1992) writes that the developing communities in Africa are at various levels of development and at different levels in the transition from traditional communities to developed communities, as measured by Western standards.

Secondly, it was not certain whether the conclusions about the advantages of concept-based learning could be generalized based on the instruction instrument used in the research methodology. Some of the peculiarities include the use of the analogy of the card catalogue in the instruction (Borgman1984a) and the use of computerised instruction (Cherry *et al.*1994). Taking note of the progression in developing countries towards increased use of online technologies, as reported elsewhere, the use of the card catalogue in academic libraries in South Africa (Sayed 1998) as in other developing countries, is gradually becoming replaced with, or in some cases has been replaced with the online catalogue. Therefore the use of the card catalogue as a point of reference and comparison in the study of a teaching method like concept-based instruction would present a barrier to students who have never encountered this service, yet who have few pre-requisite skills as those in studies reviewed. Huston (1989b) concurs that at the rate at which the online industry has developed, librarians expect to encounter users whose only library experience is the online database. Further, as online systems become more sophisticated, the differences between online and manual catalogues will outweigh the similarities. Therefore, the choice of analogy used in concept-based instruction is critical.

1.2 Statement of the problem

Searching and retrieving information on online bibliographic databases is a complex task, requiring the use of skills that are not often common to the undergraduate student. With the growth of both the online technologies used in libraries and the use of these systems by students as end-users, academic librarians are concerned about the ability of students to conduct their own online searches effectively. To this end, emphasis has been placed on the provision of instruction in the use of online technologies found in libraries. The type of instruction provided, however, should take into account the individual differences of the recipients of the instruction, the evolutionary nature of online systems and, the lack of standardization amongst the numerous online systems.

In determining the appropriate teaching methodology to adopt in online instruction, the librarian is faced with decisions as whether to concentrate on teaching the procedures for operating specific systems, or teaching concepts which can be generally applied to more than one system (Elsbernd, Campbell and Wesley 1990). A review of the literature identified studies which support the view that there are more benefits to concept-based teaching than procedural teaching (Cherry *et al.* 1994; Elsbernd *et al.* 1990; Borgman 1984a). The use of this method of teaching appearing to have preconditions needed in order for it to work effectively. In the literature search conducted no evidence could be found to support these findings in the South African context. It was perceived that earlier findings could not be generalized to the South African context in view of the contrasting profile of the sample populations in these studies compared to the South African student and in view of the methodologies adopted.

This study's premise or point of departure was that the individual differences of the recipients of instruction are important. This reasoning was based on findings of Bellardo (1990), Borgman (1989), Fenichel (1979), and others, who reported that individual differences have significant bearing on online search performance and therefore the teaching method used for each group must be different. In these studies, variables such as gender, age, academic major, prior experience in the use of libraries, frequency of computer use, and creativity, were investigated to determine effects on online search performance. Borgman (1984a) noted that some people may be more inclined to approach a problem conceptually and others are inclined to approach a search problem procedurally. Of particular interest to the study conducted were the variables of library, computer, and English language experience. The study of these variables is influenced, in the first instance, by reports in the South African literature. For example, Sayed (1998), Cuthberthson (1992) and Bell (1990) whose findings indicated that many students enrolled in higher education in South Africa experience problems in their use of library resources. Reasons cited were partly as a result of low levels of library experience, lack of familiarity with information technology, and that the use of English is a second language for many. A logical conclusion from this profile would be that this would also typify the student searching the electronic resources found in libraries and who receive online instruction in the library. In the second instance, these variables were studied as a result of discussions held at two workshops on Library User Education held at the E. G. Malherbe Library, University of Natal, Durban on the 6th and 28th February, 1996. These workshops were attended by academic and public librarians in Kwa-Zulu Natal who expressed concern about the large number of students experiencing problems in using resources in the library. The reasons cited repeatedly were the students' unfamiliarity with libraries and computer resources, and the fact that English was a second-language medium for many. These variables appeared to have some bearing on the process of the online search. For example, Convey (1989) and Harter (1986) and have outlined that online searching requires:

i) The ability to select the relevant database to search, understanding of databases subject coverage and indexing practices, types of publications included, interpreting the catalogue or index records and understanding access points, suggesting the need for library skills

ii) The user must understand the syntax and semantics of entering search terms; the interrelationship between concepts, suggesting the need for quite advanced English language skills

iii) The user must be able to interact with the system using hardware such as a keyboard, computer terminal, CD-ROM drive, and sometimes modems, suggesting the need for basic computer skills. Hence, the factors of library experience, computer experience, and English language experience were considered significant to the study

Specifically therefore, South African tertiary institution students have varied backgrounds including the use of English as a second language, lack of computer literacy, and poor information literacy skills. However, they are faced with online technologies for their information searching. They need to be taught how to search effectively and how to retrieve information. Bibliographic instructors have to choose the best teaching method to suit the varying composition of South African students. The two possible methods are the concept-based and procedural methods of instruction.

1.3 Purpose of the study

The purpose of this study was to determine which of two methods of instruction, either concept-based or procedural instruction should be preferred in the provision of online instruction. Concept-based teaching is described as the presentation of a conceptual model of a system; how the system and others of its type work, and drawing on system-independent skills. In contrast procedural teaching is described as the step-by-step instructions, focussing on the mechanics of operating the system at hand, and drawing on system-dependent skills or the procedures for operating specific systems (Cherry *et al.* 1994). One of the objectives of the study therefore was to compare the differences in online performance between two groups trained to use the OPAC at the M L Sultan Technikon using these two methods of instruction. A second objective of the research was to compare these two teaching methods in relation to undergraduate students at the first year level at the M L Sultan Technikon with differing levels or degrees of library experience, computer experience and English language experience.

1.4 Research objectives

The objectives of the study were as follows:

1. To determine whether or not any differences exist in online search performance between students trained in a concept-based, and those trained by procedural teaching methods.
2. To determine whether or not any differences exist in online search performance between students with differing library experiences trained in a concept-based and those trained by procedural teaching methods.

3. To determine whether or not any differences exist in online search performance between students with differing computer experiences and trained in a concept-based and those trained by procedural teaching methods.
4. To determine whether or not any differences exist in online search performance between students who regard English as a first or a second language trained in a concept-based and those trained by procedural teaching methods.

1.5 Research questions

The research objectives gave rise to the following research questions:

1. Are there significant differences in search performance on simple online tasks, between students who are conceptually trained and those who are procedurally trained?
2. Are there significant differences in search performance on difficult online tasks, between students who are conceptually trained and those who are procedurally trained?

3. Are there significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to students with low levels of library experience and those with higher levels of library experience?
4. Are there significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in relation to students with low levels of library experience and those with higher levels of library experience.
5. Are there significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to students who are familiar with and those who are unfamiliar with the use of computers?
6. Are there significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in relation to students who are familiar with and those who are unfamiliar with the use of computers?
7. Are there significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to students who regard English as a first language and those who regard English as a second language?

8. Are there significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in relation to students who regard English as a first language and those who regard English as a second language?

1.6 Rationale for the study

The rationale for conducting the study was driven by the need to implement an effective online instruction programme at the M L Sultan Technikon and other similar institutions, in the use of the variety of online resources available. M L Sultan Technikon is a tertiary institution in South Africa with a student enrolment in 1999 of approximately 8 000 students of diverse academic, cultural, and social backgrounds. The institution offers academic programmes in the arts, commerce, science and engineering, mainly towards the fulfilment of national diplomas. Since 1995 programmes for the Bachelors, Masters, and Doctor of Technology have been introduced. The M L Sultan Technikon is also a member of the library consortium, Eastern Seaboard Association Libraries (esAL), comprised of member institutions from the Kwa-Zulu Natal region who share a similar institutional profile, with the exception of universities offering degrees instead of diplomas. The members of esAL include, Technikons, Natal and Mangosuthu, and the Universities of Zululand, Natal, (both Pietermaritzburg and Durban), and Durban-Westville all of whom are working towards greater resource sharing and co-operation in the region. One of the specific objectives of this consortium is the development of a national standard for the provision of library education (esAL 1998).

the provision of library services to the Technikon community the library has followed e trend as reported elsewhere, of increased use of online technologies and services ch as automated library systems (for example URICA, INNOPAC) which mount the rary's holdings onto an OPAC facility, bibliographic CD-ROM products, online itabase services such as SABINET Online, First Search, and electronic full-texts. IN)99 the M L Sultan Technikon introduced plans to upgrade the character-based OPAC cility to a web-based service. By the year 2000 it is expected that students at the L Sultan Technikon will be able to access the library CD-ROM network, the OPAC, itabases hosted by SABINET Online, and the Internet, from workstations within the)rary, or from remote stations outside the library. It is also envisaged in long term ans that student residences will be equipped with the network capability to access iese online resources from remote workstations. The type of searching made possible y this access is what is referred to as end-user searching (van Brakel1989).

his researcher's concern is that unless the students as end-users are provided with ppropriate online instruction, only a few would be able to effectively use the echnologies available. Online instruction is becoming more important with respect to ie problems described of end-users in other parts of the world, as well as the lack of tandardization between online resources.

key assumption about South African students as end-users, as well as those from imilar environments, was that the difficulties reported about end-users in other studies would hold true. However, the extent of the difficulties in online searching reported in other studies might not necessarily be the same as for students in a South African context and remains to be investigated. The difficulties reported relate to problems in selecting databases, in selecting appropriate terminology for searching, difficulties in the use of computers and so forth.

The assumption made was based not only on personal experience with undergraduate students, but on research conducted in South Africa centred around the progress of black students in higher education. The educational under-preparedness of mainly black students as a result of apartheid rule which prevailed until 1994 has been the focus of research. Students were depicted as having difficulties coping with academic programmes and having low levels of library experience and difficulties with the use of English as a first language (Cuthbertson 1992; Bell 1990). Cuthbertson (1992) reported that many black university students, on entering campus libraries were confronted by the mysteries of computerised information retrieval; many experienced feelings of inadequacy and alienation and that the advent of information technology in South Africa had serious implications for the educationally under-prepared. Sayed's research (1998) indicated that in general black students are less familiar and competent in the use of computers than their white counterparts. These findings were considered significant to the study undertaken, in that the majority of the South African population is black which has bearing on the student using the academic library. In the provision of BI to undergraduate students at the M L Sultan Technikon for the past six years, it has been observed however, that students universally at the Technikon reflect a low comprehension of library resources and services. This is partially supported by monthly reviews of the OPAC transaction log of the URICA system at the M L Sultan Technikon, which reflects the errors made in online searches conducted. Some of the errors detected the use of the *Author* access points for *Subject* and *Title* retrieval, the incorrect use of subject headings, and the typing of assignment topics at the access prompt, to name a few.

One of the obstacles to the provision of online instruction at the M L Sultan Technikon and possibly at similar institutions has been the lack of standardization in the development of online bibliographic resources. For example, the index, *Educational Resources Information Centre* (*ERIC*) is supplied by two different vendors, Dialog and Silverplatter in a CD-ROM format. Although both vendors are supplying the same title there are differences in layout and retrieval techniques between each vendor's product, which requires specific training in the use of the different search protocol. Another example of the lack of standardization has been experienced in relation to the OPAC. The OPAC essentially reflects the holdings of a library on an online database. These holdings reflect the catalogued and classified works of the library. Prior to the implementation of OPACs these holdings were usually recorded on cards stored in card catalogues. In this period, BI programmes provided training on the classification system in use, and thereafter the student was able to search the card catalogue of any other library using the same classification system. This practice does not hold true for the OPAC. In South Africa, as in other countries as well (Lipow 1991: 86), there are several different OPAC systems in existence. Some of the systems used in South Africa include URICA, Public Access Library System (PALS), INNOPAC (Innovation Interface Incorporated), ERUDITE, and ALEPH to name a few. Although each of these systems adheres to universal principles governing cataloguing and classification, each one differs with respect to LOGON procedures, screen layout, command structures, and help screens. Therefore, in the provision of online instruction the librarian needs to take account of the search protocol required for the particular system in use. From the point of view of the librarian this does not augur well for the future of BI. It limits the opportunity for co-operation and articulation which is a growing concern in South African academic institutions as evident in the efforts of library consortia such as the Cape Library Consortium (CALICO), esAL and others who are standardizing on library OPAC software to enable seamless searching (esAL 1998). It also serves to add to the complexity of online retrieval.

It has been reported in the literature however, that end-users are generally excited about the possibilities of remote access to the online catalogues and databases of libraries worldwide (Cherry and Marshall 1992; Gratch 1988). As a result of the heights reached in networking capability the end-user has access to a wide range of online resources. In South Africa the sophistication of networking has reached the point of enabling access to, in-house, campus, national, and international databases and sources (Ovens 1994a). This has put a premium on the development of online instruction programmes that will enable searching of online resources available locally and in other locations worldwide. Cherry *et al.* (1994) have argued that giving users skills that can be transferred to other systems seems even more important today since gateways such as the Internet have increased access to systems.

In the provision of online instruction to undergraduate students the M L Sultan Library staff have only practised the procedural or step-by-step method of instruction. The reason is that until 1998, the OPAC was the main online technology for which instruction was provided. Other technologies are taught on a needs basis as requested by lecturing staff. The tendency to provide instruction using the procedural teaching method however, is not unique to M L Sultan Technikon. Research conducted by Nawakowski (1988) on user education for OPACs in 23 libraries in Canada also reported that overall there are a variety of different systems in Canada. Each system with its own software, file structures, command languages and other idiosyncrasies. The end result is that librarians tend to concentrate on teaching the user how to use *their* system rather than giving them skills which could translate to other systems. As more and more online technologies such as CD-ROM products, and online databases are added to the M L Sultan Technikon library the situation will arise when the amount of time allotted to conduct online instruction will not be sufficient to provide procedural instruction in all of the online resources owned. This is the case despite reports from instruction librarians at the M L Sultan Technikon that procedural instruction provides them with a practical way to teach the peculiarities of the particular system taking into account the low levels of understanding of search concepts reflected by the majority of students receiving online instruction. With respect to developments taking place in computer networking, the rate of growth of the online industry, and the trend towards end-user searching, the need has emerged to test the effectiveness of the methods of both procedural and concept-based teaching.

The value of the study undertaken was considered to be of importance to academic or instruction librarians in making decisions about the teaching emphasis in the provision of online instruction. In the long term, such a study was deemed important to the development of a general model of teaching in the provision of online instruction. Although not directly listed as an objective, the findings were also regarded as significant in providing feedback to the designers of the OPAC system URICA. Finally the study served to expand on previous research conducted on concept-based and procedural teaching methodologies. In doing so, the study has revised previous methodologies used and tested for different variables. It has also initiated research on this topic in the South African context for which no previous research could be found.

1.7 Limitations of the study

The research would have benefited from the inclusion of multiple online resources and more than one academic institution. However, the factors of time, manageability and technical constraints did not enable such a broad focus.

1. The study recruited subjects from the first year student population of only one institution, the M L Sultan Technikon. In order to control internal validity, the study sought to prevent students gaining experience in the use of the online system relevant to the study. This required delaying students from attending library orientation or accessing the OPAC system in the library prior to the experiment. Therefore the timing of the study required that the experiment be scheduled in the first few weeks of the commencement of the first term. This made it difficult to extend the study to other institutions. Other institutions that could have been included in the study were, the Universities of Natal, Durban, and Durban-Westville, Technikons Mangosuthu and Natal. However, being the beginning of the first term, staff and students at other institutions were not accessible. The access to suitable venues to conduct the experiment was not possible at these institutions.
2. The study was limited to the provision of instruction in one type of online technology, the OPAC of the URICA library system. The use of additional online technologies was not possible as this would have extended the

duration of the experiment beyond two hours. In the pilot study it was found that participants were not able to afford more than two hours to participate in the experiment that they also began to lose concentration after a two-hour period. Furthermore, the technical capability to access other databases at the time of the experiment did not enable remote access to the other online resources available.

3. The limited access to only one fifteen-station computer laboratory, did not allow for the sampling of a population of more than six % of the target population.

1.8 Definitions of key concepts

The following section provides the definitions of key concepts which appear in this research.

1.8.1 Online search performance

In the research undertaken online search performance referred to the ability of an individual to invoke an online search and retrieve information relevant to a particular query from a database of records stored in machine-readable form. The ability to search online can be measured in several ways, namely recall and precision, unit cost, utility measures and the number of search items used (Ovens 1994a). In the study undertaken the search output was controlled so that the task performed generated a precise outcome. Therefore, it was defined as the ability of the searcher to achieve a correct, or incorrect response on tasks performed in a search. In this way online search performance was measured by the number of correct and incorrect responses in tasks performed in a pre-test and a post-test.

1.8.2 Simple online tasks

Simple online tasks were operationalised as tasks which required no manipulation of search terms or making deductions from search output when the information to proceed with the task was readily available. Examples of these tasks included, searching for a given *Author*, using the *Select* option from instructions displayed on the search screen, *Browsing* from a given access point.

1.8.3 Difficult online tasks

Difficult online tasks were operationalised as tasks which required manipulation of terms; deriving solutions from search output when search generated no results; refining and broadening search results. Examples of these tasks included, *Subject* searching, the use of *Proximity* and *Truncation* devices and reconstructing search terms when no results were generated (use of *Synonyms*).

1.8.4 Experience in using a library

The term "library use" can refer to several different meanings. For example "use" can refer to the loaning of material from the circulation service point, use of the photocopy machines, or even a person intending to meet a friend in the library can be referred to as "use." In this research library use was operationalised as the frequency of using the facilities of the library to find information, no matter the type of library. In more specific terms library use was defined as either use or non-use of either a card catalogue or OPAC. Library experience was defined as low if frequency was either once a month or never or if no use was made of either a card catalogue or an OPAC. Library experience was defined as high if frequency of use was at least once a week or once a day or if use was made of either a card catalogue or OPAC.

1.8.5 Experience in using computers

Experience in using computers was based on the use or non-use of computers. In this sense familiarity with computers was operationalised as those who made use of computers whether for activities such as, playing computer games, word processing, programming, job-related activities, course-related activities, searching library databases, or for any other type of computer-related activity. Unfamiliarity with the use of computers was defined as the converse, that is, those who had never made use of a computer to accomplish an activity.

.8.6 English language preference

:nglish as a medium of communication was operationalised as a first language or a econd language if reported to be so by the research participant.

1.8.7 Record

'he information that describes the document in the database is known as the unit record Borgman, Moghdam and Corbett 1984). The term "record" is defined in the *Microsoft :omputer dictionary* (1999:376) as "... a data structure that is a collection of fields elements), each with its own name and type. A record can be accessed as a collective ınit of elements, or the elements can be accessed individually." A record may be a few nes to several pages long, depending on the type of information presented. A ›ibliographic record is usually only a few lines long, while a full-text record may be quite ɔng. Numeric records may be of any size (Mader and Park 1986).

1.8.8 Database

\ database is defined as "...a file composed of records, each containing fields together vith a set of operations for searching, sorting, re-combining, and other functions" Microsoft Press 1999:123). Behrens (1996) adds that a database is an information ;ource in a form which may be read by a computer. A database may be numeric, textual ›r both. Reference databases (including bibliographic databases), indicate where to get he complete information, and source databases contain the complete information.

Bibliographic databases are usually the computerised equivalent of indexing and abstracting services (Borgman *et al.* 1984b). Source databases may be numeric or full-text (Mader and Park 1986). A full-text database contains the complete text of sources.

1.8.9 End-user

The term end-user, appears frequently in the literature however no concise definition could be traced. In some instances the term is used to describe any person accessing and searching an online system to satisfy a personal information need. This definition includes both students and librarians as end-users (Myers 1990; Ojala 1990). van Brakel (1991) defines the end-user as a person who is interested in information searching, possesses the necessary search skills, and has his/her own equipment to search remote online databases without the assistance of an intermediary. For purposes of this research the end-user is a person who might or might not possess the necessary online search skills, who has a search need, and who conducts an online search to retrieve information to satisfy this without the assistance of a librarian or a search intermediary.

1.8.10 Search intermediary

Harter (1986) draws a distinction between the end-user and the search intermediary. According to his definition an end-user is the person who initiates a search but does not necessarily conduct the online search. The intermediary is one who might not necessarily initiate a search but conducts the search on the behalf of another. Intermediaries are typically librarians who conduct a search on the behalf of the end-user.

1.9 Structure of the thesis

Chapter 2 of the report is a review of the literature which puts the study in context and expounds on other related research.

Chapter 3 outlines the research design, incorporating a discussion on how the data was collected, the measuring instruments and indication of the data analysis.

Chapter 4 is a presentation of the research findings.

Chapter 5 provides an interpretation and discussion of the research findings.

Chapter 6 concludes the report with a summary of the findings, conclusions, and makes recommendations for the provision of online instruction, revisions to the system design and also makes recommendations for further research.

1.10 Summary

The provision of BI programmes in libraries has been expanded to include online instruction as a result of the growing use of online technologies and a growing end-user population. While online technologies such as CD-ROM, external databases and OPACs have many advantages in the provision of information, the downside has been the complexity involved in searching for information stored online, the lack of standardization, and the evolutionary nature of this format of information. At the same time advances in technology have made possible the remote access to online resources. This has resulted in online searching moving away from the control of the librarian or intermediary to include both experienced and novice or inexperienced end-users. In order to assist the end-user to access the variety of online resources available, each with its own search protocol, the librarian must make decisions as whether to concentrate on teaching the procedures required in the use of each system or to concentrate on teaching general search concepts. The teaching of general concepts is supported in research conducted overseas however, the validity of these findings in the South African context was subject to investigation.

Chapter 2

Review of the related literature

2.1 Introduction

The literature found on online instruction was extensive but lacked sufficient empirical information to provide clarity about whether any differences exist between the methods of concept-based and procedural instruction. The dearth of research data in the instruction literature was also reported by Edwards (1994) who conducted an analysis of the journal literature of BI between 1977 and 1991. This analysis recorded that "...out of 595 articles, 178 were research-based and the remaining 417 related to other types of literature classed as non-research literature such as discussion papers, literature reviews, programme descriptions, status reports and bibliographies "(Edwards 1994:72). In addition, it was found that the years 1984 and 1989 produced the most number of instruction articles. In the review conducted by this author, most of the citations relevant to the stage of development in library automation and online instruction in South Africa were found to be dated in this period, even though in the year of this research, 1999, the publication years might appear quite outdated. The number of articles on library instruction, according to Rader (1995; 1997) and Edwards (1994) is steadily decreasing. Rader, who provides an annual review of library instruction literature in *Reference services review,* reports that publications relating to user instruction in academic libraries decreased in 1994 by 32% compared to 1993 (1995:83), and by 46% in 1996 (1997:103).

The ensuing discussion of the key literature is divided into three sections. In the first section a description of the online library environment is provided to put the research into context. Section two outlines the factors which have led to the need for online instruction. This discussion includes, amongst other issues, an analysis of research on end-user search behaviour and the role of human factors and individual differences in online search performance. The third section reviews changes in BI as a result of the introduction of online technologies, techniques of evaluating instruction, followed by an in depth analysis of both research and non-research literature related to the methods of concept-based and procedural teaching. This analysis also takes into account the methodologies and variables investigated by other researchers and explains the extent to which the findings influenced the current research.

2.2 Online environment

To put the research into context, a short discussion and description of the online environment, and an overview of the types of technologies that are available, the structure of data within these technologies, and the trends and the benefits associated with the use of online technologies is necessary.

The use of online information retrieval systems to carry out library functions became pronounced in the 1960s, as reported by McClure (1994) and Armstrong (1991), and has continued to escalate as the 21st century approaches. Borgman, Moghdam, and Corbett (1984) summarized this development as slow prior to 1970 due to the expense involved in the use of online technologies and as a result of the information available for searching being limited. Since then the situation has changed. Owing to improvements in telecommunications and the increased availability of computerised data, online information retrieval systems have become commonplace and can be found in most academic and special libraries and to some extent in public libraries. These systems have come to serve as an alternative or in some cases have replaced the manual methods of information retrieval and have led to many changes in the retrieval and dissemination of information.

In an online environment the term online information retrieval system refers to the set of computer hardware and software that communicates with computer systems (possibly remote) to retrieve information stored on databases. The hardware is made up of the computer keyboard and screen which more often than not is a microcomputer workstation (Hartley *et al.* 1990). The software refers to search software which is a set of programmes and procedures that provide instructions to the computer system. In order to communicate with remote databases computer workstations can be made to operate as a terminal through the use of terminal emulation software such as Telnet for linking to remote systems. The Telnet application is run on the local system and masks the terminal specific features allowing a user to log-in to the remote system and use it as though there is a direct link (Harries 1993). This process of directly interrogating computer systems to resolve information queries is called online searching. It is a dynamic and interactive process which involves a two-way communication between the user and the computer. This kind of process is sometimes referred to as a dialogue between the computer and the searcher in that results received from the computer are provided almost immediately allowing the searcher to analyse and refine the results and continue the interaction until the desired information is found or the searcher ends the search session (Hartley *et al.* 1990).

2.2.1 Types of online technologies

The types of online information retrieval systems that are commonly referred to in the literature can be grouped according to Hartley *et al* (1990:1) as "... search systems in which the databases are stored locally, such as OPACs, external search services, CD-ROM search systems" and the World Wide Web (WWW). The differences among these and the related issues are elaborated upon in subsequent sections.

2.2.1.1 Online public access catalogue (OPAC)

The OPAC was one of the first major components in the new online library (Oberman 1991). The function of the OPAC is to provide the means to find out what materials are owned by a particular library, where they are located and whether they may be borrowed. It is common practice in the 1990s to be able to connect to the OPACs of other libraries via Telnet or any other similar protocol to search for information. Since the online catalogue reflects the holdings of an individual library collection the coverage is not subject specific, but spans the variety of disciplines prevalent in that library's collection (Hartley *et al.*1990). In the provision of OPAC systems, the end-user of a library OPAC system is not usually charged for the use of this facility. The library itself incurs costs in the purchase and maintenance of such systems, or in the case of participation in a bibliographic utility, the library usually incurs subscription costs.

Some of the early providers of OPACs were bibliographic utilities such as OCLC, Research Libraries Information Network (RLIN) and Washington Library Network (WLN) in the United States, the University of Toronto Library Automation Systems (UTLAS), in Canada, the South African Bibliographic Information Network (SABINET, now known as SABINET Online) in South Africa, amongst others. According to Breeding (1994) bibliographic utilities refer to agencies that provide the means for co-operative cataloguing wherein each participating library contributes records that it creates to the database, or uses the records created by other libraries. However, as computer technology developed and the costs of hardware dropped, more libraries could afford the automation of their internal operations which led to the development of integrated library systems. Breeding (1994) describes integrated systems as a number of software modules developed to automate the broad divisions of a library's operations such as cataloguing, acquisition of materials, circulation, and online catalogues which also incorporates a link between these various functions. In this type of system the OPAC does not function as an information retrieval system alone but as a module in an integrated library management system. Since the catalogue is linked to the circulation module, it is possible on the OPAC not only to determine whether a book is in the collection of a library but whether or not it is available for loan purposes. Hence, Potter (1990) describes the OPAC as a revolutionary tool allowing for the inclusion of services that were not possible in earlier forms of library catalogues. Some of these services include, the display of the most current information regarding the status of a particular item such as material "on order," individual issues of serial titles that have been received, items that are missing from the collection and so forth. Online catalogues also provide more sophisticated search capabilities compared to printed catalogues, adv increasing the possible number of access points as well as supplying information at a greater speed. These aspects of searching, will be discussed in greater detail in a subsequent section on databases structures.

There are currently, a variety of OPAC systems in use world-wide, each differing in the precise details of the search process (Hartley *et al.* 1990). Lipow (1991) identified at least 30 different types of OPACs in the United States at the time of his article, and Nowakowski (1988) made reference to at least 23 in Canada in a survey conducted at the end of the 1980s. In South Africa in 1999 there is evidence of at least five major OPAC systems in use in tertiary institutions and some public libraries, namely URICA, Public Access Library System (PALS), ALEPH, INNOPAC (Innovation Interface Incorporation), and ERUDITE, with other smaller systems in use in other types of libraries. There is also a growing trend in South African academic libraries to make use of web-based OPACs, which, at the time of this report were found in use in universities such as the Rand Afrikaans University, and the University of Pretoria. Other institutions such as the Technikons of the M L Sultan, Natal and Mangosuthu, and the Universities of Durban-Westville, Zululand and Natal, Durban and Pietermaritzburg who are members of the esAL Consortium were in the stage of finalizing training and installation plans for web-OPAC facilities. The installation of web-OPACs in South Africa has been part of a concerted initiative of the five library consortia, namely, esAL, The Gauteng and Environs Library Consortium (GAELIC), The Cape Library Co-operative (CALICO), South Eastern Academic Libraries System (SEALS) and The Free State Library and Information Consortium (FRELICO) to develop networked services of electronic information to enhance the ability of library and information services to deliver information more cheaply and efficiently, and to foster regional collaboration (Coalition of South African Library Consortia : 1999). In the creation of a web-based OPAC the intent of the consortia is to create an environment for "seamless searching" and ultimately the "virtual library." In a subsequent section on database structures detailed information is provided on developments such as hypertext links and graphic user interfaces which are relevant to web design.

2.2.1.2 External databases

External databases generally refer to online information systems made up of bibliographic databases produced by various types of organizations called database producers and made available for searching by various other organizations called database vendors. Hence the term external database is sometimes referred to as publicly accessible online retrieval services, or commercial online bibliographic databases. Subscribers to external databases do not own the database as they would a CD-ROM title, instead they only have access to the service to which they subscribe.

Chamis (1991) describes database producers as the compilers or publishers of the database, of which there are over two thousand, comprising professional associations, government agencies, private corporations, universities and non-profit groups. According to Behrens (1996) any organization that converts its sources into a database form and makes it available for purchase or lease is a database producer. Some examples of database producers listed by Convey (1989:14) include the "...National Library of Medicine (NLM), Chemical Abstracts Service (CAS), and the Institute of

Electrical Engineers (IEE)." In some cases however a database producer can serve two roles in that they can also be a database vendor, such as the case of NLM.

Database vendors are described by Harter (1986) as organizations that contract with database producers to provide access to their databases in an online mode. To do this he explains, they convert the machine-readable data from formats used by database producers into formats suited to their own search service. Hence, database vendors are also known as online search services. Behrens (1996) notes that the vendor does not actually sell the databases, but rather sells online access to external users of the database. Most vendors are commercial organizations that charge users for the services provided, unlike in the case of the use of OPACs. This cost could be for the length of time spent online and the number of items retrieved, for offline and online displays, for fields searched and so forth (Hartley *et al.* 1990). Due to the cost of searching, in the early period of online development searching was usually restricted to a search intermediary. However, as database vendors race to capture a wider market, they have revised their costing and other aspects of the database to meet this goal.

Some examples of online search services include Dialog, System Development Corporation (SDC), and Bibliographic Retrieval Services (BRS) who were some of the earliest providers of external databases (Harter 1986). South African vendors listed by Behrens (1996) include, Naspers, Brabys, McGregors Online Service, and InfoAccess.

External databases are classed into two divisions, namely reference databases and source databases (Hartley *et al.*1990; Harter 1986).

Reference databases can either be bibliographic databases or referral databases. Bibliographic databases contain citations and abstracts of the printed literature. Referral databases contain references to information such as directories of organizations, or addresses (Harter 1986). Many bibliographic databases are the computer-readable counterpart of printed indexing and abstracting services such as *Educational Resources Information Centre (ERIC), Psychological abstracts* and *Science citation index* (Katz 1992 v.1). In some instances, bibliographic databases have been developed that are available in machine readable form only, for example, *ABI/INFORM* (Whitaker *et al.* 1990). Examples of bibliographic and referral databases include, *Medical literature analysis and retrieval system online (MEDLINE), Library and information science abstracts (LISA), ERIC, Encyclopaedia of associations, Electronic yellow pages* to name a few.

Source databases contain the full or complete information found in the original sources. This could be numeric information (original survey data), textual-numeric information (company annual reports), or full-text (a complete newspaper).

A characteristic of most conventional external databases is that unlike OPAC systems, their coverage is limited in subject scope either to a single subject such as chemistry or to a range of disciplines linked to a particular mission, for example, AIDS. Specific search characteristics of databases will be discussed in a subsequent section on database structures.

The growth of online databases has been recorded as phenomenally high. Lancaster and Warner (1993) attribute this growth to innovation in telecommunications such as the development of Telnet and Tymnet protocols that lowered communication costs. Additionally the development in search software and the ability to store large amounts of data that could be quickly accessed was also seen as spurring this growth. Hartley *et al.* (1990:35) note that "...in a ten year period from 1979 to 1988 the number of online databases increased from 400 to 3 893." Equally phenomenal has been the growth of records contained in the databases. Williams (1990:139) reported that "... from 1976 to 1985 the cumulative number of records grew from approximately 50 million to 1.68 billion."

2.2.1.3 Compact Disc-Read Only Memory (CD-ROM)

CD-ROM is an optical recording medium used to store and distribute digital data. CD-ROM was first announced in 1983 and became commercially available in 1985 (Foulds and Foulds 1991). Akeroyd (1989) reports that the library represents one of the largest markets for CD-ROM technology both in technical services and reference services. According to these authors' CD-ROM has generally been received in libraries as a solution to avoid the costs incurred in searching online databases and as a user friendly or easier search option for inexperienced searchers. They noted further, that in developing countries CD-ROM is seen as an alternative to online search services as it can be used without linking to a telecommunications network. In this case the searching of CD-ROM discs can be done by using special compact disc players linked to a personal computer, or using compact-disc drives found on personal computers, which requires no access to an online search service and no communication link.

The capacity of CD-ROM is recorded the equivalent of about 250 000 pages of text (Katz 1992v.1). Most CD-ROMs are indexes such as *Current contents, Info trac, PsycLit*, and *Medline,* however, textual and statistical data are also published in this form, for example the *Oxford English dictionary* (Graham 1990). CD-ROM formats have been found appropriate for storing information that does not require to be updated regularly such as dictionaries and encyclopaedias. Borgman (1990) and Akeroyd (1989) report that many national and international bibliographic databases are now either available or being made available on CD-ROM. This means that end-users can have the option of searching a title either on CD-ROM or via a remote online search service (if a library subscribes to both sources). The search capability of CD-ROM is said to emulate online databases and makes use of many of the same search features (Borgman 1990) which are described in more detail in a subsequent section on database structures.

Although CD-ROM technology was initially developed and marketed as a single user device there are a number of systems which permit the networking of CD-ROM drives and software, almost all of which utilise a local area network . Trends in the 1990s have seen the networking of CD-ROM products by vendors such as Silver Platter, the simultaneous use of titles by multiple users as a result of networking, and the emergence of hardware such as the jukebox and multi-drive CD towers (Nicholls and Ensor 1994).

The literature generally reports a high number of CD-ROM bibliographic titles. *CD-ROMs in print, 1995,* reflecting over 8 000 titles, *CD-ROM finder, 1995,* reflecting a total of 800 titles in the fourth edition and 2 310 in the sixth edition. According to Richards (1995:76) between 1989 and 1994 the number of CD-ROM retrieval software packages (which is a separate concept from a CD-ROM title) grew from "...69 to 542, a 686 % increase in six years."

2.2.1.4 Internet and World-Wide Web (WWW)

The Internet is becoming increasingly popular as an information and an educational resource amongst librarians and the general academic community as is evident by the creation of Internet laboratories on campuses, electronic classrooms, and its use as a reference tool. In South Africa the home pages of many higher education institutions in 1999 reflect the interest in and the use made of the Internet and WWW.

According to the *Microsoft computer dictionary* (1999:242) the Internet is the "...worldwide collection of networks and gateways using the Transmission Control Protocol/Internet Protocol (TCP/IP) suite of protocols to communicate with one another." The Internet has been described as a network's network, linking international, national, and regional networks sponsored by universities, colleges, corporations, public institutions, and individuals (Bane and Milheim 1995). A service commonly found in use in libraries today, is WWW which was developed to enable the searching and viewing of data in all formats on the Internet (English and Margulies 1995). Developed at the European Centre for Nuclear Research (CERN) in Geneva, Switzerland, WWW is a hypertext-based model allowing cross -references between related resources, allowing multimedia information to be readily displayed. Based on the concept of the "web" information is structured so that files and documents retrieved are capable of pointing the searcher further to other useful or related resources (Falk 1994).

According to Dowlin (1999:22) "...an estimated 100 million people world-wide regularly use the Internet and the amount of data processed over the Internet doubles every one hundred days. With respect to WWW in November 1998 it was estimated that there were a half-billion web pages, and that one-and-a-half million new pages were being added every day."

The Internet provides a range of services such as File Transfer Protocol (FTP), e-mail, WWW, Usenet news, Gopher, Telnet and others (Microsoft Press 1999). Through the use of the Internet users can access a variety of information products such as traditional bibliographic databases, online library catalogues, full texts of journals and books, and images (Lancaster and Warner 1993). Some of the ways in which the Internet can be used in libraries and institutions of higher education are described by Dewey (1999) as the provision of community-based files that are linked to the web sites of co-operating agencies, many web sites maintained by organisations and government agencies can be used as an invaluable source of reference material, pay-access sites such as The Electric Library and many online databases can be accessed online, homework information and homework help can be found, fee-based access to selected newspapers and magazines can be set up, shared cataloguing can take place between libraries, and the "virtual university" which would facilitate distance learning. The author predicts that in the future economic models adopted on the Internet will foster more use of shareware or freeware making software freely accessible through this medium. He predicts a decline in library reference queries as a result of free and current information available on the Internet. Dewey (1999) further speculates that the Reference Librarian of the future will incorporate an array of new browser, navigation, portal, and search tools into their realm of expertise.

For purposes of this research however, even though the knowledge and skills of online searching, for example the conceptualizing of a search and the use of Boolean logic, are critical even in a web environment, the emphasis has been placed on the use of technologies such as OPACs, online databases, and CD-ROM and to a lesser extent on services on the Internet. The reason is that the range of services provided on the Internet, the use made in South African higher education institutions, and issues related to the idiosyncrasies of searching the different search engines requires this to be a separate area of focus, and much more research needs to be accomplished to understand how this information resource will be factored into the existing services and structures of libraries, particularly in South Africa.

The incorporation of the Internet into libraries requires many administrative issues to be addressed. Some of the issues according to Hogan (1999) relate to securing sufficient funding to acquire the technology, development of the physical site and infrastructure to support the technology, and a range of decisions related to the provision of services such as, "...Would the Internet be available to both staff and students? Would the access to the Internet be direct, or mediated by the librarian? Who will evaluate services on the Internet? How will this service be integrated with other formats of library material? What type of training will be needed to make use of the Internet?" (Hogan 1999:24). These questions as well as issues of band-with and access to technology are very relevant in the South African context and in this researcher's experience would still need to be addressed by many libraries before the use of the Internet becomes widespread in South African libraries. Other issues that need to considered have been raised by Armstrong and Hartley (1997) who argue that at best searching the Internet is a "hit-and-miss" approach to information retrieval compared to the more structured approach of searching other types of information resources such as OPACs, CD-ROMs, and online databases. Searching the latter makes used of a controlled type of search which includes pre-search strategies, the searching of specific databases and in some cases controlled vocabulary which offers a more certain response to most queries. Diaz (1997:1) writes that "...surfing may be fun, but it's no way to do reference." She points out the time taken to "surf the net," the keyword search that can generate over 200 000 hits, the lack of quality control on the Internet which requires new methods to be applied to gain a sense of reliability of the data .

The issues highlighted serve to indicate that there are many areas still to be resolved with respect to its use in most libraries. However, the Internet is on its way to becoming one of the most important sources of information for librarians and the public (Dewey 1999) and there is little doubt that it is going to have a marked impact on library services and on society as a whole as can already been seen by the popularity of this technology.

2.2.2. Database structure

With respect to the online technologies described in the preceding section the following discussion reviews the way information is organized and structured in the electronic format which sheds light on the online search process and puts into context the complexities involved in online searching which will be discussed in a subsequent section. This discussion highlights differences in the structure of the printed format and the electronic format to explain the need for new search skills to be learnt in the use of online technologies. A detailed description is provided of the inverted file index and organization of information in this type of database structure which is commonly found in character-based OPACs, online databases and CD-ROM databases. This discussion also describes the various search features that have been developed for the use of these online technologies such as Boolean operators, proximity and truncation devices. The section concludes with an explanation of newer search structures such as hypertext, graphic user interface, and "windowing " which are employed in the use of the Internet, WWW, web-based OPACS and other types of databases.

The difference in the way information is organized and structured in printed resources such as library card catalogues and indexing and abstracting services compared to the online bibliographic resources, requires new methods of information retrieval to be learnt. Persons accustomed to retrieving information from the traditional printed bibliographic resources will need to adjust to a different conceptual process for retrieval due to the increased number of search access points, and searching options and the depth of indexing found in online resources. They will also need to become accustomed to using computer hardware to conduct an information search.

Printed library catalogues represent the holdings of a specific library and typically provide search access points by author, title and by subject, filed into a single linear sequence in a dictionary catalogue. While a search by author or title most often helps one to find a known item, a search by subject aims to discover what the library owns on a particular topic. The practice of assigning subject terms to a bibliographic item is a process of subject indexing which involves a content or conceptual analysis of a bibliographic document and the translation of this analysis into a particular vocabulary or index language. According to Lancaster and Warner (1993:9) in many instances the printed format makes use of controlled vocabulary which is "...a limited set of terms used to represent the subject matter of documents which might be a list of subject headings, a thesaurus, or a list of approved keywords or phrases." Hartley *et al.* (1990) note that a common practice in the organization of printed catalogues is to represent topics with subject headings derived from controlled vocabulary resources, such as *The Library of Congress Subject Headings (LCSH),* amongst others. These authors further point out that in some cases the subject is represented by the classification number frequently assigned from the *Dewey Decimal Classification System (DDC).* This type of catalogue is organized into two sequences, the alphabetical sequence which contains the entries by author and title and the classified sequence which present the entries in class number order. In most libraries, the organization of information found in a card catalogue record is arranged according to standards defined in the second edition of the *Anglo American Cataloguing Rules (AACRII)* which results in a uniform display of bibliographic details across different libraries.

Printed indexing and abstracting services help to locate the contents of periodicals, books and various types of documents. In the case of printed indexes arrangement can be by single author, subject, classified and sometimes title arrangement. Abstracting services can vary in their arrangement, although they are normally arranged under broad subject headings, with an appropriate author and some subject indexing.

The arrangement of information in the dictionary form found in printed resources has the advantage of not having to learn a scheme of organization. However, in carrying out an information search one would have to search each printed index and abstracting service title individually which can be time consuming.

In the case of online technologies however, the retrieval of information takes on different patterns requiring knowledge of the structure and organization of the database for efficient retrieval. The remainder of this discussion will review the structure of records in databases and explain the way in which documents are represented and retrieved in the various technologies described earlier. In this discussion reference is made to terms such as "records" and "databases" which have already been described in Chapter 1.

Databases are made up of a group of records which in document retrieval systems are often referred to as bibliographic records. Pao (1989) describes a bibliographic record as generally consisting of two parts, namely, the bibliographic description uniquely identifying the item, for example author/s, title, collation details, and the topical representation, consisting of index terms describing the subject content of the item.

In order to facilitate searching, Lancaster and Warner (1993:23) explain that the organization of online databases includes "...a linear file containing each full record in the system, and one or more inverted indexes created from the linear files. The inverted index contains attributes from a record in the linear file (for example, author) along with a unique element such as an accession number that is used to retrieve the records in which that value can be found." In this type of file organization the index table rather than the entire record is searched which provides rapid access in retrieval. This type of file organization is depicted in Figure 2.1.

Figure 2.1 File organization : linear and inverted files

Linear file

Chan, Lois Mai Pollard, Richard C. Thesauri used in online databases Greenwood Press:us 1988 United States Language: English Subject heading: Thesauri/Bibliography Subject heading: Information systems/Directory BLB8809087 Monograph   Instruction materials used in teaching cataloguing and classification Chan, Lois Mai Cataloguing and Classification Quarterly 7:131-44 Summ '87 Language: English Subject heading: Cataloguing/Teaching Subject heading: Surveys/Library science literature Subject heading: Textbooks BLIB87009368 Article

Figure 2.1 continued on next page

Figure 2.1 File organization : linear and inverted files continued

Inverted index: Author

Chan, Lois Mai	88009087
	87009368
Pollard, Richard C.	88009087

Inverted index : Subject

Bibliography	88009087
Cataloguing/Teaching	87009368
Directory	88009087
Information systems	88009087
Information systems/directory	88009087
Library science literature	87009368
Surveys	87009368
Surveys/Library science literature	87009368
Teaching	88009087
Textbooks	87009368
Thesauri	88009087
Thesauri/Bibliography	88009087

(Source: Lancaster and Warner 1993:24)

Each record in the database is comprised of a number of fields and sub-fields which indicate the attributes of the bibliographic item. For example, an author field contains given names and surnames, while other fields indicate titles, imprint details, physical description, abstract of the document and so forth. Sub-fields refer to the data or values of the attributes of a particular entry. For example the field for imprint (publisher) is likely to have sub-fields related to place of publication, and date of publication. Each new record is identified with a unique internal identifier and each field has its own unique tag which is a set of characters or digits attached to a field for identification purposes (Oppenheim 1988).

Fields are indexed in many ways, either by indexing the whole field, or indexing selected parts of the field which allows for searching to take place on individual words in a title, or abstract, or by language (Harter 1986). This type of indexing enables the use of uncontrolled vocabulary or free text searching which places no restrictions on the terms used and which draws on words the author has used in the title, abstract, and so forth. Databases can be structured to make use of either controlled vocabulary or free text searching or both. Lancaster and Warner (1993) and Hartley *et* al. (1990) point out that the depth of subject indexing differs between most OPAC systems and online databases. In their view, the content of documents in OPAC systems in both America and Britain is summarized by a minimum number of subject statements represented in the controlled index language of the particular library system. Hartley *et al* (1990:327) cite that in OPAC systems "... 1.3 subject terms" is often the average number of terms used to represent a document or monograph, whereas online databases frequently include a searchable title, an abstract and several subject descriptors to represent the content of a document.

Since not all fields are used by searchers, for example the place of publication, only the searchable aspect of a field is indexed, such as the publisher name and date of publication. The non-searchable field, which is place of publication, is only accessed when the record is printed or displayed. The decision however, about what will be indexed or made searchable in a field is made by the database producer and not the searcher. Therefore, in order to search a given database, knowledge of the fields in a record and the types of data contained in each field is recommended for the formulation of effective search statements. In addition, Lancaster and Warner (1993) state that the end-user must be able to translate the search request into the vocabulary of the particular online system. They refer to this process as a search strategy in which search terms having a logical relationship are entered into the system and then matched against the database to produce the resulting outcome.

One of the significant differences between the structure and content of OPACs compared to online databases and CD-ROM systems is noted by Chamis (1991) and Hartley *et al.* (1990) as the level of standardisation of records. These authors state that while the content and structure of records vary considerably between the different online databases, with few exceptions, libraries that produce online catalogues use the same standards. As a result of each database producer and vendor developing their own search software there is seldom compatibility or standardisation in searching methods. Hence the search options and commands for each system must be individually learnt.

With respect to OPAC systems the standards used are namely, the second edition of *AACRII* for deciding the content of document representations, subject and classification schemes such as *LCSH*, and *Medical Subject Headings (MESH*), *Library of Congress* (*LC)* and the *DDC* schemes, and the Machine Readable Catalogue (MARC) standard for structuring, maintaining and manipulating these records in machine readable form. The adherence to standards makes it possible for libraries to exchange records without extensive reformatting.

Tedd (1984) noted that despite its recognition as a universal standard, the MARC format which was developed jointly by the United States and Britain has been subjected to variation to suit the precise requirements of individual countries. Hence, there is in existence the United Kingdom or UK MARC , the Library of Congress or LC MARC, and the South African or SA MARC to name a few. As a result, he explains, another standard, the Universal MARC (UNIMARC) has been developed to facilitate the international exchange of bibliographic data in machine readable form. The UNIMARC enables different variants on MARC to be converted into any other variant.

However, from about 1997 South African libraries have been debating the possibility of a new MARC format and at the time of this report consensus was reached to adopt the USMARC format in South Africa (Snyman and Broodryk 1997). The reason for the change in MARC format was that after the political transformation in South Africa in 1994 there was a re-establishment of relations with the international community which presented opportunities to access a wider information base and for the exchange of bibliographic records (Snyman and Broodryk 1997). Developments in this direction can be seen in the opportunities taken by SABINET Online to establish links with OCLC facilitating access to services such as Firstsearch, Prism and other services of OCLC.

The MARC record generally describes a computer record structure or format using a series of tags and indicators to identify parts of the record (Boss 1990). For example in a bibliographic record represented in the URICA library system the 200 tag represents the main title field, the 210 tag represents the imprint information as illustrated in Figure 2.2. Each field represented under that tag is further subdivided into sub-fields to distinguish more specific elements of information, such as main title and sub-title as illustrated in Figure 2.3. Boss states (1990) that this type of tagging structure is essential to the computer manipulation of machine-readable data. It also requires the searcher to understand the various elements of the record structure in the process of information retrieval.

Figure 2.2 Summary of SAMARC record tags

TAG	Description		
001	Record Identifier	002	Additional Record Number
010	ISBN	011	ISSN
020	National Bibliography No.	020	Various Numbers
100	General Processing Data	101	Language of the Work
200	Main Title field	204	General Material Designation (GMD)
205	Edition statement	207	Numbering (Serials)
210	Publication, etc	215	Physical description
225	Series statement	300	General Note
304	Frequency (Serials)	360	Abstract
362	Notes on Indexes	364	Bibliography note
365	Contents	380	Holdings statement
382	"With" note	393	"IN" note
463	Parent BRN	464	Analytic BRN
400	Linking entries	500	Variant titles
606	Subject Headings	675	UDC
676	Dewey Class	680	LC Class
684	Broad system of ordering (for New Acquisitions Bulletin)		
700	Personal Author	710	Corporate Author

(Source : URICA online catalogue at the M L Sultan Technikon : 1999)

Figure 2.3. SAMARC record depicting fields and sub-fields of a record retrieved from the URICA Library System

Tags	Fields and sub-fields
MLS INFORMATION RETRIEVAL OPAC	
Titles close to TECHNOLOGY IN THE 90S [works 1]	
BRN	33524 19911202 amended 24 NOV 93
000	oam [monograph]
010	0-88736-487-X $b H/C $d R113.91 $s 14
200 10	Technology for the 90's $e microcomputers in libraries $f edited by Nancy Melin Nelson $3 TEY90S $n 1
210*	London $c Meckler $d 1990 $3 LONMECR $n 13
215	107p. $c ill
300.1	Library
364.2	Includes index $3 II
364.3	Includes bibliographic references $3 IBR
410*	Supplements to computers in libraries $v 15 $3 SSCLIBS $n 7
606!	MICROCOMPUTERS - LIBRARY APPLICATIONS $3 MSLAPPS $n 16
606*	LIBRARY SCIENCE - TECHNOLOGICAL INNOVATIONS $3 LYSTINS $n 25
606*	LIBRARIES - AUTOMATION $3 LISAUTN $n 101
702*1	Nelson, Nancy Melin $4 jt. ed. $3 NELSONNM $n 2
990	33524 $b 9102548 $c 01
996	025.30285 $b TEC $n 4

(Source : URICA online catalogue at the M L Sultan Technikon :1999)

2.2.2.1 Search features

As a result of the inverted index file organization, apart from the typical author, title and subject searching that can be performed, a number of search capabilities are offered in online systems. Some of these features include keyword searching, the use of Boolean operators, and proximity and truncation features, amongst others, depending on the decisions made by database producers. The following description outlines some of these search features:

2.2.2.1.1. Keyword searching

Keyword searching allows patrons to search for words or phrases in the record. However, the way this type of searching will be conducted in the various online systems will differ according to how the fields have been indexed (Breeding 1994).

2.2.2.1.2 Boolean operations

Many online search systems permit the use of Boolean logic to combine retrieval terms in order to expand or narrow a search. The term Boolean was coined from the name of the mathematician, George Boole who employed mathematical symbolism to express logical processes (Hartley *et al.* 1990). The concept of Boolean operators is dealt with by many authors such as Pao (1998), Lancaster and Warner (1993), and others. In summary these accounts explain the function of the Boolean operators AND, OR and NOT. The use of the AND operator tends to narrow the scope of the search as it produces only those records that represent the combined occurrence of terms listed. For example flowers AND plants. The use of the OR operator expands the search by retrieving the total collection of documents indexed with either of the terms listed which is also referred to as the union of records. For example, flowers OR plants. The use of the OR operator is often used to link semantically related terms, including synonyms, and singular and plural forms of terms. The use of the NOT operator is used to focus on retrieval of a specific term and refers to the difference between terms. For example, roses OR tulips NOT flowers. The use of NOT however can sometimes cause the erroneous exclusion of documents that are of value to the search.

The order of the Boolean operation to be carried out first is a characteristic of individual online systems with which the searcher has to become familiar. In some cases a parenthesis is used to show the order of operations to be performed and in other cases the system is designed to make assumptions about what is intended in the search.

2.2.2.1.3 Proximity searches

In a proximity search two search terms are required to be adjacent or present in a particular field or fields or separated by a specified number of words. This feature can be used to narrow a search. Word proximity commands differ between online systems, which requires the searcher to be aware of all the possibilities. In cases where specific fields are not indicated in the proximity search, the system will search a default field. The default field also differs across systems and again requires the searcher to be familiar with the default field used by a particular search system.

2.2.2.1.4. Truncation

Truncation permits a term to be searched on a stem of a longer word or phrase. For example the use of "Libr" to search for "librarian, library, libraries," and so forth. However truncating too soon, for example "Lib" will generate many unnecessary results, for example "liberal, libel, Libya," and so forth.

2.2.2.1.5 Stop words

Most online search systems have defined several "stop words" which are considered to have no value for indexing or retrieval. Examples of these words can be, "a, an, the, from, of," to name a few. The searcher must be aware of stop words used with each system as well as how searches for phrases which include stop words must be conducted.

Over and above these search capabilities, a variety of additional features can be included in an online system to facilitate searching. Boss (1990) lists some of these features as menu-driven templates for inexperienced searchers, command-mode systems to enable experienced searchers to bypass the guided inquiry approach, user-invoked help screens, multiple display options, and the provision of print capabilities which are outlined in the following discussion.

As indicated by the name, menu-driven templates provide the searcher with a list of functions from which a choice is made, circumventing the need to learn an intricate command language. Command language refers to a set of operators which the searcher uses to instruct the computer to perform certain functions. Convey (1989:49) points out that the details of command languages vary from one system to the next, but the basic search functions will remain the same. He lists some of these functions as follows:

- General functions which allow the searcher to exercise control over the progress of the search, for example to erase a character wrongly typed, to interrupt the terminal's output and so forth.
- Entering and leaving the system or logging-on and logging-off.
- Selecting a particular database from the range of databases available, changing databases, searching a number of databases simultaneously or sequentially.
- Formulating the search. For example entering search terms to create records, combining search terms, obtaining displays of terms and so forth.

- Displaying the search result, namely, choosing the format, in which the records can be displayed, choosing which records to display and whether they are to be printed.

Saule (1991a) writes that most online search systems include on-screen help, either in the form of prompts found on the screen display or as separately invoked help screens that appear when the searcher selects a help command or when a problem arises in the construct of the search. He adds however, that in some cases the poor design of on-screen help do not encourage the use of this facility.

Another method used to provide online help is the formal online system documentation provided by database vendors. This can be in both printed formats or in an online version and contains information on the thesauri of the database and also serves as a user manual. A shortcoming of online documentation is that it is not entirely interactive and does not always reflect the specific context of the searcher's problem (Saule 1991a).

In any given search the online system will provide a display of the records that matched the search request. The form that this display takes differs between systems. Breeding (1994:31) mentions that "...some systems display the summary list in alphabetical order by title, some present the list in reverse chronological order," and in cases when there is no match, some systems indicate there is no match while others display a list of records that are the closest match to the search query. He notes further that in many OPAC systems the record can be displayed in a brief view which displays basic bibliographic information such as author and title. This enables more than one record to be displayed on the screen to facilitate browsing when there are many records to view. Records can also be viewed in a long format which contains all the bibliographic details of the record and usually displays one record at a time on the screen. Lastly, records can be viewed in a full MARC format if required. Saule (1991a) argues that specifying display options often requires an understanding of the structure of the bibliographic record, of the full MARC record in some instances, as well as an understanding of what the terms field and record mean. The reason is that the searcher must know how to name elements in the bibliographic record, and must understand what is meant by *LCSH* and *MESH* terms, corporate author, and so forth.

Finally, most systems allow for records to be printed, however there are several possibilities as to how this feature is offered which is described by Breeding (1994). For example, printing the information as it is displayed on the screen, which also includes irrelevant information such as the help instructions, spacing and header information that is not required. Some systems print a whole range of records with a single command, while others print records one by one. As an alternative to printing, information can also be copied to a storage device such as a stiffy disk. The use of this feature requires that the searcher have an understanding of the conventions for saving information to secondary sources.

In the discussion so far, the structure of databases has related mainly to the inverted file structure also known as index-based retrieval systems. Although this type of file retrieval software is the best known and the longest established according to Oppenheim (1988) the development of hypertext offers a new search format based on the concept of associative trails. The WWW is one of the major search services that makes use of this search format.

Harries (1993) outlines that the WWW contains many types of documents, including searchable indexes and hypertext documents which contain embedded pointers to the contents of other items. The WWW supports non-linear navigation through a universe of documents which can be extended to include different kinds of information media.

A general description of the concept of hypertext provided by Neely (1997) explains that hypertext documents incorporate hypertext links within a unit of information (which may be text, numbers or graphics) that enables the searcher to jump to different passages in a text or to other documents and then return to where they left off. He describes these links as displayed in a different colour, italicised or underlined allowing them to be readily identified. In this type of search, when a link is selected the searcher is led to the related information. The secondary document found in turn might contain highlighted words which lead to further documents. This process can be repeated indefinitely possibly traversing hundreds of linked documents while doing so. Therefore, as a hypertext search service the WWW represents a dynamic tool in which the world's information residing on the Internet can be accessed. This type of search is analogous to the type of hypermedia product available in CD-ROM for personal computers, such as the encyclopaedia *Encarta* made available by the Microsoft Corporation. Tanenbaum (1996) notes that when hypertext pages are mixed with other media the result is termed hypermedia.

In an account by Harris (1996) the WWW is said to use a page metaphor to describe its visual interface. Several pages may be linked together to form a single homepage or site. These sites can be accessed by a web browser which is software that connects to other web servers whose function is to receive connections from web browsers and pass on information requested. Some of the web browsers available include Netscape, Mosaic, and Microsoft Explorer.

The functioning of the web depends on three interacting concepts which work as standardised protocols, namely HyperText Transfer protocol (HTTP), Hypertext Markup Language (HTML), and Uniform Resource Locator (URL).

HTTP is used by a web server to communicate with network protocols used in the Internet (Transmission control Protocol/Internet Protocol or TCP/IP) to enable the connection between browsers and web servers so that information is received and replies are sent back (Harries 1993).

HTML refers to the language which describes how documents are to be formatted (Tanenbaum 1996). According to English and Margulies (1995:45) "... an HTML file is embedded with defined text codes or tags that are interpreted by the browser as commands to present information in predefined formats."

A URL is equated to the address of the web page. Tanenbaum (1996) explains that it is typically made up of three parts, namely, the transfer protocol such as hyper text transfer protocol (HTTP) or File Transfer Protocol (FTP), the name of the machine where the page is located (for example, www.anc.org) and the name of the file containing the page (for example, voter registration/voter campaigns.html). This provides the browser with the information needed to connect to a specified computer and call up a document.

If one did not have a specific URL address, information can be retrieved through the use of search engines found on the Internet, for example, Yahoo, Lycos, Alta Vista amongst others. The role of a search engine is to index what is available on the multitude of web sites around the world. Neely (1997) explains that new web sites are indexed and added to web search engines by the creator of the web site submitting a brief summary of the information available on that site, and the categories under which the information should be listed. Alternatively, search engines are programmed to scan the Internet for new sites which they in turn automatically download, and scan for keywords thus indexing the site.

In order to retrieve information using a search engine, Neely further describes two search options available. One is to search for a specific key word or words in a space provided and executing the search. The second option is to browse the contents of the database making reference to a general category of headings provided by the search engine. The use of search engines also supports features such as Boolean operators, truncation, proximity, and field delimitation (Alberico and Micco 1990).

Based on numerous reports which comment on the popularity and potential of web-resources it appears that other types of Internet resources such as Gopher, and

Veronica are becoming displaced. Gopher is described as a tool which provides access to a broad range of information services world wide using a standard menu interface. Veronica is described as a Gopher-based resource that searches many different Gopher menus using key words (Neely 1997). Gopinath and Reddy (1996:61) provide reason to believe that interest in the WWW will continue to increase because of the advantage of hypertext to "...improve accessibility to information by eliminating the need to follow rigourous search sequences," at the same time..."allowing the user to reference masses of related material."

Over and above the concept of hypertext, the introduction of windowing techniques over recent years has also changed the way information is handled and displayed. Windows is an application software, developed by Microsoft Corporation, which makes use of a graphical user interface (GUI) in which users work with on-screen icons and pull-down menus rather than with keyed-in commands. A main feature in this concept, described by Capron (1996) is that the computer screen can be divided into multiple windows that can be moved around on the screen and can be made larger or smaller. In this way windows allow for the computer screen to be used like a work table where several programs can remain open simultaneously. The user can open, close, rearrange and overlap the windows, or reduce the window into an icon when not in use, rather than completely close the file (Sharma 1995). Therefore, the Windows program provides a multi-tasking computer environment.

There are generally two types of windows, tiled and overlapping. Saule (1991b) explains, that tiled windows are always visible because they do not overlap. However, the number of tiled windows that can be displayed on a screen is limited. Overlapped windows on the other hand may be placed on top of one another, obscuring the contents of underlying windows. They are useful for switching between multiple tasks in one operation. However, it requires the searcher to know how to remove windows and how to get back to the search or original task.

According to Breeding (1994) the conventions in which the graphic symbols in a windowing system can be manipulated is consistent so that the same techniques can be used from one program to another. Therefore, it has become possible for Windows to be applied to web browsers, CD-ROM technology and many personal computer applications. Saunders (1996) reports that many integrated system vendors have incorporated Windows to make information systems easier to navigate and that many online catalogues are now appearing with Windows interfaces.

2.2.3 Trends in online development

The following sections discuss some of the trends taking place in relation to the use of online technologies.

2.2.3.1 Growth of technologies used in academic libraries

The proliferation of online information retrieval services pervades the literature. Trends provide every indication that the online industry is growing continuously. For example, while Lancaster and Warner (1993:27) reported that in "...1991 there were 23 million records," represented on the OCLC cataloguing database, statistics provided in a May issue of the *OCLC newsletter* in 1999 indicate that there are now over 41 million records . However, while this rate of development is true for most of the developed world, the rate of growth has been slower in developing countries. Reasons cited are the lack of an adequate telecommunications infrastructure and technical support, amongst others (Chisenga 1995; Abifarin 1993;Lopes 1992). Despite this, strides have been taken towards the development of an online environment even in the developing world. Abifarin (1993:13) reports that although the era of information technology has not fully arrived in Nigerian university libraries, some of the libraries have a few components of information technology, here and there.

In an account on developing countries Mambo (1993) notes that many libraries are becoming automated. In a survey conducted in Botswana, Adeniran (1997) found that six out of nine academic libraries are computerised. Services included those ranging from local databases, CD-ROM, OPAC to the Internet. Chisenga (1996) reports that library computerization in Sub-Saharan Africa is gaining ground. A large number of library software systems are readily available on the market for purchase and implementation in libraries. Reports of a survey conducted among the Southern Africa Development Community (SADC) and Preferential Trade Area (PTA) made up of Angola, Botswana, Lesotho, Malawi, Mozambique, South Africa, Namibia, Swaziland, Tanzania, Zimbabwe, Zambia, Burundi, Comoros, Djibouti, Eriteria, Ethiopia, Kenya, Madagascar, Mauritius, Rwanda, Seychelles, Somalia, Sudan, Uganda, and Zaire, found that a wide variety of library systems have been installed in these regions. Although 83% of the respondents had only partially computerised their libraries, information storage and retrieval facilities were reported in all cases (Chisenga 1996:53). The exception has been South Africa where online growth, as reported by

Walker (1995), Moodley (1988), Vietzen (1988), Allardice (1987), and Herholdt (1987) to mention a few, has occurred at a greater pace than reported in other developing countries. Services range from the provision of OPACS, to online databases, CD-ROM technology to Internet and WWW usage. As early as 1984, Musiker noted that computerised library systems were found throughout the length and breadth of South Africa.

In most developing countries the use of CD-ROM technology is reported to be the dominant technology as it provides an alternative to systems which require a telecommunication infrastructure (Salanje 1995). At the same time there is evidence of the rise in the use of services such as the Internet. For example, Ojo-Igbinoba (1993:92) reports that "...by December 1993 twelve African countries had enlisted on the Internet, all of which had over 30 000 users."

2.2.3.2 Virtual library

Writing on the subject of networking and telecommunications Harries (1993:1,64) observed that :

> Over the last decade, the importance of computer networks and telecommunications has grown tremendously... Barriers of space and time which previously limited communication have been removed as a result of information networks... The existence of this technical infrastructure and the continuing development of innovative information applications and networking projects is a potential influence on the re-shaping of some organizations as information-based activities are conducted more through networks and less through actual physical presence.

The re-shaping of organizations mentioned by Harries is supported by Moran (1989) amongst others who forecasted that technology will play the greatest role in transforming the library of the future. The reality of this statement is clearly visible in the direction libraries have taken as a result of developments which have led to remote access to online technologies and other information systems. Gapen (1993:1) describes the concept of remote access as "...an electronic network which provides access to, and delivery from, external, worldwide, library and commercial information and knowledge resources."

The logical development of remote access has been the concept of the virtual library. A definition by Saunders (1996) regards the term virtual as a way of describing a logical connection between two computer networks so that it appears transparent to a user. By this definition the virtual library is a system by which a user may connect transparently to remote libraries and databases using the local library's online catalogue or a campus network as a gateway. This term is applied to a vision of the library of the 21^{st} t century in which computer and telecommunications technologies are converging to make possible access to a wide range of information resources (von Wahlde and Schiller 1993). Gapen (1993:2) lists the following developments which have taken place as a result of this convergence:

- National and international telephonic networks with the speed and bandwith essential to transmitting the largest and most complex files of full-text and digitized graphics and images
- Standards and protocol which facilitate computer-to-computer and database-to-database linkages

- Automatic digitizing devices such as scanners and telefacsimile machines which enable the transmission of the contents of a volume in real time.

This type of connectivity has spurred the development of the virtual library. Saunders (1996:4) reports that "...a total of 343 libraries across the United States, Canada, the United Kingdom and Australia had created Internet accessible library catalogues and databases in 1995." Other trends that are reported by Saunders is that library online catalogues are including gateways to Internet accessible catalogues to supplement local collections; many libraries are creating full-text digital libraries in response to library users who are no longer satisfied just to know that an item is owned by a particular library but want to view full text documents; electronic publishing is increasing, with many full-text journal databases appearing such as those supplied by subscription agents; the number of electronic journals in general are increasing, as a result many libraries are giving up local ownership as a means of coping with small materials budgets; reference librarians are creating subject oriented Internet resource guides to be used in a virtual environment.

The progression towards a virtual library has many implications. Some of the implications discussed by Kaniki (1999) include the resulting co-operation required amongst those participating in a virtual environment. He cites the emergence of the various library consortia in South Africa, that is, esAL, SEALS, FRELICO, GAELIC and CALICO which serve as a means of establishing formal agreements that facilitate the required co-operation. Additionally Kaniki mentions the need for physical resources such as a stable information technology infrastructure and connectivity, human resources with the knowledge and skills to manage and organize virtual resources, and financial resources for sustainability of the virtual environment.

A further implication is that access to the virtual library could mean that fewer people need come to the library. Dunn (1988) states that as a result of decentralized access, those in need of information have become less tied to a particular building. The resulting effect is that the searching of information need no longer be the sole charge of intermediaries who are considered experienced searchers, but can also include end-users who range from the sophisticated to the inexperienced searcher (van Brakel 1988). As a result libraries are moving away from the warehouse philosophy toward an access and client-centred approach (Dusoulier 1994; De Klerk and Euster 1989). De Kock (1998) argues that access to virtual information services is inevitable since the provision of such services will ultimately be dictated by the demands of the end-user community. Failing to provide virtual information services will result in the end-user bypassing the library resorting to their own means of accessing such information. The implication of this is the emphasis placed on the provision of information literacy training to equip end-users with the skills and knowledge required to navigate the virtual library from within, and from outside the library.

2.2.3.3 Growth in end-user searching

Scholars like Fisher and Bjorner (1994), Summit (1989) and Welborn and Kuehn (1988) have observed that in the last ten years there has been a surge in end-user searching. This is due to the spread of micro-computers in the office and in the home, and with the marketing of online systems aimed directly at the end-user. Miericke

(1991:328) noted that "... in 1986 librarians constituted 85% of the account holders of the vendor, Dialog, which hosts over 500 databases." In the same year 80% of new accounts went to end-users. Myers (1990) attributed this growth to the increasing computer literacy of the ordinary individual; the affordability of personal or micro-computers enabling individuals and not only organisations access to computers; the desire of database producers to increase their market; the increase of more user-friendly systems and programming languages aimed at the non-professional user.

2.2.4 Benefits of online technologies

Much of the growth and increased use of online technologies in libraries has been spurred on by the numerous benefits it offers. Wainwright (1993:31) lists some of these benefits as follows:

- Electronic text can be searched quickly
- Electronic text is available simultaneously to many users
- Electronic text can be manipulated very easily
- Electronic text can be easily created collaboratively
- Electronic publications can integrate text, sound and images (still and moving)
- Access to electronic text can be obtained from a user's normal place of work or study
- The speed of access to electronic text is independent of a person's distance from the text
- Improved information retrieval

Additional benefits described by Harter and Jackson (1988:165) include the:

- High storage capacity of electronic mediums
- Access to a variety of databases, serving both popular and scholarly research needs
- Increased number of access points
- The capability of searching all, or nearly all, fields of bibliographic information in record
- The capability of capturing search results in machine readable form

In a review of the kinds of technologies in use today, it is evident that library services have experienced and continue to experience considerable change. Alberico (1995:29) captures this change as follows:

> This is an era of recombinant information. Words, images, sounds, even moving pictures are being blended to spawn new kinds of electronic documents...now a session at a workstation yields an electronic document that can communicate with other electronic documents. Students can channel streams of knowledge and drivel alike, originating everywhere, to their own machines...Information content is accessible in all sorts of places - in libraries still - but also in dorms, classrooms, and apartments...information is becoming less tangible...the building will remain a focal point but as time passes and connectivity becomes ubiquitous, it will become less necessary for students to visit [the library] in order to do their work...Information retrieval, once the exclusive domain of the highly trained librarian, is rapidly moving into the mainstream of computing, as end-users obtain their own accounts on commercial retrieval systems, as we implement online catalogues, and as database development and searching moves into the domain of desktop workstations.

2.3 The need for online instruction

The changes brought on as a result of online technologies have amongst other developments, given rise to problems related to access which has ultimately impacted on the provision of library instruction. This section reviews the specific problems related to the use and the searching of online technologies and specific difficulties experienced by the end-user. These problems highlight the need for instruction and also reflect the areas in which instruction needs to be concentrated. This is in keeping with recommendations that call for a needs assessment prior to the implementation of an instruction programme (Fjallbrant and Malley 1984).

Ford (1995) has argued that while technology has improved the physical access to information it has not necessarily improved intellectual access. Barriers related to the searching of online technologies have been attributed to factors such as the lack of standardisation, lack of subject-access tools, volume of information, the complexity of searching online systems, and inadequacies reported of the inexperienced end-user interacting with these technologies.

In conjunction, issues related to human factors, such as attitudes towards technology, and the range of individual differences found in a diverse end-user population which effect search performance, have also reinforced the need for online instruction.

2.3.1 Lack of standardisation

Numerous problems are generated from the variety and variability that is found in the use of data bases, be it an OPAC, online database or CD-ROM. Online technologies are produced by a variety of public, private and commercial organizations with widely differing aims, goals and objectives resulting in a variety of standards and search protocol (Harter 1986). The lack of standardisation in search interfaces presents a problem to both librarians and end-users. Some of the problems are listed as follows:

1. **Search strategy across systems is rarely the same** . There are many types of thesauri and informal indexing conventions with very few efforts at forming an integrated system out of these disparate tools (Alberico and Micco 1990). The database may be indexed on every word of entry or only on specified indexing terms like subject headings (Hatfield 1992:152). Some have controlled or semi-controlled vocabularies and most include free language terms (Williams 1980:83-85). Command language is different in almost every database. There are almost as many command languages in existence as there are online search systems (Hartley *et al.* 1990:84; Hatfield 1992). Online systems differ from each other with respect to access protocols, command languages, system responses, and messages, system features and data element labels or tags. Databases vary with respect to content. There is a wide range of subject material in the more than 500 bibliographic and natural language databases. Databases vary with respect to format. Each database producer has their own format and very few of them conform to a standard. Databases vary with respect to chronological coverage. Some have a coverage of one year while others go back ten years. Databases vary with respect to the way they are loaded in different systems. For example, some systems may combine corporate information terms with subject terms, others will keep them

separate, one my combine geographic information with subjects information as a result one cannot search the same database in exactly the same way in two different systems and get the same results (Hatfield 1992).

2. **At a technical level** depending on the database, keyboard functions differ, for example, the function keys may or may not be used. Printers can be activated using several different commands across systems. Logging on and off systems differ from system to system (Hatfield 1992).

The lack of standardisation is especially prevalent on the WWW given the nature of the Internet and the way in which search engines are indexed. As noted in an earlier section, new sites added to the search engine are indexed by the individual creator of each site or automatically by the search engine, neither of which follows any precise method. Hence the search engine relies on the accuracy of the individual creator or the ability of the search engine to provide an accurate listing. Neely (1997) points out that in many cases the search engine confuses listings. He cites the example of a search engine automatically listing a site on holiday destinations which was entitled *Photogenic landscapes*, under a site related to cameras and photography. The lack of standardisation in terminology also means that greater specificity is required in the use of search terms, for example to search for yachts one cannot use the word boats. Further, since indexing is done by a variety of persons from all over the world the terminology used will vary according to the part of the world from which the indexer originates. This means that a variety of possibilities of terms must be used to retrieve information.

As a result of the lack of standards for submitting and removing sites the web is also known to reflect many blind references to resources supposedly available on the server. A novice user of the web, or a person who has limited computer experience, might easily assume that the occurrence of a blind reference was due to their inexperience without realizing that in fact the site does not exist.

2.3.2 Lack of subject access tools

Various systems, database manuals and other search aids must be studied before effective online searching can be executed. Since the data structure and indexing practices differ for each system, these tools are important to acquaint the end-user with the decisions made by the search service that is being utilized. However, even if online tools are provided it is always important that a searcher will have had the basic knowledge of skills of database protocol to save time and costs.

Alberico and Micco (1990) point out that subject-access tools are important to assist the user in identifying the terminology indexed in a database. Although free-text searching is used in many online databases, in the case of the OPAC, controlled vocabulary such as *LCSH* is still common. These authors found that few OPAC systems provide online subject-access tools to assist the end-user in identifying the correct terminology. Instead, they argue, if a user does not find a term in the OPAC in most cases it is assumed that there is nothing on the topic of interest.

2.3.3 Cognitive overload

Alberico and Micco (1990) make use of the term cognitive overload which they explain occurs in two different ways. Firstly, as a result of the overwhelming amount of information one can retrieve online users become overwhelmed by the sheer volume. Dealing with so much information at once can cause the user to experience, cognitive overload. Particularly when users have few means to narrow or refine a search because of a lack of specificity in terminology in the indexing process. Supporting this view, Oberman (1991) writes that the retrieval of an excessive volume of information can lead to intellectual distress. She reports that end-users prefer to receive limited search results or they tend to abandon the search if provided with more references than they are willing to scan. Citing the work of Rudd and Rudd (1986) Oberman suggests that to prevent cognitive overload users should be able to refine searches by date, language, and so forth, and that the user be provided instruction in the conceptual aspects of searching.

Secondly, Alberico and Micco (1990) refer to cognitive overload in relation to the complexity of the search processes required to search some online services. For example since the concept of hypertext involves a "point and click" method and windowing makes use of GUI which utilizes on-screen icons and pull-down menus, it is viewed as a less complex way of searching in contrast to online search services, character based OPACs, and some CD-ROM services. In the latter case users will require to construct mental models related to the structure of records, and fields, and so forth which can be difficult for end-users to comprehend. Therefore, these systems are said to cause cognitive overload. At the same time, although the use of hypertext appears to reduce cognitive overload, others like Lancaster and Warner (1993) point out that hypertext resources can become confusing and the user can easily become lost in the maze of links.

2.3.4 Techniques and complexities in basic online searching

This discussion reviews the skills required in performing an online search followed by an overview of factors that may influence the capability of end-users to perform their own online searches.

The basic online search is described as a complex activity which requires knowledge and skills that are not easily acquired and are even more difficult to keep up to date (van Brakel 1988; Harter 1986). Skills required are dependent on the knowledge of principles, concepts and techniques of information storage and retrieval (van Brakel 1988).

The online search is influenced to some extent by whether the system is command-driven or menu-driven. Command- driven systems will require that the searcher acquire some grasp of the techniques used in such systems to be able to access the range of databases and online search services. Since each command system uses its own vocabulary and syntax, each one will have to be mastered to avoid confusion in searching. Sharma (1995) points out that if the end-user does not remember the specific command or its syntax, it will be impossible to interact with or work on that system. Convey (1989) states that the difference in the commands used to perform similar search functions can cause difficulty to experienced and inexperienced searchers alike. He cites the example where three online systems use the PRINT command to display records online at the terminal or offline at the host's computer. However in another system, the command TYPE/DISPLAY is used to display records online and PRINT is used to print records offline. Mistakes in the use of command language will result either in error messages from the computer, or in search results other than those intended.

In the case of menu-driven systems Harter (1986) has argued that while it is supposed that this method of searching is easier than the command language system for a novice user, it is not so. He states that the reason is if one makes a wrong choice at any level of the menu sequence it is time consuming and frustrating to retrace the steps in the menu structure. It is also not always obvious what the logical choice might be in a menu (Harter 1986).

The steps in online searching are summarized by Lancaster and Warner (1993), Hartley *et al.* (1990), van Brakel (1988) , and Harter (1986).

1. **Pre-search strategy.** Prior to the execution of a search it is necessary to analyse the components of the topic that is being searched. The searcher needs to identify keywords, subject headings, author's names, relationships between search terms, synonyms and related words, and the ways in which terms will be constructed in the search. Thought must be given to the use of Boolean operators and the terms that will be used to reflect the particular Boolean logic to be used. In this process it is also useful to prepare a dummy search on paper which will save time at the time of the formal search.

2. **Select one or more databases**. Many online services provide access to more than one database; the larger services may include several hundred databases covering many subject areas including many different types of information such as full text, numerical, and bibliographic.

3. **Logon to the search system** of choice either through a commercial telecommunication network if access is from a remote workstation, or from a local system, to enter the initial search statement formulated

4. **Select search terms**. Identify major concepts and their inter-relationships. Use the service's search software to retrieve citations. Translate decisions made into formal statements expressed in the command language of the search system.

5. **Identify the fields of the records that will be searched in the database selected**. If it is a menu-driven system one needs to make a choice of search access point

6. **Evaluate retrieved records**. Examine records to establish whether they are relevant to the search query. If not then the search strategy would have to be amended to include synonyms or add new concepts (Hartley *et al.* 1990:89-91) or to identify other ways to express the concepts in words, and phrases.

7. **Logoff from the search system** to terminate the search or to transfer to another database

MacDonald (1991), Lippincott, (1987), and Borgman (1986a), described the knowledge and skills needed to search online retrieval systems as mechanical skills, and conceptual knowledge. Skills of a mechanical nature in searching refers to syntax and semantics of entering search terms, structuring a search and negotiating through a system. Lipincott (1987) spells this as logging on and off the system, keyboard mechanics, and input and output procedures. These skills suggest that in order to be successful in online searching, the end-user requires basic computer skills or at least a familiarity with computer hardware and software operations.

Conceptual knowledge relates to the how and why of searching, when to use which access point, ways to narrow and broaden search results, alternative search paths, distinguishing between no matches due to search errors and no matches because the item is not in the database and so forth (Borgman 1986a). In this respect, the author of this research viewed this knowledge to be derived from an understanding of library tools, techniques and skills, as well as proficiency in English.

Harter (1986) concluded that problems encountered at the technical (mechanical), semantic, or effective levels (conceptual) can end up in a failed search under the following circumstances:

> It may fail because of an inadequate understanding of an information need, or because of misspellings or typographical errors or data transmission errors. Or, it may fail because of inadequate understanding of system characteristics such as file loading practices, or alphabetizing conventions. It may fail because inadequate attention has been paid to the representation of a search problem in a problem description language, or because inappropriate languages or search terms were selected. It may fail because the searcher was not able to interpret and react appropriately to system feedback by modifying, polishing, and improving the search.

The following section discusses research which highlights the abilities of undergraduate students in relation to the use of library services, proficiency in the English language, and computer skills which the author has shown to have a relation to the online search process. Thereafter online user research will also be discussed in relation to the mechanical and conceptual problems experienced by end-users when conducting online searches.

The literature reviewed emanated mainly from the United States but it was pointed out that students from both developed and developing countries experienced problems in the use of libraries, and computers and reported difficulties with the use of English as a second language.

2.3.4.1 Library skills of end-users

The general perspective of the research related to the library skills of undergraduates points to a low understanding of library tools. Writing about students' competencies in American libraries Mellon (1988) found out through informal surveys that students who entered college had little if any knowledge of library tools. Mellon's further investigations on students in beginning composition classes collected over a two-year period found that students experienced library anxiety to the point that they had difficulty in approaching the search problem logically or effectively.

Fields (1987) found that prior use of the library to find information did not guarantee that students in American libraries knew how to use the library effectively. Students reflected a low use of periodical indexes and did not seem to be using subject bibliographies. It was found that instruction was needed in basic research techniques and library tools and that few students were able to use *LCSH*. Fields (1987) points out that library users who do not use *LCSH* in subject searching are likely to fail to find books that are actually in the library. Although Field's comment is not entirely correct in that a student could be likely to stumble on the required information through browsing, it is still significant in that quite a few libraries use *LCSH* as a standard thesaurus for the input of subject headings. It has been the authors observation that in South Africa many academic libraries use *LCSH* as a tool to index their local collections represented in the OPAC. It must be mentioned however, that since Field's research in 1987 many changes have transpired in indexing techniques. In the period of the 1990s some OPAC systems and most external databases use free-text and online lists as well as controlled thesaurus in index construction.

In a study conducted by Kunkel, Weaver and Cook (1996) in the United States to determine library skills of freshman students, it was concluded that lower-level students are confused about the scope and diversity of library resources because they do not understand the difference in the type of records found in OPACs and in periodical indexes. They have difficulty interpreting the bibliographic records in the OPAC and in periodical indexes. The terminology of the library was found to be unfamiliar. Students lacked the critical judgement to select appropriate sources and to develop strategies for finding information when their first efforts failed. They did not have the experience and skills to use information technologies effectively. While students were found to understand the purpose of resources such as the OPAC and periodical indexes, they were reported to have a strong and sometimes inaccurate sense of the possibilities of computer resources.

Gorman's account (1995) of a diverse student population in Californian universities describes re-entry students, transfer students and recent high school graduates from certain schools lacking the most elementary library skills and in many cases having a below minimum level of literacy demanded by colleges. According to MacAdam and Nichols (1989) minority students at predominantly white, middle-class colleges and universities in America, experience many academic difficulties which in turn impact on their use of library resources such as the online catalogue.

The performance of foreign students reported in North American libraries has shed some light on the library skills of students from other parts of the world. For example, foreign students from countries such as Ethiopia, Japan, Saudi Arabia, Ghana, Egypt, making use of academic libraries in the United States were found to be experiencing difficulty in use of the American library due to differences in the construct of the American library compared to the student's country of origin. Some students were described as being used to a closed stack system where the information was provided by the librarian which eliminated the need for the student to define a search query or to understand the information tools (Jacobson 1988). A survey among foreign students conducted by Robertson (1992:45) in Scotland found that from a sample of foreign students who were a few months and even years into their course "...90% could not find and use abstracts and indexes properly, 50% did not understand the library's class number system, 40% can only sometimes use the library's OPAC."

Similar reports have emanated from the South African literature. The differences here have been between students from different academic and economic environments within and outside the country. In order to put these differences into perspective, some understanding about the social divisions introduced by the apartheid system must be explained. Under the apartheid system of governance prior to 1994, the South African population was governed along racial lines into four separate race groupings, namely African, Asian coloured, and white. The policy of the State was one of separate development which meant that each of these race groups was governed by different health, education, housing and social welfare departments. In this system the most privileged was the white race group who received the highest standard of all the services named above. Among the remaining race groups there were also differences in opportunities which was planned to maintain the government's policy of "divide and rule." Under this form of governance the African race group was subjected to the severest discrimination compared to the other race groups of colour. In the ensuing discussion, although the term Black is commonly used to refer to the race groups of colour in South Africa, in this sense the reference is to the African race group in particular.

September (1993) writes that with inadequate educational backgrounds many Black students fall by the wayside in a tertiary education system based on the First World models of Britain, the United States and Europe. Sayed's needs assessment study (1998) indicated that based on the measures used in his study, race accounted for the most differences. His results revealed that a greater proportion of black students (African, Asian and coloured students) express a need in all areas of information literacy activities such as reading and writing and computer usage than their white counterparts. Bell (1990) describing the situation at the University of Natal, Pietermaritzburg, in South Africa writes that the presence of black students since the early 1980's has made librarians acutely aware of the difficulties of students with library use. Whilst many problems are common to many students, many black students appear to have a greater degree of difficulty with library use than their white counterparts due to problems of language, and an apartheid education. Allardice (1987) has observed that black students who arrive at a university encounter a library for the first time and find using it a bewildering experience. Suttie (1990) found that many black students have limited knowledge of libraries and their functions, are unfamiliar with their procedures, and are baffled by their often confusing design. Zondi's findings, (1992) concur, with those of Suttie and Allardice's observation in that at the University of Zululand which was a historically black university in South Africa, the majority of students reflect a very low level of competence in the use of a library and displayed poor information-seeking patterns. Of added interest is a *Sunday Times* newspaper report of a campus diversity audit in 1999 which stated that "... the number of African students at Universities and Technikons has grown by 141 000 or 74%, while white student enrolments have fallen by 60 000 or 27% between 1993 and 1999." (Pretorius 1999 :11).

The significance of these findings with respect to online searching is that students with a low understanding of library tools are likely to experience difficulties in applying the conceptual knowledge required in online searching, for example, the ability to make a selection from a variety of databases.

2.3.4.2 Proficiency in English

The second factor is related to language proficiency . Due to the fact that in South Africa particularly, most databases and protocols used are in English, proficiency in the use of the English language has been emphasized as a critical element in efficient online search performance. Broidy (1989) reiterates the point made earlier that language is crucial to understanding the structure of information and by extension, the use of the library. "... The library presents a highly structured environment where use of language in such processes as constructing subject headings and index terms, and developing search strategies is important to lead a student from point A to point B" (Broidy 1989:6). Successful information retrieval in an electronic environment is dependent on the use of search mechanisms such as Boolean operators, proximity indicators, and word indexing methods, synonym searching, pluralization, compound words, and variant spellings, all of which require language skills (DiMartino, Ferns and Swacker 1995). The extent of one's vocabulary is a prime component in the process of preparing search strategies and in text-based databases. An end-user is required to know proper spellings, think about variant spellings, synonyms and so forth. Saracevic and Kantor (1988), found that semantic association is important to online searching. According to Ovens (1994b:22) "...linguistic ability in the language used in the online databases being searched is important in that online databases employ English as the command language and it is also used in searcher manuals, thesauri and database descriptions."

In an account of the obstacles to access and use of online databases in Third World countries, Dubey (1988) described language amongst other factors as a serious barrier to the use of online databases. Sayed's findings (1998) in South Africa indicated that African-language students have greatest difficulty with reading and writing. His study also revealed that overall black students had greater information literacy needs and of this group, African-language speakers were a significant number.

Koehler and Swanson (1988) found that in the United States students who spoke English as a second language experienced problems with alphabetizing, using alphabetical listings, understanding basic vocabulary, using cross-references and periodical indexes.

In relation to the search process the use of English is an important element in applying conceptual knowledge to select search terms, identify fields to be searched, and to amend the search strategy.

2.3.4.3 Computer experience

To a lesser extent, computer literacy has been mentioned as playing a role in online search efficiency. Wadell (1994) draws attention to the concept of "computerphobia" which he summarised as, fear of the computer itself, fear of breaking the computer; fear of looking stupid, losing control, and computer anxiety. He further argued that new users fail to understand that you do not need to be a programmer in order to use computers.

Pfaffenberger (1990) on the other hand submits that as a result of experience with computer technology the end-user has developed a level of computer literacy which enables an understanding of telecommunications and database management principles well enough to easily grasp online searching. Pfaffenberger's general argument is that although the end-user might not have a wide understanding of the variety of databases to choose from, the structure of online systems will lead the end-user to the relevant titles. The sophistication of telecommunications does not require the end-user to learn too many technical procedures as systems are able to save commands and re-execute them automatically. End-users will not have problems in mastering concepts underlying the various online software as they are accustomed to doing this with other types of computer software, such as MS-DOS. He continues that as a result of retrieval relying on an imperfect surrogate, that is, words, which can mean different things in different contexts, searching has become an art. This is said to require creativity, which is well suited to human beings (Pfaffenberger 1990).

Contrary to Pfaffenberger's argument, others like Sever (1995) and Martinez (1994), present a different perspective. Sever (1995) conducted a number of observations and interviews amongst staff and students in the University of Haifa in Israel to identify problems that users report in using computers and CD-ROM screens. Of the 80 persons interviewed two categories of users were identified, namely, computer literates and computer illiterates.

Sever (1995) found that computer literates had acquired the rudiments of computer literacy and that more than half of those interviewed used personal computers, those in their teens played computer games, taught themselves Basic programming, and both young and old had learned to use the Internet and Bitnet for electronic mail. However, despite the level of their skill and understanding, the bibliographic searches of these users were efficient only from the point of view of computer use (mechanical skills), but their ability to evaluate the result of their search and the precision of their retrieval (conceptual knowledge) was not successful. Knowing the correct commands did not include the ability to formulate their search in the most appropriate manner nor did it lead to a full and precise list of bibliographic sources. This group believed that their skill in using the computer automatically meant that they had acquired a mastery of information retrieval and therefore trusted that the computer was generating complete and accurate responses to their queries. They rarely reported, if ever, checking the reliability of search output (Sever 1995). This tendency was also reported by Armstrong and McPhee (1992) that while the majority of patrons do not fear the computer terminals and will approach and use them, what they are retrieving is not necessarily the best information for them.

Among Sever's sample about 40% were considered computer illiterate, comprising a group of both young and old. This group however was unable to relate to the computer and its keyboard. The machine readable form of information was considered threatening and caused anxiety to the point that a confrontation with it was avoided in most cases (Sever 1995).

Martinez (1994) and Martin (1990) present another perspective in this debate arguing that familiarity with computers, and the level of computer literacy alluded to by Pfaffenberger is common only to some sectors of society. In an analysis conducted on behalf of the National Assessment of Educational Progress (NAEP) of a nationally representative survey of the computer-related knowledge and skill of the youth in the United States, Martinez (1994:397) found that in overall computer competence ..."the mean score for white students was about five to seven points higher than for black and Hispanic students. White students were more likely than black and Hispanic students to have used a computer at least once; white students were also more likely to be studying computers in the third and seventh grades; approximately, three of ten eleventh graders had access to a computer at home, while two out of ten black and Hispanic eleventh graders had such access." Martin (1990), citing research by Cardenas (1983) noted that programmes developed for home markets were developed mainly for white middle-class boys. He further argued that this has a double negative effect on minority students. Firstly, minority students are unable to develop and practice skills outside the school. Secondly, minority students without access to computers at home are not as knowledgeable about computer applications.

Sayed's needs study in the Western Cape in South Africa also found differences In the use of computers based on race. His findings were that "...familiarity and computer competence are strongly related to race and to disciplinary domain" (Sayed 1998:165). Shapiro (1995 v.1:3) reported on the low computer literacy levels at the University of the Western Cape (UWC) noting that few students "...attain a basic computer literacy rate of two on a scale of one to four by the time they graduate, and that most remain PC [personal computer] illiterate."

In summary, these reports illustrate that familiarity with computers is not commonly found and that experience with computers may have an effect on search performance. What was evident in some of the reports cited was that some groups of people are not part of the mainstream of exposure and experience with computers and that there may be a relationship between these groups and computer literacy. McClure (1994) confirms that there is widening gap between what he terms, the information elite and those who are denied the tools to access, understand and use information. According to McClure various population segments are increasingly disenfranchised from accessing information due to race, gender, income, and a host of other reasons. He states further that unless the status quo changes the various sectors of society will become increasingly disconnected and those who are bypassed will be increasingly disadvantaged and unable to lead productive personal or professional lives. McClure's challenge to librarians is to take a leading role in educating people in the use of computers and networks.

2.3.4.4 Research on end-user online search performance

Research revealed problems experienced at both the mechanical and conceptual levels, with more problems reported at the conceptual level. Investigations focussed separately on OPACs, CD-ROMs and online databases.

The underlying purpose for most of the OPAC studies was to assess the user's satisfaction with the OPAC (Cherry and Clinton 1992; Matthews, Lawrence and Ferguson 1983); to determine how the OPACs were searched with respect to fields and search options selected (Connaway, Budd and Kochtanek 1994; Matthews *et al.* 1983); to determine the extent to which known-item searches were conducted such as author and title as opposed to subject searches, and how these searches were conducted (Hunter 1991; Akeroyd 1990) Several of the studies analysed errors that occurred, and searches which retrieved no records, to assess search performance (Cherry and Clinton 1992; Wallace 1993; Zink 1991). User studies depicted search behaviour across several different OPAC systems, namely LUMIN (Connaway *et al.* 1994); BIS (Hunter 1991), CARL (Wallace 1993); Innovative Interfaces (Thorne and

Whitlatch 1994); WolfPac (Zink 1991); GEAC, DYNIX and LIBERTAS (Slack 1992; Akeroyd 1990); TENTTU (Pasanen-Tuomainen 1993); Information Online (Schuck 1992); BLCMP, CATS (Slack 1992). In four separate research projects sponsored by the Council on Library Resources in the United States sixteen different systems in 29 libraries were investigated (Matthews *et al.* 1983).

Likewise, user studies devoted to other types of online technologies such as CD-ROM and online databases aimed to determine user characteristics in searching and reaction to these mediums (Azzaro and Cleary 1994; Lancaster *et al.* 1994; Dyckman and O'Connor 1989; Lynn and Bacsanyi 1989). CD-ROM databases studied included, *ERIC* (Lancaster *et al.* 1994; Lynn and Bacsanyi 1989), Silver Platter CD-ROMs (Azzaro and Cleary 1994), *PsycLIT, Social Science Index* (Lynn and Bacsanyi 1989). Other studies included the Easynet gateway system (Dyckman and O'Connor 1989); *UM-MEDLINE* (King 1991); *MEDLINE* available as an online database and on CD-ROM (Wildemuth and Moore 1995).

A variety of research methods have been used, including survey questionnaires (Cherry and Clinton 1992; Slack 1992), interviews with users (Summey and Walchle 1992), focus groups or combinations of these methods (Thorne and Whitlatch 1994; Matthews *et al.* 1983). By far the method cited most often has been transaction log analysis (Connaway *et al.* 1994; Wallace 1993; Hunter 1991; Zink 1991; Akeroyd 1990). This method has been popular because it provides an unobtrusive method of analysing search performance and it removes the chance of interviewer bias in data collection. Transaction logs refer to the print product of the process whereby a system has been programmed to store on tape all of the activity occurring at a specified terminal connected to that system. The act of storing the search to memory is transparent to the user and does not interfere with the interplay among user, terminal and mainframe in the execution of a search (Wallace 1993). Every search of the OPAC is recorded according to the index searched, the search request, when the search was conducted, and whether or not the search was successful (Zink 1991). Unlike surveys which assess users' opinions and perceptions of their search successes and failures rather than their actual performance, the transaction log records the actual search conducted. According to Wallace (1993:240) "...transaction logs are more beneficial than surveys because surveys are measuring attitudes whereas the transaction log allows for specific forms of behaviour, encompassing areas such as motor skills, basic knowledge, and conceptual knowledge." Connaway *et al* (1994) argue that although there is value in the use of transaction logs, the disadvantage is that this method does not identify the actual user. It is often difficult or impossible to distinguish when one searcher ends a session and another begins one. A transaction log analysis also does not identify whether a user has found anything useful during the search.

The findings of these studies are grouped according to problems related to mechanical aspects or conceptual aspects. In agreement with Borgman's observations (1986a), although online user research is usually conducted according to the different types of technologies, distinctions between online catalogues and multi-database bibliographic retrieval systems have begun to blur with respect to system design and populations served. Borgman (1986a) rightly points out that online catalogues have become increasingly sophisticated by adding capabilities such as Boolean searching and index browsing, while online database services have simplified command structures offering fewer complex interfaces for end-users. In line with this reasoning, the findings are discussed jointly for all resources.

2.3.4.4.1 Problems related to the mechanical aspects of searching

Borgman (1986a) noted that problems with mechanical aspects of searching have not proven to be a major barrier to the use of bibliographical retrieval systems, except in some cases with inexperienced and infrequent users.

A common occurrence reported in several studies were typographical errors or misspellings which ended in a zero response from the system, for example Tenopir (1997), Connaway *et al* (1994), and Wallace (1993), amongst others. Tenopir (1997) who surveyed opinions of reference librarians reported that spelling errors are probably the most common mistake made by users of all ages and levels. Borgman (1986a) categorized errors as two types, namely logical errors, or commands that could be partially recognized by the system, and typing errors, or commands that could not be recognized at all. Some of the errors related to logical errors or commands in the case of OPACs have been, the failure to press the appropriate key to view further screens, interpreting screen messages too literally, for example typing the word, "number" when instructed to type a number to make a selection, re-typing a search in all capitals or lower case after failing to retrieve any information (Schuck 1992). Wildemuth and Moore (1995) found in their study of *Medline*, that syntactical and typographical errors lowered search performance even though they were usually noticed and corrected.

2.3.4.4.2 Problems related to the conceptual aspects of searching

The greater number of problems identified were related to conceptual aspects of retrieval which are listed as follows:

1. Selection of information resources

In a library skills test, Schuck (1992:157) found that students experienced difficulty in selecting an appropriate index to find articles on a particular subject. He reported that students had difficulty in selecting the best search starting point from a number of different types of reference material. Wallace (1993), Sumney and Walchle (1992), and Hunter (1991) found that students did not understand the nature of the contents of the database. Students did not know when it was appropriate to search for journal contents on other databases and when to search on the OPAC. Hence, they missed out relevant material that could be found using alternative sources. Sumney and Walchle (1992) state that students believe that the OPAC contains more information than it really does. In their view users need to be aware of other steps necessary in completing research. Tenopir (1997) reports that some library users do not recognize that CD-ROM systems, online systems, and WWW are distinct systems, each requiring different search procedures and search strategies.

Despite the availability of online directories and other finding tools for the online system, Easynet, Dyckman and O'Connor. (1989) found that in 72% of transactions, students did not know what database to use. Lynn and Bacsanyi (1989) found that many CD-ROM users had a minimal knowledge of the library and its resources, hence they approached CD-ROMS with no prior experience in using printed indexes and abstracts therefore reflecting a poor ability to search..

2. Known-item searches

The search for a given author or title was generically referred to as known-item searches (Matthews *et al.* 1983; Akeroyd 1990). Errors resulting in zero search results were misspellings, typographical mistakes, inversion of the author's name, use of an initial article in the title, incorrect use of punctuation, repetition of unsuccessful search, improper abbreviations or forms of titles (Pasanen-Tuomainen 1993; Schuck 1992; Zink 1991). Hunter (1991) cautions however, that a zero response which occurs because the item is not included in the database is not a reflection of an error.

3. Subject searches

Subject searches accounted for the most frequent type of search conducted in most cases, followed by known-item searches (Thorne and Whitlatch1994; Matthews *et al.* 1983). Most users had difficulty with controlled vocabulary, problems with thinking of alternative search terms and search strategies, variant spellings, synonyms, and the use of singular versus plural. Most did not use *LCSH;* in some cases very broad terms were used, for example *education* and *religion*; some had difficulty with the term "use for" in *LCSH* which re-directs the user to another term; in most cases users used free-text searching and natural language; in some cases the search phrase was a replication of the query as it was phrased in the class assignment despite the fact that it did not match the conventional concepts of the system (Wallace 1993; Hunter 1991; Zink 1991). Akeroyd (1990) noted that students tended to latch on to convenient or familiar terminology, settling for the simplest term in appearance in either author or title. It was significant in Slack's findings (1992) that in some cases the OPAC system itself reflected inadequate subject descriptions which was a reflection on the indexing provided by the cataloguer.

Wildemuth and Moore's study (1995) of *Medline* with third year students found that although the student's initial selection of terms was adequate it could have improved with an increased use of an online thesaurus and expanded awareness of the importance of synonyms. Azzaro and Cleary's survey (1994) revealed that 50% of novice searchers (inexperienced searchers) and 31% of more experienced searchers produced poor searches on Silver Platter CD-ROM titles where the results did not lead to any relevant or useful articles. In a study by Lancaster *et al.* (1994) it was found that students do not identify and use all of the terms needed to perform a more complete search, mainly because they search too literally. For example, Lancaster (1994:379) explains ..."the topic of, supply and demand issues, related to teaching was searched using terms, teacher, supply, and demand, overlooking a term such as teacher shortage." Dyckman and O'Connor (1989) report that a significant percentage of end-users are confused by, or do not understand search logic and techniques. Problems encountered were misspellings, not including synonyms and/or word manipulation, conceptualizing search statements. Students were found to use a natural word order, rather than the terse statements required of the system.

4. Use of system features

Overall, users were reported to be making less than optimal use of the OPAC systems (Connaway *et al.* 1994; Hunter 1991). Zink (1991) encountered users who were unable to make appropriate choices from a given menu of search points. For example he reports instances of title searches input at subject access points and subject terms input at author and title access points. Pasanen-Tuomainen (1993) reported that users were not exploiting the different search possibilities of a system. Thorne and Whitlatch (1994) indicated that only seven out of 93 research participants made use of advanced features to narrow or expand a search. Other findings point out that students tend to make use of the simplest features provided by a system (Connaway *et al.* 1994) and that students tend to make use of one search strategy all the time (Thorne and Whitlatch 1994).

The help feature of the OPAC was reported to be used mainly by persons who were familiar with computers. Those with no computer experience resorted to trial and error or sought assistance from friends or library staff (Cherry and Clinton 1992). Slack (1992) found that students did not read or did not understand the help information provided, as the errors were often repeated, or the search abandoned altogether.

Lancaster *et al* (1994) found errors of logic relating to Boolean searches in a study related to the use of the *ERIC* CD-ROM. For example the use of the operator, AND, in a search which would have benefited more from the use of the operator, NOT, in certain instances. Dyckman and O'Connor (1989) found that inexperienced users needed to be given explanations of Boolean logical operators. It was also found that the variety of formats available, citation, abstract, full-text article, full-text directory record or numeric data caused confusion amongst end-users. King's study (1991) which evaluated the use of *Medline* found that experience had little effect on searcher utilization of most features, however the most experienced users tended to increase their use of a few search features, for example in the use of search limiters. Lynn and Bacsanyi (1989) reporting on use of *PsycLIT* on CD-ROM found that students were confused with search options. They also had difficulty in understanding Boolean search strategies and in limiting a search.

In summary, research reviewed demonstrates that end-users have problems in both the mechanical and conceptual aspects of searching the various online technologies, whether they are OPACs, CD-ROMS or bibliographic online databases. These problems also highlight that many undergraduate student's have an inadequate understanding of library resources, and the inability to manipulate the English language to effectively search online systems. Such problems existing despite advances reported in the design of "user friendly" or easy to learn systems, as pointed out by Steele and Tseng (1992). Saule (1991b: 3) contends that the kinds of problems that exist are due to the nature of computerised systems compared to the print medium to which most people are accustomed:

> It is difficult for patrons to discern easily what any given computer will do for them when all computers look the same...Unlike computer terminals, printed reference sources each tell a different story just by the look of their covers. Sources like the card catalogue give the patron more visual clues to the size and the nature of the database contained within their covers than a computer screen. Not only do online catalogues and other computer-based systems offer no sense of the size or nature of the database being searched, but the screen-by-screen display makes it difficult to understand how the database is constructed or to know how

to revise a search when the result is disappointing...The system user, may not be able to understand why and how the computer is doing what it is doing...If a search produces no results, it is difficult for the searcher to know if there are, in fact, no corresponding sources for the inquiry, or if the search strategy was at fault, or even if the system itself is flawed.

2.3.5 Human factors

Borgman (1986b) contends that the difficulties in searching information retrieval systems are due not only to them being difficult to learn, but also due to difficulties correlated with certain individual characteristics. This view is shared by other scholars such as Chamis (1991), and Saracevic and Kantor (1986) who assert that the human variables and decisions associated with searching are important. This section reviews some of the human factors that have an effect on the search process.

2.3.5.1 Attitude to library online technologies

Despite the difficulties end-users are likely to encounter, there is a demonstrated growth in the preference for resources in the electronic format (Popa, Metzger and Singleton 1988). In a nationwide survey sponsored by the Council on Library Resources in the United States, "...over 90% of users reported a favourable attitude towards the online catalogue and three quarters of users preferred this catalogue over the card catalogue" (Markey 1984:2). Popa *et al.* (1988) found that given a choice between searching a card catalogue and an online catalogue, students in America voted for the online catalogue. Similar attitudes have been reported of end-users of both CD-ROM and bibliographic online databases by Condic and Lepkowski (1994) amongst others. Overall, the data reveals that automation attracts, that users will turn to it first, and if they get enough of what they perceive to be useful, they will look no further for information (Gratch 1988).

The attitude of the end-user is an important factor in positively or negatively influencing the search. As Sever's report (1995) has already illustrated in an earlier section, end-users who were computer literate tended to underestimate the complexity of the search process. Steele and Tseng (1992:56) summarised the attitudes of end-users towards online technologies as follows:

1. End-users have a tendency to think that the computer will retrieve all relevant material or that if they retrieve nothing, there is simply no information to be had on the subject.
2. End-users are too reliant on the computer itself and too easily fall into a situation of finding a small amount of material and not knowing the ways and means of retrieving more or locating an overwhelming number of items, many of which are off-target and not what was intended

Rettig (1995:10) agrees that end-users attribute too much power to the new technologies "...If it was created on a computer, exists in a computer or came out a computer, some will view it as more valid, up-to-date, and credible than a version in the print format." Similarly, Ankey (1991) found high levels of reported end-user satisfaction with computerised services which did not correspond with the low level of search success rate. On the other hand King and Baker (1986) mention that there are also those end-users who cling to the familiar, and who resist new tools like online technologies.

In a focus on the psychological aspects of human-machine relationships, a report by King and Baker (1986) outlines the different kinds of computer relationships as espoused by Sherry Turkle (1984). The first relationship is described as master-to-tool. This refers to users who are familiar with computers, but have no information retrieval experience. This type of user views computer commands as a way of coaxing the machine to respond with the desired results. Some, who fall in this category may enjoy the sense of power and control over sophisticated and complex systems. Others may have a negative or unsuccessful experience. They may find the pseudo-human dialogue and repetitious menus cumbersome or annoying, and may respond with impatience or exaggerate the limitations of the system.

The second relationship is described as anthropomorphic, where the user ascribes human characteristics to the machine because of the interactive nature of online systems. New and infrequent users of information retrieval systems are expected to fall in this category. In this kind of relationship the tendency is to relinquish control of the dialogue to the computer. It is pointed out that new and infrequent users, even if they do not qualify in this category will find it difficult to assert authority over the system because they may be unsure of the information seeking process in general and the role of the online system.

King and Baker (1986) assert that understanding the human-computer relationship will shed light on how information retrieval systems are used, how users learn to search and how successful they are at searching. These authors contend that until there is a greater understanding of human-machine relationships, it will not be possible to design instruction that is flexible enough to accommodate a diverse clientele.

2.3.5.2 Diversity of end-user population

The growing diversity of student populations has been widely documented in the literature of developed countries such as the United States, Australia and the United Kingdom. Student populations are including a greater number of people from minority groups such as African Americans, Hispanics, Asian Americans, Pacific Islanders, Native Americans, and Alaskan natives (Chadley 1992; Fish 1992). According to Gorman (1995) students at California State University have become as diverse in terms of age, ethnicity, and other factors, as the State and region from which they come. Quezada (1992:28) writes that "... by the year 2000 more than 52% of the population of California will be Hispanic, Native American, African-American, or Asian-American." Campuses worldwide are reporting an increase in the enrolment of foreign students (Natowitz 1995; Garcha and Russell 1993; Robertson 1992).

This trend is also prevalent in a developing country such as South Africa , as pointed out by authors such as Sayed (1998), September (1993), Cuthberthson (1992), Bell (1990). Since the beginning of the 1990s institutions of higher education in South Africa have been more open to the acceptance of persons from different race groups compared to the separate development policy of the past which resulted in each of the four race groups attending institutions demarcated by race. This change becoming more pronounced after the dissolution of the apartheid government in 1994.

Inherent in this diversity are differing language, cultural, and academic backgrounds, reported to impact on the way library services are perceived. In South Africa, as a result of discriminatory education policies, and the lack of compulsory education for the black population in the past, there is disparity in the academic backgrounds of South Africa's white population and its black population (September 1993). MacAdam and Nichols (1989) mention that minority students at predominantly white, middle-class colleges and universities in the United States experience academic difficulties, as a result of prior scholastic preparation, amongst other reasons. In their view, as the library moves toward greater use of technology, such as OPACs and online databases, the gap between the academic skills of many minority and white students will widen unless the needs of minority students are specifically addressed.

Martin (1994) and Downing, MacAdam and Nichols (1993) emphasize that in the face of such diversity, there will no longer be such a concept as the "typical" student. In a description of the elements of a diverse student population, Downing *et al.* (1993:1) write:

> the stereotype of white, middle to upper class eighteen to twenty-two years old...selecting predictable majors along gender lines, no longer constitutes a valid demographic picture of the potential incoming college student. Instead, the entering college student is likely to enroll later in life, multiracial, female or non-heterosexual, to speak English as a second language, to bring a non-Western European cultural perspective, or to be at risk for academic failure due to a complex set of economic, social, academic, and cultural barriers inherent in institutions.

In the opinion of Downing *et al* to cater for a multi-cultural student community, librarians must be willing to explore innovative responses to the needs of the students, or run the risk of becoming increasingly marginal and inaccessible to students. This means developing programmes designed to reach students as individuals and to help break down the institutional barriers that alienate students and militate against their academic success.

2.3.5.3 Individual differences

The effect of diverse user populations has given prominence to the study of human-computer interaction to learn more about difficulties experienced as a result of user differences. This is reflected in the literature of library science, as well as in the disciplines of computer science, engineering and psychology (Borgman 1984b). According to Egan (1988:79), individual differences among computer users should be given attention because:

1. Individual differences, have been shown to play a major role in determining whether a person can use a computer to perform a job effectively. Performance differences for computer- based tasks are enormous when compared to performance differences in traditional jobs.

2. Some computer systems, for example OPACs are meant to be used by the public at large. It is unacceptable to effectively deny access to such systems because they are too difficult for some people to use.

Landy, Rastegary and Motowidlo (1987) submit that the significance of individual differences in cognitive strategies and personality variables is substantial for the occasional and beginning computer user. According to Logan and Woelfl (1986) if characteristics or groups of characteristics associated with effective online search behaviour can be identified, training methods for online searching can eventually target these areas with some assurance that search performance will be maximized.

Research on individual differences and human computer interaction in relation to online searching was not definitive or based on any grounded theory. What was found was data from exploratory surveys supporting the view that there are individual differences based on factors such as age, race, gender, and computer experience. These surveys cast a wide net encompassing all levels of students up to doctoral level. The short comings of the methodology used was that the findings were self-reported, relying solely on the subjective opinion and the memory of the student regarding their online search performance. Ankey's findings (1991) on end-user behaviour referred to in an earlier section of this report points out that the assessment of student's of their own search performance does not always accurately reflect their actual performance. The exception to the survey method was Bellardo (1990), Borgman (1985), and Fenichel (1979) who based their research on experimental methodology. The overall difficulty in the analysis of the research was that attributes and variables were not clearly defined. For example, reference to "library use" did not specify what constituted use. In questionnaires, frequency of use indicated by the term, "sometimes," did not identify the parameters which defined the term "sometimes." The research based on exploratory surveys however, cannot be discounted, and provides an important foundation for further investigation.

The characteristics of gender, age, extent of experience with computers and level of study were explored by Belanger and Hoffman (1990) in relation to frequency of use of the *ERIC* CD-ROM. In a survey distributed to students from all levels, a strong relationship was found between gender and frequency of use, where men were more likely than women to search the database. This study also found an association between women who had experience with use of computers and frequency of use of the CD-ROM. Women who had no familiarity with computers were correlated with non-use of the CD-ROM. These associations were not as strong in the case of the male respondents.

Allen (1993:325) found that "... 59.4% of foreign students who used computers for purposes other than online searching, did not have difficulty in searching, while eleven percent found it difficult; 40% of those who did not make prior use of computers had no difficulty in searching while 27 % experienced difficulties." The report did not specify what constituted "difficulty."

Cardman (1990) concluded after an extensive literature review that a gender gap exists in the degree of exposure to computers, mastery of the technical knowledge, and positive attitudes toward technology. In a doctoral thesis related to manipulation of computer interfaces, Morgan (1989) argued that gender differences were a result of social influences as well as cultural and cognitive differences. Morgan (1989) was careful to add that some feminist researchers condemn these theories as being inherently sexist.

A study on the information literacy needs of students in the Western Cape in South Africa called the Infolit Project found that differences between race, age, gender and disciplinary domain in the information literacy abilities and skills of students (Sayed 1998).

Hsieh-Yee (1996) surveyed the information seeking behaviour of juniors in the use of the OPAC exploring factors such as race and economic background. The factor of race included whites, African-Americans, Asians and Hispanics combined. While all students were found to need some kind of assistance, Hsieh-Yee reports that white students were more likely to use the OPAC, both in the library and via remote access, attempt to use keywords, subject headings and Boolean operators, narrow or broaden searches. African-American students were least likely to use the OPAC in this way, suggesting that they were not fully exploiting the technology.

With respect to economic factors, Hsieh-Yee (1996) found that the more affluent group was more likely to use the OPAC on every library visit, and the less affluent group used the OPAC sometimes, with some respondents whose affluence was not known using the OPAC only to complete assignments. In an exploratory survey Liu and Redfern (1997) aimed to discover how university students from diverse ethnic groups use information resources, especially in relation to educational and cultural background. Based on a sample of 237 students from Asian, Caucasian, Hispanic and African-American backgrounds it was found that success in use of the library was higher for students with English as their primary language than for those whose primary language was not English. Frequency of library use also constituted a factor in success of library use (Liu and Redfern 1997). Library use however was not defined in the report.

An experiment conducted by Bellardo (1990) tested for differences in search performance based on aptitude as measured by graduate record examination (GRE) results. The outcome was that verbal and quantitative GRE scores were found to be predictors of searching skill, but only to a small extent. A small number of cases were also found in which students with relatively low GRE scores did well on the search test.

Fenichel (1979) investigated the behaviour of novice, and experienced searchers associated with the process of online searching correlated with success. She reports that the sheer magnitude of individual differences was not expected. For example, for subjects in the same experience groups, values of the process variables for the same search topic often varied by factors of ten or more; in one search topic the number of commands used ranged from ten to 69 (1979:176).

An unexpected finding was made by Borgman (1985) in the course of evaluating teaching methodologies in online instruction. In the analysis of demographic characteristics of those who passed a benchmark test in the experiment, it was found that the dropouts were predominantly social science and humanity majors, while those passing the test were science and engineering majors. In this study Borgman discounted library use as a factor influencing online searching based on the finding that high library use did not provide any advantage in using the search system.

Allen (1990) conducted two experiments to investigate how the academic backgrounds of users may influence their interaction with information systems. Based on responses from graduate and senior graduate students in philosophy and psychology, Allen reports that although academic background can affect vocabulary selection, other influences also intervene, therefore academic background as a factor affecting information retrieval should be regarded with caution. In a comprehensive literature review Saule (1992) summarized that humanists are often characterized as unwilling to embrace new information sources and technologies. Many humanists view computers differently than their counterparts in the sciences or social sciences. Humanists take longer to learn computing skills and that humanists lack the conceptual framework and language common to professionals in these other fields. In a follow-up study Borgman (1989) examined relationships between technical aptitude, personality characteristics, and academic orientation thought to be related to information retrieval performance. A strong relationship was found between technical aptitude and academic orientation but not between personality and technical aptitude. Borgman argued that the combined findings from various studies on technical aptitudes would be useful to predict performance on systems by technical aptitudes of the user. No further research could be traced to follow-up this statement.

In the present study, the author was particularly interested in the literature on individual differences that could provide insight into variables such as prior library experience, prior computer experience, and the use of English as a primary or secondary language. These variables, as described elsewhere, were considered important with respect to performance in online searching. Literature pertaining to students in South Africa, foreign students, and minorities in America, as discussed elsewhere, revealed difficulties with respect to these variables. These variables were also of interest in the context of the South African experience in which students and educational institutions were subjected to unequal and different resource allocations which has resulted in wide disparities amongst students with respect to library and computer experiences and English language proficiency. However, the extensive literature search conducted did not locate research that specifically examined these variables in relation to online searching.

2.4 Online instruction to end-users

This section focuses on the impact of online instruction on the provision of BI, the evaluation methods of BI and key literature that is devoted to the content of instruction. Literature related to the content of instruction will include firstly, an analysis of non-research publications and secondly, research data related to the teaching methods of concept and procedural of instruction. Included in this discussion will be an overview of the theory of mental models derived from psychology which underpins the concept-based method of teaching. The research data will be considered with respect to sample populations, variables investigated, research design, and evaluation procedures. This discussion will also point to research that has influenced the direction of the present investigation.

2.4.1 The impact on online instruction on traditional BI programmes

The provision of instruction in the use of online technologies has been seen as the vehicle for enabling end-users to find their way through the bewildering array of online resources (Du Mont and Schloman 1995). This is evident in Rader's annual review of the instruction literature published in *Reference services review* which in 1991 reported that publications continue to deal with online searching, online system use and bibliographic computer applications. In 1993 it was found that articles dealing with instruction in the use of CD-ROMs, OPACs, and the Internet had increased substantially (Rader 1993; 1991). In the view of Lippincott, Stewart and Coons (1987) online instruction should be an integral part of an academic library's service programme for the reason that the attainment of skills required to search databases are increasingly important to competent performance in higher education and the professional world.

This concept of library instruction is not a new one, and is generally referred to as library use instruction, user education or BI. Kuhlthau (1994) defines BI as education for learning tools, sources, and concepts of information and strategies for locating and using tools and sources. The plethora of articles, and reports dedicated to BI demonstrate the interest and commitment to the provision of BI programmes in academic libraries. Shill (1987) reports that sophisticated programmes using learning theories and additional knowledge from education, psychology, and other disciplines have developed. He sees this development as a result of the need to provide a broader set of skills and knowledge that is relevant for lifelong functioning in an electronic information environment. Mellon and Pagles (1987) regard the value of learning theory to be a help in the design and redesign of instruction to better serve student communities. In their view it provides awareness of the ways in which students learn, their differing needs, and helps one to decide what can be done to improve the delivery of instruction.

Chadley and Gavryck (1989) report that BI has been strongly influenced by changes in library technology which have either increased the need for, or provided a new vehicle for delivery of instruction. As a result of the variety of online technologies in use and the diversity of the end-user population, the content and teaching methods used in instruction have come under review.

2.4.1.1 Formats and instructional media in BI

A survey of librarians in the Florida State University system was conducted by Rowe (1994) to determine how BI programmes have changed to accommodate the use of electronic research tools . The survey concluded that four trends have resulted in the provision of BI as a result of the increased use of automation, namely: .

1. A shift in emphasis from general orientations to specialised course-related sessions.
2. An increased use of automation workshops.
3. Handouts and printed guides are increasingly relied upon to reinforce the content of library instruction sessions.
4. The adoption of new technologies that facilitate the effective presentation of electronic research tools such as the use of liquid crystal display projection units (Rowe 1994:11).

Librarians have altered their BI programmes moving away from the popular but labour-intensive programmes such as credit courses and the use of work books to increased numbers of specialised workshops and computer-aided instruction (CAI) packages (Chadley and Gavryck 1989). According to Armstrong (1991) CAI is playing an increasingly important role in training users to search online systems. CAI is valued as a medium in which the user can learn and practise the skills of online searching, probably at the same keyboard to be later used online. It can be used at a speed which suits the individual and can be used as frequently as required. Rowe's survey (1994) found the automation workshop to be the most popular medium of instruction used.

In some instances, the literature made use of the term workshop, online course, and online lecture interchangeably, for example Rowe (1994), Chadley and Gavryck (1989). In the use of these terms in all cases, the programme descriptions described a generic session which introduced online systems followed by a hands-on session. The duration of this type of programme was generally described as lasting an hour or extending to several days (Rowe 1994; Engeldinger 1988; Tedd 1986). Engeldinger (1988) made added reference to the one hour lecture as the "one-shot" lecture which he states is the maximum time that most faculty are willing to share from their course time.

Other changes to the traditional BI programme according to Rowe's findings (1994:9-10) is that "...the term paper or research workshops have been eclipsed by the automation workshop; the offering of credit-bearing courses are decreasing due to budget constraints; and the use of slides and video presentations which were traditionally used as BI tools are being replaced by computer technology." The updating of slides and video presentations were found to be too labour-intensive, needing to be revised each time an online product is added or altered. However, the use of transparencies remained the foundation of many instruction sessions.

2.4.1.2 Resources included in BI programmes

In early BI programmes the tendency was to concentrate on how to obtain information in a particular library building. Whereas BI programmes traditionally focussed on teaching the use of resources such as the card catalogue, bibliographic indexes and abstracts, they now include online instruction in the use of OPACs, databases of the home institution, hundreds of commercial online databases of all types, stand-alone and networked CD-ROM databases which may contain bibliographic or full-text information, statistics, census data, graphics and/or sound (McLaughlin 1994; Janke 1990). Added to this list is the volume and variety of information available on the Internet which presents an overwhelming number of information possibilities and delivery mechanisms from which to choose.

With the implementation of such a variety of resources in the online environment, and the ephemerality of online resources, the issue of what to teach or the content of BI programmes has come into question. Compared to print-based library resources the complexity of searching for information using online technologies requires skills and knowledge unlike those needed for manual tools. In the view of King and Baker (1987) if the overall strategy of BI is retained and makes no changes to accommodate the use of online technologies, the mere addition of electronic tools to the content may not allow for the proper resolution of problems encountered. This view is reiterated by Shill (1987) who also argued that the instructional mission of the academic library must be reassessed as a result of the newer technologies used in libraries. Librarians must decide whether they will provide instruction as traditionally defined or a broader set of skills and knowledge to accommodate an increasingly electronic environment.

2.4.1.3 The end-user in BI

Ercegovac (1995) focussed on the importance of the end-user, who brings to the instruction class, different academic and cultural backgrounds, different experiences and attitudes towards libraries, and different levels of technical competence in the use of information technologies. Ercegovac's recommendation (1995) to meet the challenge of an ever changing online environment and a diverse student population is that four design principles should be adopted as a conceptual framework in instruction. Namely, the user, active learning, a conceptual model of teaching and a modular approach to teaching which stems from the areas of cognitive and educational psychology. In the modular approach related information is presented in "chunks" over a duration that meets the attention span of the learner. This type of approach has been proved to improve reading comprehension of both low and high performance readers Ercegovac (1995). King and Baker (1987) contend that although the reality might be that librarians do not have the experience, time or ability to control class composition, BI programmes must provide for both cognitive and affective objectives. King and Baker (1987:99) further emphasize that:

> new approaches to instruction which allows for flexibility, and alternative learning experiences for individuals according to their learning styles, and a mix of approaches to content presentation, will be necessary to educate users about newer interactive library technology

This view encourages the development of instruction programmes that accommodate the varying knowledge, skills, experience, and attitudes of students.

In the use of online systems the experience of end-users has often been classed in the literature as a novice or naive category, in the case of inexperienced end-users, and an expert category in the case of sophisticated or experienced end-users (Ovens 1994a; Solomon 1992; Borgman1984b; Fenichel 1979).

According to Cole, Landsdale and Christie (1985) end-users can be grouped into four categories, namely, naive users, casual experts, associative experts, and experienced pro's, with respect to their online searching ability. The differences between these categories are based on knowledge of the online system at a semantic and a syntactic level. At the semantic level reference is made to knowledge of general concepts of the application and approaches to tasks and problems. At a basic level this concerns the function a command elicits and the action initiated on system objects, for example files, documents, and so forth. Syntactic knowledge relates to the precise structure of system interaction with respect to the procedural and grammatical rules required in the dialogue between the system and the user. In more specific terms :

> Naive users are regarded as having the least knowledge of the system in terms of semantic and syntactic knowledge. Casual experts are said to have a working knowledge of semantic knowledge, but due to sporadic use of the system have inadequate syntactic knowledge. Associative experts are considered frequent users of electronic systems, hence are able to learn combinations of actions and specific command input sequences related to semantical knowledge without understanding the systems actions or the command structure. Experienced pro's are said to have well developed semantic and syntactic knowledge and can use the system in a powerful and flexible manner (Cole *et al.* 1985:215-6).

In the experience of this researcher at the M L Sultan Technikon and which could possibly be true for institutions of a similar profile, according to the above definition, many first year students and to some extent second year students will be likely to be classed as naive users based on their "newness" to the institution and inexperience in the use of the online resources of the library. This description will also be fitting of persons who generally have no experience with using computers or library resources no matter the academic level. Students who are at the end of their second year, and those in their third year onwards, as well as some academic staff could be classed as casual experts due to their infrequent use of the system. Associative experts might include those students and staff who are acquainted with the use of computers, or who have the experience of their specific discipline, for example engineering, science, and so forth that enables them to navigate the online system in a "hit and miss" type of approach. Experienced pro's are likely to be the trained librarian, the serious researcher, and academics who are make regular use of library printed and online resources.

Jacobson and Jacobson (1993) report that expert users are able to retrieve about five times as many highly relevant citations than novice searchers, in an equal amount of time due to the lack of search skills of novices. A report by the National Electronic Council (1983) states that whereas computer professionals and librarians as expert users are inclined to tolerate problems caused by inadequate design or faulty equipment, the non-expert user will reject products which prove difficult to use. Despite these differences in searching ability, Greer, Weston and Alm (1991) argue that whether or not students are expert or novice end-users, the expectations of the faculty are that entering freshmen be proficient in using the online catalogue, and higher level students be able to use automated or CD-ROM facilities.

In Borgman's view (1986a) novice end-users are typically low-frequency users. She reports that infrequent and inexperienced users encounter more problems related to the mechanical aspects of searching than experienced users. In this context, Borgman admitted that low frequency users were difficult to define however she cited previous research which defined low frequency as "...0.5-4.0 hours in a five-day week or 0-5 searches per month. High frequency users were described as searching the online catalogue once a week or more " (Borgman1986a:390). In short, Borgman's point was that the frequency of first-time users of online catalogues are often low enough that many online catalogue users probably remain permanent novices.

Research on the differences that exist between expert and novice end-users is significant to the development of online instruction programmes. According to Solomon (1992:162) "...novice end-users may need more instructional support; expert users may be able to operate an information system without any special support; and the users who fall in-between may need to be refreshed on system operation and capability." He adds further that individual users who have experience with a specific online system may be in a position to transfer this experience to another system. However, the search protocol of the different systems do not always permit this transfer. Therefore, some users may start at a point beyond the novice state but still need instructional support.

Having an understanding of the differences between novice and expert users will assist in pointing to the method of instruction that is most effective in addressing the searching problems of end-users.

2.4.1.4 Information literacy

The provision of online instruction, also referred to as end-user instruction, is expressed by Lippincott (1988) as a component of a broader information literacy programme. In a report by the Presidential Committee of the American Library Association (1989:90) to become information literate, a person must be able to.."recognise when information is needed and have the ability to locate, evaluate, and use the needed information, effectively." The literature on BI is increasingly focussing on the topic of information literacy as a result of the burgeoning use of technology in libraries and society in general. For example, authors such as Brevick (1993) and Behrens (1994) amongst others have made extensive contributions in this area. In South Africa there have been many important local initiatives driven by the various library consortia to promote information literacy . For example the Infolit Project of CALICO has the objective to "...ensure that the five tertiary institutions in the Western Cape are equipped maximally to develop the skill of information literacy in every student" (Sayed 1998:x). In another project, Rhodes University embarked on a pilot Information Literacy Project aimed at first year students registered for Psychology I and English for Academic Purposes (Shepherd 1997). At this researcher's institution, the M L Sultan Technikon the post of an Information Literacy Officer has been incorporated into projected plans for the year 2000.

A comprehensive discussion on information literacy however falls outside the scope of this review which is focussed on one aspect of information literacy which is to enable the retrieval of information, or the location of information through the provision of instruction.

2.4.2 Evaluation of instruction

The importance of evaluating a BI programme to assess its effectiveness has been emphasised by scholars such as Feinberg and King (1992), and Fjallbrant and Malley (1984) amongst others. Evaluation is generally viewed as a means of demonstrating the extent of learning, the effectiveness of the teacher, and the strength of specific teaching methods. In this way data needed to modify, change, or stop the training will be systematically collected and compiled. According to Miller and Bratton (1988:547) typical information sought in an evaluation relates to questions about the learner, for example, "... What do they know before instruction? What have they learned from the instruction?" Questions typically asked about the instruction programme can be, for example, "...Are the methods effective with this group?, Are all of the objectives being met?"

A variety of methods can be used to evaluate instruction which are discussed by Frick (1990), and Fjallbrant and Malley (1984). The types identified by Fjallbrant and Malley (1984) are described as the psychometric, the sociological, and the illuminative. The psychometric method is a quantitative measure which is described as making use of tests, namely the pre-test and the post-test. This method attempts to measure changes in an experimental condition where two groups are exposed to different treatments. Pre-tests and post-tests are given to both groups, and the analysis is concerned with establishing significant differences in the performance of the two groups (Fjallbrant and Malley 1984). According to Barclay (1993) this method of evaluation is concerned with measuring output in terms of predefined goals and no attention is paid to unexpected effects.

Some of the testing methods used are listed by Feinberg and King (1992:75):

1. Pencil and paper tests which include multiple-choice questions, true and false and short answers.

2. Performance tests in which students interact with a library to answer questions.

Merrill, Tennyson, and Posey (1992:128) explain the analysis of pre-tests and post-tests as follows:

1. When a test item is incorrectly answered in both tests, it can be assumed that the student has not completely learned the critical attributes.

2. If an item is incorrect in the pre-test and correct in the post-test it demonstrates that learning has taken place.

3. If an item is correct in the pre-test and incorrect in the post-test it can be assumed that the instruction promoted a misconception

4. If the item is correct on both the pre-test and the post-test it is assumed that the student understood the concept prior to the instruction.

The sociological and illuminative method of evaluation are described by Frick (1990) as qualitative approaches that measure the effectiveness of the programme in meeting the needs of the learner rather than pre-set objectives. This method includes techniques of observation, open-ended questions, personal documents, interviews, surveys and questionnaires. Frick elaborates that this type of evaluation examines changes in the structure of an organization or the roles of the participants in an educational programme and that it permits responses that are not anticipated by the evaluator. Illuminative evaluation attempts to "illuminate" the course to give an account of all aspects, rather than just measuring students' learning (Hanson 1984). This method of evaluation focuses on the learning milieu which is described by Hanson

(1984) as a network of cultural, social, institutional and psychological variables that interact in different ways for different courses. Similar to the sociological approach, this method uses a variety of techniques to collect data, including achievement and other types of tests (Fjallbrant and Malley 1984; Hanson 1984). The criticism of this approach is its tendency to be subjective (Frick 1990; Fjallbrant and Malley 1984; Hanson 1984). An added criticism from Barclay (1993) is that the use of surveys and anecdotal information in this type of evaluation sometimes results in library users either underrating or overrating the value of what they have learned. Barclay (1993) concluded that the method of applying tests has more value in that it is a more certain way of evaluating what was actually learnt as opposed to how persons felt about what they have learned. However, Barclay notes that the methods of collecting evaluation data are not mutually exclusive. Tests and surveys are often done at the same time and might be followed up by examining bibliographies which reflect evidence of use.

The timing of the evaluation leads to either formative or summative evaluation, which is defined by Fjallbrant and Malley (1984:99) as follows:

1. **Formative evaluation** is carried out during the development of a programme and provides direct feedback about the functioning of different parts of the programme. Formative evaluation can be used to improve a course.

2. **Summative evaluation** is concerned with the evaluation of the educational programme as a final product. Summative evaluation provides information about the overall worth of a given course.

Despite the benefits of evaluation towards the improvement of instruction, evidence of systematic evaluation taking place is sparsely documented, or not taking place at all.

In an article by Taylor (1993) that described the success of instruction programmes at three college libraries, it was found that little if any formal evaluation is carried out at these three colleges. Trail and Gutierrez (1991) could find few models of evaluation to incorporate in an instruction programme they were developing. A survey by Dillinger and Weech (1994) investigated BI conducted at 27 different colleges finding that 85% of the BI programmes had not been formally evaluated. Affleck's survey (1992) of 120 colleges noted that 54% of those surveyed described formal evaluation procedures, while a survey by Mensching (1989) found that only 62 % of libraries surveyed evaluated BI in any form.

Hanson (1984) attributes the lack of formal evaluation of BI programmes to the short amount of time that librarians have to conduct evaluation. Affleck's survey (1992) pinpointed staffing constraints as a reason for this shortcoming. Despite the obstacles, Hanson (1984) concluded that librarians should not be dissuaded from attempting to evaluate instructional programmes.

2.4.3 The content of online instruction

This section reviews the literature based on the content of instruction which is discussed in the context of the teaching methods of concept-based and procedural instruction. The literature found on this topic was dealt with by authors such as Huston (1989c), King and Baker (1988), Baker (1986a,1986b), and Borgman (1984a,1986c) amongst others. Borgman however, was the most prolific of all, extensively reviewing the literature of librarianship and other disciplines and laying the foundation in research on online information retrieval pertaining to human-computer interaction, individual differences, and mental model theory. For example, Borgman, (1984; 1985; 1986a,b,c; 1987a,b; 1988).

According to Baker and Sandore (1987:194):

> While there may be a growing support for instruction, the content of such instruction remains an issue of contention. Should instruction be designed around procedural matters, conceptual matters, a combination of both, or something completely different?

Tenopir (1993) reflecting on the impact of electronic reference on instruction commented that most librarians have had to rethink the content of instruction. The debate falling between teaching procedures such as, How does this software work? What keys do I press to search on this system? versus teaching concepts such as effective search strategy, Boolean logic and how to choose an appropriate database. In the context of online instruction these methods have been referred to as procedural instruction and concept-based instruction. Cherry, Yuan and Clinton (1994:356) list the differences between concept and procedural instruction as follows:

Concept-based

1. Presents a conceptual model of the system
2. Focuses on how the system (and others of its type) works
3. Focuses on system-independent skills

Procedural

1. Presents procedures for doing task with the system at hand
2. Focuses on the mechanics of operating the system at hand
3. Focuses on system-dependent skills

Borgman (1986a) specified that the importance of understanding the procedural aspects of a system is that it will determine whether a user will gain access to the system. The importance of the conceptual understanding is that it determines whether the system can be utilized sufficiently to satisfy an information need.

As stated, procedural teaching is specific to the system at hand, which ultimately determines the content of instruction. In the case of concept-based instruction some understanding of psychological models, and the use of analogies and models in teaching, is necessary to explain the content of this type of instruction.

In broad terms, the concepts which are necessary to provide an overall understanding of a bibliographic information retrieval system are listed by Lippincott (1988:185) as follows:

- The concept of a database
- A bibliographic record, its fields and access points
- How a topic is divided into component parts for development of a search strategy
- How to use controlled vocabulary and free text terms
- How Boolean operators or connectors are used to link terms or sets

These concepts are considered important to providing a conceptual framework for the learner to be able to manipulate the system. The manner in which these concepts are conveyed are discussed below in the context of psychological models and teaching analogies.

2.4.3.1 Psychological models used in concept-based instruction

In order to put the approach of concept-based teaching into context, the following discussion introduces the various types of psychological models that form the basis of this type of teaching approach. This discussion is followed by the types of analogies and teaching models that have been developed in the provision of concept-based instruction.

The underlying principle of concept-based instruction is drawn from the domain of cognitive psychology, specifically psychological models, which uses the theory of mental models to describe the learning and problem-solving processes involved in the use of computer systems (Borgman 1987b). In attempting to define the term mental model, Landsdale (1985) notes that most definitions of mental models are vague and use imprecise terms to describe other imprecise terms. There is some commonality of meaning, but less in the area of what a mental model is, as to what it achieves. Landsdale (1985) asserts that the problem is exacerbated by the indiscriminate use of different terms such as users' model, mental model, internal representation, and cognitive model amongst others. These observations were evident in this literature review which found psychological models referred to in some instances as conceptual models and mental models (Eberts 1987), or as cognitive models, conceptual models, and mental models, (Ramsey and Grimes 1983), or as conceptual representation models, implied dialogue models, and cognitive models (Landsdale 1985). King and

Baker (1987) attribute these inconsistencies to the preliminary nature of research conducted in this area. Landsdale (1985) cautioned that definitions of models serve to provide a framework for the concept of a mental model, mainly for clarity of discussion rather than representing necessarily important theoretical assertions. Ebert (1987) reiterates that the term mental model can mean many different things to different researchers. At this time, researchers use the term more as a catch-all descriptive term.

Based on a consensus of the descriptions provided, the following definitions of psychological models were derived:

Cognitive model
A model typically built by a cognitive psychologist, that attempts to describe the mental processes by which humans perform some task (Ramsey and Grimes 1983:44). The notion of a cognitive model is that the user learns with experience particular aspects of the system which cannot be described purely in terms of recruited information. The cognitive model is the undefined essence of what makes an individual skilled as opposed to merely informed (Landsdale 1985:247)

Conceptual model
The conceptual model is a description of the computer system in engineering terms so that it is accurate, consistent and complete (Eberts 1987:274). This model describes the behaviour of a system as the user is intended to understand it by the system designer (Ramsey and Grimes 1983:44), or trainer (Borgman 1984b:37). The conceptual model may be based on an analogy or metaphor for the system's operation (Borgman 1984b:37).

Mental model
Mental model refers to the model that the user forms of how the computer system works. It describes the state of understanding that the user has at a particular time. This model guides the user's actions and behaviours. It is built up through interactions with the display representation which provides a picture of the conceptual representation (Eberts 1987:274, 281). Mental models can be analogical, incomplete, unscientific and sometimes very fragmentary understandings of how something works (Ramsey and Grimes 1983:44).

> The mental model can be based on a conceptual model provided to the user but is not necessarily the same as that model, since what the user extracts from the model to form his/her own mental model cannot be controlled (Borgman 1984b:37). Past experiences influence the mental models of users as they tend to base their models of systems on previous experiences. For this reason experienced users tend to have more clearly defined models of systems than novices (Geyser and van Brakel 1991: 257)

In the context of psychological modelling, instruction that is based on an easily understood conceptual model will make online systems easier to learn and easier to use, thereby expanding access to interactive systems (Borgman 1984b). In Borgman's view this type of model-based training may be more efficient than step-by-step training because the learner can generate methods for acting on the system as needed rather than attempting to memorize all possible cases. However, she adds that even if the user is given a correct conceptual model to apply in learning the system, he/ she adopts the model independently, and the resulting mental model may be inaccurate.

2.4.3.2 Analogies and models used in instruction

In order to introduce a conceptual model of the online system that is easy for the learner to understand the use of analogies and teaching models are common (Baker and Sandore 1987). The instructor chooses a concrete situation that the student is familiar with and presents new information in terms of how it relates to the old familiar information. One problem associated with the analogy method however, is that if there is no perfect match between the old information and the new information the user could inappropriately overextend the analogy (Eberts 1987). For example, he cites the case of students being taught the concept of discarding files using the analogy of a wastepaper basket. Students overextended the analogy assuming that the information was still available until the end of the day when the "trash" was emptied, which did not happen to be the case.

The use of analogies with respect to the teaching of online retrieval systems have been discussed at length by Baker, Huston and Pastine (1991); Frick (1989);

Huston (1989a,b,c); Huston and Oberman 1989; Baker and Sandore (1987); and Baker (1986). In a summary of these scholars writings, the following analogies and teaching models are described:

- card catalogue analogy
- index analogy
- database model
- network model

2.4.3.2.1 Card catalogue analogy

Baker and Sandore (1987) describe this analogy as drawing on the four similar characteristics between the card catalogue and the OPAC. This refers to their coverage and scope, their status as union catalogues, the filing arrangement, and cross-reference provision. Comparisons can be drawn to make students aware of both the similarities of the two catalogues and of how search strategies must be adjusted depending on which type of catalogue is searched. The application of this analogy in the context of an increasingly automated library environment has raised questions related to relevance. For example Huston (1989b) argued a decade ago that the use of the card catalogue as a model in teaching is inappropriate in that in time librarians will encounter users whose only library experience is the OPAC, which quite rightly describes the case as it stands in 1999. Furthermore, as online systems become more sophisticated the differences between online and printed catalogues will outweigh the similarities. Frick (1989) maintains that as users gradually learn the online system they are likely to form new constructs qualitatively different from the card catalogue. Finally, as students become familiar with computers they would be likely to develop a mental model that views the OPAC as a variation on the computer rather than a variation of a card catalogue.

2.4.3.2.2 Index analogy

This analogy equates the OPAC to standard printed indexes. This analogy is used to illustrate an integrated author, title, and subject file (Baker and Sandore, 1987). The drawback is that students are reported to overextend the analogy in that the OPAC is assumed to have the qualities of a periodical index and therefore students expect to find citations leading to periodical literature. There has also been the problem of students not having an understanding of indexing tools in the first place to be able to make inferences from the analogy (Huston 1989b).

2.4.3.2.3 Database model

The increased use of computers and databases in daily life, led to the use of the analogy of the database model. In this instance, it was perceived that the concepts applied to the use of everyday systems such as automated banking outlets, mail order, airline and hotel reservation systems, ticket reservations, and so forth, could be generalized to a library online environment (Baker and Sandore 1987). Through the use of the database model it was hoped to convey the association between the automated systems one encounters in daily life such as online banking facilities, online ticket reservations, and so forth, and the information retrieval systems found in libraries. The shortcoming of this analogy is that it does not cater for those who are not au fait with the automated systems described. This type analogy is also found to be unable to convey to the student all that is needed about how information is processed during an online search (Baker *et al.* 1991).

2.4.3.2.4 Network model

The network model, a sociologically-based approach, proposes that the online search environment is best characterised as a communication network (Huston 1989a). The use of this teaching model presumes that people naturally participate in a variety of communication networks in gathering information. The model attempts to illustrate that conventions and protocols exist in informal communications, for example between neighbours and friends, and in the formal communication that makes up scholarly communication. In the former case, such discussions can lead to articles in newspapers, magazines, talk shows, and so forth. In the latter case, communication leads to the creation of bibliographic structures which acknowledge the outcomes of interconnected scholarly discussions. In the use of this analogy it is supposed that, students can enter scholarly discussions by accessing a prescribed set of commands and protocols, much like societies' conventional rules for entering and exiting conversations (Huston 1989a,1989c). The suitability of this model in concept-based instruction has not been tested, but initial reactions to such a model were reported to be positive. For example, a technical writer from a leading magazine appreciated the authentic sense-making portrayal of how to search for information; a graduate student in special education liked the idea that a person down the street is struggling through the same process that a researcher might experience (Huston and Oberman1989). The literature reviewed was unable to locate more recent information on the further success of this analogy.

2.4.4 Concept-based vs procedural teaching

In the debate between procedural teaching and concept-based teaching the literature reviewed generally favoured the latter method. This was demonstrated in a plethora of anecdotal, and experiential accounts, literature reviews, narrative discussions, programme reviews, and think-tank essays. Many of these writings reflected on the importance of concept-based instruction, and described the concepts that should be included in such instruction. In an equally voluminous amount of information pertaining to the delivery of instruction, namely workshops, computer-aided instruction, one-shot presentations and course-related instruction, the implementation of concept-based instruction was fait accompli. Little mention was made of the analogies that were used in the programmes described, or of the type of learner for which the method of instruction was appropriate.

Barclay (1993) cautions that although these methods of data collection are common to instruction librarians, neither anecdotal information, nor survey information by itself produces hard evaluative data. However, there was a dearth of empirical research in the library literature to provide clear evidence that one method of instruction is superior to the other, or whether a combined approach, using both teaching methods would be suitable. For the most part, the viewpoint that favoured concept-based instruction cited the findings of a benchmark study conducted by Borgman in 1984 which compared the teaching methods. This was evident in the writings of scholars such as Cherry *et al.* (1994), Baker (1986a,b), amongst others. This being, despite Borgman's submission that the data in the 1984 study was not entirely reliable due to problems relating to the nature of the sample, the sample size, and the testing environment (Borgman 1984a).

2.4.4.1 Concept-based instruction

In support of concept-based teaching the following non-research literature was relevant. Branch (1986) was of the opinion that concept-based teaching is appropriate for end-user search instruction because the complexities of computer searching demand that training exceed the rote mechanics of learning log-on procedures. Describing the instruction programme at Welch Medical Library, Branch (1986) explained that the content was designed around concepts which were derived from the difficulties experienced generally by students in the use of subject headings, and misunderstandings about the online systems. However, Branch provided no evaluative data to demonstrate the success of this programme, neither was there any mention of the use of a model to convey the required concepts.

Taylor and Penhale (1988) documented their experiences of an end-user training programme provided as a one-hour lecture to upper level students in biology and psychology who were already skilled in using print tools in their disciplines, and with library research strategies. It was concluded that teaching the concepts of searching rather than the mechanical details of using specific sources allowed students to apply what they learnt to various types of searching, referring to printed and online resources. The report indicates that both students and the faculty were satisfied with their search performance which was rated against the amount of relevant material retrieved in a specific course-related task. What was significant in this programme was that with practice, students became more proficient as library researchers. This could suggest that the more familiar one is with the procedures of a system the more proficient one becomes in search performance. However, although Taylor and Penhale (1988) found concept-based instruction favourable in comparison to procedural instruction, the report does not specify whether the method of procedural teaching was used at all and whether it was evaluated in the same way as was done for the concept-based method.

In an article by Jacobson and Jacobson (1993) it was generally agreed that concept-based instruction is preferable than procedural instruction. These authors quoted Harter's argument (1986) that online search instruction puts too much emphasis on the acquisition of rules such as online log-on protocols or syntax structures which are relatively easy to teach. Too little attention was said to be given to the acquisition of heuristics, which refers to strategies that expert searchers typically employ in solving online search problems.

Wesley (1991) conducted a literature review on concept and procedural instruction and called for a commitment to the former method in online instruction. Based on the review she concluded that naive computer users wanted to find procedural directions for a specific task at the time of need rather than contend with concept-based lectures. On the other hand those who used the system frequently, or who must use the system for their jobs, or who have advanced information needs showed a preference for concept-based instruction. Wesley (1991) rejected procedural teaching citing Nielson and Baker's concerns (1987) that procedural instruction may become excessively bogged down in the idiosyncrasies of the system to such an extent that the user feels he/she will never master the system. Concept-based instruction was also regarded as making more effective use of the time allocated for instruction since generally there is insufficient time to teach all the systems in a procedural manner. Wesley (1991) concluded that concept-based instruction is more beneficial for the reason that recipients of concept-based instruction are reported to:

1. Perform better on advanced, non-routine tasks
2. Have less trouble extricating themselves from error
3. Are better at structuring searches and interpreting results
4. Are able to move from one library OPAC to another
5. Have greater depth of understanding

Adding to Wesley's summary, Cherry *et al.* (1994) grouped the benefits of concept-based instruction into three categories, namely, improved user performance (points, 1 and 2 above), learning transfer (point 4 above), and judgement (point 5 above).

Cherry *et al.* (1994) added to Wesley's list above, stating that concept-based instruction better enables the user:

1. To structure searches and interpret results (improved user performance)
2. To apply their knowledge to new situations (learning transfer)
3. To use other related systems (for example, uses who receive concept-based OPAC training will be better able to use end-user online systems, CD-ROM products, and so forth, (learning transfer)
4. To understand the limitations of the system (judgment).

Research conducted by Cherry *et al.* (1994) which will be discussed in more detail further in this report provides little data to substantiate the categories mentioned above.

In a paper on end-user instruction, King and Baker (1988) were of the opinion that as a result of a technology driven and machine-oriented society, people are attuned to explanations in a cause and effect manner, to step-by-step procedures and to linear processes. Therefore in the provision of online instruction it is easy to outline the mechanics of searching and the use of equipment, and it is easy to learn this aspect of searching, with a little practice. They add that the traditional method for vendors to teach their systems was also based on procedures. This paper noted that concepts are more difficult to teach because it is a non-mechanical and non-linear process; that searching is a creative process, and one which librarians have difficulty articulating.

However, these authors argue, that the greatest difficulties that students experience are with conceptualization and formalisation of their information need, development of a search strategy that exploits the interactiveness of an online system, and selection of terminology, especially with regard to controlled vocabulary. Based on these difficulties, the authors recommend that the temptation to teach in a step-by-step fashion be resisted, and that online instruction focus more on the teaching of concepts (King and Baker 1986).

Similarly, in a paper submitted by Baker *et al.* (1991), concept-based instruction is recommended over procedural instruction for the reason that only when the conceptual aspects are understood can users truly exploit systems. These authors reiterate the point that teaching concepts addresses the user's greatest difficulties and therefore provides a comprehensive framework for the user to assimilate all the discrete activities that take place in the process of information retrieval. According to this view, mastery of the mechanical aspects of operating a system, "...may ensure some results, but it is only when the conceptual aspects are understood, that users can truly exploit systems" (Baker *et al.* 1991:214).

Huston (1989a) writes that after experimentation with various instructional approaches, librarians have come to understand that users require conceptual education, not merely procedural instruction, if systems are to be as intellectually accessible as they are technologically available. In a further article, Huston (1989b) noted that procedural instruction was the practice of online instruction at one point, which could have been a reflection of the discomfort of instructors who themselves were only just becoming familiar with online search tools. This comment is significant in that even though librarians may be considered to have a conceptual understanding of information retrieval, at the point of becoming familiar with online systems there is some indication that procedural instruction is sought. To substantiate the recommendation to use concept-based instruction Huston (1989b:26) cited Borgman's findings of 1984, noting that it "...seriously challenges the adequacy of step-by-step procedural instructions or even worse, rudimentary directions, demonstrations, and printed materials which emphasise the mechanics of searching."

2.4.4.2 Procedural teaching

In respect of the literature on procedural teaching, no specific information could be found that promoted the use of procedural instruction as vigourously as has been the case for concept-based instruction. However, the literature demonstrated a preference by the end-user for procedural instructions and in some cases it was inferred that some users may be more attuned to procedural teaching as will be outlined in the following discussion.

Markey's research (1984) on subject searching in library catalogues, which included members of the public, high school, college and university students, reported that this sample expressed a desire to have step-by-step instructions to assist them during computer catalogue searching. Ohio State University, OCLC, and Dallas public library users were reported to rank step-by-step instructions high up in a list of additions suggested for computer catalogues.

Literature dealing with the difficulties of training foreign students in North Americann libraries indicated that students were more akin to step-by-step instruction rather than working through concepts. For example, McCullagh and O'Connor (1989) and Jacobson (1988) discuss several problems related to proficiency in English, limited library skills and experience which compound BI provided to foreign students. Citing Moorhead's findings of 1986, McCullagh and O'Connor (1989) and Jacobson (1988) concurred that teaching the use of the library in abstract conceptual terms to foreign students did not work well. Wayman (1984) recommended that BI to foreign students should follow step-by-step observational learning. Jacobson (1988) concluded that instruction for foreign students is most effectively delivered when multiple approaches are employed. Borgman (1984a) commenting on the relationship of individual differences and teaching approach asserted that some people may be more inclined to approach problems conceptually and others inclined to approach them procedurally.

In order to identify and propose strategies for BI appropriate to African students, Bowen (1988) conducted a study to identify the learning styles of African students in two colleges in Nigeria and two colleges in Kenya. Bowen's research design included the use of two instruments to identify learning styles. One was a non-verbal test called a Group Embedded Figures Test (GEFT) that was used previously in an African context. This test was used to assess the bipolar dimensions of field dependent and field independent. The second was a Cognitive Style Inventory for African Students (CSIAS) that was further adjusted to fit the vocabulary and experience of the sample. The purpose of this was to test the ability to find meaning from words given and to perceive meaning through sense of hearing.

Scores on the GEFT test proved that both samples from Nigeria and Kenya were field dependent. Scores on the CSIAS test found that African students have a visual orientation rather than an auditory one (Bowen 1988). Based on her findings Bowen concluded that African students understood concepts better if they were related to the students' experiences. Hence when providing instruction in the use of a periodical index, a demonstration taking the student through each step, from selecting the topic to finding the article, is preferred by the students. Bowen's research described the learning style of students in the sample as field-dependent, as did Wilson (1992) describing Mexican and Asian cultures in a discussion on multicultural learners. Field-dependent cognitive styles are said to have a social orientation; profit more from a written plan for learning; tend to approach information in a global way; rely on external referents as guides in information processing. Field-independent cognitive styles were described as non-social; relies on internal referents; and is more analytical (Bowen 1988). Wilson (1992) expressed concern that if some cultures tend to be more field-dependent and others lean towards field-independency, it has implications for teaching students from multiple cultures. She argued that the dominant mode of instruction in American universities is designed for the field-independent learner, which might be in conflict in a multi-cultural environment.

The literature search conducted did not reveal any information on how foreign students, or multi-cultural learners respond to either procedural or concept-based learning.

Although the literature did not specifically advocate the use of the procedural method, there was evidence of this method being used. Nowakowski's research (1988) in

Canada on OPACs discovered that librarians tend to teach users how to search a specific system or *their own* system rather than giving them skills which could translate to other systems. Nowakowski attributed this to the fact there are so many systems with such a variety of commands and search protocol that it results in a focus on the idiosyncrasies of a particular system. In his opinion, concept-based teaching is a more beneficial method of teaching skills and concepts that are used when dealing with online files.

Similarly, a literature review by Rettig (1995) discerned that many librarians maintain the status quo in providing sequential, tool-oriented instruction, focussing on individual sources, including databases. A survey conducted of 414 libraries to assess the status of instruction initiatives in relation to the OPAC found that most of the libraries conducted some form of OPAC instruction even if the system was simple to use (Thompson *et al.* 1994). The report did not specify the method of teaching used, however, the wording of the report suggested that the instruction was provided to teach the use of a specific OPAC found in a library, which could mean that specific procedures were taught. The success of these initiatives was not evident in the report. Rowe's discussion (1994) on automation workshops as a form of delivering instruction mentioned that the tendency in such workshops was for librarians to introduce specific online systems, concentrating on teaching procedures rather than concepts which could be translated to other systems.

One exception to the general thrust of the literature on online instruction was an article by Feinberg and King (1988). Although these authors did not specifically argue in favour of procedural teaching, they also did not accept concept-based instruction as enthusiastically as have so many others. Based on a practical point of view, Feinberg and King (1988) argue that this method cannot expect to lead to long term retention in that students as a group do not regularly use the library and therefore do not strengthen their skills over time. These authors doubted that any teaching method was possible in establishing long-term retention in a population not required to use libraries on a regular basis. They argue that frequency of use is a critical factor in skill retention, rather than method of teaching; that skills taught today, whether conceptual or mechanical are not likely to last long. In their view, the state of flux in technological developments does not allow for the learning of skills for the long term.

To some degree, the literature indicated that librarians were providing online instruction using both methods of procedural and concept-based instruction. The effectiveness of this approach is again not certain, due to the lack of evaluation of programmes.

In the opinion of MacDonald (1991) end-users unlike library professionals do not value search proficiency. End-users are not willing to spend much time learning to search and once trained seldom practice searching frequently to maintain their skills. Therefore, it was concluded that more satisfaction will be derived if realistic goals that combine concepts and skills appropriate to needs are implemented. A paper presented on online instruction for information retrieval, at the Online Information Conference by Onorato (1990) discussed training as both procedural and concept-based. It was not clear whether Onorato was advocating a combined teaching approach or whether he concluded that the concept-based approach should be the method of the future. For example, he recommended that system-specific commands be taught first followed by search commands and that training should consist of showing the user how the interface behaves. Onorato's paper concluded with the view that based on global methods, users should be taught appropriate concepts, preparing them to use the technology in a flexible way. He mentioned that users will require a " ...deep knowledge of database contents, and extended practice of online searching" (Onorato 1990:112).

In a point of use survey conducted by Nahl (1993) it was found that students sought help on both procedural, and conceptual detail. For example questions were asked such as "... How do you return to the main menu?, How do you mark records in *ERIC?,* How can I print?, Which database do I use? Students requested help with Boolean search logic, and translating a query into a search statement. "(Nahl 1993:11). Tenopir's survey (1993) of academic research libraries found librarians using both methods of instruction. For example, librarians reported teaching basic features of software and use of equipment followed by concepts. Some responses noted that it was counterproductive to teach every feature of every software package. Sufficient practical information was considered necessary, but thereafter written instructions were provided. It was interesting to note that Tenopir's survey found most respondents agreeing that the effectiveness of content relies on hands-on practice.

Ready (1985) described an instruction programme which taught the use of an OPAC system. The approach used both methods of instruction as it was reasoned that novice users, in this case freshman students, needed to be taught procedures first before embarking on teaching concepts which was considered a higher level of instruction. In this programme, students who did not use the OPAC more than twice were exposed to procedural teaching. Ready's report (1985) did not include information about the programme evaluation.

Lipow (1991) deviated from the teaching of broad concepts to advocate the teaching of the MARC format which he argues would go a longer way in enabling users to transfer search skills from one catalogue to the next. However, no additional literature was found to follow up on this recommendation.

2.4.4.3 Research in online instruction

A search for quantitative data on the effectiveness of concept-based and procedural instruction in a library environment traced research initiatives which were undertaken in North America. In order to address the research questions of the present research, the researcher was particularly interested in data that could be generalized to the context of a South African academic library. The rationale for the present study was to develop an effective online instruction programme for the variety of online resources in use at the M L Sultan Technikon, a tertiary institution in South Africa. In the context of the South African experience library online resources are used by a diverse end-user population, constituting both academically prepared and under-prepared students therefore, the concern was that, unless students were provided with appropriate instruction, only a few would be able to effectively use the technologies available.

Only two studies specifically compared both teaching methods, namely Borgman's PhD dissertation of 1984, and a research project conducted by Nielsen, Baker and

Sandore (1985) which sought to develop and evaluate a model to be used in instruction in the use of online catalogues.

Borgman's research (1984a) was a pioneer investigation and formed the basis of many of the recommendations cited earlier in relation to concept-based instruction. Borgman's research was also instrumental in shaping the variables and methodology used in the present research. Borgman attempted to test the hypothesis that people would be able to use the system better if they are trained with a conceptual model than if they were trained with procedural or step-by-step instructions that do not provide a conceptual framework for system operation. It was specifically hypothesized that those trained with a conceptual model would perform better on complex search tasks compared to those trained in a procedural condition, but that performance would be equal on simple search problems.

The research project undertaken by Nielsen *et al.* (1985:13) had as one its objectives, "...the development of a general instructional model for online catalogue user education, based on a set of generalized learning objectives for teaching and evaluating online catalogue use that could be modified and adopted by other academic libraries."

The research of Cherry *et al* (1994), Cherry and Clinton (1991) and Buchanan, Rupp-Serrano and LaGrange (1992) were primarily concerned with measuring the effectiveness of CAI instruction. The method of teaching used in the first two instances was specified as concept-based, and in the case of Buchanan *et al.* (1992) although not specified, fitted the description of procedural teaching. For example, it was described that the training package and the script designed, copied specific screens of the OPAC system, Notis, and provided information on specific Notis search commands and techniques (Buchanan *et al* 1992).

A PhD dissertation by Dimitroff (1990) sought to determine the relationship between the completeness of the end-user's mental model of a bibliographic system, and the end-user's success in search performance as reflected by error behaviour. End-users that have developed more complete mental models were operationalised as those who made significantly fewer errors and retrieved significantly more items on a search task. This research was included because it provided descriptive information about end-users whose mental image of the online search system they were searching closely matched the actual conceptual model of that online system which resulted in successful online search performance.

These studies will be further discussed with respect to the online systems observed, sample data, methodology, implementation of the training, methods used in evaluating instruction and general findings related to specific variables.

The common thread in these investigations was that they focussed only on OPAC systems, rather than other types of online technologies such as CD-ROM, or online databases. The OPACs studied were Boolean-based, command or menu-type systems such as UTLAS and DRA (Cherry *et al.* 1994; Cherry and Clinton 1991); Notis, (Buchanan *et al.* 1992; Nielsen *et al.* 1985); the Mirlyn system (Dimitroff 1990) and OCLC (Borgman 1984a).

Baker (1986) stressed that separate OPAC instruction can have the consequence of failing to provide the necessary link between the online catalogue and other information retrieval methods, and may fail to assimilate the computing applications which the user may have learnt in other online search contexts. Wesley (1991) echoed this view stating that OPAC instruction presented as a separate unit would have the tendency to centre on the mechanics of using the system rather than on concepts of retrieval. To support her research of an OPAC system alone, Borgman (1986a) was of the opinion that although studies on the methods for training intermediaries on online database systems were common, they did not provide much information that could be applied to the training of end-users of online catalogues. In Borgman's view (1986a) online catalogues were simpler to use, had typically simpler command structures, and were simpler to learn compared to online databases. Therefore, given reports of other studies that end-users are not willing to invest time in learning about systems, Borgman (1986a:49) concluded that it would be easier to test theories related to teaching methods on online catalogues, than on other types of online technologies, also assuming that these conclusions could be generalized to other technologies.

2.4.4.3.1 Sample data

The sample populations studied were based in academic institutions and were either freshman students only (Nielsen *et al.* 1985) or undergraduate students from all levels (Buchanan *et al.* 1992; Borgman 1984a), or both graduate and undergraduate students

(Cherry *et al* 1994; Dimitroff 1990). The sample sizes ranged from as low as 28 in the case of Borgman (1984a) to 118 which was the largest sample in the case of Nielsen *et al.* (1985), with the others falling in between. Both Dimitroff (1990) and Borgman (1984a) concluded at the end of their research that a larger sample would have produced more reliable statistical reports.

The ability to generalise results from the samples studied to the South African context presented a fundamental problem. Firstly, in the case of Borgman (1984b) although the sample was defined as novice end-users within the population studied, the subjects were undergraduates from the science and engineering departments from Stanford University. Borgman (1984b) admitted that the requirements for admission to the university make these students atypical in a number of ways in that "...they can be considered more intelligent and technologically oriented than the mean population." This is a sharp contrast to the reports on students from South African universities, especially in the light of the findings of Sayed (1998), Shapiro (1995), Bell (1990) and others. Borgman's criticism of her sample was that it was not representative of the online catalogue-using population as a whole. In Borgman's view (1986) the nature of this sample would make them better able to generate their own mental model of the retrieval process and thus less dependent on externally provided models.

Secondly, the inclusion of undergraduate students from the upper divisions (Buchanan *et al.* 1992), and graduate students (Cherry *et al.* 1994; Dimitroff 1990), made it difficult to ascertain whether the findings would apply to an undergraduate student population in South Africa and other regions with a similar background.

As already discussed elsewhere, end-users reflect differences between field dependent and field independent learners. Bowen (1988) describing African students as the former and Wilson (1992) describing American students as the latter. With the exception of minority students, and students who regard English as a second language, an earlier discussion has also pointed to the differences in library experiences which make American students more comfortable in the library than foreign students. A literature review by Lwehabura (1999) endorses the view that in the majority of African countries, library services have no solid base:

> In many instances there is an absence of libraries, reading materials, and qualified staff to provide library services. The poor background experienced by school students had led to little or no knowledge in using library facilities. Students carry over this problem when joining universities and other learning institutions (Lwehabura 1999: 132).

These examples serve to illustrate that the library and the educational experiences are markedly different for students from North American institutions compared to students in developing countries such as South Africa and similar regions. Hence, it cannot be assumed that the learning outcomes of research on instruction conducted in the North American environment can be generalized to the South African context.

A further problem perceived with the sample populations in earlier research is that undergraduates, in particular sophomores, and juniors, and especially graduate students are assumed to have developed some understanding of the systems being studied, either through library education or self education. The inclusion of all these groups in a sample population is likely to confound the outcome of the investigation and additionally, is not likely to be able to provide information about categories such as novice, intermediate, or expert end-users in relation to instruction.

2.4.4.3.2 Methodology

Research conducted by Cherry *et al.* (1994); Cherry and Clinton (1991) ; and Buchanan *et al.* (1992) compared the search performance of two groups, one that received CAI instruction and one that was provided no instruction. In the groups that received CAI Cherry *et al.* (1994) and Cherry and Clinton (1991) used a concept-based approach and in the case of Buchanan *et al* (1992) a procedural approach was used which taught specific steps in the use of the OPAC.

The research of Nielsen *et al.* (1985) took account of prior learning that occurs as a result of many students receiving library education at previous high schools or elsewhere. Hence the experimental design was structured using two instructional sessions so that the effect of alternative modes of presentations of instruction in the use of the OPAC, and cumulative learning effects were considered.

Three experimental groups were created, each taking two tests and receiving two instruction treatments. One being a classroom lecture on the use of the OPAC, and the other included reading a printed brochure designed to convey the instructional content. The form of the lecture was concept-based and made use of the card catalogue as an analogy in teaching use of the system. All three groups were exposed to an introduction tutorial of the OPAC.

Both Borgman's research (1984b) and the present research shared the objective of specifically comparing the teaching methods of concept-based and procedural instruction, hence the methodology used by Borgman (1984a) was of great value to this research.

Borgman's experiment was structured as a two by two design with two training conditions and two genders. The training consisted of documentation which comprised an introduction and some examples of use of the system which was issued to both groups. The training given to the concept-based group used the analogy of the card catalogue to draw similarities between the concepts of searching the card catalogue and searching the OPAC. The procedural group was given written documentation introducing online systems and a step-by-step explanation of Boolean logic and other concepts which were taken directly from manuals and textbooks. An initial screening test made up of fourteen simple search tasks was conducted before the final participants for the experiment were chosen. Those who completed this test within 30 minutes were included in the experiment. The experimental environment comprised five simple and ten complex search tasks which the students were required to complete in 30 minutes after reading the training documentation for fifteen minutes (Borgman1984a). Simple tasks were operationalised as the use of only one index and at most one Boolean operator, and complex tasks as the use of two or more indexes and one or more Boolean operators. Borgman's evaluation of the instruction was based on measuring the difference in search performance on these two task levels, rather than a pre-test and post-test.

Reviewing her research after the fact, Borgman (1984a) concluded that insufficient time was allocated to the reading of the training materials which did not allow for a mental model to develop. She added further, that the research might have been better served if a classroom lecture or CAI method of delivery was used.

For reasons related to the low levels of computer literacy and academic problems experienced by South African students already described elsewhere, the researcher was sceptical of the effectiveness of the approach used by Borgman that provided instruction by expecting students to learn through reading documentation or the CAI approach used by other researchers. Instead, the automated workshop approach outlined by Rowe (1994) was assumed to be a more appropriate teaching format in the South African context.

The appropriateness of the card catalogue as a teaching analogy has been pointed out by Frick (1989); Huston (1989b) and Baker and Sandore (1987) as an irrelevant teaching analogy in a context where online catalogues are the only type of catalogue found in a library and the only type to which the student is accustomed. In South Africa, in 1999, the replacement of card catalogues with online catalogues reflects the norm rather than the exception. Borgman (1984a) also reported difficulty in being able to reflect concepts such as Boolean operators when using the card catalogue analogy.

Of interest to the researcher in the present study is the analogy related to the network model which takes note of the experiences of the student. However, the shortcomings perceived of this approach as it has been described earlier, is that, if used in a South

African context, it is not certain whether the link between informal and scholarly communication will be made. More so with respect to the low levels of library experience and research experience reported of undergraduate students. Based on the researcher's personal experience in the provision of BI to undergraduate students it was perceived that a network analogy based around experiences that are relative to the student's immediate environment will have greater effect in drawing the required associations.

Overall, research depicted the evaluation of the instruction either as a pre-test of library skills and post-test of search tasks (Cherry *et al* . 1994); or a post-test only which tested performance on search tasks (Buchanan *et al.* 1992; Borgman 1984b). The use of monitoring data found in transaction logs was a measure of evaluation reported by Buchanan *et al.* (1992); Nielsen and Baker (1985) and Borgman (1984a).

2.4.4.3.3 Research findings

The findings of the research are discussed in relation to variables of teaching method, system design, and characteristics of the end-users such as frequency of library use, academic major, computer experience and novice end-users.

- **Teaching condition**

Borgman (1984a) found no differences on performance on simple tasks between concept and procedural teaching conditions. Buchanan *et al.* (1992) found small differences in performance on basic author/title search tasks between a CAI procedural instruction group and a no-instruction group.

In performance on complex tasks Borgman (1984a) found that subjects in the concept-based condition scored higher in the number of correct responses than those in the procedural condition. The difference however was not statistically significant, recorded as, "...p=.089" (Borgman 1984b:198). Significantly, Buchanan *et al.* (1992) found that the subjects in a CAI instruction group (procedural instruction) demonstrated a clearer understanding of the use of subject headings, exhibited a better grasp of keyword searching and the use of Boolean operators, than those who received no instruction.

Nielsen *et al.* (1985) were not able to draw conclusions regarding online search performance owing to problems with the testing instrument. However, they found it necessary to teach some procedural steps because at the point of use questions were commonly asked around the specific features of the OPAC system.

- **Gender**

Performance on simple tasks found that men made more errors than women, but there were no differences on performance on complex tasks (Borgman 1984a).

- **Frequency of library use**

Borgman (1984a) found that those who were dropped from the experiment because they failed to pass a bench mark test of simple tasks within a specified time, were students who made frequent use of the library. These students made "...18.7 library visits per month compared to 8.0 visits per month by those retained in the study" (Borgman 1984a:159). In research by Buchanan *et al.* (1992) there were no differences found between those who had experience with the use of library services and in respect of frequency of use of library services. Based on descriptions of the different psychological models it would have been assumed that the experience of frequent library users would have resulted in mental models developed closer to the conceptual framework required to search the system.

- **Academic major**

Dimitroff (1990) found that library and information science students performed better on online searching than all the other students, and that science and engineering students searched better than those from the humanities and social sciences. In Borgman's research (1984a) students who qualified to participate in the experiment ranked mainly from the disciplines of engineering and science, and those who were dropped were mainly social science and humanity majors, had fewer math courses and had lower grades.

- **System design**

Borgman (1984a) reports that although her sample constituted students with high aptitude, they reported difficulty in performing the search tasks prescribed. As a test case for the general population, Borgman subjected her parents to the experiment, one parent being a reference librarian and the other having no prior computer experience. They reported difficulty in accomplishing the tasks, although they found the materials easy to read and the tasks easy to understand (Borgman 1984a). This difficulty could signify that the design of the system could have played a role in the experiment.

In two experiments conducted by Cherry *et al.* (1994) and Cherry and Clinton (1991) it was found that CAI using the method of concept-based teaching, resulted in the first instance in better search performance by the concept-based teaching group in comparison to a no-instruction group (Cherry and Clinton 1991) and in the second instance there was no difference in search performance between the teaching groups (Cherry *et al.* 1994). The experiments used the same method on both occasions but tested the instruction on different OPAC systems. Cherry *et al.* (1994) explained the results in the second experiment to the possibility that the design of the second OPAC system made it easier to search than the first. Once again, this demonstrates that system design could be an important determinant in successful search performance.

- **Computer experience**

Characteristics found common to those who had good mental models were length and frequency of personal computer experience, experience with non-word processing personal computer applications, learning how to use personal computers through informal menus, and frequency of experience with the search system under study (Dimitroff 1990). Buchanan *et al.* (1992) found that students who performed better on search tasks used computers more frequently than those who scored lower. In this case frequency of computer use included those students who used computers daily and who had taken computer classes. Cherry *et al.* (1994) attributed results which found no difference in search performance after instruction was provided, to the reason that the sample was experienced in online searching. Cherry *et al.* (1994) surmised that those with higher levels of computer literacy may benefit less or not at all from concept-based instruction.

Dimitroff (1990) reports that the more experience the end-user had with a system the more proficient he/she became in searching. The end-user learned while using the system, correcting errors as they proceeded, with the exception in the case of subject headings. This finding supports Feinberg and King's position (1988) that frequency of use of online technologies is a significant factor in successful online search performance. It also supports a notion that the more one becomes procedurally acquainted with the system the better one becomes at information retrieval on that system.

- **Difficult search tasks**

Despite Borgman describing her sample as having high academic and technical aptitude, they were found to have considerable difficulty in searching, particularly in the use of Boolean logic (Borgman 1984a). Dimitroff (1990) reported on the inability of the sample to understand subject heading concepts but did not venture to speculate on this point as the research did not include investigating subject headings. Buchanan *et al* (1992) concluded that instruction should focus on the teaching of subject headings and keyword searching as these areas of searching proved difficult for all the participants.

- **Novice end-users**

Although Cherry *et al.* (1994), Buchanan *et al.* (1992), Cherry and Clinton (1991) and Borgman (1984a) attempted to study the effects of training on novice end-users, the samples derived did not constitute novice end-users. Buchanan *et al.* (1992) reported that although instruction was offered to a freshman class, the sample in the instruction group constituted more sophomore, junior, and senior level students. These researchers concluded that the students' seniority played a role in the way the tests were answered.

Hence, it is not any clearer what the effect of concept or procedural instruction is on novice end-users. Both Cherry *et al.* (1994) and Borgman (1986c) speculated that a less sophisticated and more heterogenous community might have benefited more from concept-based instruction than the samples they tested. It is the opinion of the researcher of the present study that the group that Borgman (1984a) dropped from her study because they were unable to complete a screening task might have been the group that would have benefited from concept-based instruction according to the speculations made above. It was of interest to note that the subjects that were dropped from Borgman's experiment, resembled some of the characteristics which have described students in a South African context. For example those dropped from the experiment were reported to have lower grades, lower computer, maths and science experience, and took longer to read the training materials (Borgman 1984a). These characteristics have been similar to findings of September (1993), and Cuthberthson (1992) who reported on the academic underpreparedness of South African students. It would have been of interest to this research to note the findings of Borgman's research had these students been retained in the experiment.

It was recommended that future research investigate the relationship between user experience and the impact of concept-based instruction. That experience should be controlled so that the relationships between various types of computer knowledge and bibliographic skills and the impact of concept-based instruction could be explored (Cherry *et al.* 1994). Dimitroff (1990) recommended that future research pursue an investigation into the individual characteristics of successful end-users.

In the present research, the researcher sought to control experience by including only first year students who enrolled at the institution for the first time, by attempting to complete the experiment before students received BI and before lectures commenced at full steam. The present research also attempted to investigate the variables of proficiency in English, computer experience, and library experience on simple and complex search tasks as described by Borgman (1984a). The variables were selected because of their importance to the online search process as described, and because they represent variables that have been reported to contribute to the difficulties experienced by South African students.

2.5 Summary

In this chapter, it was demonstrated that the use of online technologies such as the OPAC, online databases, and CD-ROM have become entrenched in services provided by the academic library. Technology and libraries are now so interdependent that a library without an OPAC, a CD-ROM network, and access to a host of accessible databases is considered "...at best a novelty, and at worst, a backwater" (Oberman 1996:316). While these technologies present a myriad of benefits with respect to information management and information retrieval, they also can exist as a barrier to information retrieval. The reasons are the lack of standardisation between systems, the overwhelming volume of information that can be generated, the inadequacy of help tools, and the complexity of searching online bibliographic tools. As the suppliers of online products vie to capture a wider market of end-users, the searching of online tools which was once the charge of librarians, or intermediaries, now includes a variety of end-users, namely, the expert, and the, novice, or inexperienced searcher.

Research reveals that some undergraduate students as end-users experience a variety of problems related to the mechanical and conceptual aspects of searching. End-users have also been depicted to have varying degrees of library skills, computer experience and proficiency in the use of English all of which have been demonstrated to have a role in online search performance. Further, the study of human factors has also identified individual differences such as gender, academic major, and academic aptitude as factors that affect online search performance.

To the academic librarian the barriers to effective searching could mean that a segment of the library user community will be effectively denied access to online bibliographic tools, unless intervention is made in the way of providing online instruction.

Online instruction is a recent addition to the traditional programmes of BI which focussed on the use of printed tools. The provision of online instruction has raised a debate over whether it would be more effective to teach the use of online tools in a procedural, that is, step-by-step approach or a concept-based approach, which provides a conceptual framework for the retrieval of information. Many have argued that the variety of tools and search protocol make the approach of procedural teaching ineffective and confusing to the student and therefore they favour the concept-based approach.

The concept-based approach is described as providing a model of a system that enables the studen to construct a mental model that is closest to the conceptual model on which the system is designed. Some of the models adopted in this teaching approach have been the analogy of the card catalogue, index model, database model, and communications or network model.

Overall, there was a dearth of scientific evidence to support the view that concept-based instruction was more beneficial to online instruction. Further, the literature reviewed was not able to provide clarity on which of the two methods would be more suitable, or who would benefit from either method, or whether it is possible for students to transfer learning, as it has been suggested of concept-based instruction. Research reviewed was not entirely reliable as a result of the small samples studied which did not amount to significant differences in search performance. The ability to generalise results to a South African context from the sample populations studied did not seem possible in this researcher's estimation. Feinberg and King's description (1988:27) of the available literature on online instruction aptly described the situation:

> Instruction librarians are urged to make teaching more effective by using conceptual frameworks and other problem-solving techniques...Advocates of long-term competencies, while implying that their teaching is more effective, do not provide evidence of superior results. For that matter, only a handful of articles have appeared that describe attempts at measuring programme effectiveness. While some of these offer statistical evidence of learning and retention, there is still no compelling body of literature to indicate that one method is superior to another for teaching library skills, whether for the short or long term.

This does not however, discount the research of Borgman, and others who have made great strides towards an understanding of the differences between concept-based and procedural teaching. The present research is an attempt to build on this foundation, focussing on different variables, and varying the teaching techniques already used, at the same time using the methodology of Borgman (1984a) and others as a frame of reference.

Chapter 3

Methodology

3.1 Introduction

The purpose of this study was to identify a suitable teaching method in the provision of online instruction to a diverse student population at the M L Sultan Technikon and institutions with a similar student make-up in South Africa. Online instruction should enable students to access the variety of computerized information resources hosted in the library. Resources found in the M L Sultan library, include the online catalogue, a selection of reference titles on CD-ROM and access to external online services e such as SABINET Online, and First Search. The literature reviewed in Chapter 2 provided no concrete choice on the most suitable method for the instruction of South African students at institutions of higher learning in the search principles underlying online technologies in general. The literature advocated however, that the diversity of end-user populations warrants cognisance of the role of individual differences in search performance and in instruction provided.

To this end, the present research sought to determine whether there are differences in online search performance when instruction is provided using the procedural teaching method and when instruction adopts the concept-based method. A further objective sought to determine the differences in the effect of both teaching methods on online search performance in relation to selected individual differences among South African students, using the M L Sultan Technikon students as a "case study."

Despite, the dearth of empirical research in this area, a landmark study by Borgman (1984a) and related studies by Cherry *et al.* (1994) and Dimitroff (1990) were found invaluable to the present research and were used as a basis to attain the objectives described.

This chapter outlines the methods adopted in this research to collect the data, and describes the sample population, the instrumentation used, an analysis of the variables, the pilot test and instrument testing, procedures in data collection and methods used to analyse the data.

3.2 Data collection method

An extensive literature review discussed in Chapter 2, revealed a variety of methods used in the study of online technologies. Many of the studies which focussed on user satisfaction with online systems or which sought to determine search behaviour of students adopted the method of transaction log analysis, conducted surveys, and in some cases for example, Matthews *et al.* (1983) used a combination of methods such a focus interviews, surveys, and transaction log analysis. Research which attempted to determine cause and effect relationships and make comparisons between variables, for example Cherry *et al.* (1994); Dimitroff (1990); Borgman (1984a) and Fenichel (1979), made use of the experimental design. Following the latter examples, the present research was based on a quasi-experimental design to investigate the effect of the methods of procedural and concept-based teaching on online search performance. This research method has been recommended by several authors such as Babbie (1998), Neuman (1997) and Gratch (1983) who regard it as an effective approach to test for causal relationships. Neuman (1997) argues that compared to other social research techniques, experimental research is the strongest for testing causal relationships because the three conditions for causality, namely, temporal order, association, and no alternative explanations are met. According to Gratch (1983) if the research is intended to demonstrate that a particular instructional activity or medium caused a certain behaviour or change in programme participants, then an experimental design is required. Quasi-experimental design is described as more appropriate than a true experimental design because libraries and classrooms do not allow for conditions to be tightly controlled (Gratch 1983).

3.3 Population and sampling

The research sought to train end-users that best fitted the category of naive, or novice end-user in respect of their experience in online searching. As noted in the discussion in Chapter 2, Cole *et al.* (1985) described users in this category as having the least knowledge of the system in terms of semantic or syntactic knowledge. The rationale for training this category of end-user was done to control internal validity. Prior experience in searching the online system, as found in Cherry *et al.* (1994) and Buchanan *et al.* (1992) would have served to confound the findings. The population of first year students who registered at the M L Sultan Technikon for the first time in January 1999 best fitted the category of novice users for the following reasons:

1. Students studying at levels higher than first year, were assumed to have gained some search experience for higher education needs, either through library orientation or having searched the system at some point.
2. Concept-based teaching attempts to provide the user with a mental model that resembles the conceptual model of online retrieval systems. Students at levels higher than first year were assumed to have already been provided a mental model of the online system used in the experiment, either during BI sessions offered by the M L Sultan library, or through their own searching, which would have confounded the research findings. .
3. It was assumed that students at levels higher than first year would have gained some experience in their relative disciplines and with the institution itself, which could have affected the research findings. Buchanan, et al (1992) found that the seniority of higher level students compared to freshman students, made them better equipped to perform search tasks in a test.

Further reasons for limiting the research to the population of first year students was that:

1. First year students were considered the most homogenous group in that all students were registering at the institution for the first time, were qualified up to matriculation level, which is the entrance requirement for admission, and were of the age range of 17 to 18 years, according the Student Admissions Office at the M L Sultan Technikon.
2. Online instruction for the system used in the study is typically provided at first year level to enable access to the online catalogue.

3.3.1 Sample size

In determining the sample size, lessons gained from Cherry *et al* (1994); Dimitroff (1990) and Borgman (1984a) impressed upon the researcher the value of a big sample. As a result of the small samples used, these studies were not able to derive statistically significant results. For example, Borgman (1984a) studied a sample of 28 undergraduate students, Dimitroff (1990) studied 63 undergraduate students and Cherry *et al.* (1994), studied 30 undergraduate students. Research on online systems reviewed by Ovens (1994) found sample sizes ranging from five to 76. Borgman (1986c) maintains that a small sample size is a compromise between monitoring studies that typically have six or fewer subjects to be able to conduct a detailed inspection of the monitoring record, and large field studies that use monitoring data for statistical analysis only. In Borgman (1984a) it is argued that the sample used was large enough for statistical analysis, yet small enough to allow inspection of the monitoring record.

The sample size in the present study was influenced by the timing of the study and more significantly, the resources available to conduct the experiment. Firstly since the intent of the research was to recruit a sample population comprised of novice end-users it was considered important to conduct the experiment as early in the first term as possible. The rationale for this was that the first year student would have had limited opportunity to gain exposure to the services of the M L Sultan Technikon library, in particular, the OPAC. It was also the researcher's view that in the first few weeks of the first term, first year students would not have been sufficiently exposed to their particular disciplines to gain experience that would advantage them during the experiment. In this light it was critical that the experiment be implemented within the first three weeks of lectures commencing. This compelled the researcher to recruit the sample from the students who had completed their registration at that time of the year.

The resources available to the researcher influenced the size of the sample in that the experiment had to comply with the size of venue and hardware available at the M L Sultan Technikon. This comprised a computer laboratory consisting of fifteen personal computer workstations available in four hour blocks daily, in a four-day week. Based on the technical expertise of computer personnel at the Technikon, the researcher was advised that the experiment not rely on the use of all fifteen workstations as the equipment was prone to malfunction. In the likelihood of the hardware not functioning at full capacity and the timing of the study being of essence, the sample arrived at was 180 students. This constituted six percent of the target population of first year students. The total number of first year students was approximated at 3 000 students by the Office of Student Admissions by the closing of registration in February 1999. An approximate figure of 3 000 students was provided as it was still expected that some students would take advantage of the option of late registration. This sample size was considered adequate to produce reliable results allowing for generalization to a broader population.

3.3.2 Recruitment of the sample

The sample was recruited from each of the four faculties of the M L Sultan Technikon, to ensure variability. These were the faculties of Arts, Commerce, Science, and Engineering. Borgman (1984a) found that performance was not affected by the number of computer science courses taken or the frequency of library use, but differences in online performance was detected between academic majors.

The process of recruiting the sample began with an attempt to obtain a list of first year students enrolled at the M L Sultan Technikon for 1999 from the office of Student Admissions. Due to the Technikon's policies protecting confidentiality of student information, it was not possible to obtain this information. The method of advertising or posting flyers as was the case in Dimitroff (1990) and Borgman (1984a) was deemed unsuitable since the delay in finding students would thwart the timing of the research. The researcher resolved to seek the assistance of lecturers responsible for first year programmes. The following departments were contacted telephonically to establish the details of the relevant lecturers:

FACULTY OF ARTS

Department of Communication

Department of Library and Information Studies

Department of Teacher Education

Department of Public Relations and Journalism

Department of Design Studies

Department of Fashion Design

Department of Hotel Operations and Tourism

Department of Hotel Management

Department of Catering Studies

FACULTY OF COMMERCE

Department of Accounting and Auditing

Department of Computer Studies

Department of Economics and Quantitative Methods

Department of Law and Administration

Department of Marketing and Management

Department of Commercial Admin Administration

FACULTY OF ENGINEERING

Department of Architecture

Department of Building Management and Quantity Surveying

Department of Chemical Engineering

Department of Civil Engineering

Department of Electronic Engineering

Department of Mechanical Engineering

Department of Power Engineering

Department of Town and Regional Planning

FACULTY OF SCIENCE

Department of Biological Sciences

Department of Chemistry

Department of Medical Sciences

Department of Health Care Services

Department of Physics and Mathematics

In the course of events, it was discovered that although there were twenty-eight different academic departments, this did not translate into twenty-eight or more first year programmes. Instead, departments tended to combine first year groups sharing common introductory courses. For example, in the Faculty of Commerce, students from the Departments of Accounting and Auditing, Marketing and Management, Computer Studies and Commercial Administration were combined to enable introductory level courses to be taught on the subject of Business Practice. In the Faculty of Engineering, students from each of the eight departments listed were combined to receive introductory lectures in Drawing I. As a result it became difficult to determine the lecturers elected to teach the first year classes. With the aid of departmental secretaries, some of the lecturers were identified, and in other instances where lecturers were not finalised, Heads of Departments offered to assist.

Lecturers were contacted telephonically and in person to seek permission for the use of a double lecture period to conduct the experiment. This time of year proved to be the busiest for academic departments who were overloaded with the registration of new students, finalization of time-tables and lecture venues, which subsequently impacted on their willingness to co-operate with the request. The outcome was that:

1. At least three lecturers from the Departments of Mechanical Engineering, Health Care and Services, and Public Relations and Journalism refused permission to use their lecture periods.

2. In the Faculty of Arts it was found that the Departments of Fashion, Design, and Hotel Management and Catering had not completed entrance aptitude tests hence they were not able to be of assistance. The future of the Department of Education was uncertain in that it was not decided whether the department was going to be restructured or closed.
3. In the Faculty of Commerce, the Department of Marketing and Management failed to return telephonic messages, or were not available. Since several of the lecturers were engaged with student registration, it was only possible to liaise with a lecturer from the Department of Computer Studies who was also co-ordinating first year lectures.
4. In the case of the Faculty of Engineering, a lecturer from the Department of Town and Regional Planning was contacted who willingly agreed to make her classes available. The Department of Electronic Engineering also confirmed their assistance.
5. The Faculty of Science was equally co-operative. In this case, since class venues had not been finalised, lecturers welcomed the request made.

In summary the lecturers who responded positively were:

1. The Department of Library Science (Faculty of Arts)
2. The Department of Computer Studies (Faculty of Commerce)
3. The Department of Law and Administration (Faculty of Commerce)

4. The Department of Town and Regional Planning (Faculty of Engineering)
5. The Department of Electronic Engineering (Faculty of Engineering)
6. The Department of Chemistry (Faculty of Science)

It must be noted that firstly, although two of the departments listed, also coincide with the variables of library experience and computer experience investigated in the experiment, the first year classes were made up of combined groups of students from several departments as noted earlier. Secondly, experience has found that, first year students, do not generally start out with theoretical knowledge of the discipline for which they are registered, and therefore it was assumed that students from particular disciplines would not have any superior knowledge compared to other subjects at this point.

In order to recruit the sample, a time-table was drawn of double-period lectures for each of the participating departments. At the commencement of the lecture period, thirty students were selected randomly and alternately assigned to each teaching condition. In this way it was planned to finally enlist a total of 180 students.

3.4 Instrumentation

The instrumentation used in this research incorporated a questionnaire to elicit background information, a pre-test and a post-test to measure online search performance, a post-experiment evaluation by the participant, a transaction log analyses of the searches performed, a set of training notes for the participants in each teaching condition, the training lecture.

3.4.1 Background questionnaire (Appendix A)

A questionnaire consisting of five sections was developed. The first section pertained to the subject's personal background. Sections two to five sought information on the subject's experience and frequency of library use, computer experience, online searching experience and the use of English language as a primary or secondary language.

3.4.2 Pre-test (Appendix B), post-test (Appendix C) and evaluation questionnaire (Appendix D)

The method of evaluation used a pre-test and post-test to assess online search skills gained during the instruction, an evaluation questionnaire to elicit user reactions to the instruction and the online system used and an analysis of the transaction logs for the days of the experiment. These methods of evaluation of instruction were discussed at length in chapter two with reference to Fjallbrant and Malley (1984) amongst others.

The design of the pre-test and post-test incorporated tasks which generated a right or wrong answer. In this way search performance could be measured by the number of correct and incorrect responses on tasks performed. The design of the search tasks were influenced by Borgman (1984a) and others who grouped tasks into known items or simple tasks and difficult or complex tasks which have been discussed in Chapter 2.

The pre-test comprised three search tasks, two of which were simple tasks and one, a complex task. These search tasks specifically tested respondent's ability to find information on a selected author, title (simple task) and the ability to apply a synonym when no information was retrieved (complex task). The post-test comprised a total of seven tasks, three of which were simple tasks and four of which were complex tasks. These tasks tested the ability to find information on a selected author, title, and to browse through the database (simple task). The complex tasks were based on ability to search for information on a given subject, to narrow or broaden a search, and to find a synonym when no information was retrieved.

An evaluation questionnaire was designed to learn about students' perceptions of the instruction programme and the online system that was searched. Osegueda (1988) emphasizes the value of student evaluation as a means of getting feedback about the effectiveness of training and the extent to which training objectives were met.

The questionnaire consisted of closed-ended questions which elicited a yes or no response, but allowed for additional information to be submitted. The questions specifically sought information about :

- confidence in searching the online system URICA, after the instruction
- confidence in searching other databases after the instruction
- satisfaction with the teaching and notes provided

- the difficulty experienced in following instructions on the screen
- the difficulty experienced in understanding the tasks in the pre and post-tests

This form of evaluation was considered useful to the analysis of the data in respect of providing explanations for resulting outcomes.

Over and above these methods of evaluation, a transaction log report was generated for each day of the experiment, to trace the steps of searches conducted, identify the types of errors made, and to glean additional information about search performance. Due to technical inadequacies, the workstations used in the experiment could not be monitored separately for each student, but could provide an overall report for each training session.

3.4.3 Training materials and description of lecture provided in procedural instruction (Appendix E and F) and concept- based instruction (Appendix G and H)

The instruction given to students in the use of the online system, was designed to follow the method of teaching which depicted procedural and concept-based instruction. Reviewing the definitions provided by Cherry *et al.* (1994):

Concept-based instruction

- Presents a conceptual model of the system
- Focuses on how the system (and others of its type) works
- Focuses on system-independent skills

Procedural instruction

- Presents procedures for doing task with the system at hand
- Focuses on the mechanics of operating the system at hand
- Focuses on system-dependent skills

To effect the instruction, a set of training notes was compiled for each teaching condition and a lecture was presented relevant to the teaching condition. In both teaching conditions transparencies (which were the same for both groups) were used to demonstrate the search screen under discussion. The lectures included sufficient information in both instances to enable the post-test tasks to be performed. Both lectures used the same search examples, and the lectures were designed to last the duration of a typical instruction session at the M L Sultan Technikon, which is approximately forty-five minutes. The literature review in chapter two referred to this as a "one shot" session which is also the practice of other libraries. In some cases, such instruction is included in a semester course.

3.4.3.1 Training notes and lecture provided in the procedure-based teaching condition

The training notes designed for the procedural condition included:

- a brief introduction to the OPAC
- an explanation of typical keys on the keyboard which are required to search online system used in the experiment

- a booklet entitled A Guide to using the URICA computer system compiled by the author, which is a step-by-step manual on how to search the URICA OPAC. This guide is the same as that provided to students at the point of use of the system, in the library itself.

The lecture provided was a step-by-step demonstration of searches related to the author, title and subject index, browsing, selecting records, explanation of a record display, use of proximity and truncation features.

3.4.3.2 Training notes and lecture provided in the concept-based teaching condition

The training notes designed for the concept-based condition incorporated concepts to provide a broad understanding of online systems and searching principles. The following concepts were described, based on Lippincott's (1987) outline of relevant concepts that must be included in online instruction:

- an introduction to the online computer catalogues found in libraries
- hardware concepts such as what is a computer terminal, the use of the keyboard in general
- search concepts outlining
    - what constitutes a database
    - search jargon, for example, OPAC, online, record, term, hits

- methods of accessing systems (command, menu, form)
- author, title, subject search indexes
- search techniques, for example broadening/narrowing a search such as proximity and truncation features.

These concepts also served as the learning objectives of the lecture. The lecture in the concept-based instruction was designed to enable the development of a mental model of general principles about how information is stored and accessed on online systems. It was was organized in three sections:

> Section One provided background information on the development of OPACs, and explained search concepts related to search jargon as described above.
>
> Section Two described computer hardware, and use of the variety of keys that might be used in searching different databases.
>
> Section Three made use of an analogy to illustrate methods of accessing systems, the concept of different search indexes such as author, title and subject, controlled vocabulary, and search techniques such as narrowing or broadening a search using proximity and truncation features.

The use of analogies to convey concepts related to online searching and their shortcomings were discussed at length in the literature review in Chapter 2. Huston

(1983) advised that teaching about information access can best be achieved by first emphasizing the familiar, which is the student's experientially derived framework, and then linking this to the new, which is the searching skills they are required to develop. In this context Huston promoted use of the communications analogy. Her framework was based on a sociological approach which looked for examples from the student's daily life or experiential information to create the communication analogy. A summary of the analogy used can be found in Appendix H.

The present research, adapted Huston's communication analogy to present the required search concepts. Two models were developed. One model demonstrated the association between, the way information can be searched in an online database, and the organization of persons in a household and how these persons can be accessed by a visitor from the outside. This model explained methods of access, search indexes and search techniques.

The second model formed an association between the way information can be found on the whereabouts of a patient in a hospital and the way the "whereabouts" of information can be found on an online system. A detailed table reflecting this analogy can be found in the Appendix H.

3.4.4 Computer environment

The experiment was performed on the OPAC system, URICA Intergrated Systems, v.7, commonly called URICA, which is used at the M L Sultan Technikon, and can be accessed from remote personal computer workstations via the campus network. An example of typical search screens encountered in the use of the URICA system can be found in Appendix I. This system has features common to other types of online technologies and OPAC systems in general in that it is menu-driven, has multiple access points, incorporates features such as the use of boolean operators, proximity and truncation features, and is able to generate a transaction log to record daily search entries. The choice of using this system was based on the technical reason that it was the system most able to be accessed from the remote workstations used in the experiment. As noted by Borgman (1986a) in Chapter 2, the distinctions between online technologies are beginning to blur in respect of system design and populations served.

In order to conduct the pre-test and post-test the experiment secured the use of a computer laboratory of the Department of Library Science at the M L Sultan Technikon. The laboratory consists of fifteen terminals linked via the campus network to the OPAC, URICA in the library. Although an attempt was made to secure the use of additional laboratories, this did not materialize. With the permission of the Library Science Department, the laboratory was available to the research for four-hour blocks daily, from 12H00 to 16H00 for a period of twelve working days, excluding Fridays. This amounted to use of the venue over a period of three weeks from the 8th February to 25th February, 1999.

3.5 Analysis of variables

To meet the research objectives specified, the relationships between the following independent, moderator and dependent variables were investigated:

1. **Control variable and constant**: In order to control the variable of experience, subjects included in the experiment were restricted to first year students enrolled at the M L Sultan Technikon for the first time.
2. **Independent variables**:

   Concept-based teaching method

   Procedural teaching method
3. **Moderator variables**:

   Low frequency of library use

   High frequency of library use

   No familiarity with computers

   Has familiarity with computers

   English primary language

   English secondary language

4. **Dependent variables:**

   Online performance on simple tasks

   Online performance on complex tasks

This investigation sought to investigate:

1. The relationship between each teaching method (independent variable) on online search performance at two levels (dependent variables).
2. The relationship between each teaching method (independent variable) and the interactive effects of each of the moderator variables above in respect of online search performance at two levels (dependent variables).

3.6 Pilot test

The research instruments designed were reviewed by three members of staff at the M L Sultan Technikon library, their job titles being that of subject librarian, data administrator, and shelver. Thereafter, the instruments were reviewed by three in-service students from the Department of Library Science who were appointed to the library. The suggestions from these groups of people, led to rewording of questions in the background questionnaire, and layout of the evaluation questionnaire. Thereafter, this researcher's supervisor reviewed all of the research instruments and made additional suggestions for improvement. This led to further restructuring of the background and evaluation questionnaires in terms of layout, phrasing of questions, and instructions provided. The pre- and post-tests were also redesigned to improve on the layout and instructions provided.

A pilot run of the experiment was conducted in February 1998 to determine the suitability of the logistical arrangements, research instruments, the data collection method, and possible threats to internal validity. Problems encountered were related to the recruitment of subjects, and duration of the experiment.

The pilot study recruited 100 students from the groups of students who attended library education at the beginning of 1998. This method of recruitment proved unsuccessful because of the difficulties experienced in co-ordinating the teaching sessions of the experiment with the lecturing time-table. This form of recruitment resulted in the duration of the experiment lasting from January to April which meant that some students participating in the pilot study had made prior use of the M L Sultan OPAC or gained other experience which was a control factor in the experiment. Subsequently it was decided to seek another method of recruiting subjects for the main experiment.

Those who participated in the pilot study were found to take a long time reading the documentation and working on the keyboard. Participants were not familiar with the hardware, and were impatient when the system took long to respond . They frequently depressed keys which logged them out of the system. As a result the training session took longer than one hour as previously designed and proposed. The session was thus changed to a two-hour period in the main experiment.

Two venues located in the M L Sultan Technikon library were found suitable in that training sessions for both teaching conditions could be conducted simultaneously, allowing for a greater number of sessions to be conducted in a day. Due to the construction around the library which was taking place in 1999 these venues were no longer available for the main experiment.

After the pilot study some of the questions appearing in the research instruments were revised to achieve greater clarity. For example, a question in the background questionnaire , "Have you been employed in a library,?" was rephrased to read "Have you ever worked in a library?"

3.7 Data collection

The administration of tasks during the process of data collection was accomplished by the researcher with the assistance of a research assistant, two computer personnel, and two instructors. The research assistant, was a library science graduate from the M L Sultan Technikon who had approximately one year of experience as an ad hoc assistant in the Technikon library in the provision of library orientation. The research assistant was bilingual in both English and Zulu which was helpful in instances when students had difficulty articulating their concerns in English. The computer personnel were persons employed in the Technikon library and provided both technical and other assistance in distributing and collecting materials. The instructors comprised, this researcher and a professional librarian with a Bachelor of Technology qualification in library science employed in the Technikon library.

A time-table was arranged with lecturers to identify dates and times for the training. The training was scheduled for the 8th to the 25th February, 1999 for the duration of two hours for each teaching condition. The teaching was done back-to-back to prevent students from discussing their experiences which would have affected internal validity. On the scheduled date, the researcher and research assistant met the lecturer at the scheduled venue, students were briefed at that time about the research and were told that volunteers were needed to be trained to search the library online catalogue. The emphasis was placed on the fact that they would receive hands-on online instruction, rather than providing an explanation of the complete research objective. The students were generally enthusiastic about participating in the training. Thirty students were randomly selected and assigned to each teaching condition. This selection involved choosing every second student from the show of hands that volunteered, alternating students selected between a procedural and a concept-based condition.

Students selected were escorted to the training venue, to prevent delays in implementation. Most of the lecture periods assigned for this task were tutorial periods which afforded the researcher four hours of the student time needed for the experiment. In cases where it was not a tutorial period lecturers and students expressed no objections. The lecturer released one set of fifteen students for the first two hours and another set of fifteen students in the second two hours. At the time of the experiment, it was possible to transfer computer terminals from the library at the M L Sultan Technikon to the testing venue which allowed for fifteen terminals to be used in the teaching session.

The procedures followed in the data collection comprised:

1. A brief introduction to the research team and an explanation informing students that they were going to be given training in the use of computerized systems found in libraries.
2. Instructions were given separately for each segment of the experiment so that subjects did not become alarmed at being given search tasks to complete.
3. The background questionnaire was issued first. The instructor in charge of the session read through each question, allowing time for a response. This ensured that every question would be answered, that ambiguities could be clarified and that sections were completed in the amount of time set aside for the task. This took fifteen minutes to complete.
4. This was followed by an explanation of the pre-test. Each task was read out aloud and the information required was explained briefly. The instructions specified that each subject must work independently, that they could experiment with the system to find the answer and that could ask questions to clarify the task. Subjects were invited to list comments describing their experience in accomplishing the tasks. The pre-test was allocated fifteen minutes to complete. At the end of fifteen minutes subjects were asked to

stop working after which the research assistant ensured that each test was stored away from the student so that answers could not be revised later.

5. A lecture was delivered for approximately forty-five to fifty minutes, teaching concepts or procedures depending on the teaching condition. During this session a microphone was used as both instructors were soft spoken. The instruction was provided by the researcher in the case of concept-based instruction, and by a professional librarian from the M L Sultan Technikon in the case of procedural instruction. This instructor has at least three years of searching experience on the URICA system and is also experienced in provided instruction on the URICA system using the procedural method.
6. At the end of the lecture, the post-test was introduced. The questions were read through for clarity. Instructions were repeated as for the pre-test, except that subjects were asked to apply what they learnt rather than encouraged to experiment with the system. A maximum of forty-five minutes was assigned for this task after which the evaluation questionnaire was issued. Those who finished before this time were given the evaluation questionnaire and allowed to leave when it was completed.
7. During the testing period, students were observed as they worked and general notes made of their performance.

In an experiment such as this there are many factors that have to be balanced to ensure that plans flow smoothly. For example, lecturers needed to be reminded that they were committed to a particular time and day for the experiment. Subjects had to be herded each time to the testing venue so that no one was left out. Equipment had to be tested daily to avoid any unexpected breakdowns. However, in dealing with human subjects, it must be appreciated that a total control of events is not possible. As such there were problems encountered during the data collection.

In respect of the sample size, although 180 students were targeted, in the final analysis only 120 students accomplished the tasks. Firstly, thirty participants expected from the Department of Electronic Engineering were excluded as the lecturer had inadvertently sent the group for a library orientation session at the time scheduled for the experiment. In the group of thirty students recruited from the Department of Computer Studies, fifteen students assigned to the procedural teaching condition did not complete the experiment, the reason being that the computer laboratory had been double-booked by the computer personnel and priority was accorded to the lecturer who required the venue. Despite two attempts to reconvene the session, time-tables did not permit the students to re-schedule their time. Thereafter it was not possible to continue with this session. Students commenced with lectures in computer science which meant that they would have engaged in practical work using computers, which would have confounded the research results. The experiment had to be extended to the first week in March, as the researcher took ill and was unable to complete the sessions scheduled for the last week in February. As a result an additional fifteen students who were from the Department of Law and Administration did not take the test. The subjects who took the test in March belonged to the Department of Library Science. Owing to the extreme co-operation by two of the lecturing staff in this department who were willing to adjust their teaching programme to suit the experiment, without compromising the students, the experience factors which were being controlled, did not become an issue.

3.8 Data analysis

The research instruments described above were systematically coded to enable the researcher to compute and examine the distribution of the data. It must be noted that the manner in which data was collected resulted in no missing values in the analysis. For example, in the background questionnaire each question was read out with participants answering a question at a time, in the case of the pre-and post-test all participants attempted every search task, and all participants answered every question in the evaluation questionnaire.

3.8.1 Coding of the data

With respect to the background questionnaire, responses to each question were coded beginning with a zero. In cases where there were multiple responses the first response was coded as zero, the second response was coded as one, and so forth. Data fields in the background questionnaire were prefixed with the letter "Q" followed by the question number to distinguish these responses from data collected in the other instruments. For example "Q1", "Q2" and so forth.

With respect to performance tasks, responses were either correct or incorrect to make it possible to determine unambiguously whether the task was completed correctly or incorrectly. Tasks that were answered correctly were coded with the number zero, and incorrect answers were coded with the number one. Data fields were prefixed with the letter "A" followed by the task number, for example, "A1', "A2", "A4a", and so forth.

With respect to the evaluation questionnaire which recorded the affective responses, choices were either, yes, no, or other, which were coded with the numbers zero, one, and two respectively. Each data field was prefixed with the letter "E" followed by the question number, for example "E1", "E2" and so forth.

The raw data was captured into a programme designed in Microsoft Access software version 97. This enabled a report to be produced that could be verified against the coded instruments for correctness. Subsequently, the data was exported into a file in Microsoft Excel software version 97 which was used as an input file for analysis using the Statistical Package for the Social Sciences, (SPSS), version 9.0. The analysis conducted with the SPSS software performed chi-square and McNemar tests to determine the extent to which any differences that existed between the two teaching conditions were significant. The use of these tests will be explained in more detail in further sections.

To facilitate the analysis, data was captured on Microsoft Access '97 software and thereafter exported into an Excel '97 spreadsheet. This was used as a source of input into the Statistical Package for the Social Sciences software (SPSS) v.9.0 which was used to further compute and analyse the data. The SPSS package performed chi-square, binomial ınd McNemar tests in the analysis of the data. A presentation of the findings both in ıuantitative form using descriptive statistics, and qualitative form follows in Chapter 4.

3.9 Summary

This chapter outlined the methodology used in this research which was a quasi-experimental design to investigate the effects of the methods of procedural and concept-based instruction on online search performance. A sample of 120 first year students was ecruited from the population of first year students enrolled at the M L Sultan Technikon n January 1999. Students were randomly split between the two teaching conditions of procedural and concept-based instruction and thereafter subjected to a pre-test, followed by a lecture on online searching for an hour concluding with a post-test and an evaluation of the instruction provided. Instrumentation used in this research entailed a background questionnaire, and a pre-test and a post-test to measure online search performance. To acilitate the analysis of data collected the Microsoft Access '97, Excell '97, and SPSS .9.0 software was used. The presentation of the findings both in quantitative form using escriptive statistics, and qualitative form follows in Chapter 4.

Chapter 4

Presentation of the results

4.1 Introduction

The purpose of this study was to determine whether there were any differences in search performance between persons who were provided online training in a concept-based and those trained in a procedural teaching method. The study sought to further investigate the degree of variance in search performance between persons trained in each teaching method in relation to individual differences such as library and computer experience, and English language usage. The specific objectives and research questions posed in the study which are also indicated in Chapter 1 are listed as follows:

1. To determine whether or not any differences exist in online search performance between students trained in a concept-based, and those trained by procedural teaching methods.
2. To determine whether or not any differences exist in online search performance between students with differing library experiences trained in a concept-based and those trained by procedural teaching methods.
3. To determine whether or not any differences exist in online search performance between students with differing computer experiences and trained in a concept-based and those trained by procedural teaching methods.

4. To determine whether or not any differences exist in online search performance between students who regard English as a first or a second language trained in a concept-based and those trained by procedural teaching methods.

The research objectives gave rise to the following research questions:

1. Are there any significant differences in search performance on simple online tasks, between students who are conceptually trained and those who are procedurally trained?
2. Are there any significant differences in search performance on difficult online tasks, between students who are conceptually trained and those who are procedurally trained?
3. Are there any significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to students with low levels of library experience and those with higher levels of library experience.
4. Are there any significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in relation to students with low levels of library experience and those with higher levels of library experience.
5. Are there any significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to students who are familiar with and those who are unfamiliar with the use of computers?
6. Are there any significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in relation to students who are familiar with and those who are unfamiliar with the use of computers?

7. Are there any significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to students who regard English as a first language and those who regard English as a second language?
8. Are there any significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in relation to students who regard English as a first language and those who regard English as a second language?

To meet these stated objectives a quasi-experiment was implemented, which made use of a background questionnaire issued to participants prior to training to collect data related to demographic information. Evaluative methods used to assess whether there were significant differences in performance between the teaching methods of concept-based and procedural instruction included a pre-test issued to participants prior to training and a post-test issued after training was provided. Additional methods used to evaluate the instruction provided made use of an evaluation questionnaire issued after the post-test was completed, direct observations made of search performance, and an analysis of transaction log reports. The evaluation questionnaire was used to collect data on the opinions of the participants in relation to their confidence in searching the OPAC system used in the study and other systems, and their satisfaction with the training provided. A transaction log of the search input to complete the experiment tasks was analysed to identify search errors, and in turn understand search behaviour of the participants. These instruments can be found in Appendices A-D. This chapter presents an analysis of the data collected. The implications and interpretations of this data are presented in Chapter 5.

The first part of this discussion describes the sample population and the second, presents the results for each of the research questions posed. Data is presented in both qualitative and quantitative form which includes tables and graphs and are arranged according to the questions posed in the research.

4.2 Background of the participants

The sample population comprised a total of 120 first year students who were recruited from the M L Sultan Technikon. The students were randomly selected from academic faculties of the institution, namely, Arts, Commerce, Science and Engineering. For purposes of the experiment the sample was divided into two groups of 60 which were split by two online teaching conditions, namely, concept-based and procedural instruction. In order to limit the effect on the results of prior experience in online searching and course related experiences, the experiment was conducted at the commencement of the academic programme in 1999.

Demographic information was elicited through the background questionnaire which provided data on prior online searching experience and on personal characteristics such as library and computer experience, and English language usage. However, it must be noted that more data on personal characteristics were captured than was used in the final analysis.

4.2.1 Search experience

The search experience of the participants was important to the research for two reasons. Firstly, the research aimed to investigate the outcome of the teaching conditions on search performance in relation to inexperienced or novice end-users only. As noted in the discussion in Chapter 2, there are different categories of end-users who are defined according to their experience levels and skills and knowledge of online searching. Hence, each category of end-user was considered to have different training needs and likely to respond differently to the type of instruction received. Secondly, the novice status of end-users was important to interpreting the results of search performance after participants received concept-based teaching. The underlying principle of this teaching method is to provide a conceptual model of online searching to the learner in helping them to understand and learn how to search online. Extensive prior experience would serve to confound the results in that it will make it difficult to assess whether it was the model presented in the teaching, or whether alternative reasons such as the individuals own mental model developed through prior experience, was responsible for search performance on tasks in the experiment.

The level of search experience of the sample was reflected in responses in the instrument to items fifteen, seventeen and eighteen respectively. Question fifteen of the instrument queried prior search experience using the URICA library system and found that out of 120 respondents, there were eleven (9.2%) positive responses and the majority of the participants, 109 (90.8%) had not used the system prior to the experiment. The use of computers in general to search for information was queried in question eighteen and this produced similar findings, namely, that out of 120 responses twenty (16.7%) responded positively while the majority, 100 (83.4%) indicated never having used nor having any idea about the use of computers to find information. Responses to question seventeen of the instrument found that out of the 120 participants fifteen (12.5%) had received online training prior to enrolment at M L Sultan Technikon, but the majority of the participants, 105 (87.5%), had no prior online training at all. Of those who had used computers previously or received online training, there was no indication as to what system they had used and the type of training received. The overall search experience of the sample was low which according to a definition by Cole, *et al.* (1985) constitutes a novice status. Since the majority of participants had not used the URICA system prior to the experiment, this was an indication that a specific conceptual model of the system might not have been developed. This also meant that although participants had their own perceptions of the system, according to the literature reviewed in Chapter 2, the method of concept-based teaching could be used to provide end-users with a model that closely matched the conceptual model of the online system. In the literature reviewed in Chapter 2 it was also reported that if end-users are not provided with a model of the system they will resort to the use of their own conceptual models of the system which might not necessarily be match the conceptual model of the system.

In order to address the research questions posed, data was collected on characteristics such as prior library experience, computer experience and English language usage . Data related to these variables were collected after the participants were split into the respective teaching conditions, which comprised 60 participants in each teaching group.

Data was collected from responses to questions ten and thirteen of the instrument which indicated prior use of OPACs or card catalogues, and frequency of library use. Question 4a of the instrument depicted computer experience, 4b listed the types of computer experience and questions nineteen and twenty solicited data on experience with the English language. That is, whether English was the respondent's first or second language. In order to measure the degree of experience of the participants in relation to library experience, computer experience and English language use, specific criteria were used. These variables and the criteria used to measure the variables are depicted in Table 4.1. Data collected on each of these variables is presented in sections which follow.

Table 4.1 Library and computer experience, and English language usage

Variable	Measure
Library experience	Reported use of OPACs or card catalogues and frequency of using a library to find information. **Low library experience** . This constituted a frequency of once a month or never and no prior experience in the use of OPACs or card catalogues. **High library experience** . This constituted a frequency of once a day or once a week and having prior experience either in the use of an OPAC or card catalogue.
Computer experience	Reported use of computers where a yes or no response indicated prior experience.
English language use	Reported use of English as a first or second language.

4.2.2 Library experience

As indicated in Table 4.1, library experience was categorised into two groups, namely those who had high library experience and those who had low library experience. Based on the criteria developed in this research, those who made prior use of OPACs or card catalogues and who had high frequency of library use, that is use of the library to find information, daily, or once a week, were classified as having high library experience. Those who did not make prior use of OPACs or card catalogues and who had low frequency of library use, that is use of the library to find information, monthly or never, were classified as having low library experience . However, if participants had high frequency in library use but no prior OPAC or card catalogue experience they were not included in the analysis. If participants made prior use of an OPAC or card catalogue but had low frequency in library use they were also not included in the analysis.

Data was collected on library experience after they were divided into two groups of 60, one of the groups receiving concept-based training and the other receiving procedural training. In the overall sample of 120 participants, only seventy-seven of the participants met the criteria to be included as having either low or high library experience. The results indicate that out of a total of 77 participants more than half of the participants, 44 out of 77, constituted high library experience, and 33 out of 77constituted low library experience. Of the77 participants, those who met the criteria for high library experience were made up of twenty out of a total of 60 participants in the concept-based teaching condition and 24 out of 60 in the procedural teaching condition. Those who constituted low library experience were made up of twenty out of 60 in the concept-based group and thirteen out of 60 in the procedural group, which was less than half in this group. Overall, the procedural condition had slightly more participants with high library experience than the concept-based group, and fewer participants than the concept-based group with low library experience.

In the overall sample of 120 participants, confidence in use of the library to find information was low. The majority of the 120 respondents indicated being either unsure which was a total of 65 (54.2%), or experiencing difficulty in the use of the library, which was a total of five. Reported confidence in the use of the library of respondents in each teaching condition found that out of 60 in the concept-based teaching condition, 22 (36.7%) felt confident in using the library and a slightly higher number 28 (46.7%) out of 60 in the procedural condition felt confident in using the library.

4.2.3 Computer experience

Data was collected on computer experience after participants were divided into two groups of 60, one for the teaching condition of concept-based instruction and the other, procedural instruction. With respect to the use of computers, results indicated that of the total sample of 120 the majority of participants, 73 (60.8%) of the 120 respondents had not used a computer prior to the experiment. Out of 60 participants in the concept-based group, 38 (63.3%) had no computer experience and out of 60 participants in the procedural group 35 (58.3%) had no computer experience.

Amongst those who made prior use of computers, there were 22 (36.7%) out of 60 respondents in the concept-based and 25 (41.7%) out of 60 in the procedural group. The reported confidence in use of computers reflected that out of the overall sample of 120 the majority of participants, 59 (49.2%) of the 120 felt either unsure of their ability to use a computer, or considered it difficult to use (fourteen or 11.7%). Out of 60 participants in the concept-based group, 36 (60.0%) felt unsure about the use of computers and four (6.7%) felt that they would have difficulty in using computers. Out of 60 participants in the procedural instruction group23 (38.3%) felt unsure and ten (16.7%) felt that they would have difficulty in using computers. Hence, in comparison more participants from the concept-based group than the procedural instruction group reported a lack of confidence in their ability to use computers. Those who felt confident in their ability to use computers made up twenty (33.3%) in the concept-based group and 27 (45.0%) in the procedural instruction group. It is also noted that of the overall sample of 120, 47 (39.2%) indicated feeling confident in their ability to use computers . This was equal to the number of participants in the overall sample of 120 who indicated that they had made prior use of computers.

4.2.4 English language use

In relation to the use of the English language, of the overall study sample of 120 participants, 96 (80.0%) indicated that English is their second language and 89 (74%) of the 120 participants indicated that it is not the language they most often speak at home. The distribution of this variable between both teaching conditions found thirteen out 60 respondents (21.7%) in the concept-based group, and of 60 in the procedural group eleven (18.3%) regarded English as a first language. Of those who regarded English as a second language, there were 47 (78.3%) participants out 60 in the concept-based group, and 49 (81.7%) out of 60 participants in the procedural group.

In summary, the sample can be described as a group that had some exposure to libraries as indicated by library experience, were not very experienced in the use of computers and who do not regard English as their dominant language. Overall they did not feel confident in their ability to use either the library or computers to seek information.

In further analysis binomial tests conducted using SPSS, v.9.0 software revealed no significant difference in the distribution of these variables, between both teaching conditions. A binomial variable is one that has only two attributes (Babbie 1998). In this case the variables of library experience had the attributes of either high or low library experience, the variable of computer experience had the attributes of use or non-use of computers, and the variable of English language use had the attributes of English used as a first or a second language. A more precise definition refers to a binomial test as one that is used to compare the "...observed frequency in each category of a dichotomous variable with expected frequencies from the binomial distribution and makes use of a specified probability parameter" (SPSS v.9.0 1999:341,346). In this research the probability parameter was set at a 95% confidence level or 0.05 significance levels, which is a common measure of probability as indicated by Simpson (1988) and others. Hence throughout this research results where the significance level or p value is greater than 0.05 are not significant and where the p value is less than 0.05 results are significant. Values of 0.0000 indicated high significance. As reflected in Tables 4.2a and 4.2b the distribution of the variables reflected no significant differences between the teaching conditions of concept-based and procedural instruction.

Table 4.2(a) Demographic variables of respondents and teaching method groupings

Demographic variables	All N=77		Conceptual N=40		Procedural N=37		Binomial Test P=
	No.	%	No.	%	No.	%	
High library experience	44	57.1%	20	50.0%	24	64.9%	0.6511
Low library experience	33	42.9%	20	50.0%	13	35.1%	0.2963

Table 4.2(b) Demographic variables of respondents and teaching method groupings

Demographic variables	All N=120		Conceptual N=60		Procedural N=60		Binomial Test P=
Have computer experience	47	39.2%	22	36.7%	25	41.7%	0.7705
Without computer experience	73	60.8%	38	63.3%	35	58.3%	0.8149
English 1st language	24	20%	13	21.7%	11	18.3%	0.8388
English 2nd language	96	80%	47	78.3%	49	81.7%	0.9187

4.3 Evaluation of instruction

Evaluation is an important component of instruction for the reasons in that it can be used to compare different methods to assess the effectiveness of instruction, to determine the effect of instruction on student search behaviour, to assess students' opinion about the library programme, or to find out if students were able to attain the learning objectives

(Svinicki and Schwartz 1988). Several methods can be used for the evaluation of instruction which have been dealt with in more detail in Chapter 2. This research made use of a few different methods, namely a pre-test and post-test to compare the effectiveness of the teaching methods of concept-based and procedural instruction, a transaction log analysis to assess search behaviour and an evaluation questionnaire to elicit affective responses about the student's opinion of the instruction programme. The methods of evaluation used in this research will be discussed further in subsequent sections. Fjallbrant and Malley (1984) pointed out that the learning and teaching process is dependent on a variety of factors, many of which are unpredictable. Hence, the use of more than one type of evaluation method is both valuable and complementary enabling the evaluation of the total situation. Based on the outcome of responses to an evaluation, decisions can be made about the future development of the instruction programme. The following sections provide the results of the various evaluation methods used to determine significant differences in performance between the teaching method of concept-based and procedural instruction.

4.3.1 Online search performance on pretest and post-test

Instruments used to collect data on search performance was a pre-test and a post-test comprised of simple and complex tasks performed on the URICA OPAC system available at the M L Sultan library. URICA contains most of the search access points and features commonly found in online information retrieval systems such as the conventional author, title, subject heading as well as boolean operations capability, truncation and proximity features, and keyword search capabilities. The system is menu-driven and provides prompts, instructions and help screens throughout the use of the system. The data on the system is organized as an inverted index and the input of subject headings makes use of controlled vocabulary using *The Library of Congress Subject Headings.* Typical search screens that are generated when searching the URICA system are displayed in Appendix I.

In order to meet the objectives and address the research questions posted, online search performance was evaluated using the method of a pre-test and a post-test which is described by Fjallbrant and Malley (1988) as a quantitative measure of changes in an experimental condition where two groups are exposed to two different treatments. Pre-tests are given to participants before training is conducted and post-tests after training is conducted. The analysis is concerned with significant differences in performance of the two groups which in this case was the difference between the teaching methods of concept-based and procedural instruction on online performance. In this research the pre-test and post-test were measured according to differences between the two teaching conditions in the number of correct responses attained on tasks in a pre-test issued to participants before any training was provided on online searching, compared to the number of correct responses in a post-test was issued after training was provided. The difference in performance on the pre-test and post-test indicated improvement in performance after the training was received. The implementation of the pre- and post-tests took place after the background questionnaire was completed.

Both the pre-test and the post-test were made up of simple and difficult tasks. In research conducted by Borgman (1984a) it was found that search performance took place differently on simple tasks, hence this research analysed these tasks separately. The delineation of simple and difficult tasks however, was not apparent to the participants. The description and types of tasks that are defined as simple and difficult have been discussed in Chapters 1 and 3. Stated briefly, simple tasks are those tasks which seek known-items such as author or title, and complex tasks comprise those that require manipulation of terminology or the use of advanced features. A complete list of the pre- and post-test tasks can be found in Appendices B and C.

The outcome of a pilot study found that students worked at a slow pace on the computer. As a result the number of search tasks assigned was limited to three questions in the pre-test and seven in the post-test. In the analysis of the data each task was assessed according to the ability of the participant to use specific search indexes, for example the ability to search for an author using the author index, the ability to search for a specified title using the title index, and the ability to search for a specified subject using the subject index. The use of the proximity feature required correct use of the title index followed by the implementation of a proximity command. The use of truncation did not require the participant to use the computer. Instead they were required to write down on an answer sheet, the search statement they would use when performing a truncated search. The use of these search indexes and search features were related to the learning objectives covered in the training provided in both the concept-based and procedural teaching conditions. Prior to the training, but after the pre-test, participants were informed of the learning objectives set out in the training. Fjallbrant and Malley (1984) state that it is important that the learner accept the goals of the instruction to be provided. Even though the full responsibility for the goals formulated cannot be left entirely to the learner because they are not in a position to make such decisions, it is considered important that the learner has some sense of participation in the learning objectives decided upon. This view was supported by Nielsen, Baker and Sandore (1985) who stated that trainees should be aware of learning objectives. They argue that by communicating objectives to the learner it gives both the student and the teacher a standard for evaluating progress and for clarifying the purpose of the instruction. In a typical BI session at the M L Sultan Technikon, students are normally informed of the goal of the instruction prior to training being received. This is found useful in the evaluation of instruction programmes when students rate their abilities in relation to specific learning objectives. Specific concepts taught and the methods used in the instruction programme in this experiment have been discussed in Chapter 3. The teaching instruments that were used are listed in Appendices E-H.

The pre-test was made up of three tasks. The first task related to the use of the author index, and the second task related to the use of the title index. These two tasks were classified as simple tasks. The third task related to the use of the subject index, however the task also required the searcher to identify a synonym for the search term given. This task was classified as a difficult task. The latter task is hereafter referred to as a subject/synonym task.

The post-test was made up of a total of seven tasks which comprised three simple tasks and four difficult tasks. The simple tasks required the use of the author and title index and a task to browse the database. The author task was repeated from the pre-test. Difficult tasks assigned on the post-test included tasks related to a proximity search, a truncated search, use of the subject index to find information on a given topic, and a subject/synonym task. The latter task was repeated from the pre-test.

The tasks were graded from answer sheets that the participant completed during the experiment. In cases where the participant arrived at the correct answer but did not use the access point specified in the test, the answer was marked incorrect. The reason was that the intent of the question was to assess ability to use the given access point. The other reason for this was that the assumption that participants would have also been able to find the answer through trial and error. Therefore the researcher considered the "preferred" way of searching as the most efficient way in which a person conversant with online retrieval at this level should use. In cases where a participant correctly retrieved a listing of relevant records but selected the wrong record to match the query, the answer was also marked incorrect. This again indicating that the respondent was unable to make the right decision, reflecting a lack of knowledge or ability to make a critical assessment of information retrieved. In the case of the question related to truncation, if the symbol for truncation was not present, but the correct form of the word stem was indicated then the answer was marked correct. The reason for this was that the ability to remember specific system features was not being tested, but rather the participant's grasp of the search concept.

The method of analysing pre-tests and post-tests has been discussed in Chapter 2. In this research however, due to the time available to the researcher, tasks could not be developed so that there were an equal number of pre-test and post-test tasks. When tasks on the pre-test which were issued prior to training corresponded to tasks on the post-test which were issued after training was received, the analysis compared the number of correct scores achieved on the pre-test against the number of correct scores on the post-test. Those tasks that had no corresponding pre-test were analysed based on the number of correct responses. Search performance was compared for tasks that appeared both on the pre-test given prior to training, and on the post-test after training. These were specifically an author, title and a subject/synonym task.

The data collected on the pre-test issued before training and post-test issued after training was analysed using the SPSS, v.9.0 software. Binomial tests were carried out to compute a two-sample proportion test comparing concept-based and procedural instruction at different levels of the research variables. McNemar's test was conducted to compare differences within a teaching group in the pre- and post-test. Chi-square tests were conducted to compare overall group differences. These tests are non-parametric tests which do not require assumptions about the shape of the underlying distributions (SPSS 1999). As already discussed, binomial tests compare proportion between two groups, where the variable has either one of two possibilities. Definitions of chi-square and McNemar tests are described as follows (SPSS v.9.0 1999:341):

- Two-related sample tests compare the distributions of two variables for which the McNemar test can be used. McNemar is a nonparametric test for two related dichotomous variables. It tests for changes in responses using the chi-square distribution. It is useful for detecting changes in responses due to experimental intervention in "before and after" designs.
- A Chi-Square test tabulates a variable into categories and computes a chi-square statistic based on the difference between observed and expected frequencies.

The probability parameter used in these tests was a 95% confidence level. Differences in performance was considered significant if the p value was less than or equal to 0.05. In cases when the p value was 0.0000 this was indication of high significance. The degrees of freedom is represented as "df" and refers to the number of rows and columns used in the cross tabulations in the analysis of the data. Cross tabulations were used to measure the frequencies of responses on each task for the concept-based group and the procedural instruction group. In the tables below, degrees of freedom are indicated as one, because each task represented one row and one column.

Results of the pre-test and the post-test are compared in relation to differences in performance on simple and difficult tasks after the teaching methods of concept-based and procedural instruction were implemented. Comparisons in search performance firstly considered differences in overall performance, and then in relation to the variables of high, and low library experience, use and non-use of computers, use of English as a first or second language. This is summarized as follows:

1. Overall performance between concept-based and procedural instruction groups on simple tasks on the pre-test which was conducted before training was received, and on post-test tasks conducted after training was received.
2. Overall performance between concept-based and procedural instruction groups on difficult tasks on the pre-test which was conducted before training was received, and on post-test tasks conducted after training was received.
3. Performance between concept-based and procedural instruction groups between groups with high library and low library experience, on simple tasks on the pre-test which was conducted before training was received, and on post-test tasks conducted after training was received.
4. Performance between concept-based and procedural instruction groups between groups with high library and low library experience, on difficult tasks on the pre-test which was conducted before training was received, and on post-test tasks conducted after training was received.
5. Performance between concept-based and procedural instruction groups between groups with no computer experience and those who have computer experience, on simple tasks on the pre-test which was conducted before training was received, and on post-test tasks conducted after training was received.

6. Performance between concept-based and procedural instruction groups between groups with no computer experience, and those who have computer experience on difficult tasks on the pre-test which was conducted before training was received, and on post-test tasks conducted after training was received.
7. Performance between concept-based and procedural instruction groups between groups who regard English as a first language and those who regard English as a second language, on simple tasks on the pre-test which was conducted before training was received, and on post-test tasks conducted after training was received.
8. Performance between concept-based and procedural instruction groups between groups who regard English as a first language and those who regard English as a second language, on difficult tasks on the pre-test which was conducted before training was received, and on post-test tasks conducted after training was received.

The following discussion of the research results is arranged according to the specific research questions they address. In the case of simple tasks, tables have been used to depict improvement in performance, and in the case of difficult tasks, graphs have been used to depict improvement in performance.

4.3.1.1 Performance on simple tasks

The question posed in the research was, are there significant differences in search performance on simple online tasks, between students who are conceptually trained and those who are procedurally trained?

Results on a pre-test conducted prior to training being provided found no significant differences in performance between both teaching groups on simple tasks related to use of the author and title search index. This was indicated by a p value above 0.05 on performance on these tasks. Performance on an author task before training, found that 27 (45.0%) out of 60 respondents in the concept-based group scored this task correctly and a slightly higher number, 31 (51.7%) out of 60 respondents in the procedural group scored this task correctly.

Performance on a post-test issued after training, found considerable improvement in performance on simple tasks of author and title in both teaching conditions. On the author task those in the concept-based group had correct scores of 52 (86.7%) out of a total of 60 respondents and the procedural group had 50 (83.3%) correct scores out of a total of 60 respondents. Compared to performance on the pre-test, the concept-based group showed an improvement of 25 more participants scoring the author task correctly while the procedural group showed an improvement of nineteen more participants scoring the author task correctly. On tasks related to use of the title search index in the post-test, an additional 32 participants in the concept-based group scored this task correctly, and an additional 33 participants in the procedural group scored the title task correctly on the post-test. However, performance on a task classified by the researcher as a simple task which related to browsing the database showed a significant difference in performance. On the task related to browsing a total of 43 out of 60 (71.7%) respondents in the concept-based group scored this task correctly and of those in the procedural group 31 out of 60 (51.7%) respondents scored this task correctly. The concept-based group performed significantly better on the task related to browsing with a significance level of p= 0.02425. The differences that emerged on performance in the pre-test before training was received, and on the post-test after training was received are reflected in Tables 4.3 and 4.4.

Table 4.3 Respondents' performance on simple tasks on pre-test

	Concept-based N=60		**Procedural N=60**		**df**	**p=**
Pre-test task	Number	Percentage	Number.	Percentage		
Author	27	45.0%	31	51.7%	1	0.46496
Title	20	33.3%	19	31.7%	1	0.84547

Table 4.4 Respondents' performance on simple tasks on post-test

	Concept-based N=60		**Procedural N=60**		**df**	**p=**
Post-test task	Number	Percent	Number	Percent		
Author	52	86.7%	50	83.3%	1	0.60913
Title	50	83.3%	51	85.0%	1	0.80254
Browse	43	71.7%	31	51.7%	1	0.02425*

*Indicates a significant difference on search performance between teaching conditions

4.3.1.2 Performance on difficult tasks

The question posed in the research asked, are there significant differences in search performance on difficult online tasks, between students who are conceptually trained and those who are procedurally trained?

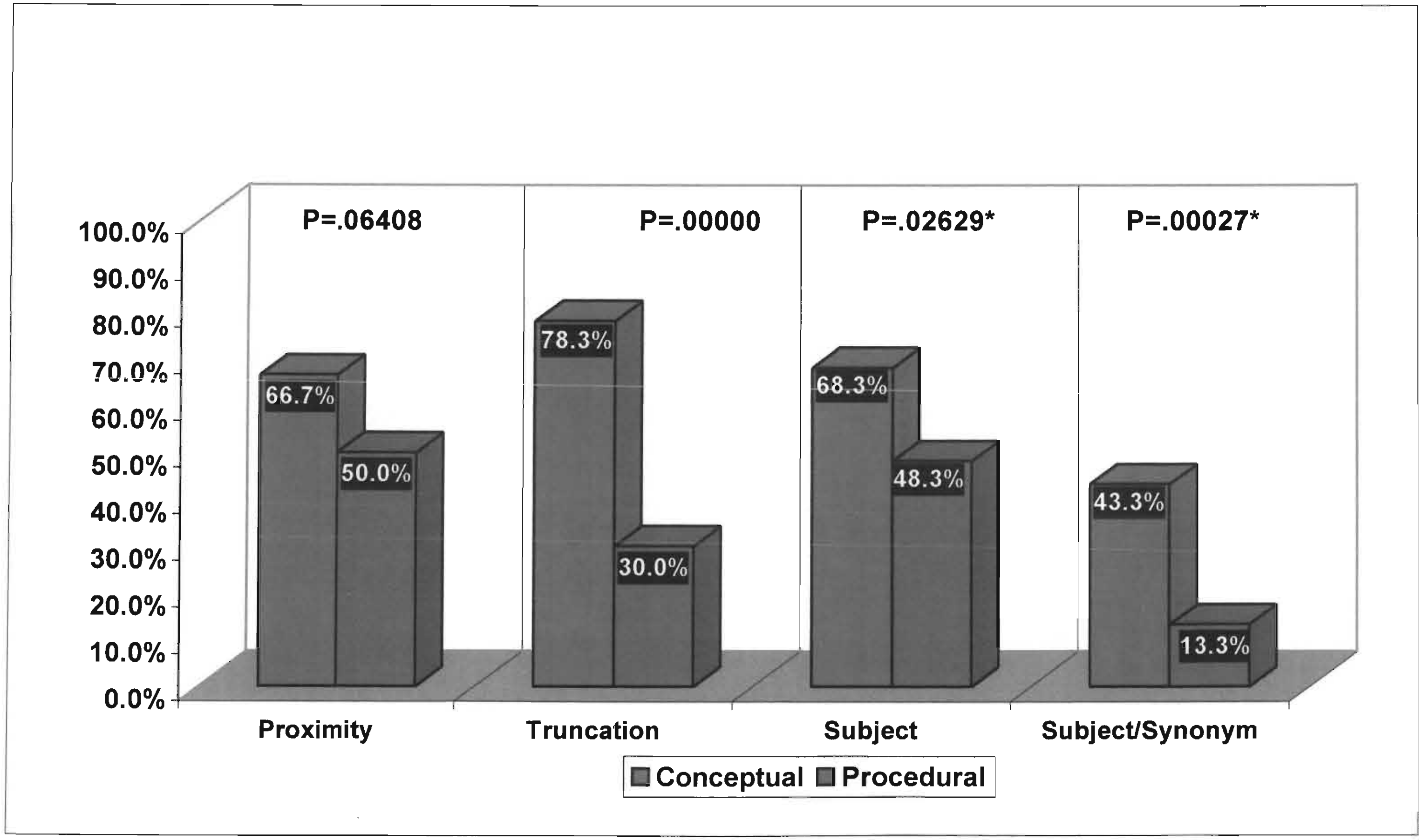
Performance on a difficult task related to a finding a subject/synonym in the pre-test conducted prior to training, found that participants in both the concept-based and the procedural teaching condition performed poorly on this task. There was no significant difference in performance on the pre-test, with five respondents each (8.3%) in both training groups scoring this task correctly. This task was repeated on the post-test after training was received after which there was a marked difference in performance between the concept-based and procedural instruction groups. Although improvements in performance were not as high as reflected in performance on author/title search tasks, the concept-based group demonstrated greater improvement. Five out of 60 respondents scored this task correctly on the pre-test prior to training, 26 out of 60 (43.3%) respondents in the concept-based group scored this task correctly after training. After training an additional eleven participants scored this task correctly. In relation to the procedural instruction group out of a score of five out of 60 in the pre-test prior to training, scores improved to eight out of 60 (13.3%) after training with an additional three participants scoring this task correctly. There was a significant difference in performance on this task with $p=0.00027$.

Performance on difficult tasks for which there were no pre-test tasks performed found significant differences in performance on tasks related to truncation and on a subject search. The concept-based group achieved a score of 47 out of 60 (78.3%) on the task related to truncation and the procedural group achieved a score of eighteen out of 60 (30.0%) on this task. There was a significant difference in performance with p=0.00000. On the task related to use of the subject index, the concept-based group achieved a significantly higher score than the procedural instruction group. In this case significance was reflected as p = 0.02639. On a task related to a proximity search, there was no significant difference in performance with the concept-based group scoring 40 out of 60 (66.7%) and the procedural group scoring 30 out of 60 (50.0%). The differences found in performance are reflected on the following pages. Table 4.5 is a representation of overall performance on difficult tasks and a graph in Figure 4.1. represents overall performance on difficult tasks.

Table 4.5 Respondents' overall performance on a difficult task on the pre-test

	Concept-based N=60		**Procedural N=60**		**df**	**p=**
Pre-test task	Number	Percentage	Number	Percentage		
Subject/Synonym	5	8.3%	5	8.3%	1	1

FIGURE 4.1 Respondents' performance on difficult tasks on a post-test



* indicates significant difference

In order to assess amongst the respondents who gets simple tasks and difficult tasks correct and to which teaching condition they belong, the variables of library experience, computer experience and English language usage were analysed.

4.3.1.3 Performance on simple tasks : low and high library experience

The research question posed was, are there significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to students with low levels of library experience and those with higher levels of library experience?

Of the participants in the concept-based group who had a low level of library experience eight out of twenty (40.0%) respondents achieved correct scores prior to training on a simple task related to an author search and eighteen out of twenty (90.0%) of the same respondents scored this task correctly after training. In the procedural group it was found that of those with low library experience six out of thirteen (46.2%) respondents scored correctly on an author task before training and ten out of thirteen (76.9%) respondents scored this task correctly after training. On a title task, prior to training six out of twenty (30.0%) respondents in the concept-based group scored this task correctly. The procedural group performed poorly on the title task prior to training, with two out of thirteen (15.4%) respondents achieving correct scores. On a post-test after training both groups with low library experience improved performance with the concept-based group scoring up to 90.0% (eighteen out of twenty respondents) for both the author and the title tasks and in the procedural group ten out of thirteen (76.9%) respondents scored the author task correctly and twelve out of thirteen (92.3%) respondents scored a title search task correctly. Chi-square tests revealed no significant difference in performance on an author and title task. A task related to browsing the database also found no difference in performance between the teaching conditions of procedural and concept-based teaching between those with low library experience. On this task the concept-based group scored thirteen of a total of twenty (65.0%) respondents and the procedural group scored lower achieving scores of seven out of a total of thirteen (53.8%) respondents. The results on the pre-test and post-test for those with low library experience are displayed in Tables 4.6 and 4.7.

Table 4.6 Performance of respondents' with "low library" experience on simple tasks on a pre-test

	Concept-based N=20		**Procedural N=13**		**df**	**p=**
Pre-test task	Number	Percentage	Number	Percentage		
Author	8	40.0%	6	46.2%	1	0.72671
Title	6	30.0%	2	15.4%	1	0.33843

Table 4.7 Performance of respondents' with "low library" experience on simple tasks on a post-test

	Concept-based N=20		Procedural N=13		df	p=
Post-test task	Number	Percentage	Number	Percentage		
Author	18	90.0%	10	76.9%	1	0.30596
Title	18	90.0%	12	92.3%	1	0.82173
Browse	13	65.0%	7	53.8%	1	0.52169

Those with high library experience in both teaching groups scored higher than those with low library experience on simple tasks of author and title. In the concept-based group those with high library experience achieved a score of thirteen out of twenty (65.0%) on the author search before training was received and improved performance on a post-test for the same author task achieving a score of eighteen out of twenty (90.0%). On this task, the procedural instruction group scored sixteen out of 24 prior to training and scored 22 out of 24 after training was received. In both teaching groups performance on this task improved with five additional respondents scoring this task correctly. Performance on a title task found improvement in both groups with the concept-based group showing an improvement from ten out of twenty respondents scoring this task correctly on the pre-test and eighteen out of twenty (90.0%) scoring this task correctly on the post-test. On the same task, the procedural instruction group scored ten out of 24 (41.0%) in the pre-test and twenty out of 24 (83.3%) on the post-test. There were no significant differences in performance between those with high library experience in the concept-based and the procedural group on the author task or the title task. However, on a task related to browsing those with high library experience in the concept-based group scored significantly higher than the procedural group, p=0.03942. These results are reflected in Tables 4.8 and 4.9.

Table 4.8 Performance of respondents' with "high library" experience on simple tasks on a pre-test

	Concept-based N=20		Procedural N=24		df	p=
Pre-test task	Number	Percentage	Number	Percentage		
Author	13	65.0%	16	66.7%	1	0.9076
Title	10	50.0%	10	41.7%	1	0.5804

Table 4.9 Performance of respondents' with "high library" experience on simple tasks on a post-test

	Concept-based N=20		Procedural N=24		df	p=
Post-test task	Number	Percentage	Number	Percentage		
Author	18	90.0%	22	91.7%	1	0.84815
Title	18	90.0%	20	83.3%	1	0.52111
Browse	16	80.0%	12	50.0%	1	0.03942*

*Indicates significant difference between teaching condition on performance

4.3.1.4 Performance on difficult tasks : low and high library experience

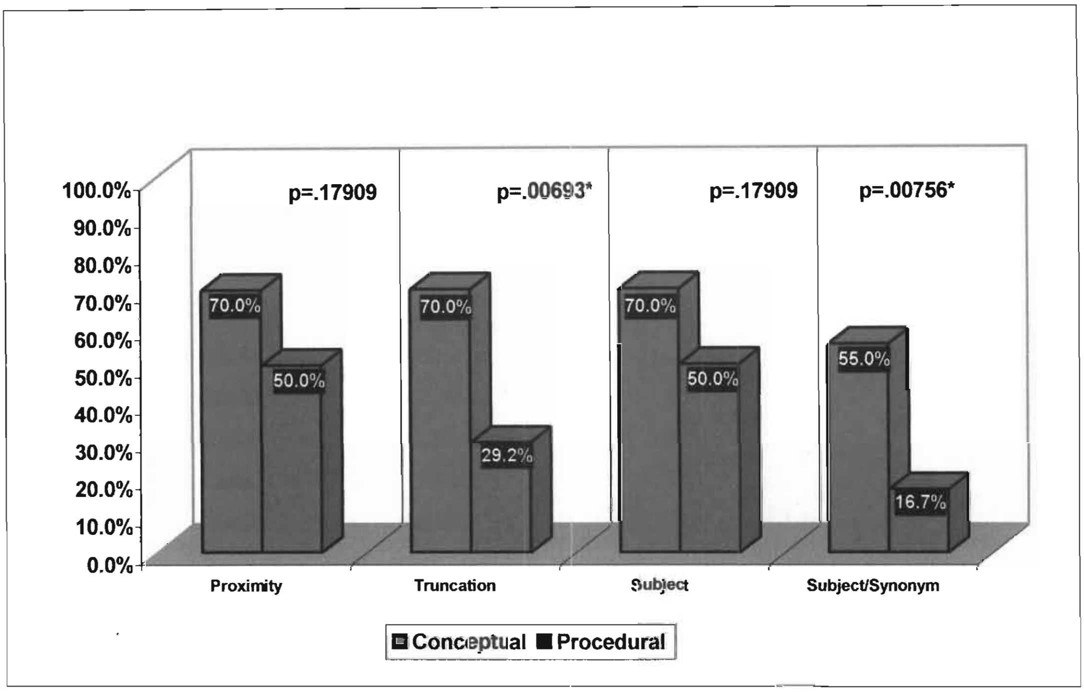
The research question in relation to difficult tasks sought to find out whether there were significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in relation to students with low levels of library experience and those with higher levels of library experience.

Performance on a pre-test task related to a subject/synonym task that was a given before training was received found low scores for both the concept-based group and the procedural instruction group. Those with high and low library experience in the concept-based group achieved the same scores in that two out of twenty (10.0%) respondents in both groups were able to achieve correct scores. In the procedural group out of thirteen respondents with low library experience, none were able to pass this task prior to training. The respondents with high library experience in the procedural group performed slightly better with three out of the 24 responses correct. Significance levels were p=0.23944 for respondents with low library experience and p=0.79473 for those with high library experience which were higher than 0.05 indicating no significance in performance.

Performance on four difficult tasks performed after training on a post-test found significant differences between both teaching conditions for high and low library experience. Presented in Figure 4.2, the results indicate that for those with high library experience, the respondents in the concept-based group performed significantly better than the procedural group on a truncation and a subject/synonym task with p=0.00693 and 0.00756 respectively. The analysis found no significant differences in performance between the teaching conditions for respondents with high library experience on tasks related to proximity and a general subject search.

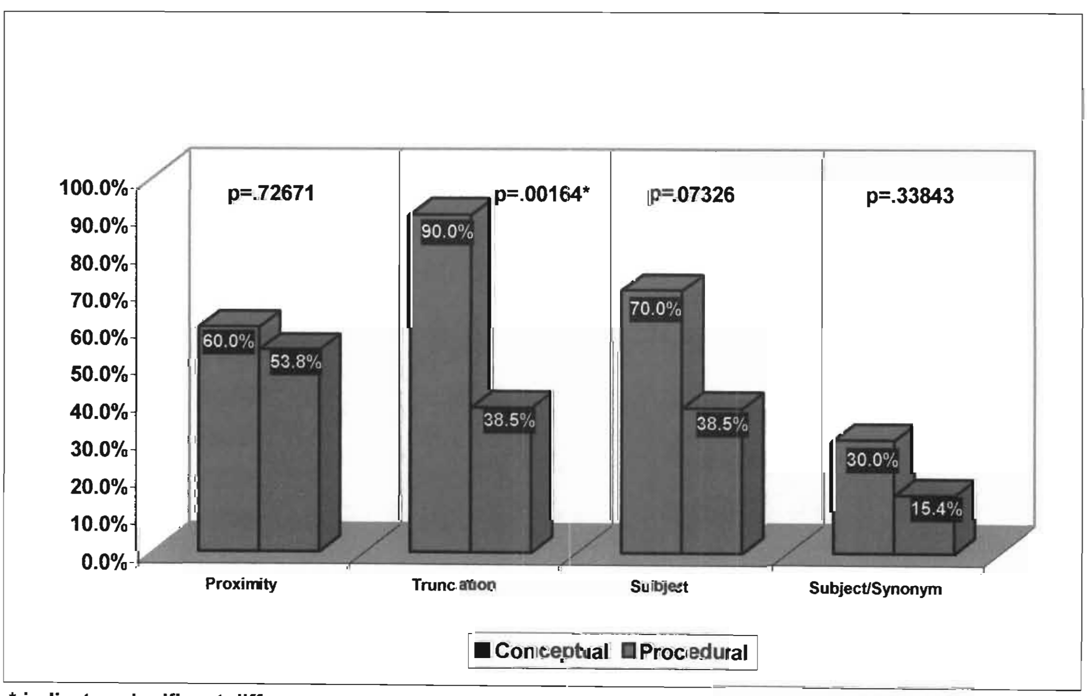
On difficult tasks performed after training, respondents with low library experience in the concept-based group performed significantly better on a truncation task, p=0.00164. On other difficult tasks performed there were no significant differences found. Performance on a proximity task found that out of twenty respondents in the low library experience group, twelve (60.0%) scored this task correctly. In comparison, of those with low library experience in the procedural group, seven out of thirteen (53.8%) respondents achieved correct scores. The task related to a general subject search resulted in respondents with low library experience in the concept-based group performing better on this task than the procedural group. Out of twenty responses for this category in the concept-based group, fourteen (70.0%) scored this task correctly and out of thirteen respondents with low library experience in the procedural group, five (38.5%) scored this task correctly. Figures 4.2 and 4.3 on the following page presents the findings on performance on difficult tasks

Figure 4.2 **Performance of respondents with "high library" experience on difficult tasks on a post-test**



* indicates significant difference

Figure 4.3 **Performance of respondents with "low library" experience on difficult tasks on a post-test**



* indicates significant difference

4.3.1.5 Performance on simple tasks : participants with no prior computer experience and those who have computer experience

Research questions in relation to simple tasks were asked in order to find out whether there were any significant differences in search performance between those who are conceptually and procedurally trained, in relation to those who have and do not have computer experience, respectively.

Performance on simple tasks related to an author and a title task prior to training was not very high for respondents with no computer experience. In the concept-based group thirteen out of 38 responses (34.2%) were correct on the author task and the title task. On the same tasks, the procedural group made up of 35 respondents with no computer experience, eleven (31.4%) correct responses were found on the author task and six (17.1%) on the title task. Binomial tests indicated no significant differences in performance with p=0.80044 for the author task and p=0.09685 on the title task.

Respondents with computer experience reflected a far higher performance on a pre-test on simple tasks issued prior to training. Out of a total of 22 respondents in the concept-based group fourteen (63.6%) scored the author task correctly and only seven (31.8%) were able to get the title task correct. In comparison respondents with no computer experience in the procedural group reflected better performance on the author and title tasks. In this instance, out of a total of 25 in this group, twenty (80.0%) arrived at the correct answer on the author task and thirteen (52.0%) were able to perform the title task correctly. No significant differences were found in performance, levels of significance reaching above 0.05.

After training was provided, the improvement on performance results in both teaching conditions was high. Differences were noted in the way respondents with no computer experience and those with computer experience performed. In the procedural teaching condition of a total of 35 respondents with no computer experience, 28 (80.0%) got correct scores on an author task, 29 (82.9%) got correct scores on a title task, and on a task related to browsing introduced only on the post-test, fifteen (42.9%) achieved correct scores. Respondents with no computer experience in the concept-based group produced slightly lower results. Out of a total of 38, there were 30 (78.9%) who passed an author task, 29 (76.3%) passed a title task and a higher number than the procedural group, 26 (68.4%) were able to get the task on browsing correct. The concept-based group scored significantly better on the browsing task by those with no computer experience, the level of significance indicated as $p=0.02787$.

As in the case of their performance on the pre-test, after training, respondents who had computer experience achieved high scores. However, those with computer experience in the procedural group did not perform very differently from those without computer experience in this group. This was an indication that the provision of training can bring lesser experienced students up to the level of those with higher experience. Out of a total of 25 respondents in the procedural group who had computer experience, 22 were able to score the author task correctly, which is equal to two more who scored this task correctly on the pre-test. On the title task this group scored 22 out of 25 responses (88.0%) and sixteen out of the 25 (64.0%) were able to get correct scores on the browsing task. The respondents with computer experience in the concept-based group achieved a 100.0% score on the author task with all 22 respondents arriving at the correct answer. On a title task, 21 of the 22 (95.5%) participants achieved correct scores and on a task on browsing, seventeen of the 22 respondents (77.3%) were able to achieve correct scores. No significant differences were found in performance between the procedural and the concept-based groups with significance reflected as p=0.09310 on an author task, p=0.36078 on a title task, and p=032080 on a task on browsing.

4.3.1.6 Performance on difficult tasks : participants with no prior computer experience and those who have computer experience

Research questions in relation to difficult tasks were asked in order to find out whether there were any significant differences in search performance between those who are conceptually and procedurally trained, in relation to those who have and do not have computer experience.

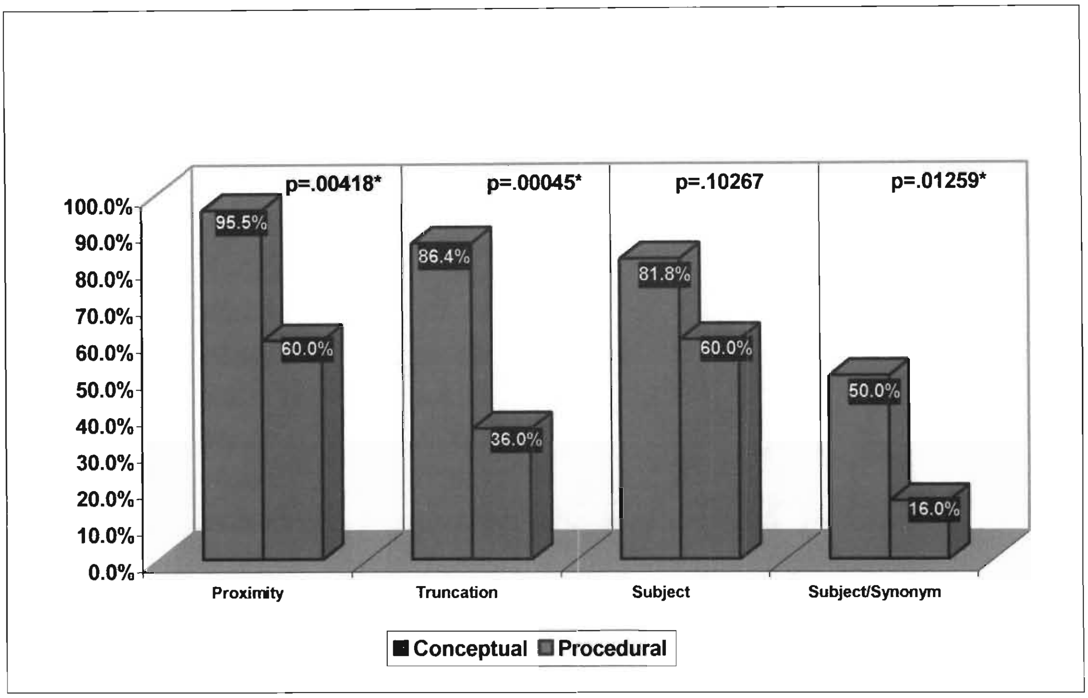
It was found that of 38 concept-based respondents with no computer experience only three (7.9%) were able to score a subject/synonym task correctly prior to training. After training was provided this group achieved a score of 39.5% with fifteen of the 38 scoring this task correctly. In the procedural group none of the 35 respondents with no computer experience were able to pass a subject/synonym task. After training was provided there was a small improvement made on performance with four (11.4%) of the 35 respondents scoring a subject/synonym task correctly. A significant difference in performance was found with p=0.00637. On other difficult tasks performed after training, of the 38 respondents in the concept-based group, nineteen (50.0%) were able to get correct scores on a proximity task, 28 (73.7%) on a truncation task, and 23 (60.5%) on a general subject search task. Respondents with no computer experience were 35 persons in the procedural group who achieved scores of fifteen (42.9%) on a proximity task, nine on a truncation task and fourteen on a general subject search (40.0%). There was a significant difference in performance on the task on truncation with significance levels of p=0.00004.

A similar pattern of performance was found between those who had computer experience. Of the 22 respondents in the concept-based group who had computer experience, 21 (95.5%) were able to get correct scores on a proximity task, nineteen (86.4%) got correct scores on a truncation task, and eighteen (81.8%) on a general subject search task after training was provided. In the procedural instruction group of the 25 respondents with computer experience, fifteen (60.0%) responses were correct on the proximity task, nine (36.0%) on the truncation task, and fifteen (60.0%) on a general subject search task after training was provided. A significant difference in performance was found on the task related to truncation with p=0.00045.

In relation to a subject/synonym task, prior to training only two (9.1%) of the 22 in the concept-based group with computer experience were able to achieve correct scores on this task. After training scores improved with eleven (50.0%) of the 22 getting this task right.

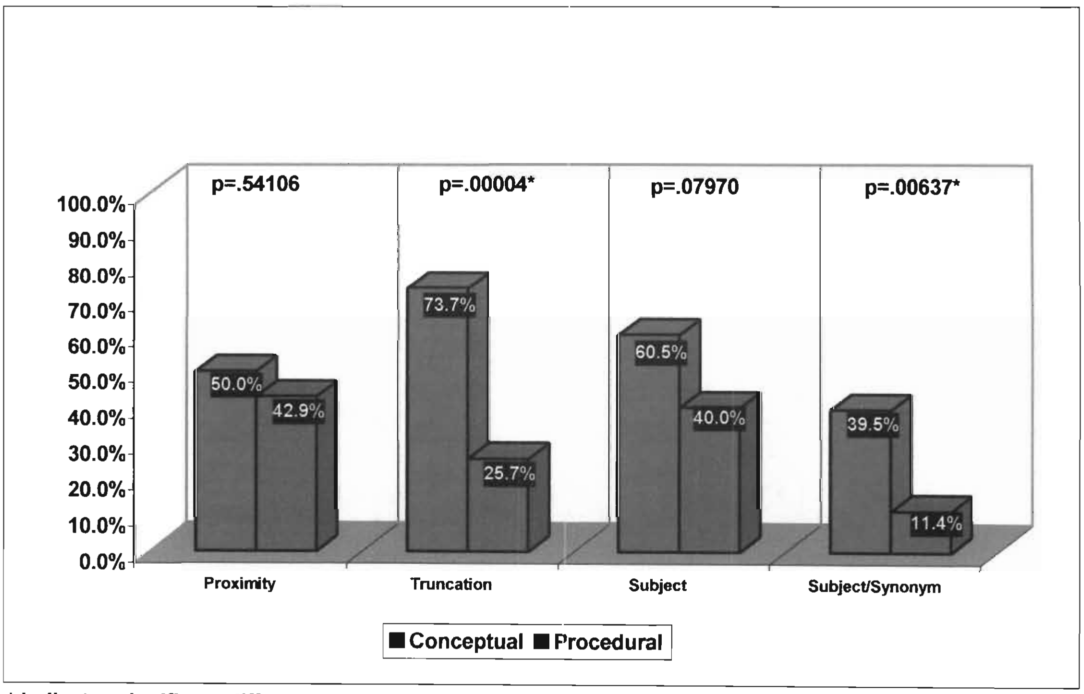
However, in the procedural group out of 25 respondents the score from five (20.0%) prior to training dropped to four (16.0%) after training. The literature discussed in Chapter 2 referred to this as a misconception taking place in learning. A significant difference was found in performance on this task between those who have computer experience between the concept-based group and the procedural group with p=0.01259. The results of performance on difficult tasks of respondents with and without computer experience can be found in Figures 4.4. and 4.5 respectively.

Figure 4.4 **Performance of respondents with computer experience on difficult tasks on a post-test**



* indicates significant difference

Figure 4.5 **Performance of respondents with no computer experience on difficult tasks on a post-test**



* indicates significant difference

4.3.1.7 Performance on simple tasks : English as a first language and English as second language

Research questions in relation to simple tasks sought to find out whether there were any significant differences in search performance between those who are conceptually and procedurally trained, in relation to those who regard English as a first language and those who regard English as a second language.

On a pre-test assigned before training commenced, eight (61.5%) of the thirteen respondents in the concept-based group who used English as a first language got an author task correct and five (38.5%) of the thirteen got a title task correct. After concept-based training, twelve (92.3%) of the thirteen respondents achieved correct scores on the author task and eleven (84.6%) of the thirteen gained correct scores on a title task. In the procedural group eleven respondents used English as a first language. Of the eleven, eight (72.7%) got an author task correct and six (54.5%) a title task correct prior to training. On a post-test after procedural training, there was no difference in performance on the author task, but nine of the eleven (81.8%) got correct scores on the title task. No significant differences were found in performance after training on these tasks with significance levels for author being p=0.9967 and title, p=0.85463. On a task classified as a simple task, of the thirteen respondents in the concept-based group, eight (61.5%) achieved correct scores on a task related to browsing and six out of eleven (54.5%) achieved correct scores on this task in the procedural group. Binomial tests found no significant differences on performance on this task with p=0.72916.

Respondents who regarded English as a second language in the concept group amounted to 47 of whom nineteen (40.4%) scored an author task correctly in a pre-test before training and 40 (85.1%) scored this task correctly on a post-test after training was provided. Of this same group of 47, fifteen (31.9%) scored a title task correctly on a pre-test and 39 (83.0%) did so on a post-test after training. Those in the procedural group who regarded English as a second language, of which there were 49 respondents, 23 (46.9%) scored an author task correctly and thirteen (26.5%) scored a title task correctly prior to training. After training, 42 (85.7%) of the 49 respondents with English as a second language in the procedural group scored the author and the title task correctly. There were no significant differences in performance with levels of significance for author being p=0.52018 and title being p=0.561788.

On a task related to browsing the respondents with English as a second language in the concept-based group scored better with a significant difference in performance of p=0.0.01768. Of the 47 respondents who regarded English as a second language, 35 (74.5%) scored this task correctly and 25 (51.0%) out of 49 respondents in the procedural group who used English as a second language performed this task correctly.

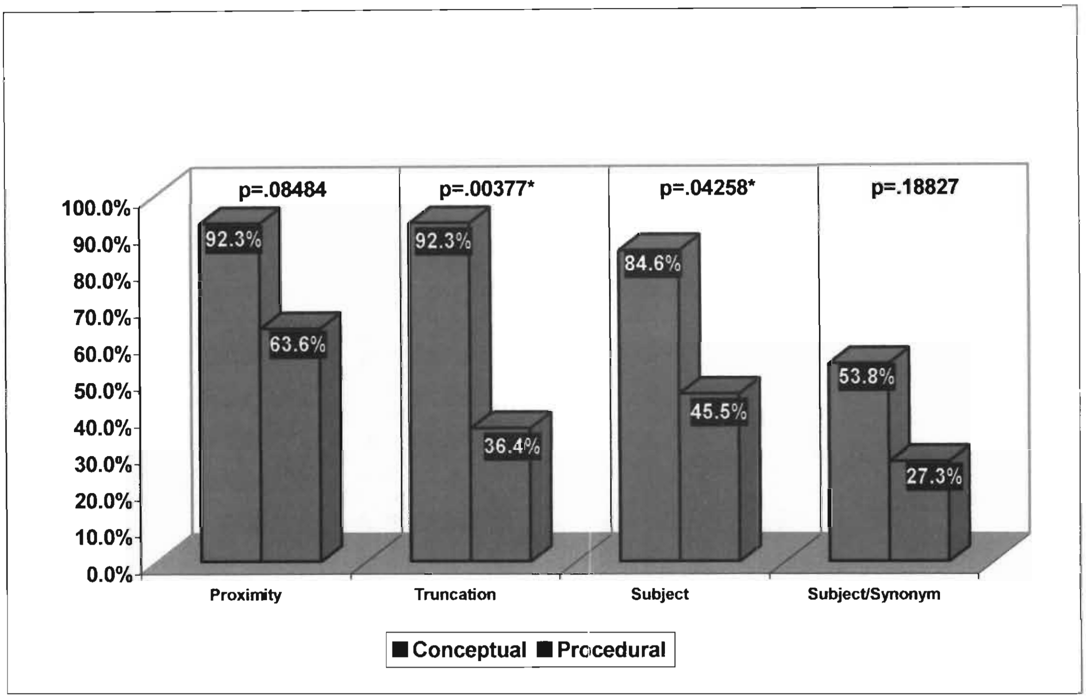
4.3.1.8 Performance on difficult tasks : English as a first language and English as a second language

Research questions in relation to difficult tasks sought to find out whether there were any significant differences in search performance between those who are conceptually and procedurally trained, in relation to those who regard English as a first language and those who regard English as a second language.

On a difficult task related to a subject/synonym task of thirteen respondents in the concept-based group who regarded English as a first language, two (15.4%) got correct scores on this task prior to training, and after training, seven of the thirteen (53.8%) respondents scored this task correctly. On the same task, of the eleven respondents who used English as a first language in the procedural group, only one (9.1%) person got the correct answer prior to training. After procedural training was implemented only three of the eleven respondents (27.3%) scored the subject/synonym task correctly. No significant differences were found between the teaching conditions between respondents who used English as a first language, with p=0.18827. These scores indicating that this was a task which caused some difficulty for participants. However on other difficult tasks related to a truncated search and a general subject search significant differences were found with p=0.0037 for truncation and p=.04258 for the general subject task. Scores attained by respondents with English as first language in the concept-based found that of a total of thirteen responses, twelve (92.3%) achieved a correct score on the proximity and the truncation task, and eleven (84.6%) on a general subject task. In comparison, of the eleven respondents in the procedural group, seven (63.6%) were able to perform the proximity task correctly, four (36.4%) performed the truncation task correctly and five (45.5%) performed the general subject search correctly.

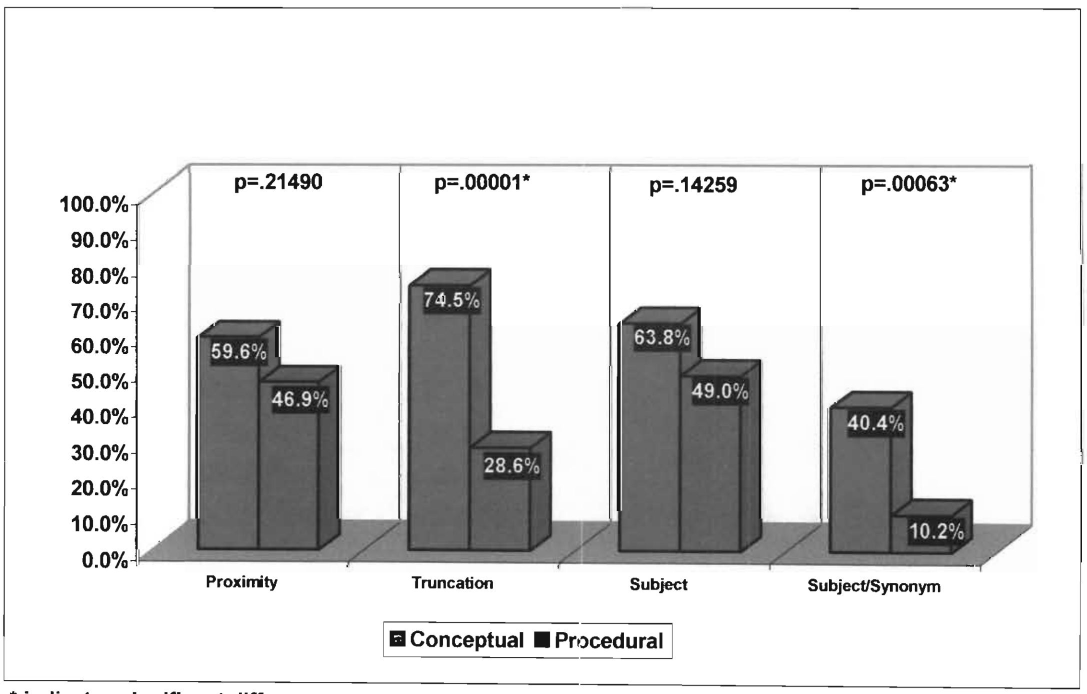
Amongst the respondents who regarded English as a second language a significant difference in performance was found with the concept-based group scoring higher on the task on truncation, p=0.00001, and on a subject/synonym task, p=0.00063. Respondents in the concept-based group made up of 47 English second language users, achieved a score of three (6.4%) on the pre-test on the subject/synonym task and nineteen (40.4%) in the post-test, thirty (63.8%) on a general subject task, thirty-five (74.5%) on a truncation task, and 28eight (59.6%) on a proximity task. The procedural group achieved lower scores on these tasks, where out of 49 English second language respondents, four (8.2%) were able to get a subject/synonym task correct on a pre-test, and on a post-test after procedural training, five persons (10.2%) got this task correct. On other difficult tasks, out of the 49 procedural group respondents with English as a second language, 24 (49.0%) scored a general subject task correctly, fourteen (28.6%) scored a truncation task correctly, and 23 scored a proximity task correctly. As found in performance scores of groups with differing library experiences, and computer experience, respondents with differing English language experience also reflected a low performance on a subject/synonym task. In most cases the procedural instruction group reflecting a far lower performance than the concept-based group, where scores also reflected a significant difference in performance. Performance on difficult tasks of respondents with English as a first and second language are reflected in Figures 4.6 and 4.7 following.

Figure 4.6 **Performance of respondents with English as a first language on difficult tasks on a post-test**



* indicates significant difference

Figure 4.7 **Performance of respondents with English as a second language on difficult tasks on a post-test**



* indicates significant difference

4.3.1.9 Overall performance on individual tasks answered incorrectly in the post- test

In order to understand which tasks the participants found most difficult, an analysis was conducted of incorrect responses on the search tasks in the post-test. The purpose of this was to point out those areas of difficulty that should receive attention in an online instruction programme, to determine the degree to which learning objectives were met, and also to identify which teaching method produced better performance on a specific search task. The results are depicted in Table 4.10.

Table 4.10 Incorrect responses on search tasks on the post-test

	Total Sample N=120		Concept-based N=60		Procedural N=60	
Tasks	**Number**	**Percentage**	**Number**	**Percentage**	**Number**	**Percentage**
Author	18	15.0%	8	13.3%	10	16.75%
Title	19	15.8%	10	16.75%	9	15.0%
Browse	46	38.3%	17	28.35%	29	48.3%
Proximity	50	41.7%	20	33.3%	30	50.0%
Truncation	55	45.8%	13	21.7%	42	70.0%
Subject	50	41.7%	19	31.7%	31	51.7%
Subject/Synonym	86	71.7%	34	56.7%	52	86.7%

Amongst the overall study sample of 120 participants, the subject/synonym task, appeared to be the most difficult with 86 (71.7%) of the total number of 120 scoring this task incorrectly. Between each teaching condition, concept-based instruction appeared to be more successful in achieving correct scores on this task with 34 (56.7%) of a total of 60 having difficulty on this task compared to 52 (86.7%) out of 60 in the procedural group.

Since more than half the respondents in both teaching groups had difficulty on this task it emphasises the need for more time to be spent on this aspect of searching in training. Based on the number of incorrect responses reflected by the procedural group on difficult tasks in comparison to the concept-based group it seems apparent that the former teaching method was not very effective in promoting understanding of the use of these search indexes. For example, of the 60 procedural group participants, on tasks related to a general subject search, 31 (51.7%) scored incorrectly, 42 (70.0%) scored a truncation task incorrectly and 30 (50.0%) or half the respondents scored a proximity task incorrectly.

4.3.2 Affective responses on evaluation questionnaire

Upon completion of the training, participants in the concept-based and the procedural instruction groups were asked to complete an evaluation questionnaire. This was done to get participants' views on their confidence in the use of the URICA OPAC system and in using other OPAC systems to assess the sense of mastery felt in their ability to perform online searches after training. It also evaluated the training provided in the experiment to assess whether performance was affected by negative attitudes towards the lecture, the instructional materials used and in the use of the OPAC system. Svinicki and Schwartz (1988) point out that student self-reports are an important means of assessing the progress of the instruction in terms of planned objectives. These authors caution however, that self reports cannot be relied on as a measure on its own due to the unreliable data that is sometimes found because students do not always report their opinions accurately. Fjallbrant and Malley (1984) described evaluation based on affective responses as formative evaluation which can be used to improve a course and to enable both the instructor and the learner to compare their observations with their expectations. The evaluation questionnaire can be found in Appendix D.

The participants' overall response to the evaluation was very positive. The evaluation questionnaire was completed by all the participants in the study and of an overall sample of 120 students it was found that the majority, 103 (85.8%), felt confident after the training that they would be able to retrieve information on the URICA system. A slightly higher number of the 120 respondents, 105 (87.5%) indicated that they felt confident about their ability to search other OPAC databases. In both instances the more confident participants stemmed from the concept-based teaching condition. In this group of 60 participants, 49 (90.0%) felt confident in their ability to use URICA and 45 (91.7%) were confident that they would be able to use other OPAC systems. Of the 60 participants in the procedural instruction group 49 (81.7%) felt confident in their ability to search the URICA system and 50 (83.3%) felt confident in their ability to search other OPAC systems. At least fourteen (23.3%) of the participants out of the total of 60 in the procedural group experienced difficulty following instructions found on the URICA system and fifteen (25.0%) in this group experienced difficulty in the use of the keyboard. In the concept-based group of the 60 responses received, sixteen (26.7%) experienced difficulty in understanding instructions on the URICA OPAC and nine (15.0%) reported difficulty with the keyboard.

With respect to the training provided, an overwhelming majority expressed satisfaction with the provision of the lecture notes. Out of the 60 respondents in the procedural group 59

(98.3%) were satisfied with the lecture notes and 100% were satisfied with the lecture. In the concept-based group of the 60 respondents, 55 (91.7%) were satisfied with the lecture and 58 (96.7%) were satisfied with the lecture notes. The results of the evaluation questionnaire are depicted in Table 4.11.

Table 4.11 Affective responses towards the instruction provided

	Total Sample N=120		Concept-based N=60		Procedural N=60	
Evaluation Question	**Number**	**Percentage**	**Number**	**Percentage**	**Number**	**Percentage**
Confident in using URICA	103	85.8%	54	90.0%	49	81.7%
Confident in using other OPAC systems	105	87.5%	55	91.7%	50	83.3%
Notes provided were helpful	117	97.5 %	58	96.7%	59	98.3%
Lecture was clear	115	95.8%	55	91.7%	60	100%
Had difficulty with keyboard	24	20.0%	9	15.0%	15	25.0%
Had difficulty understanding instructions on URICA	30	25.0%	16	26.7%	14	23.3%
Had difficulty understanding worksheet	23	19.2%	10	16.7%	13	21.7%

4.3.2.1 Comments by participants on the pre-test and post-test

Comments were encouraged from participants on tasks performed in the pre and the post-tests, as a means of further understanding search behaviour. This information was viewed as important to understanding whether there were any intervening variables which may have affected the participant's performance. Therefore by asking for comments, it was regarded that some of these variables may be reflected. However, comments were found only in relation to the pre-test which was conducted prior to training. A content analysis was done of the responses received, which is a procedure cited by Busha and Harter (1980:171) "...to facilitate the objective analysis of the appearance of words and phrases." This process entails the transformation of observed data into themes which can then be quantified. The data was grouped according to difficulties experienced in the use of the system because of general inexperience, inexperience in the use of a computer, and because of the time constraints in which to perform the tasks. The comments by participants appeared to be useful in gaining some understanding of the thoughts of novice end-users towards searching when no training is provided. Table 4.12 reflects the comments elicited from participants from the concept-based and the procedural instruction groups on the pre-test.

Table 4.12 Attitude to online searching on a pre-test

Pretest	Concept-based N=18	Procedural N=13
It was difficult, had no idea where to start/confusing	5	0
It was difficult, never used a computer before	7	4
Not difficult, but needs time to get used to the system	5	8
It was difficult to find subjects	0	1
One does not get the results one expects	1	0

4.3.2.2 Comments of participants on the evaluation questionnaire

Comments elicited from the evaluation questionnaire were also analysed according to content and grouped according to themes which reflected on, the time allocated to perform tasks, use of computer hardware, difficulty in performing search tasks, difficulty understanding the worksheet, satisfaction with the instruction and difficulty in understanding instructions on the computer system. Table 4.13 reflects the views of participants from the procedural and concept-based teaching groups.

Table 4.13 Views of respondents on instruction provided

General comments	Concept-based instruction N=23	Procedural instruction N=26
More hands-on practice is needed	8	6
I had difficulty using the keyboard therefore it took a long time to finish the tasks	7	8
Experienced difficulty in finding synonym	0	2
Could not understand some of the words on the worksheet	0	3
Appreciated the individual attention	1	0
Worksheet was clear	1	3
Instructions on URICA were difficult to follow	6	4

4.3.3 Search behaviour of participants on tasks

Search behaviour was recorded using the direct observation method and the unobtrusive method of transaction log analysis. Busha and Harter (1980) describe the value of direct observation as a means of being able to understand situations and processes much better. They argue that the advantage of observational method is that the data increases the validity of results by providing the opportunity to verify findings. Transaction log analysis is an unobtrusive method used to analyse search behaviour. The outcomes of these methods of evaluation are discussed in the following sections.

4.3.3.1 Direct observation methods

The size of the sample did not permit observations of search performance to take place systematically. Individual participants could not be observed from the beginning of a search task to the end. Instead, general observations to the researcher were made of use of the URICA OPAC as tasks progressed. These are listed below. Reference to URICA search screens can be found in Appendix I.

Direct observations made on the pre-test

- Search behaviour observed during the pre-test found that initially many of the participants were apprehensive to type on the keyboard and had to be coaxed and encouraged into beginning the tasks before training was provided.
- Participants demonstrated difficulty in the use of the system in that many appeared to find difficulty in choosing an access point from the menu, even though the search question provided clues that they will be looking for an author, or subject. Instead, many participants tried out several different

access points. In some instances the right steps were followed but due to spelling errors participants failed to get any search results. In this case it was generally noted that participants changed to another search index instead of correcting the spelling error.

- Instead of entering the number of the relevant index at the search prompt some participants typed out their search statement at the prompt.
- Several of the participants depressed the enter key continually instead of typing out the number of the search option from the menu.
- Many of the participants were generally confused when a keyword list was displayed.
- Questions were asked seeking clarity on the meaning of the term author in a few instances. In other cases questions were asked in relation to units of record. For example some participants had difficulty establishing what constituted the title and what constituted an author in a full record display.

Direct observations made on the post-test

- Participants appeared to experience difficulty in using the SELECT option on the URICA system to choose a line of information from a display. In many instances, participants were observed ending the search at this point and beginning a new search using another search index. In some instances they resorted to literal search statements or typed search statements that could not be recognized by the system.

- There was a general tendency to work slowly inputting search information, and some hesitation in the use of the system amongst many participants. However, this was not the case during sessions that included computer literate students.
- During the post-test session there was a repeated problem of the use of the enter key, and the quit command to end a search. There was some difficulty in the use of the URICA system because participants expected to get a direct response to their search query. Due to the way the system is designed they were required to go through three screens before the information they sought was displayed. This had a tendency to cause confusion and resulted in unnecessary use of the enter key, and the quit option.
- On occasions when participants resorted to the use of the Help Function, or when they "landed" on a screen that displayed keywords, they appeared to experience difficulty in exiting the screen.
- It was noted that participants generally did not take the time to read instructions on the screen and to correct spelling errors. The system does not have an inbuilt spell-check function as is in the case of many word processing softwares.
- Searches that did not yield results were often repeated
- On several occasions many participants were found searching the wrong index. Although the search task specified that it is a subject search, on their first attempt of the task, some participants searched the title index.

- At least four participants queried the difference between URICA and OPAC at the end of the post-test.
- Those who completed the post-test first, usually did so within ten to fifteen minutes. These participants were noted by the responses on the background questionnaire to be either those who regarded English as a first language or who had computer experience. Many of the participants took at least forty-five minutes to complete seven post-test tasks. Three of which were repeated from the pre-test.

4.3.3.2 Transaction log monitoring

Transaction log monitoring has become a popular method for studying search behaviour of end-users as indicated by the number of online user studies that have made use of this method. For example, Wallace (1993), Hunter (1991), Zink (1991) to name a few. The popularity of this method is that it provides an unobtrusive method for analysing search performance and eliminates possibilities of bias in data collection. Nielsen, Baker and Sandore (1985) noted that transaction log facilities are not common to all OPAC systems, however they typically comprise a history of the searching activity that takes place on a daily basis. Every search of the OPAC is recorded according to the index searched. The act of storing the search to memory is transparent to the end-user and does not interfere with the interaction between end-user and the computer. However, the forms of transaction logs differ between online systems since there are no accepted standards for the type of data recorded, nor for the form in which data is to be recorded. Hence some OPAC systems record whether or not a search was successful (Zink 1991), others indicate when the search was conducted, the computer terminal used, and the search request (Wallace 1993), the use of "enter" and "clear" keys, user requests and computer responses (Nielsen, Baker and Sandore 1985). In the case of the URICA OPAC system the transaction log report related to end-user search history only provided the date and time of the search, the general port number from which the search originated and the exact data input by the end-user. Transaction logs are arranged according to the particular search index used. No indication is provided about the use of help screens, failed searches, and the beginning of one search and the end of another search. Hence, in the analysis of the transaction log it was not possible to assess the data according to the number of participants in the teaching condition or according to the search emanating from a particular terminal.

Analysis of data collected in the transaction log was a lengthy procedure in that the search activity of participants in the research needed to be extracted from an accumulative transaction log file that recorded all searches done from the previous year up to the period of the experiment. Search details related to performance of participants in the experiment were extracted according to the date and time of the search transaction. This enabled data to be collected on searches done by participants in the procedural group and concept-based group. Each search index was analysed by the date and time of the transaction to determine search details related to the experiment tasks and thereafter errors that were made on tasks performed were analysed. The importance of reviewing errors is that it may indicate the type of difficulty the participant encountered in the use of the system and in turn explain search performance on experiment tasks and areas of difficulty in searching.

Search errors are typically classed as semantic, syntactic or command type of errors. According to Borgman (1984a) a semantic error is one which cannot be interpreted by the system. In this case the searcher may have entered a command that is not valid on the system or she/he may have made a typographical error. A syntactical error is one where the system can detect the approximate meaning of the search input but the format or syntax of the input is incorrect. In a command error the searcher inputs a term that may or may not be a system command, but is not appropriate at that point in the search.

Data collected in transaction log reports in this research found errors of a semantic and command type. Other types of errors were also found related to the conceptual aspects of searching. The common type of conceptual error found in this research was the use of the wrong search index to conduct a search. The title index reflected forty instances of author search statements input in this index by the concept-based group. The title index was used by those in the procedural group to seek subject information. Monitoring data reflected twenty instances of subject/synonym searches and nine instances of a general subject task done in the title search index. Another conceptual error was the use of truncation when a search strategy produced no results, rather than seeking alternative search terms or revising the search strategy. Instances of literal search statements were evident (a total of ten) in both teaching conditions. Examples were phrases such as, " I am looking for the author, Virginia Brodine," or the word, "search." Results of the transaction log analysis are presented in Tables 4.14 to 4.16. However, it must be noted that even though the tables reflect the total number of responses it is not an indication of the total number of respondents since the transaction log did not indicate whether the errors were made by one individual or many individuals.

Table 4.14 Number of errors found in title search index

Type of error	Concept based	Procedural
Commands	60	62
Semantic	13	7
Conceptual	48	36

Table 4.15 Number of errors found in author search index

Type of error	Concept based	Procedural
Commands	65	20
Semantic	32	16
Conceptual	5	6

Table 4.16 Number of errors found in the subject search index

Type of error	Concept based	Procedural
Commands	47	80
Semantic	3	4
Conceptual	7	13

4.4 Summary

This chapter collated the results of the research to facilitate a systematic discussion of the implications of these findings in online instruction. The data presented in both qualitative and quantitative format depict the results of a quasi-experiment which sought to determine whether any differences exist in search performance between two different training conditions, namely, concept-based and procedural instruction. The results are expressed in relation to the demographic information collected in a background questionnaire, significant differences found in performance between the teaching conditions as found in data collected through evaluation instruments such as a pretest issued before training and a post-test issued after training, an evaluation questionnaire that elicited affective responses to the instruction programme and the online system, direct observations made of search performance during the pre-test and post-test, and a transaction log analysis of errors found in the search input.

In order to address the research questions raised, results were explained firstly, with respect to overall performance, and secondly as they related to the variables of library experience, computer experience, and English language use. The results presented can be summarized as follows:

The research objective to determine whether or not any differences exist in online search performance between students trained in a concept-based, and those trained by procedural teaching methods gave rise to the research questions:

> Are there significant differences in search performance on simple online tasks, between students who are conceptually trained and those who are procedurally trained?
>
> Are there significant differences in search performance on difficult online tasks, between students who are conceptually trained and those who are procedurally trained?

The results indicated that no significant differences were found in performance between both teaching conditions on simple tasks related to an author and title search, but a significance of $p=0.02425$ was found on a task related to browsing the database. In the latter case the concept-based group produced a higher number of correct responses.

With respect to performance between the teaching conditions on difficult tasks, participants in the concept-based group performed better than those who were procedurally trained. Significant differences were found on a task on truncation, $p=0.00000$, on a task on a general subject search, $p=0.02629$, and on a subject/synonym task, $p=0.00027$.

The research objective to determine whether or not any differences exist in online search performance between students with differing library experiences trained in a concept-based and those trained by procedural teaching methods gave rise to the research questions:

Are there significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to students with low levels of library experience and those with higher levels of library experience?

Are there significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in relation to students with low levels of library experience and those with higher levels of library experience?

The findings of this research indicated that no significant differences were found between the teaching conditions on simple tasks in relation to participants with low library experience. However, there was a significant difference in performance on a task related to browsing the database in that those with higher library experience in the concept-based group achieved significantly higher scores on this task, $p=0.03942$.

Performance on difficult tasks found significant differences in performance between the teaching conditions. Those with low library experience in the concept-based group attained higher scores on a truncation task, $p=.00164$. Participants in the concept-based group with high library experience performed significantly better on a task on truncation, $p=0.00693$, and a subject/synonym task, $p=0.00786$.

The research objective to determine whether or not any differences exist in online search performance between students with differing computer experiences trained in a concept-based and those trained by procedural teaching methods gave rise to the research questions:

> Are there significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to students who are familiar with and those who are unfamiliar with the use of computers?
>
> Are there significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in relation to students who are familiar with and those who are unfamiliar with the use of computers?

Results indicated that there were no significant differences in performance on simple tasks between the teaching conditions by those with computer experience. However, a significant difference in performance was found in a task on browsing, between those with no computer experience in the concept-based group, p=0.02787.

With respect to search performance on difficult tasks the concept-based group produced higher scores with a significant difference in performance between those with computer experience on a truncation task, p=0.00045, and between those with no computer experience on a truncation task, p=0.00004, and a subject/synonym task, p=0.00637.
In the overall study the subject/synonym task proved to be the most difficult task experienced by the study sample of 120 participants.

The research objective to determine whether or not any differences exist in online search performance between students who regard English as a first or a second language trained in a concept-based and those trained by procedural teaching methods gave rise to the research questions:

> Are there significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to students who regard English as a first language and those who regard English as a second language?
>
> Are there significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in relation to students who regard English as a first language and those who regard English as a second language?

With respect to simple tasks no significant differences were found between the teaching conditions amongst participants who used English as a first language. On a task related to browsing the database, those who used English as a second language in the concept-based group performed significantly better than the procedural group, p=0.01768.

Results with respect to difficult tasks found a significant difference in performance. The participants who regarded English as a first language in the concept-based group performed better on tasks related to truncation, p=0.00377 and a general subject search task, p=0.04258. Those who regarded English as a second language in the concept-based group performed significantly better on a truncation task, p=0.0001, and a subject/synonym task, p=0.00063, which was also found the most difficult task by the overall sample of 120 participants.

The research results indicate that of the overall sample of 120 participants the subject/synonym task was demonstrated to be the most difficult, followed by the task on truncation, proximity, and a general subject task. The concept-based group had more difficulty with performance on a subject/synonym task, followed by a proximity task and then a general subject search task. The procedural group experienced more difficulty with a subject/synonym task, followed by a task on truncation, and then a general subject search task.

With respect to the confidence of the participants in their ability to search the URICA OPAC and other OPAC systems, an evaluation questionnaire reflected a high level of confidence in both teaching conditions. A high level of satisfaction was found in relation to the provision of the instruction and the training materials used. Opinions specifically expressed in the evaluation questionnaire indicated that the instruction should be held over a longer duration. Others expressed difficulty in the use of the keyboard, and difficulty in following instructions on the URICA OPAC.

Comments made on a pre-test prior to training indicated that some participants found the OPAC system difficult to search because of their lack of computer experience, while others indicated that the system was not difficult to use, but that more time was needed to perform the tasks. These comments demonstrate the different responses to online systems in a community with divergent backgrounds. Direct observations made during the pre-test found participants experiencing difficulty with the use of the keyboard, search menu, keyword listings and a high rate of spelling errors as well as a lack of understanding of terminology such as subject headings and so forth. Direct observations made on a post-test found difficulty in the use of some URICA commands, such as to end a search, or to select records and generally with the system design. There were also difficulties in the selection of the relevant search index, and generally participants worked at a slow pace.

An analysis of transaction logs produced, found that the highest number of search errors were made with respect to the use of commands such as "Q to quit," semantical problems and conceptual problems related to the use of search indexes. Participants in the concept-based group made the higher number of semantic errors and errors in the use of commands.

This summary served to highlight the general findings of the research. The following chapter will provide an interpretation of these findings in relation to the objectives of the research and theoretical considerations in online instruction.

Chapter 5

Interpretation of the results

5.1 Introduction

The rationale for the present study was based on the need to provide effective online instruction to students at a tertiary institution in South Africa. South African academic libraries, along with many other countries both in the developed and developing worlds, are making increasing use of online information retrieval systems such as OPAC systems, external online databases, and CD-ROM products. However, while the use of these technologies serves to enhance the delivery and storage of information, they also have drawbacks which can become a barrier to effective searching for some end-users. For example, the lack of standardisation between systems and products, the volume of information that can be generated when searching, and the complex nature of searching. The effective use of online information retrieval systems has also been demonstrated to require prerequisite skills and knowledge relating to information literacy, computer literacy and proficiency in the use of the English language. These are found in varying degrees amongst undergraduate students, particularly in South Africa and those countries who share a similar profile to South Africa. Furthermore, in comparison to traditional information tools such as the card catalogue or subject indexes and abstracts, the structure and organisation of data stored in online retrieval systems differ significantly and require new search techniques to be learnt for the efficient and effective retrieval of information.

Based on the difficulties experienced by students reported in research conducted in the United States the literature has for the most part argued that unless online instruction is provided to students only a few will be able to effectively use online information systems available. The need for online instruction becoming even more necessary with the status quo of the librarian as a search intermediary changing to a situation where searching can be carried out by end users, be they experienced or inexperienced.

The literature has emphasised that the variety of academic, and cultural backgrounds, different experiences and attitudes towards libraries and computer technology must be taken into account in the provision of instruction. Borgman (1986a) noted that the provision of instruction must not only emphasize the difficulties of a retrieval system but must take into account difficulties experienced in online searching as a result of personal characteristics.

Information about the personal characteristics of potential end-users also has value in determining a point of departure for the instruction. Although admission to tertiary institutions in South Africa requires the minimum of a Matriculation or high school certificate it cannot be assumed that all students are at the same stage of academic readiness for tertiary education and more so have similar skills and knowledge for information searching. Students will be likely to respond to online instruction based on their prior academic, information searching and, or other experiences. Therefore, the point of departure in online training is dependent upon the level at which students have acquired the basic pre-requisites mentioned for searching. These prerequisites are then enhanced by the bibliographic instruction provided to students in academic libraries.

Similar to the reported cases in other regions, South African students are not likely to have the experience to cope with the idiosyncrasies and complexities of online searching. The concern of this research was that students in South African tertiary institutions have varied backgrounds and both research (Sayed 1998; Cuthberthson 1992; Bell 1990) and the personal experience of this researcher, indicate that many students have not accumulated the prerequisite skills and knowledge required for effective online searching. The disparate development of South Africa's population groups due to apartheid rule has led to many students from the "African" race group and to a lesser extent other race groups of colour being denied an education which promoted access to libraries or a well-grounded academic programme. Furthermore, the social and economic plight for the vast majority of the African sector as a result of the apartheid system did not make it easy to afford individual ownership of equipment such as computers, amongst other things nor did it provide for the technical infrastructure in residential areas to create the connectivity required to gain access to telecommunication services. Hence the majority of the South African community, in particular those from the African sector, are likely to have had limited exposure to computers outside their school environment or the public library, which was also discovered in Sayed's research (1998). Therefore, mainly as a result of the apartheid system, but also due to other social, economic and cultural differences South African students comprise a diversity that includes varied computer literacy, information literacy and language background.

The literature reviewed found that throughout the world student populations were becoming more diverse. Many reports discussed in the literature review in Chapter 2 pointed to the lack of prerequisite skills and knowledge of students both from developed and developing countries. For example, in the United States some of the difficulties reported were library anxiety and poor library skills amongst undergraduates, computer anxiety as well as over confidence in the use of computers and poor manipulation of the English language amongst non-English speakers, in online searching. Reports of foreign students in American libraries, for example students from parts of Africa, Asia, and Latin America pointed out the difficulties experienced by these students as a result of limited exposure to libraries, the use of closed-access systems or not having libraries in their countries of origin. This can be equated to a similar situation in South Africa where students who were exposed to poor school conditions under the apartheid system have enrolled in "Model C" schools which were formerly "whites-only" schools that were well resourced, or enroll in tertiary institutions, where they encounter "real" libraries and online search systems for the first time. These students are expected to adjust to the new structure and organisation or else they become alienated or "excluded' from the system. A report by Lwehabura (1999) reiterates the lack of libraries in the majority of African countries, which results in students having limited information literacy skills, a problem which is transferred from school to university. This is also evident in the experience of many students attending South African tertiary institutions.

In order to provide online instruction to students in South African tertiary institutions instructors must choose a method of teaching best suited to the majority of students, or groups of students with particular needs. This instruction should take into account differences in relation to information literacy, computer skills and use of the English language. It should also take into account the evolutionary nature of online information retrieval systems and the lack of standardization amongst the different systems. To this end two methods of instruction have been looked at as potentially useful for online instruction to end-users. One which concentrates on teaching the procedures in the use of a specific system (procedural instruction) and the other which teaches concepts which can be applied to many systems (concept-based instruction). Various scholars such as Cherry *et al* (1994) and Elsbernd, *et al.* (1990) have argued in favour of concept-based instruction. A landmark study by Borgman (1984a) confirmed to some degree that concept-based instruction is more beneficial than procedural instruction. However the extent to which these results could be generalised to the South African context was not apparent due to problems relating to Borgman's sample methodology, and the environment in which the study was conducted. Hence, the objective of the present research was to determine whether or not any differences exist in online search performance between novice end users trained in a concept-based and in a procedural teaching method in a South African context. The research further sought to determine whether or not any differences exist in online search performance between each teaching condition in relation to novice end users who have different library, computer, and English language experiences. Online search performance was viewed in two categories, namely performance on simple and complex or difficult tasks.

This chapter provides interpretations and discussion of the research results. The discussion is organised in relation to a summary of the findings as they related to the research objectives and questions posed, theoretical considerations in online instruction, issues related to the research design, and generalisation of the results to the broader population.

5.2 Summary of the findings

In order to meet the research objectives, specific research questions were posed which were tested in a quasi-experiment that compared performance on search tasks between two groups who received concept-based and procedural instruction respectively. This served the purpose of collecting data necessary for determining which method of online instruction was more beneficial in a South African context. To determine who benefits from either teaching method, search performance between the two groups was further compared in relation to the variance in performance as a result of differing levels of library experience, computer experience and English language use. In order to assess whether the outcome on search performance was due to the training received and not to other factors affective responses to the instruction programme were collected in a self-reported evaluation questionnaire. Demographic information was sought to determine the extent of experience novice end users in a South African tertiary institution bring with them, in relation to the variables of library experience, computer experience and English language use. This information was also useful in establishing a point of departure for the implementation of an online instruction programme.

In order to discuss the findings systematically, this section will review the demographic profile of the sample and discuss search performance in relation to the research questions posed.

5.2.1 Demographic profile of the sample

Demographic data was gleaned from a background questionnaire which sought information on characteristics which were considered to be sources of variability on online search performance. These were the participants' level of library experience, computer experience and English language usage. As already pointed out in Chapters 1 and 2, online searching implies the need for some level of information literacy in order to select, and understand the scope of specific databases, to understand the use of access points and to have the ability to interpret records retrieved (Harter 1986; Convey 1989). Computer literacy facilitates the use of the hardware to interact with the online system. Proficiency in the use of the English language is important in order to manipulate search terms and understand the syntax and semantics of entering search terms. The questionnaire further sought to establish the online search experience of the sample population targeted by seeking information about prior online search experience, both in relation to the OPAC system used in the experiment (URICA) and other online systems and to training received in the use of online retrieval systems.

Overall the sample participants in the study could be categorized as novice end-users with limited or no prior search experience and training in the use of the URICA OPAC or other

OPACs and online technologies. According to Borgman (1986a) novice end-users are typically low-frequency users. They have been described by Cole *et al.* (1985) as those who have limited knowledge of a system in terms of semantic and syntactic knowledge. A detailed description of the various categories of end-users is outlined in the literature review in Chapter 2. The novice status of the participants was important to the outcome to this research in that since the majority of the sample population did not have prior exposure to online information retrieval systems it could be assumed that they did not develop a mental model of the URICA system or other online systems prior to the experiment. Hence, there was a greater possibility of the teaching condition being the reason for the resulting effect on search performance

Demographic data related to library experience found that a greater portion of the participants had high library experience with twenty participants out of the total of 77 in the concept-based condition and24 out of the total of 77 in the procedural condition. Demographic data related to computer experience found that the majority of the overall sample had not used computers prior to the experiment. Out of the73 participants who had not used computers, the majority, just over 60.0% were in the concept-based group compared to the procedural group. A higher number of participants with computer experience were found in the procedural group. Demographic data related to English language usage found that the majority of the participants considered English as a second language. The distribution of the participants from these two language categories, between each teaching condition was small. The concept-based group having a slightly higher number of participants with English as a first language and a slightly lower number, who considered English as a second language.

In summary, the sample can be described as a group that had exposure to libraries as indicated by the number with high library experience, were inexperienced in the use of computers and who did not regard English as their dominant language. These findings confirm the view that students, in this case of those in the first year of South African tertiary institutions do not make wide use of computers. They also have differing backgrounds with respect to experience in the use of libraries and technology as well as in the use of English. In comparison to the concept-based teaching condition those in the procedural teaching group constituted higher library and computer experience and had more participants who considered English as a second language. However, statistical analysis presented in Chapter 4 revealed no significant difference in the distribution of these variables between the groups allocated for instruction using the two teaching conditions.

With respect to confidence in the use of libraries and computers the study found that there was a lack of confidence in participants' ability to use either a library to find information or in the use of computers. Therefore even though the sample reported high library experience, it did not necessarily mean that they had sufficient information literacy skills to make them confident and effective users of library resources.

Data was collected on confidence in the use of computers to find information through the means of a background questionnaire prior to training being instituted. Between the concept-based group and the procedural instruction group, 40 of the participants were from the concept-based group and 33 were from the procedural group. These results were similar to the number of participants who reported not having used a computer before with 38 of the participants in the concept-based group and 35 in the procedural group. Hence, prior to instruction it suggests that those with computer experience are likely to be more confident in the use of online systems. More so since those who reported being confident in the use of computers to find information prior to training equalled the number of participants who made prior use of computers.

The relation of these variables to search performance will be discussed in more detail in the following section which will review performance on the experimental tasks. END. 20/09/0

5.2.2 Search performance on experiment search tasks

This section discusses the performance on search tasks assigned on a pre-test issued before training was instituted and on a post-test issued after training. These results will be discussed in relation to performance on simple and difficult tasks, following Borgman's example (1984a). The reason for this is that conceptual processes are considered to be different between simple and difficult tasks. As defined in Chapter 1, simple tasks require no manipulation of search terms, or making deductions from search output. Information to proceed with the task is readily available in that the search is usually for known items such as author or title. Difficult tasks were operationalised as tasks that required manipulation of search terms, deriving solutions from search output, and refining and broadening search results when required.

The arrangement of this section includes a discussion firstly, of performance on simple tasks in terms of differences found in overall performance, and then in relation to the variables of library experience, computer experience, and English language usage. Secondly, the discussion will review performance on difficult tasks in relation to differences found in overall performance and in relation to the variables as for simple tasks. The discussion explains what was found on the pre-test before training was provided and what was found on the post-test after training was provided. Finally the differences found in performance are assessed in relation to research questions posed.

In order to appreciate the differences in performance after training was instituted, the methods used in both teaching conditions must be reiterated. In the case of procedural teaching emphasis is placed on teaching specific steps to be followed in performing search tasks. With respect to concept-based teaching, the use of an analogy is made to provide the learner with a model that they can use to understand the architecture and arrangement of information on online systems in general. In both teaching conditions the training covered topics which allowed for performance on search tasks in the experiment. These tasks were made up of typical search tasks such as author, title and subject searches, that undergraduates encounter, and the use of features such as browsing, proximity, and truncated searches. Therefore in a comparison of the teaching methods of concept-based and procedural teaching, one is assessing the effect of step-by-step instruction against the use of model-based instruction.

5.2.2.1 Performance on simple tasks

Simple tasks were made up of an author and title search task and one that required the respondent to use a system feature to browse the database.

5.2.2.1.1 Overall performance on simple tasks

In overall performance prior to training being received, scores on an author and a title task, of both teaching groups were just under 50.0%. Statistical testing of the scores between the two teaching groups found no significant differences in search performance between both groups prior to training being instituted.

After training was implemented, overall search performance on author and title tasks improved for both teaching groups with scores above 80.0%. However, there were no significant differences in performance on simple tasks between the two teaching groups. This finding concurred with a study conducted by Borgman (1984a) who predicted that training will have no effect on the ability to perform simple tasks correctly nor that it will have an effect on the process of using the system for simple tasks. Based on arguments presented by King and Baker (1987), Borgman (1984a) and others who have supported the use of model-based teaching this result is not unexpected in that simple tasks are described as not needing the use of a model. According to these authors, the use of a model in teaching is to generate a method for using the system. Performance on simple tasks requires mechanical use of the system, which does not require one to probe the database to seek unknown information, or to manipulate search terms and so forth. Simple tasks are also referred to tasks for known-items. In performing these tasks, unless there are semantic errors made, the OPAC system, in this case URICA, provides some direction for conducting the search through the use of system prompts. After training both teaching groups were given a method to understand the way in which the system can be used to find information on this task which led to them following the mechanical steps required to access the author or title index and selecting the appropriate record/s. Hence, the "maps" provided in both training situations were sufficient to enable effective performance on simple, author and title tasks. Since prior to training, performance on author/title tasks found scores of under 50.0% it is interpreted that the training more so than the participants' prior searching knowledge and skills affected performance on simple tasks. After training was received, both groups made considerable improvement in performance on the author/title tasks with scores for both groups reaching at least 80.0%.

A higher score by the procedural group on the title task in the post-test indicated that procedural instruction is necessary in some instances. The title task required the use of a system command to select a line of information representing the title. Having learnt the command in the procedural lecture, it is speculated that the procedural group was able to perform better on the task. The concept-based group were not taught specific procedures but only the concepts related to author/title searching and the way in which information is stored on a database. They are likely to have become confused with the use of the command to “select” records.

Overall in comparison of performance on simple author and title tasks, there was no significant difference in performance after concept-based and procedural teaching with levels of significance at $p=0.80254$, which addresses the research question raised in this respect. The results indicated that instruction is beneficial to students. However, it may be necessary to look at the influence of repeated instruction and/or practice in searching using the two teaching methods.

In a third simple task which was not included in the pre-test, participants were required to browse through the database to find additional information on a specific subject. This required the use of a specific system feature on the URICA OPAC which is used to browse through the database. These features are the use of tags found on the OPAC called T1 to browse through the title index and D1 or D2 to browse through the subject index. A sample of this screen can be found in Appendix I at the end of this report. The task was classified as a simple task because it did not require manipulation of search terms. However, unlike author/title tasks this task did not constitute a known-item search.

On this task there was a significant difference in performance between the concept-based group and the procedural group ($p=0.02425$). Although performance did not match that of the author/title tasks, well over half of the participants in the concept-based group

(71.7%) scored this task correctly. In the procedural instruction group despite the teaching method specifically pointing out this feature, just over half (51.7%) scored correctly on this task. In further analysis of this task, the researcher was inclined to think that this task would have been more appropriately classified as a difficult task because the outcome of the search is not known and therefore falls into a similar category as subject searching.

Since the concept-based group had lower library and computer experience than the procedural group, it can be assumed that the model introduced in the training may have been beneficial to these participants. Performance on this task also supports the theory of Borgman (1984a) and others that a model is only put into use when the methods for operating a system are not known.

Hence, in response to the research question:

> Are there significant differences in search performance on simple online tasks, between students who are conceptually trained and those who are procedurally trained ?

The results of the overall search performance on simple tasks indicate no significant differences between the teaching methods.

5.2.2.1.2 Performance on simple tasks of respondents with low and high library experience

Performance on author and title tasks found no significant differences in performance prior to training being received. However, those with high library experience, as expected, were able to score higher on tasks assigned than those with low library experience. In both teaching groups those with low library experience scored under 50.0% on author/title tasks. The procedural group however did far worse on the title task, scoring 15.4% compared to 30.0% in the concept-based group. Since those with high library experience reported prior use of an OPAC or catalogue and frequented the library to find information at least weekly or daily, these results suggest that prior knowledge and skills gained from this experience influenced their ability to search the OPAC system. It also suggests that the prior knowledge and skills of those with high library experience provided them with some level of information literacy that enabled them to achieve some results in the use of the system. Hence, this is indicative that competency in information literacy skills is one of the prerequisites in the use of the online system.

After the training was received, both teaching conditions reflected a high rate of improvement on the post-test on simple tasks related to author/title, but no significant differences were found. The effect of instruction in both groups was that respondents with low library experience demonstrated the same ability in performance on simple author/title tasks as those with high library experience, with confirms the view that information literacy skills have a role in the effective use of online systems. The results on this task again indicated that use of a model was not required for effective performance on simple tasks by those with high or low library experience.

On the one hand this finding simply reconfirms the significance of bibliographic instruction and how it improves user' abilities to conduct effective searching. However, with respect to the major issue of the study, namely differences between the two teaching methods, the study did not show any significant difference.

Hence in response to the research question

> Are there significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to students with low levels of library experience and those with higher levels of library experience?

the findings of this research indicate no significant differences in performance after training was instituted. Those with low and high library experience benefited the same from procedural and concept-based instruction, with slight differences in overall scores.

In the case of the task related to browsing, results confirm the researcher's view that this task would have been more appropriately classified as a difficult task. Respondents in the concept-based group performed better on this task than the procedural group. On this task those in the concept-based group with higher library experience performed significantly better than respondents with high library experience in the procedural group ($p=0.03942$).

The higher score achieved by those in the concept-based group on this task suggests that conceptual training or more specifically model based training played some role in the respondent's performance on this task. To some degree performance could also be attributed to the influence of prior library experience. Although if one reviews performance of respondents with low library experience in the concept-based group, on pre-test performance prior to training, it was revealed that this group was not able to perform effectively without training, and also performed lower than those with high library experience in the procedural group. However, on this task, those with low library experience in the concept-based group achieved a higher score than those with high library experience in the procedural group, hence there is more indication that training rather than prior library experience influenced performance on the task related to browsing. This leads to the conclusion that more research related to model-based instruction needs to be conducted to be certain of the effect of this type of training on performance.

5.2.2.1.3 Performance on simple tasks of respondents with and without computer experience

Performance on simple tasks prior to training reflected no significant differences between concept-based and procedural instruction for those with and without computer experience. As expected, those with computer experience scored higher on pre-test tasks than those with no computer experience. This confirms that familiarity with the use of computers plays a role in use of the online system.

Performance on simple tasks on the post-test also reflected no significant difference on author/title tasks between the two teaching conditions for those with and without computer experience. However, the level of improvement between each teaching condition was of interest. Those with no computer experience in the concept-based group scored the lowest on author/title tasks (78.9% and 76.3%). Those with no computer experience in the procedural instruction group appeared to have benefited from training received in that their scores shifted from 31.4% and 17.1% on author/title tasks in the pre-test to 80.0% and 82.9% on the post-test. Those with computer experience in the procedural instruction group did not show a large margin of improvement on the author task shifting from 80.0% on the pre-test to 88.0% on the post-test. On the other hand those with computer experience in the concept-based group made a 100% improvement from 63.6% on the pre-test. This group also reflected a high improvement on the title task scoring 95.5% on the post-test compared to 31.8% on the pre-test. This indicates that concept-based instruction was of benefit to those with computer experience, and procedural instruction was of benefit to those with no computer experience. Since those with no computer experience are unfamiliar with use of computer hardware, it can be expected that these respondents would have appreciated the explanation of the specific procedures needed to search.

However, the task related to browsing, reflected different results between the two groups. Compared to performance on author/title tasks, those with no computer experience in the concept-based group scored higher, than those with and without computer experience in the procedural instruction group. Less than half (42.9%) of those with no computer experience in the procedural instruction group had correct scores on this task compared to their earlier performance on author/title tasks. Those with high computer experience in the concept-based group scored the highest on this task but did not perform as well as they did on author/title tasks. A significant difference, p=0.02787, was found in performance of respondents with no computer experience between participants in the concept-based group and the procedural group. Hence, as argued earlier by Borgman, (1984a) the effect of the model is seen in performance on tasks that require the use of conceptual knowledge. The model is able to provide a method for using the system. In this case respondents with no computer experience benefited more when concept-based training was instituted. This infers that for those with no computer experience, both procedural and concept-based training is required to learn different aspects of searching. King and Baker's argument (1987) has relevance in this context in that they state that a variety of factors other than content, influences response to instruction and how well students learn.

In response to the research question:

> Are there significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to students who are familiar with and those who are unfamiliar with the use of computers?

the research findings indicated no significant difference in performance on author/title tasks between concept-based and procedural instruction. However, those who had no computer experience demonstrated greater benefit from procedural instruction in performance on simple author/title tasks and those who had computer experience benefited more from concept-based instruction.

5.2.2.1.4 Performance on simple tasks of respondents who regard English as a first or a second language

Performance on simple tasks of author/title prior to training found no significant difference in performance between the groups allocated for instruction using the two teaching conditions between those who regarded English as a first language and those who regarded English as a second language. Participants who considered English as a first language scored the highest on author/title tasks reaching scores above 60.0% while English second language respondents scored under 50.0%. This result provides some indication that familiarity with English plays a role in search performance.

Performance on simple tasks of author/title after training produced no significant differences between respondents and teaching conditions. Overall those in the concept-based group with English as a first language scored the highest on the experiment tasks. Those who regarded English as a second language in the procedural group scored higher than those in the same category in the concept-based group. Those with English as a second language in the procedural group also scored higher on simple tasks than those with English as a first language from the procedural group. These findings indicate that for respondents who regard English as a second language, procedural instruction led to higher performance than when provided with concept-based instruction. Hence, even though it has been argued by Cherry *et al.* (1994) and Borgman (1984a) that simple tasks require information about known items which require mechanical use of an online system it is evident that for some students knowledge of the mechanical procedures is required as a result of the particular circumstances of the student. van Brakel (1988) pointed out that language is crucial to understanding structure of information. For those respondents who did not regard English as a first language, procedural instruction might have been found useful in that it provided a visual presentation of the system. Although concept-based instruction also attempts to provide a visual presentation of a system through the use of a model in teaching, for students who have less familiarity with English, this form of instruction does not appear to be useful for all types of searches.

Respondents who regarded English as a first language did appear to benefit from procedural instruction. Although this group scored higher on author/title tasks on a pre-test prior to training, compared to respondents who regarded English as a second language, after training, the English second language speakers scored higher on these tasks. Even though the tasks were repeated from the pre-test. This indicates that English first language speakers derived no benefit from procedural instruction. However, other factors related to attitude to the task could have influenced performance, although there was no indication of this on the evaluation conducted of the instruction. Jakobovits and Nahl-Jakobovits (1990) list the affective domain as a behavioural objective that is important for information searching competence. According to these authors, feeling empowered was one of the levels in a taxonomy of behavioural objectives that must be attained. If those who considered English as a first language did not feel empowered after procedural instruction, or felt that they did not learn anything new, it might possibly have affected their performance.

On the other hand those who regarded English as a first language appeared to benefit from concept-based instruction in that they reflected the highest performance between the two training conditions on author/title tasks. The explanation for this is that experience with English as a first language is likely to have enabled these students to follow the instruction provided by the system more easily because of their grasp of the language. Coupled with the training provided, they were better able to make sense of the online system.

On the task related to browsing, those who regarded English as a second language in the concept-based group scored the highest. There were significant differences in performance on this task between respondents who regarded English as a second language. Those in the concept-based group performed significantly better with $p = 0.01768$. The difference in performance in the concept-based group between English first language and second language users could be as a result of some English first language speakers having developed their own model of the online system which could have interfered with their learning in this instance.

In relation to the research question :

> Are there significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to

students who regard English as a first language and those who regard English as a second language?

The findings indicated no significant difference in performance on simple tasks related to author/title searching. However, English second language respondents appeared to benefit more from procedural instruction on simple tasks and English first language respondents appeared to benefit more from concept-based instruction.

5.2.2.2 Performance on difficult tasks

Difficult tasks included a task related to a truncated search, a proximity search, a general subject search and a subject search that required the use of a synonym which will be referred to as a subject/synonym task.

5.2.2.2.1 Overall performance on difficult tasks

The results indicated that on performance in a pre-test task issued prior to training there was no significant difference in performance between the concept-based and procedural instruction groups. Only one difficult task was assigned in the pre-test which was a subject search that required the use of synonyms. This task deliberately included a term that generated no search results and led the participant to the use of alternate search terms. Both groups performed poorly on this task and produced an equal result of 8.3%. Since the task was issued prior to training, it can be speculated that respondents might not have had the analytical or conceptual knowledge to conduct a search of this nature. In transaction log studies of user behaviour it was found that many undergraduates had problems with subject searching, for example in the use of controlled vocabulary, problems with thinking of alternative search terms, variant spellings, and synonyms (Wallace 1993; Zink 1991, and others).

A post-test issued after training found no significant difference on a task related to proximity searching. This task made use of the title search index, which respondents appeared to find little difficulty in performing. The use of a proximity feature is provided as an option by the OPAC system URICA. Since the wording of the task specified the search statement to be used, it was found that most respondents made use of this term and thereafter followed instructions on the system. Hence, a task of this nature needs to be re-tested to find out what differences in performance would result when students formulate their own search statements.

However, for other difficult tasks related to truncation, subject searching and a subject/synonym search there were significant differences found between the teaching conditions. The concept-based group performed significantly better on a truncation task with a significance of p=0.00000, on a task related to a subject search with a significance of p=0.02629 and on a task repeated from the pre-test significance was p=0.00027. The procedural instruction group scored below 50.0% on all three tasks. The performance of the procedural instruction group can be explained by arguments submitted by Nielsen, Baker and Sandore (1985) that a person with only procedural knowledge has learned a set of rules to apply in interacting with the system but has not organized these rules into a related framework for the system's functional operation. The results of the performance of the procedural group on difficult tasks confirm these authors' view that if conceptual models are not provided, users will develop their own mental understanding of the system which may prove erroneous, and incomplete, leading to misconceptions, poor interaction and ineffective searching. The findings of this research confirms Borgman's (1984a) theory that performance on tasks that require extrapolation from search results or manipulation of search terms achieve better results when concept-based instruction is implemented. She argued that the model provided in the use of the system provides a map or conceptual framework to understand or find one's place in the system and is relevant when difficult tasks are encountered. Others, like Baker, *et al.* (1991) interpreted better performance on difficult tasks by those who are conceptually trained as the result of the conceptual teaching method enabling users to exploit the system. In their view, teaching concepts addresses the user's greatest difficulties, which could be the reason for the results obtained in this research.

In relation to the research question

> Are there significant differences in search performance on difficult online tasks, between students who are conceptually trained and those who are procedurally trained?

the results demonstrated that concept-based instruction produced more effective search performance on difficult tasks than did procedural instruction.

Despite the subject/synonym task being issued on the pre-test, experience with this task prior to training did not lead to overwhelmingly better results as was found on author/title tasks. The procedural instruction group showed little improvement on this task after training, with a score of only 13.3% compared to the concept-based group who achieved 43.3%. Those who had high experience in the use of libraries, who had computer experience and who regarded English as a second language scored at least 50.0% on this task, while those respondents who did not have these experiences always scored below 50.0% on this task. Performance on this task overall indicated that it was found difficult by the study sample.

Some of the reasons for the difficulty experienced on this task could be related to the student's unfamiliarity with searching terminology. Although it is assumed at tertiary level that students have some understanding of what is meant by a subject search or use of a synonym, this researcher found that in the course of the lecture provided a few students queried the term "author, " and "spine of a book." As a result of the kind of education systems to which some students were subjected with under the apartheid system, this type of problem is likely to occur and therefore instruction provided needs to be mindful of content of programmes and methods used.

Another reason for poor performance on a subject/synonym task is seen as the student's inexperience in formulating a search strategy and defining an information need. Although the search task specified the use of the subject index and indicated which number should be selected from the access menu, transaction log reports revealed the use of various search indexes to perform this task. Baker (1986) found that the greatest difficulties that students experience are with conceptualization, and formalisation of their search need, and development of a search strategy that exploits the interactiveness of an online system. Dyckman and O'Connor (1989) found in research conducted that many end-users are confused by, or do not understand search techniques, and have problems with the use of synonyms and/or word manipulation and conceptualized search statements. The findings on the difficult task in general, confirm Huston's argument (1989) that undergraduate students lack the contextual understanding necessary for online problem solving.

5.2.2.2.2 Performance on difficult tasks of respondents with low and high library experience

There were no significant differences in performance on a difficult task in the pre-test between the categories of low and high library experience in both teaching groups. Performance on this task which was a subject/synonym search was poor for both groups. In the concept-based group those with both high and low library experience scored 10.0% on this task. In the procedural instruction group those with low library experience scored zero and those with high library experience scored 12.5%. The low performance on this task indicates that even though students reported prior use of OPACs or card catalogues and prior use of the library to find information as in the case of respondents with high library experience, it cannot be taken for granted that these students have a complete understanding of searching concepts, or the level of information literacy that will enable them to search effectively. As this research demonstrated, although respondents with high library experience performed reasonably well on a pre-test on simple tasks on a difficult task which required some analytical skills they were not able to perform as well. Hence, the importance of information literacy and instruction to all students, despite their prior experience is of importance. It is also important when setting learning objectives that one not only considers the stated needs of learners, but also addresses areas where there is a demonstrated problem. In this instance a subject/synonym search, and a search that produced no results in the first search attempt were found to be difficult by students participating in the research.

In the post-test after training was received, there was a significant difference in performance between the concept-based and procedural instruction group on the subject/synonym task. The concept-based group performed better with respondents with high library experience achieving a higher score with a significance of p=0.00756. Those with low library experience in the concept-based group scored higher in the post-test after training was received than participants in the procedural instruction group. Those with high library experience in the concept-based group scored the highest overall. The concept-based group reflected a rate of improvement of 30.0% and 55% while the procedural instruction group improved by a rate of 16.7% and 15.4%.

Overall the results indicated a significant difference in performance between the two teaching conditions on difficult tasks. Between those with low library experience the concept-based group performed significantly better on the task on truncation with p=0.00164. Between those with high library experience the concept-based group performed significantly better on the task related to truncation, p=0.00693.

In relation to the research question:

> Are there significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in relation to those with low levels of library experience and those with higher levels of library experience?

the results of this research found that those with high library experience performed significantly better on a subject/synonym task, and on a truncation task. Those with low library experience performed significantly better on a truncation task. However, performance scores indicate that in the concept-based group, respondents with both low and high library experience scored higher than those in the procedural group.

5.2.2.2.3 Performance on difficult tasks of respondents with and without computer experience

Performance on a subject/synonym task prior to training reflected no significant difference in performance between each teaching condition. Both groups performed poorly on this task. The concept-based group for respondents with no computer experience and those with computer experience scored under 10.0% on this task . In the procedural instruction group those with no computer experience scored zero while those with computer experience scored the highest (20.0%). As already noted this type of search was generally found to be difficult for the respondents in this study. Even though respondents with computer experience were able to achieve some results on simple tasks, they appeared to lack the conceptual knowledge required for performance on a difficult task. These findings disprove an argument submitted by Pfaffenberger (1990) which reasoned that computer literate students will be able to easily grasp online searching and that they will be able to follow the structure of the online system to find the information they require. He further argued that searching is an art and requires creativity to find the terms required in performing a search, which is a quality inherent to human beings.

The post-test conducted after training found significant differences in performance on difficult tasks between the teaching conditions in relation to computer experience. On the task related to proximity searching those with no computer experience in the concept-based group scored higher than those in the procedural instruction group. Performance on a proximity task found a significant difference in performance between those who had computer experience between the two teaching conditions. Those in the concept-based group scored higher with a significance of $p=0.000418$.

In the task on truncation those with no computer experience in the concept-based group scored higher than those with computer experience in the procedural group. Those in the concept-based group reflected a significantly higher level of performance with $p=0.00004$ between those with no computer experience, and $p=0.00045$ between those with computer experience.

The task to find a subject reflected no significant differences in performance however, the concept-based group scored higher on this task. With respect to the subject/synonym task performance was improved from that of the pre-test. Both those with and without computer experience in the concept-based group scored significantly higher than the procedural instruction group. Levels of significance were $p=0.00637$ between those without computer experience and $p=0.01259$ for those with computer experience. Overall performance on this task was the lowest compared to other difficult tasks. The highest score on this task was 50.0% achieved by those with computer experience in the concept-based teaching condition. Those with computer experience in the procedural group who scored 20.0% on the pre-test prior to training, dropped performance to 16.0% in the post-test. According to Merrill *et al.* (1992) such a drop in performance assumes that the instruction promoted a misconception. King and Baker (1987) pointed out that when learners are not provided with a conceptual foundation for manipulating the technology, they develop their own models which lead to misunderstanding, and ineffective system use. The overall performance of respondents with no experience in the use of computers in the procedural instruction group was low on the post-test. Scores for this group were under 50.0% on all the difficult tasks after training was received, which was a contrast to their performance on simple tasks.

In relation to the research question :

> Are there significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in relation to students who are familiar with and those who are unfamiliar with the use of computers?

the results found in this indicated that both those with and without computer experience showed superior performance in the concept-based group.

5.2.2.2.4 Performance on difficult tasks of respondents who regard English as a first language or as a second language

Overall performance by this group was poor on the subject/synonym task in the pre-test. Those with English as a first language scored the highest on this task with scores of 15.4% for the concept-based group and 9.1% for the procedural group. This result was expected because of the different experiences in English language use. However, it was not expected to find that English first language respondents would perform at a low level as they did. The term used in the task required respondents to find a synonym for the word elderly which was considered to be a part of everyday vocabulary. The difficulty with performance on this task could signify that when the system output results in "no hits," students have difficulty understanding how to proceed with the search, or have little means to revise their searches in the way of using alternative terms or revising their search statement. It is also indicative that the nature of this task required skills in information literacy which the respondents did not have. This signifies an area on which training must be emphasized. No significant differences were found in performance on the pre-test prior to training.

On the post-test the concept-based group demonstrated better performance on all difficult tasks, with some tasks reflecting significant differences in performance. Those in the concept-based group who regarded English as a first language performed significantly better than those in the procedural group with a significance of p=0.00377 for truncation, and p=0.04258 on the subject search task. Those in the concept-based group who regarded English as a second language scored significantly better than the procedural group on truncation (p=0.00001) and on the subject/synonym task (p=0.00003).

In relation to the research question:

> Are there significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in relation to students who regard English as a first language and those who regard English as a second language?

the results indicated that concept-based instruction leads to more effective performance on difficult tasks in comparison to procedural instruction for students who regard English as a first and a second language. Once again Borgman's theory is confirmed wherein the provision of a model in instruction helps in the performance of difficult tasks. However, despite concept-based teaching leading to better performance on difficult tasks, performance on a subject synonym task was lower than performance on other tasks. According to Baker and King (1987) mental models take time to develop and therefore a training model should be introduced over a period of time. In their view, attempts to cover too much may cause students to be overloaded, and unable to absorb or apply the information provided. Hence, they recommend that instruction will stand to benefit from credit bearing courses that offer sufficient time to introduce library resources, and searching fundamentals.

5.2.3 Search behaviour

The extent and nature of search errors recorded in the transaction log analysis confirmed the view that most novice end-users do not have the skills necessary to cope with the complexities of online searching. Errors recorded highlighted those aspects of searching which were found difficult and which should become a focus in the instruction programme with the intent of improving performance. Logan and Woelfl (1986) noted that if characteristics associated with effective online searching can be identified, training methods can eventually target these areas so that search performance can be maximized. Errors recorded also provide some indication whether search performance was due to reasons other than the training methods provided.

The transaction log reports, and the patterns of searching revealed during the grading of the search tasks reflected problems in online searchng both at a mechanical and a conceptual level. Borgman (1986a) pointed out that problems with the mechanical aspects of searching are most often found amongst inexperienced and infrequent end-users.

Harter (1986) noted that failed searches are typically as a result of an inadequate understanding of the search query, and of the system characteristics, semantical errors, the use of controlled or system vocabulary, inability to respond appropriately to system feedback, amongst others. The errors recorded in this research encompassed all of these types of errors. The following discussion provides a summary of the errors and search problems which indicate the difficulties encountered by participants in this research. The discussion is grouped according to mechanical and conceptual problems and will be discussed under headings for simple and difficult tasks.

5.2.3.1 Problems related to the mechanical aspects of searching

Search errors that are of a mechanical nature have been discussed in Chapter 2. These generally refer to errors in syntax and correct spelling or typographical input of search terms, and the use of commands to execute search operations.

Search errors recorded in the transaction log of this research were mainly of a semantic nature or errors in the use of commands. Semantic errors such as incorrect spelling and typographical errors, for example, depressing keys too hard which caused letters to be repeated, were commonly found. Some problems were found in the use of spacing between terms. The concept-based group reflected a higher tendency for semantic errors than the procedural instruction group. A similar occurrence was found in Borgman's research (1984a). Although performance results demonstrate that the concept-based group fared better on some tasks, the rate of errors found on the transaction log report seem to contradict these findings. Without actually interacting with the participants of the study to determine what they were doing during the search, it can only be speculated that these errors could have been as a result of difficulty in the use of the keyboard, unfamiliarity with procedures of the system, or just someone who typed too fast. The absence of any interaction with the participant about the search conducted was identified as a weakness in the research design, since without this data, the use of the transaction log report had limited value.

Several instances were found of the use of the string ".OD" after a search statement in the concept-based instruction group. For example, beginning photography.OD. It could not be determined whether this was an abbreviation for online-database or just an error made. However, it was noted in all of the search indexes. The transaction log report did not provide any indication whether this was an error of one individual or many individuals which reflects a limitation of the transaction log that has been developed on the URICA system.

Errors related to the use of commands were mainly in the use of the key to end a search which is the letter Q to quit. This was most often experienced by those in the concept-based group. However, the procedural group displayed more cases of this error in the subject index which also proved to be the most difficult type of search task for this group. An explanation for this occurrence is provided by Saule (1991a) who argued that the use of a computer to find information provides no clues about the size of the database or how the database is constructed which makes it difficult to revise a search when the search produces no results. Hence, the person using the system may not understand what is transpiring when there are no results. As a result, it is speculated that when participants in the procedural group found no results on a subject/synonym task they could have resorted to various methods of finding a solution to the task, or as Baker asserted (1986), resorted to the use of their own models of the system. This may have led to confusion in the use of commands.

The URICA system makes use of the "enter" key to go backwards to the main menu, and the use of the letter "P," to scroll forward. The presence of the letter Q or P in many of the entries where a search statement was required indicated that some confusion might have prevailed in the use of these commands. There was an indication that some participants in the concept-based group encountered difficulty using the system menu in that some entries reflected the menu number in the line that required a search statement. This was found both in the pre-test prior to training and on the post-test after training. However, again the transaction log was not able to indicate whether this was the error of one or many individuals.

The errors recorded were similar to reports of research conducted in the United States, for example Zink (1991), Connaway *et al.* (1994) and others. The way in which these errors affected the search result was not entirely clear. Although there is some evidence that an incorrect statement was corrected, the transaction log did not generate the number of failed searches. The higher number of mechanical errors was recorded amongst those in the concept-based group which indicates that these participants could have experienced difficulty in following the procedures of the system. The concept-based group however also constituted slightly more participants without prior computer experience. The number of errors could have been as a result of difficulty in the use of the keyboard. Since the concept-based group reflected higher search performance than the procedural group, it can be concluded that the difficulties experienced did not hamper performance of the concept-based group. Instead, the higher scores achieved by this group on the post-test, suggests that model-based instruction assisted their performance.

5.2.3.2 Problems related to the conceptual aspects of searching

Problems of a conceptual nature relate to the use of correct access points to match the search query, ways of narrowing or broadening a search, revising search strategies when no results are retrieved amongst others. This section reviews frequent errors found on simple tasks and difficult tasks performed in this research.

5.2.3.2.1 Transaction log reports of search input on simple tasks

In simple tasks related to author/title searching in both the pre-test and post-test many errors were made as a result of misspelling. For example the author Virginia Brodine was spelt as Brodline, Bromine, Brodined, VirgiaBrod and so forth. The title, "Beginning photography" was found spelt as biginning or beginnning photography. A common problem was the absence of a space between the forename and the surname, for example VirginiaBrodine. Although the URICA system allows for the forename to be entered before the surname, spacing of the terms is necessary. Incidents were found of searches input literally, such as, "I am looking for Virginia Brodine," How many books written by Virginia Brodine," and "I need information on Virginia Brodine." King and Baker (1986) described this as an anthropomorphic relationship with a computer system where end-users ascribe human characteristics to the machine because of their interactive nature. New and infrequent end-users were said to commonly fall into this category.

In some cases a string of irrelevant terms were entered having no relation to the search task. For example, Town Planning, which is the title of an academic programme from which a sample of participants had been drawn. There was also evidence of the wrong index used to search for author and subject information. The concept-based group revealed a higher tendency to search for authors in the title index. In total there were 40 counts of such occurrences. In many cases in the procedural instruction group there was evidence of the title index used to find subject (29 occurrences) and author information (seven occurrences). The author index was sometimes used to conduct the truncation, proximity and subject tasks of the experiment. The count of errors however, did not indicate whether it was an error of one, or many individuals. Despite this weakness, the types of search errors found suggest that one-off training alone is not sufficient to teach end-users how to search effectively, in particular training that lasts for only one-hour . As was the case in this research. Based on errors found on the transaction log, it would appear to be more beneficial to the student if the length of training, following recommendations made by King and Baker (1987), either comprised a credit bearing course or lasted for at least three days. This would provide students a longer time to absorb the concepts, or procedures of the lesson as well as afford a longer time for hands-on experience. Feinberg and King (1988) have argued that frequency in the use of a system improves search skills. Therefore a longer period for instruction would lead to a more meaningful instruction rather than what could turn out to be a superficial understanding of a system in a one-hour session. However it must be borne in mind that the amount of time required for instruction is also dependent on one's background and prior experience.

The task related to browsing was not reflected on the transaction log report. Therefore, the difficulties related to this task could not be established. Overall performance scores and performance of individual variables like library experience, computer experience and English language usage found a significant difference in performance on this task by the concept-based group. Although the procedural instruction group were provided with instructions in the use of the specific features to perform this task, the concept-based group performed better on this task. This suggests that the task is more inclined to be classified as a difficult rather than a simple task because of conceptual processes that need to be understood to perform the task. Unlike known-item searches like author and title, this task required the use of a subject indicator such as D1 which appears on the URICA screen, and further selecting the title found from the record displayed. Although the search task specified the use of the D1 feature on URICA, it was left to the participant to be able to select the title from the record. Results support the assertion that the concept-based group were able to distinguish the title element in a record better than the procedural group. It was uncertain as to what difficulties the procedural group encountered in this task as the transaction log did not display information related to this task.

5.2.3.2.2 Transaction log report of search input on difficult tasks

Search errors appearing on the transaction log were found mainly in relation to the use of search indexes, and the formulation of search terms. Difficult tasks comprised tasks related to proximity and truncation, and subject searching.

5.2.3.2.2.1 Proximity and truncation

The search tasks assigned in the experiment required the use of the title index to conduct a proximity search. The task related to truncation did not require use of the system. Instead the correct answer was required to "worked out" by the participant and entered on the answer sheet.

Search results indicated that the concept-based group did comparatively well on the proximity task. The transaction log supported this finding with many of the entries reflecting the correct form of the search statement. However, at least four of the proximity searches revealed the use of the wrong search index. The procedural instruction group used the wrong index for this task on six occasions. Similarly, the transaction log did not reveal whether this error was made by one person or many people. Performance on this task reflected common errors made by both groups such as misspelling, the use of truncation symbols between each word searched, for example national] education] or national education].

In the case of the task on truncation the transaction log reflected that some of the participants performed the search on the system, even though it was not required. The entries recorded for the concept-based group did not reflect any errors on this task. However, the entries recorded for the procedural instruction group reflected an incorrect use of of this feature. For example, the correct form of the truncated term should have been librar] but entries were recorded as broad as library] and as narrow as lib] both of which were incorrectly applied. In grading this task it was found that those in the concept-based group were able to formulate the search statement correctly but were unable to remember the symbol used by the system. In the procedural group participants seemed to know what the specific symbol was to be used but did not know how to formulate the search statement. This finding was significant in that it reflected that those in the concept-based teaching condition understood the concept of narrowing the search, whereas the procedural group had simply mastered the use of a mechanical symbol.

These findings were similar to those of online systems user studies reported. For example, Lynn and Bacsanyi (1989) found that students appeared to be confused with search options and had difficulty in understanding Boolean search strategies and in limiting a search. Similarly Lancaster *et al.* (1994) reported student difficulty in the use of advanced search features such as the use of Boolean operators and truncating terms.

5.2.3.2.2.2 Subject searching

The tasks for subject searching constituted two different searches. One search was a straightforward subject search, namely, to find maps on South Africa. The other search was a subject search which was deliberately chosen because it generated no results. This required the participants to derive a synonym for the term, "elderly," in order to continue with the search.

On the first task there appeared to be less difficulty in formulating the search phrase as the search task incorporated the subject phrase to be used. The concept-based group showed a greater tendency to use the correct search index than the procedural instruction group. In the case of the latter group, the title index was used in many instances to find subject information. In a research by Thorne and Whitlatch (1994) it was reported that students tend to make use of one search strategy all the time, which seemed to be the case for the procedural instruction group. Common to both groups on this task, was the use of broad search terms, for example, "maps;" the use of truncated search terms, for example, maps in South Africa]; abbreviation of terms, for example, "maps in SA;" the use of the word maps in the singular, for example, "map in South Africa;" incorrect spacing between terms, and misspelling.

In the second task related to subject/synonym the concept-based group reflected a greater use of synonyms than the procedural group. Some of the synonyms used were old, old age, big, aged, oldy, grown up, parents, abnormal, pensioner, retired. The procedural instruction group reflected more use of both the title and subject index to find perform this task. Synonyms used by this group included, adults, aged, ageing, mom, senior citizen and elders. In some cases words were incorrectly spelt, for example ansient, and udult. Errors common to both groups was the use of truncation, for example, eld], elderly], and old]. The use of truncation when a search produced no result provided some indication that the use of this feature was not well understood by both groups and that searching was done on a "hit and miss" method in some cases.

In the grading of the subject tasks it was found that those who used the title index for subject searching often ended up with the wrong information. For example records on geological structures were retrieved when the search was for maps on South Africa.

However, even though the result did not match the search query the answer was accepted as correct. In the case of the subject/synonym task, it was found that the concept-based group were not able to make a critical judgement about records found. For example, for those who used the synonym, "old," two records were generated. One related to old age and was displayed as the first record. The second related to the Old Testament and was the second record. Many chose the second option instead of the first option, even though the first record answered the search query. A possible explanation is that as noted by Lippincott (1998) online instruction is only one component of a broader information literacy programme. The instruction provided in the experiment simply explained how information is organized but did not provide added information on making a critical selection of retrieved items. As discussed in Chapter 2, other aspects of information literacy deal with recognizing when information is needed and evaluating the needed information effectively. This finding suggests that although online instruction deals with means of accessing electronic resources, some aspect of the instruction should include additional information literacy skills to make the instruction more meaningful. This provides more justification for instruction to extend beyond the "one-shot" presentation to a longer course-based instruction.

The general findings of the transaction log report which pointed out errors related to spelling, the use of system commands, and conceptual errors indicate a low level of experience in the use of online systems of first year students or novice end users. The types of errors made serves as an indication that these students do not have sufficient experience with pre-requisite skills such as information literacy, computer literacy and proficiency in use of the English language.

The implication of the transaction log findings is that searches such as truncation and subject searching must assume greater attention in instruction. It also points out the importance of making help tools available such as *LCSH* (when controlled vocabulary is used) and other sources both online and in print form, as well as the design of user-friendly help screens provided on the system.

5.2.3.3 Direct observations

Direct observations made by the researcher, in both teaching conditions, indicated that participants experienced difficulty in the selection of records from a display, and in determining the elements of a record such as author and title. However, since the sample size did not enable the recording of observations in a systematic way, the extent to which this difficulty was experienced was not recorded, but it can still be regarded as a problem.

The search behaviour reflected in the transaction log analysis and through direct observation indicated difficulty in the interpretation of the catalogue or the index records, and in understanding the use of access points which points to a greater need for information literacy skills. The errors found in relation to semantics, syntax and the formulation of search terms also reflects a greater need for information literacy skills but also that in students populations where English is not the predominant language some emphasis must be placed on this aspect of searching. Further, the errors found in relation to the use of commands suggests a need to explain the use of the keyboard, as well as that some attention needs to be paid to revising the system screen design and commands used.

The overall performance on the search tasks concurs with the findings of Kunkel *et al.* (1996) that undergraduate students find the terminology of the library unfamiliar. They lack the critical judgement to develop strategies for finding information and they do not have the experience and skills to use information technologies effectively which reiterates the need for online instruction and retraining. The specific problems encountered by students in this research confirmed the need for instruction that allows for sufficient time for students to learn and absorb the material being presented and for a hands-on approach to teaching. It also confirmed the need for a greater focus on information literacy in order for the online systems to be more effectively used.

5.2.4 Affective responses

Affective responses were elicited in relation to mastery and confidence in the use of the URICA and other online systems. Affective responses were also sought to determine whether factors other than the teaching method were reasons for the level of search performance. Feedback in an evaluation questionnaire indicated that participants were positive about the instruction received in the case of both teaching conditions. Those in the concept-based teaching condition reflected a higher rate of confidence than those in the procedural condition. This signifies that participants felt positive about the models used in instruction. It is also noteworthy in that prior to the instruction the concept-based group reported a higher incidence of lack of confidence in their ability to use a library or a computer to find information. Those in the procedural group felt very positive about the lecture received in that there was a score of 100% on this question. Hence, this should be an indication that the delivery or forms of instruction did not negatively influence search performance. However, the high satisfaction toward the instruction contradicts performance on some tasks that generated low scores by participants in both the concept-based and procedural instruction groups. This could suggest that students were comfortable with the way the lecture was delivered but not necessarily indicating that the lecture led to greater understanding of online searching. The lecture could have also been rated high because it may have provided a better sense of direction in the use of the online system compared to the low understanding of the system as demonstrated in the pre-test. More so since the majority of participants in the concept-based group (90.0%) indicated that after the instruction they felt confident in the use of the URICA system. However, at least 26.7% of participants from the concept-based group also indicated that they found instructions on the URICA system difficult to understand which seems to contradict the former response. The high rate of satisfaction with the concept-based lecture is suggestive that the participants were favourable to the model used, since most reports, for example Wesley (1991) and other point out that students generally do not want to spend time in understanding concepts, but instead prefer to be shown procedures at the point of need.

In relation to performance scores which were high in some instances and low in others, affective responses did not provide any clue as to the possible reasons for these outcomes. Ankey (1991) found a similar situation where high levels of reported end-user satisfaction did not correspond with the level of performance. The results found in the self reports of the participants confirm the view of Svinicki and Schwartz (1988) that such reports are useful to an extent, but must be complemented by other forms of evaluation since the data is not always reliable.

Affective responses noted that more hands-on time was required. Borgman's research (1984) found that 45 minutes to implement a model is not enough and concluded that a longer time should be allowed. In the case of this research, the intent was to provide instruction in the typical amount of time allotted by faculty for this purpose. Furthermore, it was not possible to conduct the experiment longer than two hours owing to the availability of the participants and the physical resources in which to conduct the experiment.

5.2.5 Search performance in relation to research objectives

The objectives of this research project were as follows:

1. To determine whether or not any differences exist in online search performance between students trained in a concept-based, and those trained by procedural teaching methods.

2. To determine whether or not any differences exist in online search performance between students with differing library experiences trained in a concept-based and those trained by procedural teaching methods.
3. To determine whether or not any differences exist in online search performance between students with differing computer experiences and trained in a concept-based and those trained by procedural teaching methods.
4. To determine whether or not any differences exist in online search performance between students who regard English as a first or a second language trained in a concept-based and those trained by procedural teaching methods.

Results indicated that significant differences are found in search performance between procedural and concept-based teaching on difficult tasks but not on simple tasks which were for known-items such as author and title. Concept-based teaching led to better performance on tasks that made use of the subject index and on a task related to browsing, and truncation. Significant differences in performance were found on these tasks.

In relation to the variables of library experience, computer experience, and use of English as a first or second language, it was found that on simple tasks those with no computer experience and who regarded English as a second language performed better when procedural instruction was provided. However, overall there were no significant differences in performance on simple tasks between the variable of high and low library experience, between the variable of computer use and non-use, and between the variables of English as a first and English as a second language. Those who regarded English as a first language appeared to benefit more from concept-based instruction on simple tasks. The participants in the concept-based group performed significantly better on difficult tasks with respect to the variables of library experience, computer experience and English language use.

The implications of these results in the implementation of online instruction will be discussed in more detail in the following sections which discuss theoretical issues related to the research.

5.3 Implications of the results

The findings of this study bring to the fore theoretical issues related to the need for online instruction and the type of teaching method best suited to instruction. The following sections will discuss these issues in relation to pre-requisite skills that affect online search performance, novice end users, search behaviour related to tasks in the experiment, and the differences found between concept-based and procedural teaching.

5.3.1 The need for online instruction

As academic libraries in South Africa become increasingly computerised and incorporate a wide range of information retrieval technologies into their services, the provision of online instruction to end users becomes an increased challenge to overcome. Given that these technologies require the use of computer hardware which might be a new experience for some, and that one requires to become familiar with a structure and organisation of information that is markedly different from printed resources, online instruction seems to be a logical means to introduce and enable the effective use of the new technologies.

This view however is not widely shared. Baker and Sandore (1987) point to the school of thought that argues that online systems, specifically online catalogues, should not require any instruction in their use. According to this view, online catalogues should be user-friendly systems designed with instructions embedded in the system so that even the most inexperienced end user can search effectively without additional help. This argument states that the provision of instruction is an indication that the online catalogue is not fulfilling its purpose. Additionally instruction forces users to adjust to the inadequacies of the system rather than improving the system to meet end-users requirements. Although this argument is a valid one, it overlooks the diversity that exists amongst end user populations. As discussed in Chapter 2, Martin (1994) and Ercegovac (1995) have pointed to the varying backgrounds of end users and attitudes toward the use of computers and libraries. In the face of this diversity design alone cannot be expected to improve access to online systems. Nielsen *et al.* (1985:4) argued that system design and online instruction should not be mutually exclusive. In their view "...the perfect online catalogue does not yet exist and the general perception is that the online user interface may not be able to accommodate all user's needs and may never do so." At best design appears more in a position to improve the mechanical use of a system and to a lesser degree conceptual access. More significantly Nielsen *et al.* (1985) and others in the same school of thought assume that designers of systems will have taken into consideration the varied needs of users. While this should be the basis for systems design, other factors such as end-user markets determine what should be produced. Most systems are imported and even URICA which is a local system attempts to emulate an “internationalness” so that it can be sold elsewhere in the world and not only in South Africa. To this end URICA has established a market in Australia and in parts of the United Kingdom.

The conceptual knowledge required to search online systems that stems from information literacy, such as formulating a search statement, making use of controlled vocabulary, revising a search strategy, and so forth, appear to be pre-requisite skills in system use which system designers assume are inherent to end-users at a tertiary level. Despite the design of the URICA OPAC incorporating embedded instructions, help features, and a user interface that accommodates first-time, regular and expert end-users, performance scores on tasks in the pre-test were low for many of the participants. However, results on the post-test found that participants definitely benefited after instruction was provided.

5.3.2 Search behaviour of novice end users

Improvements in the post-test after training was provided, particularly on difficult tasks which required conceptual knowledge in the use of the system demonstrated that novice end-users, in this case first year students, did not have the skills required to conduct effective searches at this level unless training was provided. Even those who had some of the pre-requisite skills mentioned, and who scored higher on tasks in a pre-test, were not fully able to exploit the system until they received online training.

The literature review in Chapter 2 reported that undergraduate students entering college had little knowledge of library tools such as indexes and abstracting services, or library catalogues (Mellon 1988). Students were reported to experience library anxiety to the point that they could not conduct effective searches. Demographic data collected in the present research found that the majority of participants reported having no confidence in their ability to use either a computer or library resources to search for information. This was found even amongst those who had high library experience and who made prior use of computers. Observations recorded of behaviour of the participants during the experiment found that when initially faced with use of the computer some students displayed apprehension at the keyboard, and in the use of the system.

Search tasks were worded so that the appropriate access point could be chosen for the search task, for example, "...using the option number 3 for subject, find a book...." or, "Virginia Brodine is the name of an author, how many......" Despite these clues participants were observed in the pre-test as having difficulty in choosing options from the search menu. Some participants continually pressed the ENTER key instead of making a choice from the menu. Some students were observed entering search statements next to the cursor prompt instead of inputting an option from the menu. Comments made by some participants on the pre-test stated they were confused because of their inexperience with computers. However, after training was provided confidence was reversed and participants in both teaching conditions reported in an evaluation questionnaire that they felt confident about their ability to search the URICA OPAC and similar online systems. These findings support Solomon's view (1992) that novice end-users may need to be provided with instructional support. It also suggests that training provided more sense of control in the use of the system.

5.3.3 Prerequisite skills

Overall the scores on the pre-test indicated that online performance is affected to some extent by prior experience in the use of libraries, computers, and English language. Performance on the pre-test prior to training found that those participants with the qualities of high library experience, who made prior use of computers, and who regarded English as a first language fared better on search tasks compared to those that did not have these qualities. A similar finding was reported by Liu and Redfern (1997) who reported that success in the use of the library was higher for students with English as their primary language. This discounts Borgman's findings (1984a) which reported that library use was not a factor influencing online searching and that high library use did not provide any advantage in using the search system.

These particular qualities translate to possible pre-requisite competencies needed in order to negotiate online systems. The higher performance of those students with these skills indicated that they had a higher advantage in the use of the system than those who did not. However, after training was received, specifically concept-based training, performance improved for all participants, with and without these pre-requisite skills. The significance of this finding is that the research sample was found to be mainly without prior computer experience and regarded English as a second language. The lack of computer literacy amongst South African students has also been pointed out by Shapiro (1995) in his discussion of students at the University of the Western Cape. Since the sample was, representative of first year students at a tertiary institution, it is an indication that many of these students do not have the pre-requisite skills assumed of tertiary students. While the design of some online systems can be adjusted to accommodate this situation, many online retrieval systems are developed by commercial organisations whose interest might not lie in making adjustments to their systems for what they may consider a small market. Nevertheless, libraries are committed to including these products in their services based on the value to research amongst other reasons. In this light it seems apparent that students without the prerequisite competencies will be at a disadvantage in the use of online retrieval systems if no instruction is provided. In addition, it seems apparent that without the provision of instruction, the use of online systems found in academic libraries will primarily serve those who have the advantage of technological experience, have skills or experience in using libraries, and who have a good command of the English language. Such a situation is not only likely to result in many students being denied access to online retrieval systems, but it could possibly perpetuate a system where the retrieval of information through electronic means will be the privilege of a few. Given the history of South Africa, many students, particularly from the African sector, originate from economic backgrounds that could not afford the ownership of computers, and educational backgrounds that did not always entail the provision of libraries. Hence, based on prerequisite competencies, unless training is provided, many of these students are likely to experience greater difficulty in accessing online systems. According to Downing *et al.* (1993) unless librarians are willing to explore innovative responses to the needs of students, they run the risk of making library resources such as online technologies increasingly marginal and inaccessible to students.

5.3.4 Concept-based instruction versus procedural instruction

The central thrust of this investigation was to determine if there are significant differences between the two training methods and if so to determine the best method to use in the provision of online instruction in a tertiary institution's library. The overall findings of this research support to a large extent, the theories presented in Chapter 2 which argued that concept-based teaching is a more effective method of teaching. In particular these findings lend support to earlier research conducted by, Cherry *et al.* (1994), Nielsen *et al.* (1985) and Borgman (1984a) which concluded that concept-based teaching is superior to procedural instruction. In the pre-test, overall performance found that the procedural instruction group did better than the concept-based group on an author search task, and that both groups performed about the same on remaining tasks. After training was received, post-test scores reflected that those in the concept-based group scored higher on all tasks with the exception of a title search task in which the procedural group performed marginally better. Significant differences were found in performance on a simple task related to browsing the database, and on difficult tasks which were truncation, and a subject/synonym task. No significant differences were found on simple tasks such as author and title searches which serves as an indication that in some cases procedural instruction is as effective as concept-based instruction.

In the case of performance on difficult tasks such as proximity searching and finding information on a subject there were no significant differences found unlike the case of tasks related to truncation and subject /synonym. The possible explanation for this may be attributed to the design of the search task. Both the proximity and subject task incorporated the search statement in the wording of the task which was used by participants in performing the task. Unlike in the case of the tasks on truncation and subject/synonym participants were required to derive the search phrase on their own. Hence, it is not certain that if the wording of the tasks changed to allow the student to "work out" the search phrase on the proximity and subject task, whether the results would be the same. The findings that revealed significant differences on difficult tasks concur with Borgman's research (1984a) that persons who receive concept-based instruction are better able to perform on difficult tasks than persons trained in a procedural method. However Borgman based her conclusions on performance scores but was unable to find significant differences in performance as was the case in the present research. Therefore, it appears from this study that particular aspects of searching may lend themselves to particular teaching methods.

5.3.4.1 Individual differences

The literature reviewed in Chapter 2 noted Egan's view (1988) which said that compared to other types of tasks, performance differences on computer-based tasks are greater due to individual differences. He argued that more attention must be paid to the role of individual differences for the reason that it would be unacceptable to deny access to systems because they are difficult for some people to use. According to Landy *et al* (1987) individual differences in performance that are related to cognitive strategies and personality variables are substantial for the occasional and beginning computer user.

The present research investigated differences in performance between both teaching conditions based on the variables of library experience, computer experience and the use of English as a first or second language. The comparison of differences in performance on search tasks based on these variables indicated those who benefited from concept-based and those who benefited from procedural instruction.

As in the case of overall performance, scores based on a pre-test and post-test supported the assertion that concept-based instruction was a more beneficial method of instruction to all categories investigated. This again was more prevalent in performance on difficult tasks. The findings are summarized as follows:

- Those in the concept-based group with high library experience, who had prior computer experience, and who used English as a first language performed better on all post-test tasks (simple and difficult) compared to the procedural instruction group
- Those in the concept-based group with low library experience scored better than the procedural instruction group on all tasks, with the exception of a title search task

- Those in the concept-based group with no prior computer experience scored better than the procedural instruction group on all difficult tasks but not on simple tasks
- Those in the concept-based group who regarded English as a second language scored better than the procedural instruction group on all difficult tasks but not on simple tasks
- Within the concept-based group those with low library experience scored the same as those with high library experience on almost all post-test tasks
- Those in the procedural instruction group who regarded English as a first language performed better on a pre-test than those in the concept-based group. After receiving procedural training this group did not make any improvement in performance on the author task.
- Those in the concept-based group who regarded English as a second language performed better on difficult tasks in a post-test than those who regarded English as a first language in the procedural group.
- Those with computer experience scored lower on a subject/synonym task on a post-test after procedural training. This task was the repeat task given in both the pre-test and post-test. Hence there is indication of misconception taking place in learning.

The implications of these findings are that on known-item searching such as for author and title, participants with limited experience in computers and who make secondary use of the English language benefit from the step-by-step method of instruction, that is procedural instruction. Unfamiliarity with computer keyboards, and with system design may require some emphasis on procedural methods. Likewise unfamiliarity with terminology used in online systems by those who regard English as a second language may require some emphasis on procedures.

Findings which revealed that those with high experience in the variables being studied, performed well after concept-based training contradicts Cherry *et al.* (1994) who stated that those with high computer literacy may benefit less or not at all from concept-based instruction. These authors reasoned that persons with extensive use of computers might have already developed a conceptual model about the way the online system functioned based on their prior experience. However, the difference between the present research and that of Cherry *et al* (1994) could be that the higher the level of computer literacy the less effective the use of model based instruction. It is not known whether Cherry *et al.* investigated the effect of procedural teaching with persons with high computer literacy. Hence, this difference may be some indication that although first year students in this research have made prior use of computers they have not developed mental models about computer use to the point that it affected performance on this experiment, which is an area for further investigation. The rate of improvement on difficult search tasks by those with low experience in the variables studied, confirms Borgman's conclusions (1984a) that a less sophisticated sample benefits more from concept-based instruction on difficult tasks.

The positive effect of procedural instruction on some of the participants and concept-based instruction on others indicates that persons with differing backgrounds have varied responses to instruction provided which is often overlooked in the common type of instruction typically provided to all first years in BI programmes. In the view of Downing *et al.* (1993) it is necessary to design instruction programmes that reach students as individuals in order to make the library accessible to a diverse student community. However, King and Baker (1987) argue that librarians have little opportunity shaping instruction that takes account of such factors since they are often placed in situations with limited time and no control over class composition. In this case instruction appears to be best served by combining both procedures and concepts that serve novice and expert end-users, as well as taking into account the value of training and practice.

Of significance to the present research are the reports which stated that more online searches are done for difficult tasks such as subject searches than for known-item searches (Thorne and Whitlatch 1994). Since concept-based instruction proved to be of more benefit to performance on difficult tasks, it would stand to reason that this method may be more appropriate in online instruction related to subject searching.

Performance between the variables found that concept-based instruction produced significant differences in performance on the following tasks:

- Truncation, when low library experience was a factor
- Browsing, truncation, subject/synonym, when high library experience was a factor

- Browsing, truncation, subject/synonym, when prior computer experience was a factor
- Browsing, truncation, subject/synonym, when no prior computer experience was a factor
- Truncation, subject task, and subject/synonym when English first language was a factor
- Browsing, truncation, subject/synonym, when English second language was a factor

As mentioned earlier, performance on the task of browsing indicates that this was a difficult task for participants. Participants were required to make some procedural use of the system, but on the other hand also required to make inferences about records found. The better performance of the concept-based group on this task, supports the view of Cherry *et al* (1994) that concept-based instruction will produce better performance on non-routine tasks and that end-users will be better able to make inferences on results during a search.

Performance results found that those in the concept-based group with higher experience in library use, computer use and who used English as a first language, scored higher on almost all pre-test tasks prior to training compared to those with lower experience in these variables. The implications of this finding is that:

- When no training is provided those with higher levels of experience in the research variables, will be in a better position to use the system on some tasks than those with lower experience.

The results revealed that participants both with high use of the research variables and those with low use of these variables, benefited from instruction, in particular, from concept-based instruction. The implications are that:

- Those with higher experience in the research variables will be in a position to conduct a search with some degree of success. However, in order to perform effective searches on difficult tasks that require conceptual knowledge, both those with high and low experience in the research variables mentioned will benefit from concept-based rather than procedural instruction

Robertson (1992) and Fields (1987) reported similar patterns of performance amongst those who made prior use of libraries. Sever (1995) found this in relation to those who were considered computer literate. According to the former reports, those who make regular use of a library do not necessarily know how to use a library effectively. In the case of Server's findings, it was concluded that computer literate end-users were efficient with respect to mechanical skills but their ability to perform effectively at a conceptual level was not uniformly successful. This lends support to the views of Baker *et al.* (1991) who argued that it is only when the conceptual aspects are understood that an online system can be truly exploited. These authors pointed out that concept-based teaching addresses the end-users greatest difficulties, and provides a framework within which searching can take place. Therefore, as demonstrated in the findings of the present research, although some results were produced in the mechanical operation of the system, it was only with concept-based instruction that participants were able to exploit the system. An added significance of these results suggests that in the case of pre-requisite skills needed for searching, an interrelationship between skills seems necessary for performance to be effective. Contrary to Pfaffenberger's argument (1990) related in Chapter 2 which stated that those who are computer literate have the necessary skills to grasp online searching, the present results indicate that along with these computer skills end-users also require conceptual knowledge to perform effectively. Hence, even though those with higher experience were able to produce some level of success, after receiving concept-based training which explained the concepts of searching they produced improved performance. This suggests that information literacy with English skills, or information literacy with computer skills result in greater success than simply having English skills, or computer skills on its own.

END,

5.3.4.2 The use of a model in online instruction

The provision of concept-based instruction was based on the use of a model which served as an analogy to teach the use of the system. According to Borgman (1984a) model-based instruction generates methods for operating an online retrieval system. The use of the model comes into effect when it is needed for problem solving, place keeping, or debugging. Therefore, effects of this instruction are found to be stronger on difficult tasks than on simple tasks. Evidence for Borgman's argument was found in the present research firstly in the transaction log analysis which reflected a high error rate for those in the concept-based group but no effect of this on performance scores. Performance on search tasks was also significantly different in relation to difficult tasks. These results suggest that the model provided in the training did have an effect on performance.

The type of model used to convey the concepts of information retrieval is important. The learners must be familiar with the model to the point that they can map the analogy used to the concepts being taught. Borgman's research (1984a) made use of the card catalogue analogy which she found was not entirely effective in conveying the meaning intended. Other analogies discussed in Chapter 2 pointed to the use of a database model and a network model. Drawing on the principles of the network model, the present research experimented with a different type of model based on the immediate experiences of the participants. This model was reasoned as one that could be related to by almost all the participants. The model developed by this researcher equated the online environment to a neighbourhood comprised of its individual residences, each with its own entry or access points. Drawing analogies between the variety of households and the processes that take place when seeking persons in a particular household, the instruction was able to convey general concepts related to online information retrieval. The use of such a model made it possible to teach concepts such as author, title, subject searching. Concepts such as use of synonym were equated to the use of nicknames and given names. A further analogy made use of a model that related to seeking information about a person in an organization, in this case a friend in a hospital. The events involved in this scenario were equated to concepts such as browsing, select, and display. Details of the lecture and analogies used in the concept-based lecture can be found in Appendix H at the end of this report.

The use of the card catalogue analogy commonly found in earlier studies was not adopted in this study for the reason that this analogy did not seem suitable in the present context of increased use of online resources. Research conducted in the 1980s may have been able to use this analogy in that both card catalogues and OPACs were found in use in libraries. The card catalogue was used as a model to convey the concepts of searching in the use of online systems in Nielsen *et al.* (1985) and Borgman (1984a). However, the shortcoming of this model is that the differences between the structure of the card catalogue and online systems do not allow for concepts such as boolean logic, proximity searching, truncation, keyword searching to be adequately explained. Another shortcoming mentioned by Baker and Sandore (1987) is that the extent to which libraries have encompassed online technologies, means that for more and more end-users the only experience with library catalogues will be the online catalogue. As a result the analogy of the card catalogue will have limited value.

The results of the search tasks provide some indication that the model used in the present research was understood and that the students benefited from its use. For example, performance on tasks such as truncation, browsing, and subject/synonym produced significant performance differences which proved that the model was effective.

Performance on pre- and post-tests also indicated that the model used was beneficial. For example, those in the procedural group appeared to have an edge in performance on the pre-tests in that they scored higher than the concept-based group on some of the tasks. However, although training improved performance to some extent in the procedural group, it was not as great as the improvements made in the concept-based condition. This can be explained by the use of the model in teaching concepts which enabled students in the concept-based group to understand what was required and to follow what was taking place during the search. In the case of the procedural group it is not known whether they found it difficult to remember the steps to follow or whether it was because they did not understand why they were searching in a particular way. The questions asked by participants in relation to procedures during the experiment, and errors revealed in transaction log reports, implied that problems were due to both reasons. It seems necessary therefore for further research to be done around model and procedural behaviour to discover these reasons. The experiment was conducted early in the academic year to reduce the problem of prior experience and training from confounding the research results. In this respect although some of the participants reported prior experience and training in OPACs, this experience did not appear to impact on search performance as proved in results on the pre-test. Those with computer and library experience demonstrated that they benefited from the use of a model in instruction, and that their prior experience did not interfere with them assimilating the instruction model. However, more research on mental models needs to be done to determine how persons with high computer literacy respond to model teaching.

5.4 Implications for library Managers

The experience of the researcher in conducting online instruction in this experiment found that for instruction of this nature to be successfully implemented, the physical and human resources available to the instruction is critical. These resources refer to the provision of a suitable venue to accommodate the instruction and adequate staffing to teach and manage the instruction programme. The implication for library managers, based on experiences of this research, suggest that budgeting and future planning need to make provision for these resources if online instruction is to become an integral service of the library. The need for these resources is discussed below.

5.4.1 Venue for instruction

In order to carry out the online instruction, both procedural and concept-based teaching required the use of a venue equipped with the technical infrastructure that enabled the use of networked online resources and computer hardware to access the resources. The use of computer hardware was required both by the participants conducting the tasks and the instructor for teaching purposes. In library circles such a classroom is sometimes referred to an electronic classroom, however in the case of this research a computer laboratory available at the M L Sultan Technikon was used.

The value of having an electronic classroom, is that it enables hands-on experience for students, which is an important component of the instruction. As noted by some of the responses in the evaluation questionnaire, participants indicated that they required such hands-on practice. Further, the slow pace in which the participants worked on the computer terminal re-enforces the need for students to have the space in which they can learn at the pace they require. Novice students were found in this research to have limited experience in the use of online technologies and a number of students had no prior computer experience at all, which also demonstrates the need for hands-on practice. For tasks that require the use of procedural instruction, the use of computer hardware is essential to teaching the step-by-step procedures. For tasks that require the use of concept-based instruction, access to multiple online systems, such as commercial online databases and CD-ROM networks, OPACs of other libraries, is important since this method of teaching attempts to teach the use of online systems in a general rather than a specific fashion.

5.4.2 Staffing

The experience of this researcher found that in order to be able to provide a lecture and to make use of computers to demonstrate concepts, or procedures, it was helpful to have a teaching team where one person delivered the lecture and others assisted students with hands-on applications. In the case of this research the instructors were professional librarians who were considered to have the accumulative experience to teach the lesson. The assistants comprised three persons, two of whom were paraprofessional staff and one a library science diplomat who had a year of experience in assisting with library orientation. During the lesson, these assistants helped students with the use of the keyboard, the OPAC system, or generally troubleshooting when students ended up logging themselves out of the system. The value of having this type of assistance ensured the smooth flow of the lesson, helped students keep pace with the lesson, and enabled individual attention to students experiencing particular difficulties without holding up the rest of the class.

5.5 Problems related to the research methodology

This section reviews the research design in relation to the objectives of the investigation. Overall the experiment met the objectives set out in the research. Results obtained were able to provide useful data to point to the most effective of the teaching methods between concept-based and procedural instruction under given conditions and circumstances. It was also possible to point out which categories of end-users benefit from either teaching method. However, analysis of the data suggests that the experiment might benefit more from revision to the research design in relation to the following:

5.5.1 Definition of the variable library experience

The experiment considered participants to have library experience based on frequency of use and prior use of card catalogues or OPACs. On reflection, the experiment would have benefited more from knowing the level of the library skills of participants rather than just whether they made prior use of resources. This would have indicated more clearly the extent of library experience.

5.5.2 Duration of the experiment

Participants indicated that they would have liked to have more time to have hands-on experience. Taking into account the constraints under which the experiment was undertaken, it was not possible to conduct the experiment for longer than two hours. However, given the slow pace at which participants worked and the level of inexperience of the participants in both library and computer use more time for hands-on experience would have benefited the experiment.

5.5.3 Pre-test/Post-tests

Comparison of performance would have been much simpler if the pre-tests and post-tests were evenly matched in the number of questions. Due to the length of time participants took in a pilot- test to perform an even number of pre-tests and post-tests a decision was made to design the tests so that a sufficient number of tasks could be assigned to cover all of the important concepts that needed to be learnt in the time available. As a result he final test design did not have an equal number of tests in the pre- and the post-test. Answers to the tests could only be graded as correct or incorrect responses which did not make it possible to find out how close respondents were to the right answer or how far off they were.

5.5.4 Size of the sample

The size of the sample made it possible to produce results that were statistically significant. Lessons learnt from research conducted by Dimitroff (1990) and Borgman (1984a) found that small samples did not generate strong performance results. However, the downside of working with such a large sample is that resources available to the researcher did not make it possible to interview participants during the search to understand difficulties they were experiencing, and their opinions of the teaching method.

5.5.5 Transaction log analysis

The transaction log generated by the URICA OPAC was found to have weaknesses in the design and form of the report. In the first instance, it was found to be a difficult and lengthy undertaking to sort the experiment search entries from the general searches on the report. Unlike some other OPAC systems it was not possible to determine the specific terminal that generated the search, or to determine the search input and computer response. The transaction log analysis did not prove to be adequately designed to reflect searches which produced no results. It was also not possible to indicate whether errors were the errors of one or many individuals. As a result the report was of limited value to the study.

5.5.6 Participants' evaluation of the instruction

Responses generated from an evaluation questionnaire were generally positive. The instrument was not able to provide insight into reasons why there was low performance on some of the tasks. The research would have benefited if time permitted participants to be interviewed after post-test tasks. Alternatively, questions should be restructured making use of rating scales to evaluate the instruction. Questions related to specific search tasks would also have been useful to the evaluation.

Reflecting on the research conducted it must be noted that a project of this nature required the use of various physical resources and the co-operation of various individuals including the participants, which made it a difficult undertaking. Firstly, it required securing a venue equipped with computer hardware that was reliable, a goal not easily accomplished in an environment with short resources. Secondly, it required co-ordinating both the faculty and the students involved in the experiment. Since the experiment was done at a time of the year when class time-tables, student numbers and lecturing staff were not yet determined it made the task all that more difficult. However, despite the many difficulties, the project was successfully undertaken with the generous support of many individuals.

5.6 External validity

The extent to which the results of this research can be generalised to a typical academic library in South Africa and regions with a similar profile is high. The reason for this is threefold.

Firstly, the online system incorporated in the research is one that is used both locally and internationally and includes many of the search features that are commonly found in online retrieval systems. Secondly, the sample population appeared to be representative of first year students who make use of academic library services. They matched the profile of first year students attending tertiary institutions in South Africa and elsewhere in that at entry level most first year students are school leavers who hold a matriculation or high school certificate, which is the criteria for admission. The sample also constituted a diverse group of students who had varied backgrounds in relation to library, computer and English language use which also fits a general description of students using South African libraries often reported by librarians. In addition, research discussed in the literature reviewed in Chapter 2 pointed out problems experienced by minority students, foreign students and undergraduate students in general in American libraries in relation to the variables of library, computer, and English language experience. Reports of libraries in parts of Africa also noted that there were difficulties experienced in relation to these variables. Hence, the findings of this study can be of use to these communities.

Lastly, the experiment assimilated conditions as they exist in a typical instruction programme. Training was conducted in a one-hour time period which is usually the amount of time allocated by lecturing faculty for library education at the M L Sultan Technikon. Reference to "one-shot" library instruction programmes in the literature review in Chapter 2 indicated that this is the case in other institutions as well.

Hence, overall there appears to be a strong possibility for the results of this research to be generalised to the provision of online instruction programmes for first year students, or novice end-users in South African academic libraries and to communities who share a similar profile.

5.7 Summary

This chapter provided an interpretation of the results of the research and discussed the implications of the findings in relation to the provision of online instruction. In relation to the objectives of the research, the results were able to determine that differences exist in search performance when online instruction is provided in a concept-based and procedural method. Further, the results proved that between the two teaching methods, differences in search performance are also found between first year students who have different library experiences, computer experience and use of English as a first or second language.

Based on the research results it was concluded that online instruction is an essential service which libraries must provide. The effect of instruction was found to maximise the effectiveness of search performance, and made the online system more accessible and even more user-friendly to persons with limited experience in the use of libraries, in the use of computers, and who did not regard English as a first language.

The importance of providing instruction is that South African libraries are increasingly making use of online retrieval services and most libraries have introduced online catalogues to replace printed or card catalogues. At the same time the online performance of first year students who constituted the research sample proved a novice category of end-users who had limited experience to cope with the complexities of online searching. If instruction is not provided those who do not have prerequisite skills such as library, computer and English language proficiency, stand to be excluded from the use of online services. Those who have the prerequisite skills might be able to make some sense of the systems but will not be able to fully exploit systems or necessarily retrieve relevant information. Instruction becomes even more critical in the light of the fact that if end-users have limited ability to search library OPAC systems they will have limited access to the library's collection save for the methods of browsing or relying on the help of colleagues or other means.

The results of this research were able to provide a clear direction about the method of instruction to choose. Prior to this research, there was uncertainty between the methods of procedural instruction and concept-based instruction. The literature reviewed supported concept-based teaching for the most part, but provided little empirical evidence in support of this method. Based on the search performance on tasks in a quasi-experiment conducted, this research proved overwhelmingly that concept-based instruction is superior to procedural instruction, mainly in the performance of difficult tasks. It also proved that the use of a model as an analogy in teaching the use of online systems is an effective method of instruction.

Affective responses gleaned from the evaluation supported the view that instruction is necessary. The high level of satisfaction with the instruction provided and the reported confidence in the use of the URICA OPAC and other types of online systems demonstrated that the instruction was responsible for the outcome on search tasks, and that the experiment was not hampered by other factors. However, the high rate of positive responses made it difficult to understand the reason for low performance on some of the search tasks, especially by those in the procedural instruction group. This suggested a possible weakness in the evaluation instrument.

Despite the research being able to meet the research objectives stated, on reflection of the data collected, there were indications that the research would have benefited more if certain aspects of the methodology were revised. These were namely in relation to the definition of library experience, the size of the sample which reduced the effectiveness of direct observation and interviewing methods, the construction of the pre and post-tests, the duration of the experiment tasks, and the design of the evaluation instrument.

In relation to the external validity of the research, there are many indications that the results can be generalised to a broader population. Namely because the online system used in the experiment supported many of the search functions found in most systems; the sample was comparable to the broader population of first year tertiary-level students, in relation to their academic qualifications and diverse profile; the sample was comparable to other populations who share the individual characteristics that were studied; and the instruction provided resembled a typical instruction programme in everyday circumstances.

Chapter 6

Summary of findings, conclusions and recommendations

6.1 Introduction

Several issues have been raised in this research in relation to trends in the online environment and in relation to the end-user community. Some of the trends include the growing use of online technologies in academic libraries, not only in the developed world but also in South Africa. This has occurred to the point that some printed resources are being replaced by online resources including the printed catalogues of libraries.

Another development has been the realisation of the virtual library as a result of connectivity that enables remote access to the world's information resources, and as a result of resources such as WWW on the Internet. The extent to which the end-user has embraced virtual information sources has been reported to be so great that events will likely overtake those libraries that do not keep abreast of these services (de Kock 1998).

However, despite the general enthusiasm demonstrated towards the use of online retrieval systems, these technologies do not come without problems. The lack of standardisation between the various systems, the overwhelming volume of information generated by these resources, the complex nature of searching these formats, and the general inability of undergraduate students to effectively use them for their information needs, has been repeatedly cited. The use of online systems to satisfy information queries has also been found to require pre-requisite competencies such as information literacy, computer literacy, and English language proficiency which are not uniformly found amongst end-users.

Online systems are also described as encompassing many differences compared to the printed resources to which some end-users have become accustomed. For example although the purpose of the online catalogue and the card catalogue are the same, that is to find bibliographic information, both methods do not presume the same approaches. Other differences exist in indexing structures, determining intellectual authorship is not as crucial in online systems due to the many access points, online systems make use of unique search techniques not found in printed resources (Nielsen *et al.* 1985). Online systems also require the use of computer hardware which evokes different feelings amongst different people.

Since many academic libraries in South Africa have followed the trends described in online development, they are faced with the challenge of overcoming these difficulties and seeking ways to ensure that the end-user community develops the skills and knowledge needed to search online technologies effectively and efficiently. This is necessary, particularly since many students attending South African tertiary institutions are reported to have few of the pre-requisite competencies required in using these technologies. South

African tertiary institution students have varied backgrounds including the use of English as a second language, lack of computer literacy, and poor information literacy skills. (Sayed 1998). However, they are faced with online technologies for their information searching and therefore need to be taught how to search effectively and how to retrieve information. Bibliographic instructors have to choose the best teaching method to suit the varying composition of South African students.

The traditional way in which information resources are introduced to students has been through the means of library education or BI. Although this tradition is not universally upheld, it is widely practised throughout the world and is a common service found in most South African academic libraries. The typical form of this instruction has been to impart the skills and knowledge needed to use printed information sources, which was also usually tool-based type of instruction. A logical progression therefore is for librarians to provide online instruction to equip students with the competencies needed to search online information systems. The dilemma however, is that with the evolutionary nature of online systems, and the variety of search protocols found, as well as the low level of prerequisite competencies found amongst undergraduates, it was unclear whether the traditional method of tool-based teaching should be continued, or whether other methods of instruction should be provided to enable the use of the multiple types of online technologies found in libraries. Furthermore as a result of the varied backgrounds of students receiving instruction some attention must be paid to the method of instruction if it is to benefit the end-user. Baker *et al* (1991) have argued that in teaching the use of information retrieval systems there must be a connection between learning strategies and the instruction programme, and between the library user and life long learning skills. In order to assist end-users to successfully access the host of local and remote online systems librarians must adopt a leadership role. Instruction must be provided in a meaningful way so that independent, individualized learning is assured.

The decision in online instruction is generally considered to be between teaching the procedures of a specific system or teaching general concepts that can be applied to many systems. In order to make this decision, the concern was to find out which of the two methods would be better in a South African context where students had unequal abilities with respect to the use of libraries and computers and when the use of English was a first or second language.

The literature reviewed found a scant amount of empirical data to enable a deliberate choice between either of the two teaching methods. Research found, originated mainly in North America and provided little evidence that the findings could be generalised to a South African context. For example, Borgman's research (1984a) used a sample population whom she admits had a higher technical and academic aptitude than is generally found, even in the United States where her study was conducted. In addition, the methodologies used in previous research, for example CAI (Cherry *et al.* 1994) and a card catalogue analogy as a model for instruction (Nielsen *et al.* 1985; Borgman 1984a) were not considered relevant in a South African context. In the latter case, the card catalogue analogy appeared to have little relevance in a context where the online catalogue is the only format available.

The present research therefore was conducted to determine what the effects would be on search performance between the methods of concept-based and procedural instruction in a South African context. Using earlier research as a frame of reference, the present research revised previous methodologies, focussed on a sample from a different environment, and on different variables. The specific objectives pursued in this research were as follows:

1. To determine whether or not any differences exist in online search performance between students trained in a concept-based, and those trained by procedural teaching methods.
2. To determine whether or not any differences exist in online search performance between students with differing library experiences trained in a concept-based and those trained by procedural teaching methods.
3. To determine whether or not any differences exist in online search performance between students with differing computer experiences and trained in a concept-based and those trained by procedural teaching methods.
4. To determine whether or not any differences exist in online search performance between students who regard English as a first or a second language trained in a concept-based and those trained by procedural teaching methods.

The research objectives gave rise to the following research questions:

1. Are there significant differences in search performance on simple online tasks, between students who are conceptually trained and those who are procedurally trained?
2. Are there significant differences in search performance on difficult online tasks, between students who are conceptually trained and those who are procedurally trained?
3. Are there significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to students with low levels of library experience and those with higher levels of library experience.
4. Are there significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in relation to students with low levels of library experience and those with higher levels of library experience.
5. Are there significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to students who are familiar with and those who are unfamiliar with the use of computers?
6. Are there significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in

relation to students who are familiar with and those who are unfamiliar with the use of computers?

7. Are there significant differences in search performance on simple online tasks between those who are conceptually and procedurally trained, in relation to students who regard English as a first language and those who regard English as a second language?

8. Are there significant differences in search performance on difficult online tasks between those who are conceptually and procedurally trained, in relation to students who regard English as a first language and those who regard English as a second language?

The primary method used for the study was through the means of a quasi-experiment. Using the M L Sultan, a tertiary institution in South Africa, as a "case study," a sample of 120 first year students were recruited from the institution. Research instruments used to collect the data included a background questionnaire which elicited demographic data, a pre and post-test and transaction log reports which provided data on search performance, and an evaluation questionnaire which generated data on self-reported confidence and mastery of the system, satisfaction with the instruction programme, and the online system used. Data was analysed using the computer software, Microsoft Access and Excel '97, and SPSS v9.0. Search performance was evaluated according to outcomes on simple and difficult tasks and was further evaluated to determine the variance in performance between those with differences in library and computer experience, and who used English as a first or second language. Research findings were presented in a qualitative and quantitative format.

6.2 Summary of findings

This section reviews the main findings of the research in relation to the demographic description of the study sample and the research objectives and related research questions.

6.2.1 Profile of sample

Although the research sample emanated from only one institution, the M L Sultan Technikon, it is considered representative of most first year students enrolled in tertiary institutions in South Africa. The reason is that even though the Technikon offers different academic programmes at different levels compared to universities, the entry requirement for first years, in most tertiary institutions, is a matriculation certificate. Since, the experiment was conducted immediately after student registration at the beginning of the academic year, the sample at that point resembled first year students enrolled in other tertiary institutions in South Africa. The timing of the research also served to reduce the effect of the academic programme on search performance.

Based on demographic data collected and performance on pre-test tasks, the profile of the sample confirmed earlier reports of Shapiro (1995), Cuthbertson (1992) and Bell (1990) that undergraduate students attending South African tertiary institutions do not have high levels of information literacy and computer literacy. It also confirmed the general view that many students making use of South African academic libraries use English as a second language. This research found these qualities to be pre-requisite competencies needed for the effective use of online retrieval systems. The inference therefore is that many first year students entering tertiary institutions in South Africa will have difficulty in the use of online technologies found in academic libraries, a situation which could ultimately impact on academic performance. It also means that basic access to the library's resources via the online catalogue will be curtailed as a result of the low levels of these prerequisite competencies.

6.2.2 Online search performance

The general inexperience and inability of first year students to cope with the use of an online search system was evident amongst this research sample. This conclusion is based on the poor performance on pre-test tasks, the slow pace in which tasks were performed, and the types of errors reflected in transaction log reports. Overall performance on search tasks found that students experienced considerable difficulty with tasks that required manipulation of search terms, or extrapolation of information from search results. Performance on tasks also indicated that students were not able to identify clearly what their information need was, nor did they make use of a pre-search strategy. Evidence of this was found in the performance of a subject search that produced no results which required revision of the search strategy and which required the use of synonyms. These results provided a strong argument that instruction in the use of online information systems is necessary for novice end-users, more so, since performance on post-test tasks improved considerably after instruction was provided.

The better performance on search tasks by those who had prior experience in the use of libraries, use of computers and who regarded English as a first language, further implied that the presence of online information systems will best serve those who are familiar with libraries, who have skills in the use of computer technology and who have the advantage of using English as a first language. In order to ensure that the online systems found in academic libraries are accessible to all end-users, the library has a responsibility to provide online instruction as of the means of bridging this gap. However, the teaching or training methodology used must be appropriate to the background of the trainee.

In relation to the research objectives set out, the differences found in search performance between the groups who were provided with the method of concept-based instruction and the method of procedural instruction is summarised as follows:

6.2.2.1 Overall performance on simple tasks

Overall performance on post-test tasks revealed that there were no significant differences on simple tasks related to author or title between the two teaching conditions. However, a task related to browsing of the database did produce significant differences. Performance on this task found significant differences between the teaching groups even in relation to the variables of library, and computer experience and the use of English as a first, or second language. However, the task might have been erroneously grouped as a simple task by the researcher, since the tasks required the conceptual understanding of a record structure to be able to select the right answer to the task. In all cases in the performance on this task, the concept-based group performed better than the procedural group.

6.2.2.2 Overall performance on difficult tasks

Overall performance on post-test tasks revealed significant differences. The concept-based group performed better on tasks related to truncation, a general subject search, and a subject that required the use of a synonym. The latter proving to be the most difficult task for all participants.

6.2.2.3 Performance on simple tasks: low and high library experience

Although training produced a high rate of improvement in both groups, no significant differences were found in performance on simple tasks related to author/title. The effect of concept-based training on the performance of those with low library experience was that they equalled performance of those with high library experience on the post-test. Hence, both instruction methods appear to be suited to the teaching of author/ title tasks. It also suggests that instruction can be used to bring students with different experiences (in this case library experience) on par in terms of online system use.

6.2.2.4 Performance on difficult tasks: low and high library experience

Performance on difficult tasks found that the concept-based teaching group performed significantly better than the procedural teaching group. Those with low library experience in the concept-based group did better on difficult tasks than those who had higher library experience in the procedural group. Significant differences were found in performance on tasks related to truncation and a subject/synonym task. The task related to a subject/synonym was generally found difficult. Those in the procedural group did not reach a performance level above 15.4% while those in the concept-based group reached 55.0%. Those in the concept-based group who had low library experience scored 30.0% on this task which indicates that instruction must pay particular attention to the teaching of subject searching.

6.2.2.5 Performance on simple tasks: with and without computer experience

Performance on simple tasks produced no significant differences in performance in relation to author/title tasks. However, performance on tasks showed a high rate of improvement for those who received procedural instruction and who had no computer experience. Procedural instruction made little impact on performance scores of those with computer experience. Those who benefited the least from instruction were those with no computer experience in the concept-based group. Those who benefited the most from instruction were those with computer experience in the concept-based group. In relation to the use of models in teaching this result indicates that prior use of computers did not prevent students from assimilating a new model into their existing model. However, there is still a need to investigate this further, as the extent of computer experience of this group was not ascertained.

Those from the concept-based group with no prior computer experience, might not have performed as well on tasks due to difficulties with the use of hardware, or tasks that relied on an understanding of specific procedures. Hence, there is some indication that for end-users who have a low comprehension of computer technology there is a need to provide some procedural instruction. However, it cannot be concluded that concept-based instruction was not beneficial to this group since performance on difficult tasks found that they did better on tasks than the procedural group.

6.2.2.6 Performance on difficult tasks: with and without computer experience

Performance on difficult tasks found that the concept-based group performed significantly better on tasks related to proximity, truncation and a subject/synonym. Those with no computer experience in the concept-based group benefited the most from instruction based on the improvement of pre and post-test scores.

Performance on a subject/synonym task was found to be the most difficult task overall. The highest score on this task was 50.0% achieved by the group with computer experience in the concept-based teaching condition. Those with computer experience in the procedural group benefited the least from instruction, with a misconception occurring in the task related to subject/synonym. An explanation for this occurrence suggested in the literature, is that when no model is provided for the use of a system, users resort to their own models which may be erroneous.

6.2.2.7 Performance on simple tasks: English as a 1st or 2nd language

There were no significant differences in performance between the two teaching conditions on simple author/title tasks. Those who regarded English as a second language benefited from procedural instruction, reflecting higher scores on these tasks in the post-test. Those who regarded English as a first language appeared not to benefit at all from procedural teaching in that performance scores reflected little or no change at all in some of the post-test score. The converse was true for those in the concept-based group, where those who regarded English as a first language scored the highest on author/title tasks.

6.2.2.8 Performance on difficult tasks: English as a first or a second language

Those in the concept-based teaching condition performed significantly better than the procedural instruction group on difficult tasks. Participants from the concept-based group who regarded English as a second language performed better on difficult tasks than they did on simple tasks. Significant differences were found between English first language participants on tasks related to truncation and a subject search task. Significant differences were found on a task related to truncation and a subject/synonym task for those who regarded English as a second language.

6.3 Conclusions

Based on the findings of this research it has been established that first year students enrolling in South African tertiary institutions tend to be generally inexperienced in the use of online information retrieval systems and can be termed as novice end-users. The majority of first year students have no experience in the use of computers and make use of English as a second language. This serves to inhibit their ability to some extent to make effective use of an online retrieval system when no assistance is given. For example prior to training students commented that their lack of experience with computers, made it difficult to search the OPAC system. In this respect it was discovered that prior experience in the use of OPAC systems, and/or card catalogues, computers, and use of English as a first language helped some novice end users to search the OPAC when no assistance was provided. Hence, in order to make use of online systems it is apparent that certain prerequisite competencies are required. Namely information literacy skills, computer skills and proficiency in the use of English. However, the varied responses in relation to the difficulty of search tasks, confidence in the use of computers, the accumulative experiences with respect to the use of libraries, and the specific competencies students have to use information retrieval systems, indicate the varied background and abilities of students using online information systems in South African academic libraries.

At the conceptual level first year students included in this research sample demonstrated a difficulty in searching for information that required them to explore the database, for example to find information on a specific subject. They also experienced difficulty in deriving synonyms in subject searching. At the mechanical level it was found that searching for known-item information such as author and title did not seem to cause the same level of difficulty. However, semantic and command errors were common amongst novice end-users. Performances on tasks before and after training indicated several difficulties, including the use of computer hardware, the use of menus, the use of search indexes and understanding the structure of fields in a record. Novice end-users therefore were found to lack the contextual understanding to use online information systems effectively and efficiently.

In relation to use of the OPAC system URICA the difficulties experienced with some of the system commands, the number of search screens and wording of help information made it apparent that the URICA system needs to be re-examined in relation to system design to become more user friendly to novice.

The difficulties experienced by first year students reaffirmed the need for online instruction. Regardless of the type of instruction it was demonstrated that both procedural and concept-based instruction lead to improvement in search performance. Faced with a choice between the two methods of instruction, it cannot be categorically stated that one method is better than the other. This is due to the fact that based on their backgrounds, students, and the individual differences between students, everyone does not respond uniformly to one or the other method. This research found a variance in search performance when it came to mechanical use of the system such as in the case of author/title searches. On this type of search, students with no computer experience and who use English as second language, responded better to procedural teaching, and those with computer experience and who use English as second language, responded better to concept-based teaching. However, the difference in performance between the teaching conditions on author/title tasks were not significant, which means that either method can be used to teach this type of search.

Concept-based teaching was found to be more effective in teaching the type of search that requires analytical skills and conceptual knowledge to manipulate search terms and to extrapolate information from search results. Examples of this type of search include subject searching and truncating terms. In this type of search students with varying backgrounds in library experience, computer experience and English language use were found to benefit more from concept-based teaching rather than procedural teaching. This proved that use of a model that makes use of analogies to convey the meaning of search concepts is a beneficial way of teaching.

In the provision of online instruction, whether procedural or conceptual, certain conditions are important. For example there must be access to a venue that is suitably equipped with hardware for hands-on and demonstration, sufficient staff to manage the hands-on session and the lecture components of the instruction, and sufficient time allocated for the instruction.

6.4 Recommendations for online instruction

The completion of this research provided some insight into the search behaviour of first year students and a clear indication about the use of teaching methods in the provision of online instruction to South African first year students. Prior to this research there was some skepticism about the generalization of findings from investigations conducted in North America, particularly because the circumstances prevailing in a developing country like South Africa seemed quite disparate to the level of development in countries in North America. However, the overall findings of this research concurred with that of earlier research in that concept-based instruction produced better results when searching involved conceptual process of revising search strategy, manipulating search terms and so forth which is typically the nature of subject-type searching. The difference between this research and earlier research is that based on definitions of this research, both sophisticated and unsophisticated end-users benefited from concept-based instruction in performance on difficult tasks. In the case of procedural instruction, it was found that some students benefited from this instruction in performance on known-item type of searches such as author and title. A study of the transaction log reports revealed mechanical errors which indicated that some attention is needed to the procedural aspects of searching if it is to be efficient and effective.

Arising out of the findings from the present research it is recommended that the background of the trainees must be of importance. Much as it seems that concept-based instruction produced high rates of improvement on task scores, procedural instruction was also beneficial in some instances and therefore cannot be completely discounted. The use of a model in teaching proved to be an effective method of teaching as shown in performance on tasks in the experiment. The model used in this research made it possible to convey all of the search concepts intended, however, some revision is required in relation to concepts of truncation and proximity. Arising from search performance based on the research variables, the pace in which experiment tasks were performed, and transaction log reports, the following recommendations are made:

6.4.1 Physical resources

The experience of this research found that provision of online instruction is reliant on physical resources such as computer hardware in order to demonstrate concepts and for hands-on practice by students. It is recommended that venues such as a computer laboratory or electronic classroom be secured for the purposes of instruction, to be equipped with hardware that enables access to local, and external information databases, multimedia resources such as CD-ROMs, and to virtual information resources in general.

6.4.2 Instructors

Based on experiences in this research, it was of great value to have a teaching team of professional and paraprofessional persons to conduct instruction. The professional librarian had the responsibility of delivering the lecture because of in-depth experience acquired in the use of a range of online and printed resources. Since instruction needs to include both theoretical explanations and practical experience, the assistance of paraprofessional staff and a library science diplomat during hands-on sessions was found necessary. On this basis it is recommended that a similar type of staffing profile be used in the provision of instruction.

6.4.3 Timing and duration of instruction

It is recommended that instruction to first year students should best be offered at the beginning of the first term or semester, to enable students to locate the basic information resources for their academic programmes. In order to cover all of the concepts important to online searching, and to work according to the pace of the student, the ideal situation is for such a course to be integrated into the curriculum and taught as a course on its own. If the provision of a course of this nature is not possible, the instruction then should be held over a period of one week, or at least for a minimum of three days, rather than as a one-day presentation as was done in this research. Unlike the one-day session a course extended over a few days will enable time for hands-on experience, and for specific concepts to be explained.

6.4.4 Content of instruction

The content of instruction must be guided by the objectives of the individual library and the background of the trainees. Some libraries prefer to introduce basic concepts such as author, title, subject searching to first years and progress to the teaching of advanced features to second years and so forth. Arising out of the experiences of this research recommendations made in this regard provide a general indication of what to include in a basic online instruction programme to first year students.

Firstly it is strongly recommended that as a result of low levels of searching and other prerequisite skills found, online instruction be compulsory for first year students at tertiary institutions. Secondly, the programme should include both a lecture and hands-on sessions. While others have made use of computer-aided instruction and the use of printed brochures and narrative notes, these methods require more investigation before they can be implemented in South Africa. In the provision of the lecture the use of a model or analogy to convey concepts was found useful to the instruction. Those students who were taught the use concepts of online searching through the use of a model drawing on their everyday experiences reflected a more successful rate of performance, particularly on difficult tasks such as subject searching. However, the use of a model in the provision of online instruction was a new experience for the researcher and as such, the specific model used in the lecture in this research although found beneficial to search performance, should be subjected to continuous testing to further refine and perfect the model.

Since those with no computer experience demonstrated difficulty on some tasks performed, it is recommended that the training begin with an introduction to computer hardware such as use of the keyboard, computer mouse, screens, and a brief description of the concept of being online. This information will assist in reducing the mystique associated with computers.

The research found little difficulty in the performance of author/title tasks hence these access points can be taught in the same way as was done in this experiment. On these tasks, the librarian has the option of implementing procedural or concept-based instruction as indicated by the results of this research. Some attention should be paid to the form of names, if the inverted form is necessary, and spacing between first and last name.

Based on the finding of this research considerable emphasis needs to be placed on the provision of information literacy to assist in online search performance. Students were found to require more practice related to the conceptual aspects of searching. In particular, students need to learn ways of developing a pre-search strategy, of understanding their information needs, ways of narrowing and broadening a search, manipulating terms, revising search strategies, and interpreting a record. The experiences of this research found that it is important to bring attention to the explanation of basic terminology such as the term "subject heading," 'author", "records," and "database. " Attention should also be drawn to the use of thesauri and dictionaries, to reduce the rate of semantic errors.

The research findings indicated that those with no computer experience, and thosewho regarded English as a second language benefited from procedural instruction on certain tasks. It was also revealed that when procedures were not understood, for example the "SELECT" option there was some effect on search performance. Transaction logs revealed that participants had problems with commands to end a search or to scroll through a screen. In this regard, some attention seems necessary in relation to teaching procedures. However, instead of teaching the procedure for a specific system, it is recommended that typical procedures found in the variety of online resources should be clustered together and taught as a concept. For example, the various ways of ending a search can be explained as one concept, the various ways of selecting information as another, the purpose of menu search screens or the use of commands, and so forth. This can be taught on a separate day of the training programme and should include a hands-on session that demonstrates these procedures as they are found on the various systems.

To supplement the procedural component of the instruction, it is recommended that a print-out of various procedures for the major online retrieval services be given out at the end of the instruction. It is also recommended that a booklet or a list of procedures be available near the computer terminals. This includes subject thesaurus tools such as *LCSH* if this is used as a source of input in the online catalogue

6.5 Recommendations for improvement of the URICA system

Based on the difficulties reflected in the transaction log reports, and some of the responses received in the evaluation questionnaire, the following recommendations are made:

1. Improvements should be made to the layout of the system to make it easier to navigate for the inexperienced searcher. Although the search menu has the option for first-time, regular and expert user, this does not appear to make it easier to

search for those who are inexperienced. For example, as a first-time user the student expected to be able to conduct the entire search on a simplified level. However, this option was only useful as an initial selection, as the students progressed in the search they arrived at the same screens used by the regular and expert users which they appeared to find confusing.

2. The number of screens that are generated in the process of a search appear to be confusing to the student. For example after entering the search query a second screen provides a summary of the search statement and the number of relevant records found. After selecting the line of the relevant record, a third screen appears which requires the searcher to enter a command to display the record. At this point the student most often expects the line selected to be automatically displayed. However, when they enter the command to display they are shown a further screen which requires them to indicate the level of the display and provides the option to remove duplicates. By this time many of the participants in the research were found to get thoroughly lost in the system. It is recommended that after selecting a line, this information should be displayed in a default format, unless otherwise changed by the searcher.
3. It is recommended that the use of Q to end a search be changed and that the use of the word quit also be changed to a phrase such as “end” or “exit” which is more widely understood. The use of windows software would help in this regard.
4. The use of help features proved to be a source of difficulty in that once in help mode, some participants could not exit this function. The help information and instructions found on the bottom of the screen were also found too wordy, or written

too close together, that they were often ignored in the search. It is recommended that the use of pop-up help functions be built into the system, that a blinking cursor be used when something needs to be selected, and that if a user makes more than two attempts in selecting records, a pop-up help screen should automatically appear to indicate the correct route to follow.

5. It is recommended that the display of transaction log reports be revised to indicate the number of failed searches so that these reports can be used to improve system performance and to understand search behaviour.

6.6 Recommendations for further study

The critical importance of online instruction has been demonstrated in the findings of this research. However, the South African literature reflects a dearth of research on the provision of such instruction. In order to make online systems more accessible to all of its users and to build on the findings of the present research, the following recommendations are suggested:

1. This research did not have sufficient resources to base instruction in the use of more than one system. For the future it is recommended that further research be conducted to investigate the effects of concept-based instruction in the use of two or three different online systems to determine whether this teaching method enables learning to be transferred to many systems as noted by Cherry *et al.* (1994).

2. The use of a model in teaching proved beneficial to learning. Further research needs to be conducted on different types of models, and to test the current model used to arrive at the best possible model for instruction.

3. It is recommended that the instruction carried out in this experiment be conducted for a longer duration to determine the effects of teaching methods on search performance.

4. It is recommended that further research be conducted concentrating only on performance on difficult tasks to be able to fine-tune the content of instruction and to further test the effectiveness of concept-based instruction.

5. It is recommended that other forms of delivery be used in the presentation of instruction, for example, computer-aided instruction, which could eventually minimize the amount of time spent on instruction.

6. It is recommended that use of transaction log monitoring to evaluate search performance be investigated more extensively as there are many benefits that can be derived from this method in relation to enhancing online search performance.

The use of technologies in libraries and in other kinds of services is continuing to grow. As we become a more technology-driven society, and as end-users gravitate more toward the services of a virtual library, the social effects of those who have the skills and confidence to use the technology will also become greater. So as not to leave anyone behind, there should be a firm commitment to the provision of instruction and to the constant improvement of system design. In South Africa there is evidence of the tendency amongst some librarians, to develop on-the-job instruction theories, use trial and error methods in instruction, use information gleaned from colleagues, and to refine instruction techniques as they go along. Discussion with colleagues indicates there is a greater emphasis on procedural or tool-based online instruction. There are a variety of reasons that can be suggested for this situation. For example, procedural instruction is an offshoot of instruction based on the use of printed resources; the limited experience of some librarians with the range of online resources; some librarians have received limited instruction themselves in the use of online resources, and when they do, vendors tend to teach the procedural steps needed to use their specific systems which librarians transfer to their own teaching experiences; librarians appear to have limited skills in how to teach and provide and instruction. For those who graduated in the 1980s there was little if any attention paid to teaching librarians how to teach the use of information tools. It is not certain whether schools of librarianship offer such programmes in the 1990s, yet this appears to an important component of library services.

However, if teaching is to be effective and meaningful, there is a need to find out more about how students learn, attitudes towards technology, how a changing South Africa, and new resources such as the Internet and the WWW will change the online environment and the end-user responses to these changes. This research serves as a starting point in this direction . It also provides a starting point towards the development of a common online instruction programme in South Africa. It is hoped that this momentum is retained and that future research in different contexts, with different end-users and online systems will continue to build on this theoretical base.

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APPENDICES

Appendix A

BACKGROUND QUESTIONNAIRE

Background Questionnaire for participants training in online searching

Please note this is not an examination or a test. The Co-ordinator will read out and explain each question and allow you time to provide your answer.

Please complete all questions listed below. Provide a tick (✓) next to your choice. Where you are required to write in your answer, please use the space provided. If more space is needed you may use the back of the question sheet. If you are unsure of any of the questions, please ask the co-ordinator of your group for clarification. If you cannot answer any question please provide your reason in the space provided. Thankyou for your participation in this study.

---

1. This instrument is both for the participants and the group co-ordinator.
2. Participant's copy did not have notes in square brackets
3. Participants are required to complete this questionnaire prior to commencement of the task worksheet

1. Are you a first year student?

____ yes

____ no, I am a __________year student

2. What course are you enrolled in ?e.g. medical technology, public administration, etc.

____

3. Have you taken any courses in computing at this institution or any other institution?

____yes

____no

4a) Do you currently, or have in the past made use of a computer?

____ yes (If you answer yes, proceed to question 4(b) below)

____ no (If you answer no, proceed to question 6)

4b) If you make use of computers, for what purpose do you use the computer? You may tick more than one answer if it is relevant.

____games

____word processing

____ programming

____ my job

____ my studies

____ searching library databases

____ other, please describe ____

____

5. If you have used computers for any purpose, state the amount of time you spend on the computer.

Please tick next to **ONE** of the appropriate categories.

___ at least one hour a day

___ at least one hour a week

___ at least one hour a month

6. Whether or not you have used a computer before which category below best describes you?

____a) confident, I am able to work on a computer with ease

____ b) unsure, but I can manage if I have to use a computer

____ c) I find it difficult to work on a computer (In the space provided, please explain why you find it difficult)

____

____

____

____ d) Other, please describe ______________________________

____

7. Tick the category which best describes your typing experience or skills

____I have no typing experience

____I have some typing experience

____I have done typing in school, or had other formal typing training

____I have used typewriters or keyboard devices extensively

____I have no formal typing training but I can type using my own style

8. Have you had any training or orientation in how to use a library?

____ no

___ yes. In the space below, please name the place or describe where you received this training.

____

____

9. The first place to *start* when looking for a book in the library is the

___a) Reference section
___b) the library catalogue or OPAC
___c) browse on the shelf
___d)Other, please explain____

____

10. Have you ever used a library card catalogue or OPAC at any institution other than the M L Sultan Technikon?

____yes, I have used a card catalogue
____yes, I have used an OPAC
____ no, I have not used either a card catalogue or OPAC

11. What is the number found on the spine of the book called?
[The Co-ordinator will demonstrate the spine of the book and the class number on the spine]

____a) the ISBN number
____b) the class or classification number
____c) I do not know

12. How would you describe yourself with regard to finding information in the library?

____a) confident, and am able to understand how to find material in the library

____b) unsure, but I can find my way around the library

____c) I find it difficult to use the library. Please explain your reasons in the space provided.

____

____

____ d) Other, please describe ____

____

13. How often do you visit a library, whether it be school, public, or any other type of library to find information?

___ at least once a day

___ at least once a week

___ at least once a month

___ never

___ other, please describe ____

14. Have you ever been employed in a library?

____ yes

____ no

15. Have you ever used the URICA library system at this library or any other institution?

____ yes
____ no
____ no idea what it is

16. Have you ever used the SABINET library system at this library or any other institution?

___ yes
___ no
___ no idea what it is

17. Have you ever had training in online searching (computerised searching) at this library or any other institution?

____ yes
____ no
____ no idea what it is

18. Have you ever used a computer to find information in a library?

____ yes, please describe where you use or used it

____

____ no
____ no idea what it is

19. Please indicate whether English is your first or second language.

____

20. Is English the language you most often speak at home?

____yes
____ no

21. How would you describe your ability to communicate in English? Please indicate within the following range, 1 being poor and 10 being excellent.

	1	2	3	4	5	6	7	8	9	10
Read										
Write										
Speak										

[When all participants complete the questionnaire they will be instructed to proceed with Part 1 (One) on their task worksheet]

Appendix B

PRE-TEST TASKS

Task Worksheet for Online training participants ***prior to*** URICA training being provided

This exercise is intended to help the library plan an online training course that will be best suited to your needs. **Please do not regard this as a test or examination. You will not be penalized in any way for any answer you submit, or if you are unable to complete any question.**

This worksheet appears in 2 parts. Part 1 is to completed prior to any information being supplied to you. Part 2 is to be completed after you have received training in using the URICA library system.

Please do not proceed unless requested

---

1. This instrument is both for the participants and the group co-ordinator
2. Participants copy did not have notes in square brackets

PART ONE

A. Using the URICA database please complete the tasks below. If you cannot find the solution to any question it will be helpful to this study if you could state your reason/s in the space provided. For example, that you were not able to find the answer, or if it was difficult for you to find the answer, or if you did not have enough time, or any other reason you may have.

1. **Virginia Brodine** is the name of an **Author**. How many books can you find on the computer system that have been written by her?

____

2. Find a book with the **title** called **Beginning Photography**.

   Write down the BRN _________
   (The location of the BRN will be demonstrated by the Co-ordinator of the group)

3. Using the option 3 on the main menu for **SUBJECT**, find books on the topic, the **ELDERLY**

   Write down the BRN of the first book _________________

PLEASE DO NOT PROCEED TO PART 2 UNTIL REQUESTED

Appendix C

POST-TEST TASKS

Task Worksheet for Online training participants ***after*** URICA training was provided

This exercise is intended to help the library plan an online training course that will be best suited to your needs. **Please do not regard this as a test or examination. You will not be penalized in any way for any answer you submit, or if you are unable to complete any question.**

This worksheet appears in 2 parts. Part 1 is to completed prior to any information being supplied to you. Part 2 is to be completed after you have received training in using the URICA library system.

Please do not proceed until requested

---

1. This instrument is both for the participants and the group co-ordinator
2. Participants copy did not have notes in square brackets

PART TWO [The numbering of this worksheet follows the sequence from Part One, hence the first task is number 4.]

B Using the URICA database please complete the tasks below. If you cannot find the solution to any question it will be helpful to this study if you could state your reason/s in the space provided. For example, that you were not able to find the answer, or if it was difficult for you to find the answer, or if you did not have enough time, or any other reason you may have.

The next three questions 4. a,b,c are related. Do not quit (Q) after you answer 4.a but go on to answer 4.b and 4.c. (Remember quit means to "End" your task)

4.a) **Virginia Brodine** is the name of an Author. How many books can you find on the computer system that have been written by her?

____

Do not Quit (Q) but proceed to answer question 4(b) below

4.b) **SELECT** the **first** record from your results in 4a). What is the title called?

____

Do not Quit (Q) after you answer 4b) but go on to answer 4c)

4.c) Examine the record you found in question 4b) and choose the option **D1** from your record to find other books on **AIR - POLLUTION**. Write down the **BRN** of the **first** book you found.

____

5. Do a **TITLE SEARCH** to find books where the words **NATIONAL** and **EDUCATION** appears **NEXT TO EACH OTHER** in the title. Name the first book on the list.

____

6. If you need to find books with titles on , **LIBRARIES, LIBRARIANS, and LIBRARY**. What term will you enter on the computer to do your search. **Write** down your answer in the space below.

____

7. Using the option 3 on the main menu for **SUBJECT** enter appropriate terms to find books on the topic MAPS in SOUTH AFRICA. Write down the BRN of the first book

____

8. Using the option 3 on the main menu for **SUBJECT** find books on the topic, the ELDERLY. If you get 0 results, try using another term .
Write down in the space below, the **term/s** or words you used to search

____

Write down the BRN of the first book.______________________

Thank you for your participation in this study

Appendix D

EVALUATION QUESTIONNAIRE

Evaluation by participants on online instruction received

PLEASE COMPLETE THE FOLLOWING QUESTIONNAIRE TO PROVIDE FEEDBACK ON THE USEFULNESS OF THE TRAINING YOU RECEIVED TODAY
(Please put an X in the box that applies to you)

1 **After the training do you feel confident that you will be able to search for information on the URICA system.**

☐ yes

☐ no, Please explain your reason ______________________________

____

2 **After the training do you feel confident that you will be able to search other OPAC databases**

☐ yes

☐ no, Please explain your reason ______________________________

____

3 **Do you feel that the notes provided were helpful?**

☐ yes

☐ no, Please explain your reason ______________________________

____

4 **Do you feel that the lecture on using the system was clear?**

☐ yes

☐ no, Please explain your reason ______________________________

____

5 **Did you find it difficult to type on the keyboard?**

☐ yes. Please explain your reason ______________________________

☐ no

6 **Did you find it difficult to follow the computer instructions on the URICA system?**

☐ yes. Please explain your reason

____

____

☐ no

7 **Did you find it difficult to understand what was required in the worksheet?**

☐ yes. Please explain your

reason____

____

☐ no

____

THANK YOU FOR YOUR ASSISTANCE IN THIS STUDY

Appendix E

TRAINING NOTES PROVIDED IN PROCEDURAL INSTRUCTION

Training notes for Participants in the "Procedural Group" in online searching

NOTES ON USING THE COMPUTER CATALOG

One of the main functions of libraries, the world over, is to **collect** information in the form of books, journals, and other formats, and to **arrange** this information in some logical order so that persons seeking that information are able to find it. Although some libraries still use manual techniques to do this, many libraries have now changed from a manual system to using a computerised catalog to record information. By using the **computer catalog,** it allows for an **item to be found in more than the three ways**, ie. author, title and subject. The computer catalog can handle more information at a time, allowing for **an item to be found in approx. 10 or more different ways**, depending on the individual system. The item can now be located by : Author, title, subject, publisher, series name, ISBN/ISSN number, accession number, Dewey/LC number, computer generated number, or keywords. However, although libraries still try to keep to the same system of describing their collections and arranging this information on the shelves, they are all using many different types of computer systems to do this.

URICA

In our library we are using a system called URICA. This is a complete library system which we also use for CIRCULATING books, ORDERING, and other library processes. The URICA OPAC module reflects all the books, journals, and other materials owned by the library.

To search this database you may be able to search by knowing the Author's name, the Title, the Subject/s, Publishers name, Series Title, the Dewey Number, the ISBN number, the BRN number, the Accession Number, or by doing general keyword searches.

What Equipment will you need to understand to be able to Search?

KEYBOARD MECHANICS

The keys on the keyboard will be used to type in the information you are seeking

The **ENTER/RETURN** key when pressed will transmit your search
The **ENTER/RETURN** key is also used to go backwards to your previous screen

The **shift key** must be held down if you want to type a **CAPITAL** letter

The **backspace key** must be used to **erase** incorrect information

You will be able to search up and down the page or move backwards and forwards between pages by usually pressing the **Arrow keys**, or the letter **P** for paging back and forward, or the letters **B** and **F** to go **Backward** and **Forwards.**

If you are using a **MOUSE**, the first button is equivalent to the **ENTER** key on the keyboard. When you press this once with your finger it will transmit your information in the same way as when you pressed the ENTER key. The mouse allows you to move an arrow marker around the screen to the point where you need to be. This is done by dragging the MOUSE on the table. This arrow will move around. You will drag the arrow to the point you want and press down the left button once.

ONLINE SEARCHING

Online searching is the process of directly interrogating the computer system to resolve particular requests for information. The search will usually be conducted by means of a keyboard and screen that communicates with a computer system. When you conduct a search on the library system it is also referred to as an OPAC search and OPAC system. OPAC standing for the term **ONLINE PUBLIC ACCESS**. Public Access referring to the fact that this database is available for any person to search.

SEARCH STRATEGY

When you are searching for information always attempt to describe your topic and identify the main concepts, and keywords to make your searching easier.

Searching URICA

Logging on to the System

1. At the LOGIN: prompt type the word **lib** (in lower case)

2. The URICA system is MENU-driven which means that you must do your search by making selections from a menu and proceeding with the instructions provided by the computer.

3. Using the Booklet called **A Guide to Using the Computer System**, your instructor will take you through the steps to conduct an online search on URICA.

Appendix F

HANDBOOK PROVIDED IN PROCEDURAL INSTRUCTION

A GUIDE TO USING

THE

LIBRARY

COMPUTER SYSTEM

M L SULTAN
TECHNIKON

TABLE OF CONTENTS

GETTING STARTED...

PLEASE NOTE THAT <H> (FOR HELP) MAY BE ENTERED AT ALL PROMPTS.

WHEN THE FOLLOWING SCREEN IS DISPLAYED PRESS THE ENTER BUTTON ON THE KEYBOARD TO BEGIN YOUR SEARCH

```
==========================================================
                           URICA
==========================================================
      S     O     F     T     W     A     R     E
==========================================================
        COPYRIGHT URICA LIBRARY SYSTEMS BV. HOLLAND.

                 PRESS <ENTER> WHEN READY
```

2. AT THE FOLLOWING DISPLAY CHOOSE OPTION 1 OR 2 OR 3 ACCORDING TO YOUR NEED.

TYPE THIS NUMBER NEXT TO THE WORD OPTIONS AT THE BOTTOM OF THE SCREEN.

THE LINE OF THE NUMBER YOU SELECTED WILL BECOME HIGHLIGHTED.

PRESS THE ENTER KEY ON THE KEYBOARD (TWICE) TO SELECT THIS OPTION.

```
              URICA INTEGRATED SYSTEMS (PTY) LTD
                            OPAC
                ONLINE PUBLIC ACCESS CATALOGUE

1 .. ENQUIRY [FIRST-TIME USER]
2 .. ENQUIRY [REGULAR USER]
3 .. ENQUIRY [EXPERT USER]
4 .. BULLETIN BOARDS
5 .. OPAC HELP TOOLS
6 .. DEPARTMENTAL REQUISITIONS
7 .. END THE ENQUIRY

OPTIONS : SELECT   HELP   TERMINAL

USE ARROW KEYS <- & -> TO CHOOSE AN OPTION AND PRESS <ENTER>
```

IF YOU NEED MORE HELP CONSULT THE SECTION IN THIS GUIDE FOR:

1. FIRST-TIME USER : PAGE 3
2. REGULAR USER : PAGE 5
3. EXPERT USER : PAGE 6

FIRST-TIME USER

DEFINITIONS

URICA	=	THIS IS THE NAME OF THE LIBRARY COMPUTER SYSTEM.
OPAC	=	THIS STANDS FOR, ONLINE PUBLIC ACCESS. AN OPAC TERMINAL OR SCREEN IS THE TERMINAL USED TO LOCATE BOOKS AND MAGAZINES IN THE LIBRARY COLLECTION. IT IS THE LIBRARY CATALOG STORED ON COMPUTER.
PRINT CATALOG	=	THE PRINTED CATALOG IS A PRINTED VERSION OF ALL THE BOOKS AND MAGAZINES FOUND IN THE LIBRARY COLLECTION. YOU CAN USE EITHER THE OPAC TERMINAL OR THE PRINTED CATALOG TO LOCATE BOOKS AND PERIODICALS IN THE LIBRARY.
ENTER	=	THIS IS THE KEY OR BUTTON ON THE COMPUTER KEYBOARD WHICH HAS THE WORD ENTER OR RETURN WRITTEN ON IT. AFTER YOU TYPE INFORMATION YOU MUST PRESS THE ENTER OR THE RETURN TURN KEY SO THAT THE COMPUTER CAN PROCESS YOUR REQUEST.
KEY	=	THE LETTER AND NUMBERS ON THE KEYBOARD ARE REFERRED TO AS KEYS OR BUTTONS
MAIN	=	BOOKS THAT ARE FOUND IN THE GENERAL COLLECTION. THEY WILL BE LOCATED ON THE FIRST OR SECOND FLOOR
SHORT LOAN	=	BOOKS FOUND IN THE RESERVE COLLECTION ON THE 3RD FLOOR.
JOURNALS	=	THE WORDS, MAGAZINES, SERIALS, PERIODICALS, AND JOURNALS REFER TO THE COLLECTION FOUND ON THE 4TH FLOOR.

HOW TO CONDUCT A SEARCH AS A FIRST TIME USER

1. IF YOU ARE USING THE LIBRARY TERMINAL FOR THE FIRST TIME OR IF YOU ARE UNSURE ABOUT HOW TO SEARCH FOR INFORMATION ON THIS SYSTEM CHOOSE NUMBER 1 FOR FIRST TIME USER.

2. TO CHOOSE NUMBER 1, TYPE IN THE NUMBER 1 FROM THE TOP ROW OF THE COMPUTER KEYBOARD AND PRESS THE KEY WHICH IS MARKED ENTER.

3. THE FOLLOWING SCREEN WILL BE DISPLAYED:
AT THIS SCREEN YOU CAN SEARCH FOR INFORMATION ABOUT TITLES

```
LIB 1        M L SULTAN TECHNIKON                              URICA
 OPTION 1      ENQUIRY (FIRST-TIME USER)           PASSIVE MODE

ENTER TITLE, EG <PERSONNEL MANAGEMENT> OR WORDS FROM THE TITLE
```

4. IF YOU ARE LOOKING FOR INFORMATION ON A TITLE TYPE THE WORDS OF THE TITLE AND PRESS THE ENTER BUTTON. WHEN YOU ARRIVE AT THE TITLE SCREEN TURN TO PAGE 9 IN THIS GUIDE FOR TITLE SEARCH.

5. IF YOU WANT TO LOOK FOR INFORMATION ABOUT AUTHORS, DO NOT TYPE ANYTHING HERE - JUST PRESS THE ENTER BUTTON.

6. AT THE FOLLOWING SCREEN TYPE IN YOUR SEARCH FOR AUTHORS

```
LIB 1        M L SULTAN TECHNIKON                              URICA
         OPTION 1 :  ENQUIRY (FIRST-TIME USER)           PASSIVE MODE
                                          SPELL-CHECK OFF
ENTER AUTHOR, EG <SMITH, L J> OR <L J SMITH> OR <SMITH>
```

7. TYPE THE SURNAME OF THE AUTHOR, OR THE SURNAME, AND THE FIRST NAMES OR INITIALS. SEE THE EXAMPLE ABOVE FOR SMITH, L J. WHEN YOU ARRIVE AT THE AUTHOR SCREEN REFER TO PAGE 7 IN THIS GUIDE FOR AUTHOR SEARCH.

8. IF YOU DO NOT WANT INFORMATION ABOUT TITLES OR AUTHORS, BUT YOU ARE LOOKING FOR INFORMATION ON A SUBJECT - DO NOT TYPE ANYTHING HERE, JUST PRESS THE ENTER BUTTON.

9. AT THIS SCREEN YOU CAN LOOK FOR INFORMATION ON SUBJECTS.

```
LIB 1        M L SULTAN TECHNIKON                              URICA
         OPTION 1 :  ENQUIRY (FIRST-TIME USER)           PASSIVE MODE

ENTER SUBJECT, EG <NATURE CONSERVATION> OR WORDS FROM THE SUBJECT
```

10. TYPE THE WORDS OF THE SUBJECT YOU ARE SEEKING AS DISPLAYED IN THE EXAMPLE ABOVE. WHEN YOU ARRIVE AT THE SUBJECT SEARCH SCREEN TURN TO PAGE 12 IN THIS GUIDE FOR SUBJECT SEARCHING.

REGULAR USER

1 Type in number 2 for Regular User and press the ENTER button.

2. This line will be highlighted.

3. Press the ENTER button to select.

4. The following screen will be displayed:

```
LIB 2       M L SULTAN TECHNIKON                              URICA
          OPTION 2 .  ENQUIRY [REGULAR USER]

          1 . AUTHOR ENQUIRY
          2 . TITLE ENQUIRY
          3 . SUBJECT ENQUIRY

OPTIONS : SELECT  HELP  QUIT

USE ARROW KEYS <- & -> TO CHOOSE AN OPTION AND PRESS <ENTER>
```

5 Choose number 1 if you are looking for books by a specific AUTHOR
Choose number 2 if you are looking for a specific TITLE
Choose number 3 if you looking for all books on a specific SUBJECT

6. To choose a number type in the number and press the ENTER button.

7. For further information on how to seek information on an author, title or subject turn to :

PAGE 7 FOR AUTHORS
PAGE 9 FOR TITLE
PAGE 12 FOR SUBJECT

EXPERT USER

1. Type in number 3 for EXPERT USER and press the ENTER BUTTON.

2. This line will become highlighted.

3. Press ENTER to proceed.

4. The following menu will appear:

```
LIB 3        M L SULTAN TECHNIKON                              URICA
             OPTION 3 : .. Enquiry [Expert User]

             1 .. Personal Author
             2    Title
             3 .Subject
             4 .. Corporate Author
             5 .. Series Name
             6    Publisher
             7 .  Class or Call Number
             8 .. ISBN or ISSN
             9 .  Barcode Number
             10 ..BRN or SAVE-LIST of BRNs
             11 ..Keyword Boolean Search

OPTIONS   Select   Help   Quit

Use ARROW keys <- &  > to choose an option and press <ENTER>
```

5. Type the number of the function you wish to select, eg 1 to search for authors, 2 to search for titles, or 3 to search for subjects, etc. You can choose any ONE number from 1 to 11.

6. Press the Enter button.

7. The line you selected will be highlighted. Press the Enter button. The screen of the option you selected will be displayed.

8. For further information on how to find information on an author, title or subject turn to:

PAGE 7	FOR AUTHORS
PAGE 9	FOR TITLES
PAGE 12	FOR SUBJECTS

SEARCHING FOR AUTHORS

1. Type the number for author (1) and press enter.

2. At the following screen type the surname first, comma, space, first name or initial, and press enter, eg. Martin, James or Martin, J, or Martin

Enter Author, eg <SMITH, L J> or <L J SMITH> or <SMITH>
MARTIN, JAMES
(PLEASE PRESS THE <ENTER> KEY IF YOU HAVE FINISHED OR ENTER <H> FOR HELP.)

3. A list of names with numbers appearing in two columns will be displayed. The numbers in the far-left margin are the line numbers you will select.

MLS 3.1	M L SULTAN TECHNIKON	URICA
Authors including MARTIN plus [JAMES]		
#	Works	
1	11	Martin, James
2	16	Martin, Larry
OPTIONS : Select Expand Word-list Help Quit		
Use ARROW keys <- & -> to choose an option and press <ENTER>		

4. To select from this list choose the number from the first column,(far left) that corresponds with the name you are searching. Eg. If you want to choose Martin, Larry in the figure above you will type number 2.

   If you wish to select all the names type an asterisk (*).
   I.E. press the shift key on the keyboard and the number 8 button.
   Or
   Type S to make a specific selection
   Enter the numbers you wish to review eg. 1-5 or 1 4 7 8

5. When the screen reads : <R>emove duplicates - press enter.

6. At the following screen press the Enter button and continue.

SPECIFY SELECTION AS FOLLOWS WITH BOOLEAN OPERATORS:-

MATERIAL TYPE	IF GMD "[AUDIO]" (EG. AUDIOVISUAL PROGRAMMES) OR IF GMD "[ILL]" (EG. ILLUSTRATIONS)
CALL NUMBER	IF CALL "940]" OR IF CALL "[VI]" (EG. VIDEOS)
TITLE	IF ANYTITLE "[EDUC]" OR "[TRAIN]"
LANGUAGE OF WORK	IF LANG "LAT" AND IF LANG "GRC"
DATE	IF DATE AFTER "1973" AND BEFORE "1978"
AUTHOR	IF SURNAME "CHURCHILL" AND INITIAL "WI"
CORPORATE AUTHOR	IF CORP "[INSTITUTE]"
PUBLISHER	IF PUBLISHER "COLLINS"
NOTE	IF NOTE "[THES]" OR IF NOTE "[PROEF]"
SUBJECT	IF SUBJECT "[ENERGY]" AND IF SUBJECT "[CONSERVATION]"

Note : Brackets are used to indicate that the character string specified.
may be bordered (surrounded) by other text on either side.

enter Selection as <IF ... >, <A>ttributes, <L>ocation or <ENTER>

7. When the screen reads:

Select format from 1 to 8 , < H >elp, < Q >uit ?

Choose a number from 1-6 to display the record.

Type number 6 and press enter to display the full record.
Or
If you do not want so much of information you can select number 2 for a shorter display or number 5 for a medium record.

8. Example of a record displayed:

author———Martin, James
title ———Application development without programmers.
publisher – Englewood Cliffs, N.J. : Prentice-Hall, 1982.
ISBN 0-8202-3901-X.
R222.47
250p. : ill.
Includes bibliographic references

location on — 001.6424——— (classification number)
shelf BRN 30924 ——— (computer record number)
HID 10350, Copies 2—— (number of copies in the library)
copy 95/2095 MAIN * ON LOAN (general book)
copy 95/3618 SHORT LOANS — (reserve book)

Exploration	Access Points
A1 works 11	Martin, James
T1 works 1	Application development..
D1 works 39	ELECTRONIC DIGITAL COMPUTERS
D2 works 265	ELECTRONIC DATA PROCESSING
P1 works 974	Eng Cliffs, Prent-Hall
N1 works 339	001.64

9. Exploration points above are useful in that it can help you expand your search.

10. Make a note of the class number and location, eg.
001.64 MAR (MAIN and SHORT LOANS/RESERVE).

11. Press enter to view other records on your list
press Q to quit and to begin a new search for another author

12. To quit from an author search and to go to another type of search.
example, title or subject:
press Q to quit
press enter to go to the main menu

HOW TO SEARCH FOR TITLES

1. TYPE THE NUMBER FOR TITLES (2) AND PRESS ENTER.

2. TYPE THE NAME OF THE BOOK OR JOURNAL YOU WANT, E.G.:

   PERSONAL MANAGEMENT

   PRESS THE ENTER BUTTON

3. FOR EXAMPLE, A TYPICAL TITLE SCREEN WILL APPEAR AS FOLLOWS:

```
ENTER TITLE. EG <PERSONNEL MANAGEMENT> OR <PERS] MANAGE]>

PERSONAL MANAGEMENT (THIS IS THE TITLE YOU WOULD HAVE TYPED )

(PLEASE PRESS THE <ENTER> KEY IF YOU HAVE FINISHED OR ENTER <H> FOR HELP.)
LAST SEARCH :-    (TYPE '=' TO REPEAT)

EXAMPLES OF INPUT :-      TITLE ENQUIRIES
PERSONNEL MANAGEMENT   (SEARCH EXPANDS TO KEYWORD SEARCH IF NO MATCHES)
MANAGEMENT PERSONNEL   (SEARCH COMMENCES WITH KEYWORD SEARCH)
PERS] MANAG]           (TRUNCATED KEYWORD SEARCH)
WORLD .. CHURCHES      (PROXIMITY SEARCH UP TO 2 WORDS APART)
WORLD ... CHURCH]      (TRUNCATED PROXIMITY SEARCH UP TO 3 WORDS APART)
COUNCIL] CHURCH]       (IF <P>ROXIMITY SELECTED LATER, ABSENCE OF '..'
                       INDICATES AN ADJACENCY OR PHRASE SEARCH)
ABAAAAA [EG.]          (ENTERS WORDLIST AT ABACUS [EG.] )
ZZZZZZZ [EG.]          (ENTERS WORDLIST AT 001 [EG.] )
```

3. THE BOLD PRINT IN THE FIGURE ABOVE ARE EXAMPLES OF THE MANY WAYS IN WHICH TITLES CAN BE ENTERED. TRY A FEW OF THE EXAMPLES ILLUSTRATED TO BECOME FAMILIAR WITH THE TECHNIQUES THAT CAN BE USED IN TITLE SEARCHES.

4 AFTER YOU ENTER THE TITLE YOU ARE SEARCHING PRESS ENTER.
A LIST OF TITLES WILL APPEAR, CHOOSE THE NUMBER/S YOU WANT FROM THE FIRST COLUMN OF NUMBERS ON THE FAR-LEFT.

```
MLS 3.2      M L SULTAN TECHNIKON                              URICA
TITLES RETRIEVED ON PERSONNEL MANAGEMENT
#   WORKS
1   8    PERSONNEL MANAGEMENT
2   1    PERSONNEL MANAGEMENT : MODERN CONCEPTS AND TECHIQUES
3   1    PERSONNEL MANAGEMENT : PRINCIPLES AND PRACTICE
4   1    PERSONNEL MANAGEMENT : THE BUSINESS OWNER'S HANDBOOK FOR SMALL AND
         MEDIUM-SIZED COMPANIES

OPTIONS : SELECT   KEYWORD-SEARCH   WORD-LIST   HELP   QUIT
USE ARROW KEYS <- & -> TO CHOOSE AN OPTION AND PRESS <ENTER>
```

5. Select 1 or 2 or 3 or 4 for the title you require.

To select, Type the number appearing in the far-left column and press enter.

Or

Type S
and enter the range of numbers you wish to choose
E.g 1-3 or 1 2 3

If you want to choose all the titles, type an * (press the shift key and the number 8).

Type D to display

6. When the screen reads <R>emove duplicates, press enter.

7. At the following screen just press ENTER and continue.

```
SPECIFY SELECTION AS FOLLOWS WITH BOOLEAN OPERATORS :-

MATERIAL TYPE        IF GMD "[AUDIO]" (EG. AUDIOVISUAL)
                     OR IF GMD "[ILL]" (EG ILLUSTRATIONS)
CALL NUMBER          IF CALL "940]"
                     OR IF CALL "[VI]" (EG. VIDEOS)
TITLE                IF ANYTITLE "[EDUC]" OR "[TRAIN]"
LANGUAGE OF WORK     IF LANG "LAT" AND IF LANG "GRC"
DATE                 IF DATE AFTER "1973" AND BEFORE
                     "1978"
AUTHOR               IF SURNAME "CHURCHILL" AND INITIAL "W]"
CORPORATE AUTHOR     IF CORP "[INSTITUTE]"
PUBLISHER            IF PUBLISHER "COLLINS"
NOTE                 IF NOTE "[THES]" OR IF NOTE "[PROEF]"
                     (EG. THESES {ENG} OF PROEFSKRIFTE {AFR}
                     OR IF NOTE "[IN]" (EG. PERIODICAL ABSTRACTS)
SUBJECT              IF SUBJECT "[ENERGY]"
ENTER SELECTION AS <IF...>, <A>TTRIBUTES, <L>OCATION OR <ENTER>
```

8. When the following screen appears:

```
SELECT FORMAT FROM 1 TO 8 , < H >ELP, < Q >UIT ?
```

Choose a number from 1-6 to display the record.

Type number 6 and press enter to display the full record.
Or
If you do not want so much of information you can select number 2 for a shorter display or number 5 for a medium record.

9. EXAMPLE OF A RECORD DISPLAYED:

AUTHOR———MARTIN, JAMES
TITLE ———APPLICATION DEVELOPMENT WITHOUT PROGRAMMERS.
PUBLISHER – ENGLEWOOD CLIFFS, N.J. : PRENTICE-HALL, 1982.
ISBN 0-8202-3901-X.
R222.47
250P. : ILL.
INCLUDES BIBLIOGRAPHIC REFERENCES

LOCATION ON — 001.6424——— (CLASSIFICATION NUMBER)
SHELF BRN 30924 ——— (COMPUTER RECORD NUMBER)
HID 10350, COPIES 2—— (NUMBER OF COPIES IN THE LIBRARY)
COPY 95/2095 MAIN * ON LOAN (GENERAL BOOK)
COPY 95/3618 SHORT LOANS — (RESERVE BOOK)

EXPLORATION	ACCESS POINTS
A1 WORKS 11	MARTIN, JAMES
T1 WORKS 1	APPLICATION DEVELOPMENT..
D1 WORKS 39	ELECTRONIC DIGITAL COMPUTERS
D2 WORKS 265	ELECTRONIC DATA PROCESSING ———(SUBJECT)
P1 WORKS 974	ENG CLIFFS, PRENT-HALL
N1 WORKS 339	001.64

10. EXPLORATION POINTS ABOVE ARE USEFUL IN THAT IT CAN HELP YOU EXPAND YOUR SEARCH.

11. MAKE A NOTE OF THE CLASS NUMBER AND LOCATION, EG.
001.64 MAR (MAIN AND SHORT LOANS/RESERVE).

12. PRESS ENTER TO VIEW OTHER RECORDS ON YOUR LIST
PRESS Q TO QUIT AND TO BEGIN A NEW SEARCH FOR ANOTHER AUTHOR

13. TO QUIT FROM A TITLE SEARCH AND TO GO TO ANOTHER TYPE OF SEARCH.
EXAMPLE, AUTHOR OR SUBJECT:
PRESS Q TO QUIT
PRESS ENTER TO GO TO THE MAIN MENU

HOW TO FIND INFORMATION ON A SUBJECT

1. TYPE THE NUMBER FOR SUBJECTS (3) AND PRESS ENTER.

2. TYPE IN THE SUBJECT THAT YOU WANT:
   EG. NATURE CONSERVATION
   PRESS ENTER. (SEE FIGURE BELOW)

```
ENTER SUBJECT, EG <NATURE CONSERVATION> OR <CONSERV]>

NATURE CONSERVATION
(PLEASE PRESS THE <ENTER> KEY IF YOU HAVE FINISHED OR ENTER <H> FOR HELP.)
```

3. A LIST OF SUBJECTS WILL APPEAR.
   CHOOSE THE NUMBER OF THE SUBJECT YOU WANT TO REVIEW FROM THE FAR-LEFT COLUMN.

```
SUBJECTS RETRIEVED ON NATURE CONSERVATION
#   WORKS
1   3    NATURE CONSERVATION
2   1    NATURE CONSERVATION - LAW AND LEGISLATION

OPTIONS : SELECT  KEYWORD-SEARCH  WORD-LIST  HELP  QUIT
USE ARROW KEYS <- & -> TO CHOOSE AN OPTION AND PRESS <ENTER>
```

4 IF YOU WANT TO SELECT ALL THE SUBJECTS TYPE AN ASTERISK (*) (PRESS THE SHIFT AND THE NUMBER 8 KEY TOGETHER).
OR
IF YOU WANT TO MAKE SPECIFIC SELECTIONS TYPE S TO SELECT TYPE IN THE LINE NUMBERS EG. 1-2 OR 1 3 7

TYPE D TO DISPLAY THE RECORDS AND PRESS ENTER

5. WHEN THE SCREEN READS <R>EMOVE DUPLICATES, PRESS ENTER.

6. AT THE FOLLOWING SCREEN PRESS THE ENTER BUTTON AND CONTINUE.

```
SPECIFY SELECTION AS FOLLOWS WITH BOOLEAN OPERATORS:-
MATERIAL TYPE          IF GMD "[AUDIO]" (EG. AUDIOVISUAL PROGRAMMES) OR IF GMD "[ILL]" (EG. ILLUSTRATIONS)
CALL NUMBER            IF CALL "940]"   OR IF CALL "[VI ]" (EG. VIDEOS)
TITLE                  IF ANYTITLE "[EDUC]" OR "[TRAIN]"
LANGUAGE OF WORK       IF LANG "LAT" AND IF LANG "GRC"
DATE                   IF DATE AFTER "1973" AND BEFORE "1978"
AUTHOR                 IF SURNAME "CHURCHILL" AND INITIAL "W]"
CORPORATE AUTHOR       IF CORP "[INSTITUTE]"
PUBLISHER              IF PUBLISHER "COLLINS"
NOTE                   IF NOTE "[THES]" OR IF NOTE "[PROEF]"
SUBJECT                IF SUBJECT "[ENERGY]" AND IF SUBJECT "[CONSERVATION]"
NOTE : BRACKETS ARE USED TO INDICATE THAT THE CHARACTER STRING SPECIFIED,
MAY BE BORDERED (SURROUNDED) BY OTHER TEXT ON EITHER SIDE.
ENTER SELECTION AS <IF ...>, <A>TTRIBUTES, <L>OCATION OR <ENTER>
```

7 WHEN THE SCREEN READS:

SELECT FORMAT FROM 1 TO 8 . < H >ELP. < Q >UIT ?

TO DO THIS, CHOOSE A NUMBER FROM 1-6 TO DISPLAY THE RECORD.

TYPE NUMBER 6 AND PRESS ENTER TO DISPLAY THE FULL RECORD.
OR
IF YOU DO NOT WANT SO MUCH OF INFORMATION YOU CAN SELECT NUMBER 2 FOR A SHORTER DISPLAY OR NUMBER 5 FOR A MEDIUM RECORD.

8. EXAMPLE OF A RECORD DISPLAYED:

AUTHOR-------MARTIN, JAMES
TITLE ----------APPLICATION DEVELOPMENT WITHOUT PROGRAMMERS.
PUBLISHER -- ENGLEWOOD CLIFFS, N.J. : PRENTICE-HALL, 1982.
ISBN 0-8202-3901-X.
R222.47
250P. : ILL.
INCLUDES BIBLIOGRAPHIC REFERENCES

LOCATION ON — 001.6424——— (CLASSIFICATION NUMBER)
SHELF BRN 30924 —·—— (COMPUTER RECORD NUMBER)
HID 10350, COPIES 2—— (NUMBER OF COPIES IN THE LIBRARY)
COPY 95/2095 MAIN * ON LOAN (GENERAL BOOK)
COPY 95/3618 SHORT LOANS — (RESERVE BOOK)

EXPLORATION	ACCESS POINTS	
A1 WORKS 11	MARTIN, JAMES	
T1 WORKS 1	APPLICATION DEVELOPMENT..	
D1 WORKS 39	ELECTRONIC DIGITAL COMPUTERS ———\	SUBJECTS
D2 WORKS 265	ELECTRONIC DATA PROCESSING ---·—/	
P1 WORKS 974	ENG CLIFFS, PRENT-HALL	
N1 WORKS 339	001.64	

9. EXPLORATION POINTS ABOVE ARE USEFUL IN THAT IT CAN HELP YOU EXPAND YOUR SEARCH.

10. MAKE A NOTE OF THE CLASS NUMBER AND LOCATION, EG.
001.64 MAR (MAIN AND SHORT LOANS/RESERVE).

11. PRESS ENTER TO VIEW OTHER RECORDS ON YOUR LIST
PRESS Q TO QUIT AND TO BEGIN A NEW SEARCH FOR ANOTHER AUTHOR

12. TO QUIT FROM AN AUTHOR SEARCH AND TO GO TO ANOTHER TYPE OF SEARCH, EXAMPLE, TITLE OR AUTHOR:
PRESS Q TO QUIT
PRESS ENTER TO GO TO THE MAIN MENU

WHERE TO FIND THE LOCATION OF BOOKS AND MAGAZINES

IF THE BOOK IS IN MAIN IT IS A GENERAL BOOK AND WILL BE EITHER ON THE 1ST OR 2ND FLOOR
000-699 - FIRST FLOOR
700-999 - SECOND FLOOR

IF THE BOOK IS IN SHORT LOANS IT IS A RESERVE BOOK AND CAN BE FOUND ON THE 4TH FLOOR - . NO MATTER WHAT THE CLASS NUMBER.

IF THE BOOK IS IN REF OR REFERENCE IT IS ON THE GROUND FLOOR AND IS NOT FOR LOAN

IF THE RECORD INDICATES "ON LOAN" THE ITEM HAS BEEN BORROWED. YOU CAN RESERVE IT FOR YOURSELF.

THE WORD COPY REFERS TO THE NUMBER OF COPIES IN STOCK. IT DOES NOT NECESSARILY MEAN THAT THEY WILL BE ON THE SHELF AT THE TIME.

THE CLASSIFICATION NUMBER IS ALSO THE LOCATION OF THE BOOK. ALL BOOKS ARE MARKED WITH THE CLASSIFICATION NUMBER THAT YOU FIND IN THE COMPUTER RECORD. LOOK FOR THIS NUMBER ON THE SPINE OF THE BOOK. SHELVES ARE MARKED TO INDICATE THE CLASSIFICATION NUMBERS THAT CAN BE FOUND ON THAT SHELF.

DIRECTORY OF LOCATIONS

REFERENCE BOOKS	= GROUND FLOOR
DEWEY 000-699	= FIRST FLOOR
DEWEY 700-999	= SECOND FLOOR
SHORT LOANS OR RESERVE BOOKS (ALL CLASSIFICATION NUMBERS)	= THIRD FLOOR
PERIODICALS OR JOURNALS	= FOURTH FLOOR

NEED FURTHER HELP??

IF YOU REQUIRE FURTHER ASSISTANCE PLEASE DO NOT HESITATE TO CONTACT THE LIBRARY STAFF NAMED BELOW:

MRS V JAYARAM	: SUBJECT LIBRARIAN (COMMERCE/ARTS)
MS T MABASO	: SUBJECT LIBRARIAN (COMMERCE/ARTS)
MRS S NAIDOO	: SUBJECT LIBRARIAN (SCIENCE/ENGINEERING)
MR S NCGOBO	: GENERAL INFORMATION DESK
MR V MKHIZE	: GENERAL INFORMATION DESK
MRS S NARISMULU	: GENERAL INFORMATION DESK/INTERLIBRARY LOANS
MS N NAICKER	: GENERAL INFORMATION DESK
MRS S NEERPUTH	: SERIALS LIBRARIAN (4TH FLOOR)

Appendix G

TRAINING NOTES PROVIDED IN CONCEPT-BASED INSTRUCTION

Training notes for Participants in the "Conceptual Group" in online searching

A. HOW LIBRARIES ORGANIZE INFORMATION

One of the main functions of libraries, the world over, is to **collect** information in the form of books, journals, and other formats, and to **describe and arrange** this information in some logical order so that persons seeking that information are able to find it. These details are usually recorded in **catalogues** of the library. In the past, the details stored in library catalogues were typed or hand written on cards called **catalogue cards** and stored in units called a **card catalogue**. Separate cards were made out for the name of each author, the title of the item, and for each **subject term** or **topic** that was used to describe the item. In this way, an **item could be** found if information was known about the **author, the title, or the subjects or topics** that the book covered. Therefore an **item could be found in three different** ways.

[Sample catalogue cards will be demonstrated to students]

In addition to **describing** the information that a book/journal deals with, libraries **arrange** information on the shelves, in a way that will make it easy to find material on a particular subject. In this system each item is given an "address' where it will be located on the shelf. In library terminology this "address' is the **call number** or the **classification number.** This "address" points to the **location of the item on the shelf** and is usually written on the **spine** or the side of the book.

[A book will be displayed to explain author/title/subject and point to the spine]

Almost all libraries followed the same system of **describing** their collections and **arranging** information on the shelves so that a person could in most cases, be able to use any library no matter where it was geographically located.

Computer Catalogue

Although some libraries still use card catalogues, many libraries have now changed from a manual system to using a computerised catalogue to store information. By using the **computer catalogue,** it allows for an **item to be found in more than the three ways**, described above, ie. author, title and subject. The computer catalogue can handle more information at a time, allowing for **an item to be found in approx. 10 or more different ways**, depending on the individual system. The item can now be located by : Author, title, subject, publisher, series name, ISBN/ISSN number, accession number, Dewey/LC number, computer generated number, or keywords, an so on. However, although libraries still try to keep to the same system of describing their collections and arranging this information on the shelves, they are all using many different types of computer systems to do this. So you will be encountering different systems when searching for information, depending on the library you are using. Fortunately in the region of Kwa-Zulu -Natal, many

Academic libraries and Public libraries are using the same computer system called URICA.

The computer systems that a library can use however, does not only have to be related to the stock of books/journals, etc that the library *owns*. There are many varieties of computer systems which are used for different purposes. For example some systems are used to access products in the CD-ROM format, and in some cases a particular computer system can be used to search for material found in other libraries, or institutions.

In this session we will concentrate on the library system, **URICA**, but some general concepts will be introduced which you can apply generally when searching for information using a computer.

What Equipment will you need to be able to Search?

When you conduct a search on the computer you interact or communicate with the system via the:
- computer terminal/screen/monitor, and the
- computer keyboard

COMPUTER TERMINAL
[Co-ordinator will physically point to th^

Specific keys that are of importance:

- **ENTER/RETURN KEY**

The **ENTER/RETURN** key when pressed will transmit your search
The **ENTER/RETURN** key is also used to go backwards to your last screen in the URICA system

- **Q**

The key marked **Q** is used in the URICA system to **END** what you are doing. **Q** stands for **QUIT** which also means **END** or **FINISHED**. When you press Q and than press the ENTER button you end your search and return to the main screen or the MENU screen, or to your search request..

- **SHIFT KEY**

When you hold the **shift key down** and at the same time type in any alphabet, it will appear as a **CAPITAL** letter.

- **BACKSPACE OR DELETE KEY**

Some keyboards allow for the BACKSPACE key to be used and others allow for the DELETE key to be used to **erase** incorrect information typed. If you press either one of these keys the information you typed will be erased.

- **SCROLLING**

When you read through information displayed on the computer screen you sometimes need to go backwards and forwards between pages, or to read the top of the page and move down to the bottom of the page. This is called **scrolling.** In a setup which does not use a MOUSE you will be able to search **up and down** the page or move **backwards and forwards** between pages by usually pressing the **arrow keys**, or the letter **P** for paging back and forward, or the letters **B** and **F** to go Backwards and Forwards.

- **CURSOR**

When you read a page your finger is usually used as a marker to point where you are reading. In the case of the computer a **FLASHING BAR** or **ARROW** most often indicates the point at which you can enter information. Using your **up and down arrow keys** or just by typing on the keyboard you cursor moves in a particular direction. In some computers, a device called a MOUSE is attached to the computer. The MOUSE is used to move your cursor around on the computer screen.

- **MOUSE**

If you are using a **MOUSE**, the first button is equivalent to the **ENTER** key on the keyboard. When you press this once or click this button once, it will transmit your information in the same way as when you pressed the ENTER key. The mouse allows you to move an arrow marker around the screen to the point where you need to be. This is done by **dragging the MOUSE on your table** which causes the cursor on your screen to move around.

In the current version of URICA being demonstrated (version 7.3) you will not need to use a MOUSE

The mental model used to teach the lesson

Unlike studies reported, an initial pilot study in the case of the present research revealed that the use of the card catalogue as a mental model will not be appropriate :

a. Many of the students in the current period have only been exposed to a computerised catalogue and have no history of using card catalogues

b. Many of the subjects in the pilot have never had the experience of using libraries that had the resource of a card catalogue, or have never visited a library to find information.

In this study the concepts of online searching are taught using the following scenarios.

1. The concepts of DATABASE, ACCESSING THE DATABASE, i.e. Menus, Command-Language, Worksheets, ACCESS POINTS, TERMS, WORD LISTS and organization of the computer are explained by using the model of a neighbourhood with its many households. It demonstrates that there are different ways of physically accessing each house. That each household is differentiated from the next by their family name or some other means, and that within each household persons are differentiated by their role, e.g there is the mother, father, or by their sex, or age, etc.. The model describes how one would go about seeking information in respect to persons living in a particular household. It is shown that through a process of refining and redefining information, and following up from directions provided, one finally derives the information required.

This example is used to show that in libraries today, there are many different computer systems in use. To access these systems there are physically different procedures that one has to follow. As with a household, the computer system is made up of different elements, namely the author, title, subject, etc. One can access the information through a process of interacting with the system, refining and redefining information until one finally derives the information required.

[A row of houses will be displayed on an OHP and will be used to illustrate the concepts as the lecture proceeds]

CONCEPTS

The following examples relating to a neighbourhood with the many households living there will be used to illustrate how a library computer database in URICA functions.

What is a database?
A collection of related information that is available in machine readable form and has to be accessed through interaction with a computer is called a DATABASE (Mensching : 1988)

In a library computer system, all the information stored on that computer system is collectively referred to as the library **DATABASE.** This is better understood if you think of a family or group of persons belonging to one house which is collectively referred to as the **HOUSEHOLD**
In our library the details of all the books/magazines, etc. that we own have been captured on the computer. We now have a **DATABASE** *of our collection.* To find anything in our collection you will be required to search through this database by using the computer equipment provided. i.e. the computer screen and keyboard.

Think of your neighbourhood with its many different households. For example you may have the Khumalo's living at one address, and the Naidoo's at another address and the Mkhize's at another. In the same manner **you get many different types databases.** For example a big company like Telkom (South African Telephone Company) might have all their **staff names** stored on a database. Or they may have all the **telephone numbers** of South Africa stored in the database. This will be a database of telephone numbers. A database can be textual or numeric, or both. In libraries common types of databases found include a database of the library collection, or databases that allow you to search for information that is found in a location outside the library.

OPAC
When you are searching the library database it is said that you are ONLINE because these computers are connected through telecommunication lines. When you search on a library computer system to see what books/magazines that library owns, you are doing an ONLINE SEARCH. The databases in all the libraries are available for any person to search therefore they are public systems. So we have developed the term **O**nline **P**ublic **A**ccess or **OPAC** for short. When you look for information in the library collection using the computer system, you are searching the OPAC.

[Diagram showing remote access from host and the online connection]

What Information will you find on the OPAC?

The library OPAC will lead you to the information about the collection of materials that the library owns. Referring to our example of different households. To identify the different persons living in the house, we can use descriptive terms such as "the old man," or the "young girl" or "your brother", etc.

In a similar manner, a library has many different sources of information and there are different ways of identifying them. For example, you can find information by identifying the Author/s, Titles, Subjects, Classification Numbers, Series, Publishers, etc. These are also called **ACCESS POINTS.** In the example used, when you visit a household, you explain your purpose, i.e. "I would like to see your mother." In the same way when searching the library OPAC you will be required to explain your purpose, i.e. "I wish to find an author."

How do I look for information on an OPAC?
When you visit the homes of your friends each one will have a different type of house. To enter you will either

- ring a doorbell
- press a buzzer on an intercom
- knock on the door

Similarly, to begin searching a library OPAC, remember that different library computer systems have different types of doorbells:

- menu-driven, as in URICA
- command language
- worksheets to fill in as found on WEB Browsers

Menu - Driven Systems
Some systems have a menu displayed with a list of selections such as, Author, Title, Subject, Publisher, etc. For example, the URICA library system has 11 different selections from which you could choose. Each selection is numbered, so you have a list from 1 to 11. To search on this system you are required to choose the number from the list which will lead you to further information. For example if you want information on an author, you will select number 1, or if you want information on a title, you will choose number 2 and so forth.

[A example of the URICA menu will be demonstrated on an OHP]

Command Language
Some computer systems use specific commands for searching. For example in the DIALOG system. These commands are used to instruct the computer to carry out certain functions. Some of the commands used are :

AU=, TI =, SU=, SELECT, SHUTDOWN, DISPLAY

To search for information on the DIALOG databases, you will need to be familiar with the commands to be used

[An example of command language will be demonstrated on an OHP]

Worksheets or Forms
In newer systems that have been developed, particularly those that are available through searching the INTERNET, the search screen looks like a form. To enter your search terms you will be required to fill in the blocks on the form. Instead of pressing the ENTER button on your keyboard to transmit the search, you are required to use a MOUSE to locate the block where your search term must be entered. Your access points are displayed when activated by your MOUSE, as well as your commands to process the search.

[An example of a worksheet format will be demonstrated on OHP]

TERMS
At the entrance to the house, the person who answers the door, will ask you who it is you need to see.

When you press the **AUTHOR** doorbell on the menu, the computer prompts or "asks" you type in a name of the person you wish to see. Or if you press the **TITLE** bell, the computer will "ask" you to type in the name of the title you wish to see., etc. The information you type in is also called a **TERM**. So if you indicate that you are searching for the title, **TITANIC**, you type in the **TERM,** TITANIC. The word **TERM** is commonly used to refer to the words or information you entered on the computer or to information housed in the database, e.g subject terms, or terms for titles, etc.

Getting back to your visit, when you name the person you wish to see, e.g. Vincent, the person who answered the door will go into the house and look for Vincent. Now they will not go into all the rooms, but they will go directly to the place where Vincent is likely to be at the time.

When you instruct the computer to find, for example, an AUTHOR, or a TITLE or SUBJECT, it does not go and look everywhere, but only in those rooms that it knows the AUTHOR's name is stored or where the TITLE is stored.

In your visit to the house, when you mention who you are looking for, i.e. "Millicent" the person will not find Mary for you but will look ***specifically*** for **"Millicent."**
Similarly, the computer will try and find an exact match for the term you entered. So if you type in a word, e.g. **"read"** but you meant to type in **"ready,"** the computer will only search for the term **"read."**

Getting back to your visit if for example you requested to see "Millicent" but in fact no such person could be found living there. The person helping you may tell you that "we do not know any person called Millicent, but there is a person called Mildred living here."

In a like manner, if the computer was not able to find an exact match with the AUTHOR's name you requested, or the SUBJECT term, it will present alternatives to you, to further assist your search. In doing so, it will display a list of other words that are found in the vicinity of where your term would have been located.

Demonstrate this by:
[Using the example of the word ELECTRIFY to demonstrate a WORD LIST
Using the example Fashionable to demonstrate a WORD LIST]. These words have been chosen because they relate to courses at the institution.

Talk about Controlled Vocabulary and Keywords and Synonyms. Use example of person having two names, one being the nickname and one their formal name. Use the word dad and father to illustrate how information can be conveyed in different ways. Show example on the system using the terms, "dad" and "father."

2. Interpreting Search Results

A second model is used to explain how to SELECT/DISPLAY/BROWSE:
Here the student is asked to consider the scenario where they have to visit a family member or relative who just had a baby and they pay her a visit in the hospital.

"In your haste you did not find out the number of the ward so you make enquiries at the reception counter. You give the attendant the name of the person who had the baby. If you tell them that the name of the person is Millicent Khumalo and her address is 12 Noble Road, they will be able to find the exact person for you. But if you just say you are looking for an M Khumalo, this is a popular name, so they might have a list of at least 5 people with those initials. They will show you the list of people and you identify the person from the list. You might point out, that it is the third person on the list and they will tell you the number of the ward."

In the same way, when you tell the computer what you want to find, it will **firstly** try and find you an **exact match,** if there are many items with the terms you entered, it will show you the whole list, like the receptionist in the hospital. This is the **result** of your search enquiry. Other words that also mean result are :

- **HITS**
- **WORKS (This is used in the URICA system)**
- **RESULTS**

From the result, you will have to instruct the computer to **SELECT** the particular items you want to see, even if there is only one line of information. . Each item that is displayed in your result is called a **RECORD.** For example if your results displayed 5 items, each one is a record. Hence the database is made up of a record for every item that it has stored. In the URICA system each record that you found will be numbered so that you will be able to indicate to the computer the **line number** on which your information can be found. In other systems the computer will indicate your result and display your records in batches of 10, 15, 25, etc., per screen or per page.

After you instruct the computer to SELECT items from the result, you can then look at the full record of what you chose to be able to identify its location in the library. In order to look at the full record the URICA system requires you to type the instruction **"D"** to **DISPLAY the item**. The use of SELECT and DISPLAY differ from system to system, however, in the URICA system SELECT and DISPLAY are used when searching. Some systems use the word **TAG**, some systems use the word **BOOKMARK** to mean **SELECT**.

In the same way when you tell the receptionist at the hospital that you wanted to visit the person whose name is written on line 3, you will be informed as to which ward to go, and will be given the bed number, where you can see the actual person (like you display the full record)

BROWSE

In another scenario you might arrive at the hospital but be too shy to ask the receptionist to give you the information you wanted. Instead you choose to go directly to the Maternity Ward and browse through the wards to find your relative.

In the same way, the computer allows you to browse for information. If you DISPLAYED a record, you could browse through the AUTHORS, TITLES, PUBLISHERS, SUBJECT to find other books of a similar nature. In URICA this is done by entering A1, T1, P1, D1, etc.

[The example of the author THOMAS HARDY is used to demonstrate the above up to the point of browsing.]

Levels of the Bibliographic Record

- Each item in a OPAC catalogue is called a record, namely a bibliographic record.
- All of the ACCESS POINTS that you used to search, are found on this record, eg. Author, Title, etc. .
- Every item or record that you select can be viewed in many levels, from 1 to 8. For example
  level 1 is a basic display which only shows the author's name and the title.
  level 2 displays a little more information showing the author's name, the title and the publisher.
  The level usually preferred by the library user (students/staff) in URICA is level 6 which shows the author, title, publisher, series, gives information about the physical description of the item, the copy numbers, location and whether the item is out on loan.

SEARCHING TECHNIQUES(INDEXING, KEYWORDS, DESCRIPTORS, CONTROLLED VOCABULARY, BOOLEAN LOGIC)

The following techniques are useful ways to help you to **broaden** or **narrow** your search or in some cases to get a close a match as possible.

CONTROLLED VOCABULARY

Sometimes when information is entered, it is entered in a special way following certain rules. For example the Library of Congress Subject Headings is a book containing the format in which the SUBJECT TERMS should be entered. You are required to search using that particular terminology. For example, you know of the term movies. In the Library of Congress Subject Headings it is known as motion pictures. This is what we call a CONTROLLED VOCABULARY. There are other examples of controlled headings, eg. MESH (Medical Subject Headings). It is advantageous to use controlled headings because everyone has different ways of describing things and in this way there is a uniform approach to searching.

KEYWORDS

In some databases you can search using keywords. For example, you might be searching for information on a specific topic and want to see whatever information might be represented in the database on that topic. In that case it will be useful to use a KEYWORD e.g. CHILD which will bring up all the titles dealing with that topic. You can also enter a phrase, e.g. CHILD ABUSE which will bring up all articles related to child abuse, abuse of children, etc.

TRUNCATION

In some instances you require information on a topic dealing with EDUCATION, but you require articles about all aspects, i.e. EDUCATIONAL, EDUCATING, EDUCATION. In this case you will enter the first part of the term that is common to all the words. In this case EDUC. Next to this you must add a Square bracket because the square bracket is the signal to the computer that you want all titles that have those five letters at the beginning.

[Using the term "sport" as this is a familiar term to students, explain that one might be looking for words such as "sporting," "sportsman," "sports-day," etc. For example you might want to survey all people in the neighbourhood with the surnames beginning with KHUM. Hence you will end up surveying the Khumalos, and the Khumars, and the Khomotoso's and so forth

[Using the URICA system follow through the example of a truncated search for the term EDUC]

PROXIMITY SEARCHING

[Using the newspaper, Weekly Mail, and magazine Fair Lady illustrate the concept of proximity]
You might only want to survey everyone who has the name Millicent Khumalo and not Henry Khumalo or Dr Khumalo. In this case you specifically ask for Millicent Khumalo in that order

On some occasions you will require to find titles where the terms you use must occur next to each other in the title, e.g. **WEEKLY MAIL**. In this case you want the computer to find a record where the words **WEEKLY** and **MAIL** are found next to each other or **ADJACENT** to each other. This can be achieved by doing a **PROXIMITY SEARCH** which will indicate to the computer that you require both terms to be next to each other in the record. You might only want to survey everyone who has the name Millicent Khumalo and not Henry Khumalo or Dr Khumalo. In this case you specifically ask for Millicent Khumalo in that order

[Follow through an example on the URICA system using the terms "education" and "policy" as a keyword search which retrieves 11 items, and PROXIMITY search which retrieves 2 items]

Where do I Begin when I need to Search?
Unlike manual systems, the computer allows for a search to be conducted in many different ways. In some instances, the database you use might cost money for every minute you are working on the system, so it will be good policy to plan your search before you begin to work on the computer. It is also wise to plan a search strategy so that your search does not take you a long time.

SEARCH STRATEGY

When searching the database always have a search strategy from which to start.

- Name the concepts that describe your topic, e.g. Education failure rate in SA deals with Education in South Africa
- If you have many databases to choose from, decide which database will be best suited to the type of query you have
- Decide which keywords and subject headings best describe your topic. Eg. in the above example EDUCATION in SOUTH AFRICA - PERFORMANCE. Decide which words can be truncated. Select the most important terms to use
- Be prepared to modify your search strategy. This may mean re-examining your topic, using a different database, or changing your search terms used, finding synonyms to describe your topic.

Steps in Searching URICA
Logging on to the System

1. Type the word **lib** when you see the prompt **LOGIN:**

2. At the menu choose the type of search you require , e.g. **author, title, subject, etc.** and proceed with the search. Remember to follow the instructions provided at the bottom of the screen and refine your search as required.

3. **Press the ENTER** key each time you have entered your information.

You are now ready to begin the second part of the search tasks on the worksheet provided.

Appendix H

SUMMARY OF EXAMPLES USED IN THE CONCEPT-BASED TEACHING ANALOGY

ANALOGIES USED IN THE CONCEPT-BASED LECTURE

Search concept	Association with household analogy	Association with online search
Method of access	Visitor Rings a doorbell, or knocks on a door, or uses intercom	Access a menu, enters a command, or types in a work form, for example on the Internet
Search indexes	Persons in a house: mother, father, brother, sister, and so forth	Resident in databases are authors, titles, subjects, and so forth
Controlled vocabulary	Names of people Everyone has their own name, or the same person can be known by a nickname	Terms controlled vocabulary synonyms
Exact match	When a visitor requests to see Mary, John does not appear If Mary is in the kitchen she will not be looked for in the bathroom	When a specific term is entered only that information pertaining to that term appears When a search for author is indicated only that file is searched, not the title or any other title
Keywords	If Mary is not at home you might be told to search in other places, e.g in the sportsfield or the supermarket	If the computer does not find an exact match for your search statement it will supply you with a list of the terms that seem close to the search term you entered
Narrow search	Look for surnames that begin with a common stem	Look for titles with a common stem by identifying what the stem is and using the truncation appropriate
Broaden search	Look for a specific person by their given names	Look for a specific title or phrase by stating the title in that order and instructing the computer to do a proximity search

Appendix I

SAMPLE OF THE URICA OPAC SEARCH SCREENS

M. L. Sultan Technikon

OPAC

URICA Integrated Systems (Pty) Ltd.

Online Public Access Catalogue

1 .. Enquiry [First-time User]
2 .. Enquiry [Regular User]
3 .. Enquiry [Expert User]
4 .. Bulletin Boards
5 .. Other Network Resources
6 .. OPAC Help Tools
7 .. Departmental Requisitions
8 .. End the enquiry

OPTIONS : 1 2 3 4 H T (H=HELP, T=TERMINAL-TYPE)

Enter number or letter of your choice, and press the ENTER key :

MLS 3 M L SULTAN TECHNIKON URICA

OPTION 3 : .. Enquiry [Expert User]

1...Personal Author
2...Title
3...Subject
4...Corporate Author
5...Series Name
6...Publisher
7...Class or Dewey Number
8...ISBN or ISSN
9...Barcode/Accession Number
10...BRN or SAVE-LIST of BRNs
11...Keyword Boolean Search

Select <Option>, <H> for help or press <ENTER> 1

AUTHOR SEARCH

MLS 3.1 M L SULTAN TECHNIKON URICA
OPTION 3 : .. Enquiry [Expert User] Passive Mode
Spell-check OFF
Enter Author, eg <SMITH, L J> or <L J SMITH> or <SMITH>

BRODINE, VIRGINIA

(Please press the <ENTER> key if you have finished or enter <?> for help.)

MLS 3.1 M L SULTAN TECHNIKON URICA
Authors close to BRODINE, VIRGINIA
\# Works
1 2 Brodine, Virginia

Select authors eg. <3 5 9> or a range eg. <3-9>, <*> for All
<Q>uit <K>eysearch <W>ords <H>elp <I>nfo <N>on-catalog

M L Sultan Technikon - On-line Public Access Catalogue (OPAC) Passive Mode
Authors close to BRODINE, VIRGINIA [works 2]
Work 1 of 2 BRN 21261 Page 1
AUTHOR Brodine, Virginia
TITLE Air pollution / Virginia Brodine
PUBLISHER New York : Harcourt Brace Jovanovich, 1973. - SAPSE 08
ISBN ISBN 0-15-502112-5 : R10.25
DESCRIPTION 205p. : ill
SERIES Environmental issues series
NOTE Includes bibliographic references
LOCATION 628.53 BRO
HOLDING copies 1
COPY 791531 MAIN
Exploration Access Points
A1 works 2 Brodine, Virginia
T1 works 4 Air pollution
S1 works 3 Environmental issues series
D1 works 65 AIR - POLLUTION

SUBJECT SEARCH

3.3 M L SULTAN TECHNIKON URICA
OPTION 3 : .. Enquiry [Expert User] Passive Mode

Enter Subject, eg <NATURE CONSERVATION> or <CONSERV]>

aged

(Please press the <ENTER> key if you have finished or enter <?> for help.)

```
MLS 3.3    M L SULTAN TECHNIKON                    URICA
Subjects retrieved on AGED
#  Works
1  5    AGED
2  10   AGED - CARE
3  1    AGED - CARE AND HYGIENE
4  1    AGED - COUNSELING OF
5  1    AGED - CROSS-CULTURAL STUDIES
6  8    AGED - DISEASES
7  2    AGED - DWELLINGS
8  1    AGED - FAMILY RELATIONSHIPS
9  11   AGED - HEALTH AND HYGIENE
10  1   AGED - INSTITUTIONAL CARE
11  1   AGED - INSTITUTIONAL CARE - DURBAN
12  1   AGED - MENTAL HEALTH SERVICES
13  1   AGED - PHARMACEUTICAL ASSISTANCE
14  1   AGED - PSYCHOLOGICAL ASPECTS
15  1   AGED - PSYCHOLOGY
16  1   AGED - SOCIAL ASPECTS
17  1   AGED - UNITED STATES - INFORMATION SERVICES

Select subjects eg. <3 5 9> or a range eg. <3-9>, <*> for All
   <Q>uit <P>age <K>eysearch <W>ords <H>elp <I>nfo <N>on-catalog
```

M L Sultan Technikon - On-line Public Access Catalogue (OPAC) Passive Mode
Subjects retrieved on AGED [works 5]
Work 1 of 5 BRN 32660 Page 1

AUTHOR Atchley, Robert C
TITLE Social forces and aging : an introduction to social gerontology / Robert C. Atchley
EDITION 5th ed
PUBLISHER Belmont, Calif. : Wadsworth, 1988. - SAPSE 22
ISBN ISBN 0-534-08790-6 (H/C) : R181.03
DESCRIPTION 527p. : ill
NOTE Includes index
NOTE Bibliography : p. 379-519
LOCATION 305.26 ATC
HOLDING copies 1
COPY 9101629 MAIN

Exploration Access Points
A1 works 1 Atchley, Robert C
T1 works 1 Social forces and aging : an introduction to social gerontology
D1 works 5 AGED
D2 works 13 GERONTOLOGY
P1 works 171 Belmont, Calif. : Wadsworth
N1 works 8 305.26

Page Work Holdings Explore Format Browse Quit
Zap from INDEXB =1 Copy to INDEXC =0 Review indexes

Appendix J

SUMMARY REPORT OF RESPONSES TO THE BACKGROUND QUESTIONNAIRE

Summary report of responses to background questionnaire

Q1 **Student Enrollment**	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
First year enrollment	60	100.0%	60	100.0%	120	100.0%

Q2 **Academic Enrollment**	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
Library & Information Studies	12	20.0%	3	5.0%	15	12.5%
Analytical Chemistry	14	23.3%	20	33.3%	34	28.3%
Computer Studies	9	15.0%	0	0.0%	9	7.5%
Town & Regional Planning	11	18.3%	15	25.0%	26	21.7%
Electronic Engineering	14	23.3%	15	25.0%	29	24.2%
Law and Administration	0	0.0%	7	11.7%	7	5.8%

Q3 **Courses taken in computing**	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
	13	21.7%	11	18.3%	24	20.0%

Q4a **Prior computer experience**	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
	22	36.7%	25	41.7%	47	39.2%

Q4b **Computer experience**	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
Games	11	18.3%	15	25.0%	26	21.7%
Word Processing	10	16.7%	8	13.3%	18	15.0%
Job	0	0.0%	0	0.0%	0	0.0%
Programming	0	0.0%	1	1.7%	1	0.8%
Studies	0	0.0%	2	3.3%	2	1.7%
Library Databases	1	1.7%	1	1.7%	2	1.7%

Q5	Conceptual		Procedural		Total	
Time spent on computer	n=60	%	n=60	%	n=120	%
One hour daily	7	11.7%	11	18.3%	18	15.0%
One hour weekly	9	15.0%	13	21.7%	22	18.3%
One hour monthly	6	10.0%	1	1.7%	7	5.8%

Q6	Conceptual		Procedural		Total	
Confidence using computers	n=60	%	n=60	%	n=120	%
Confident	20	33.3%	27	45.0%	47	39.2%
Difficult but can manage	36	60.0%	23	38.3%	59	49.2%
Difficult	4	6.7%	10	16.7%	14	11.7%

Q7	Conceptual		Procedural		Total	
Typing experience	n=60	%	n=60	%	n=120	%
No Experience	27	45.0%	33	55.0%	60	50.0%
Some Experience	14	23.3%	8	13.3%	22	18.3%
School	6	10.0%	9	15.0%	15	12.5%
Experienced	3	5.0%	1	1.7%	4	3.3%
Other	10	16.7%	9	15.0%	19	15.8%

Q8	Conceptual		Procedural		Total	
Library - training/orientation	n=60	%	n=60	%	n=120	%
Yes	0	0.0%	4	6.7%	4	3.3%
No	60	100.0%	56	93.3%	116	96.7%

Q9	Conceptual		Procedural		Total	
Search for book in library	n=60	%	n=60	%	n=120	%
Reference	24	40.0%	27	45.0%	51	42.5%
Catalogue	25	41.7%	28	46.7%	53	44.2%
Shelf	2	3.3%	0	0.0%	2	1.7%
Other	9	15.0%	5	8.3%	14	11.7%

Q10 Usage card catalogue /OPAC	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
Catalogue	10	16.7%	8	13.3%	18	15.0%
OPAC	16	26.7%	25	41.7%	41	34.2%
None	34	56.7%	27	45.0%	61	50.8%

Q11 Number on Spine	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
ISBN	14	23.3%	5	8.3%	19	15.8%
Classification	25	41.7%	20	33.3%	45	37.5%
Don't Know	21	35.0%	35	58.3%	56	46.7%

Q12 Library information retrieval	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
Confident	22	36.7%	28	46.7%	50	41.7%
Unsure	33	55.0%	32	53.3%	65	54.2%
Difficult	5	8.3%	0	0.0%	5	4.2%

Q13 Library usage	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
Daily	7	11.7%	17	28.3%	24	20.0%
Weekly	27	45.0%	21	35.0%	48	40.0%
Monthly	10	16.7%	10	16.7%	20	16.7%
Never	10	16.7%	7	11.7%	17	14.2%
Other	6	10.0%	5	8.3%	11	9.2%

Q14 Employment in library
None

Q15 URICA- usage	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
Yes	1	1.7%	10	16.7%	11	9.2%
No	31	51.7%	32	53.3%	63	52.5%
Other	28	46.7%	18	30.0%	46	38.3%

Q16 **SABINET - usage**	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
Yes	0	0.0%	1	1.7%	1	0.8%
No	28	46.7%	31	51.7%	59	49.2%
Other	32	53.3%	28	46.7%	60	50.0%

Q17 **On-line search training**	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
Yes	4	6.7%	11	18.3%	15	12.5%
No	42	70.0%	44	73.3%	86	71.7%
Other	14	23.3%	5	8.3%	19	15.8%

Q18 **Computer usage -find info in Lib**	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
Yes	10	16.7%	10	16.7%	20	16.7%
No	48	80.0%	50	83.3%	98	81.7%
Other	2	3.3%	0	0.0%	2	1.7%

Q19 **English 1st or 2nd language**	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
First	13	21.7%	11	18.3%	24	20.0%
Second	47	78.3%	49	81.7%	96	80.0%

Q20 **English most often spoken**	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
Yes	15	25.0%	16	26.7%	31	25.8%
No	45	75.0%	44	73.3%	89	74.2%

Appendix K

SUMMARY REPORT OF RESPONSES TO THE PRE-TEST AND POST-TEST TASKS

Summary report of responses to pre-test and post test tasks

OVERALL PERFORMANCE

			CONCEPTUAL n=60 No	%	PROCEDURAL n=60 No	%	Chi-sq Significance
Pre-test	Q1	Author	27	45.0%	31	51.7%	0.46496
Pre-test	Q2	Title	20	33.3%	19	31.7%	0.84547
Pre-test	Q3	Subject / Synonym	5	8.3%	5	8.3%	1.00000
Post-test	Q4a	Author	52	86.7%	50	83.3%	0.60913
Post-test	Q4b	Title	50	83.3%	51	85.0%	0.80254
Post-test	Q4c	Browsing	43	71.7%	31	51.7%	0.02425
Post-test	Q5	Proximity	40	66.7%	30	50.0%	0.06408
Post-test	Q6	Truncation	47	78.3%	18	30.0%	0.00000
Post-test	Q7	Subject	41	68.3%	29	48.3%	0.02629
Post-test	Q8	Subject / Synonym	26	43.3%	8	13.3%	0.00027

LOW LIBRARY FREQUENCY - PERFORMANCE

			Conceptual N=20 Total	%	Procedural N=13 Total	%	Chi-Sq Significance
Pre-test	Q1	Author	8	40.0%	6	46.2%	0.72671
Pre-test	Q2	Title	6	30.0%	2	15.4%	0.33843
Pre-test	Q3	Subject / Synonym	2	10.0%	0	0.0%	0.23944
Post-test	Q4a	Author	18	90.0%	10	76.9%	0.30596
Post-test	Q4b	Title	18	90.0%	12	92.3%	0.82173
Post-test	Q4c	Browsing	13	65.0%	7	53.8%	0.52169
Post-test	Q5	Proximity	12	60.0%	7	53.8%	0.72671
Post-test	Q6	Truncation	18	90.0%	5	38.5%	0.00164
Post-test	Q7	Subject	14	70.0%	5	38.5%	0.07326
Post-test	Q8	Subject / Synonym	6	30.0%	2	15.4%	0.33843

HIGH LIBRARY FREQUENCY - PERFORMANCE

			Conceptual N=20 Total	%	Procedural N=24 Total	%	Chi-Sq Significance
Pre-test	Q1	Author	13	65.0%	16	66.7%	0.90755
Pre-test	Q2	Title	10	50.0%	10	41.7%	0.58042
Pre-test	Q3	Subject / Synonym	2	10.0%	3	12.5%	0.79473
Post-test	Q4a	Author	18	90.0%	22	91.7%	0.84815
Post-test	Q4b	Title	18	90.0%	20	83.3%	0.52111
Post-test	Q4c	Browsing	16	80.0%	12	50.0%	0.03942
Post-test	Q5	Proximity	14	70.0%	12	50.0%	0.17909
Post-test	Q6	Truncation	14	70.0%	7	29.2%	0.00693
Post-test	Q7	Subject	14	70.0%	12	50.0%	0.17909
Post-test	Q8	Subject / Synonym	11	55.0%	4	16.7%	0.00756

WITH COMPUTER EXPERIENCE - PERFORMANCE

			Conceptual N=22 Total	%	Procedural N=25 Total	%	Chi-Sq Significance
Pre-test	Q1	Author	14	63.6%	20	80.0%	0.21079
Pre-test	Q2	Title	7	31.8%	13	52.0%	0.16261
Pre-test	Q3	Subject / Synonym	2	9.1%	5	20.0%	0.29455
Post-test	Q4a	Author	22	100.0%	22	88.0%	0.09310
Post-test	Q4b	Title	21	95.5%	22	88.0%	0.36078
Post-test	Q4c	Browsing	17	77.3%	16	64.0%	0.32080
Post-test	Q5	Proximity	21	95.5%	15	60.0%	0.00418
Post-test	Q6	Truncation	19	86.4%	9	36.0%	0.00045
Post-test	Q7	Subject	18	81.8%	15	60.0%	0.10267
Post-test	Q8	Subject / Synonym	11	50.0%	4	16.0%	0.01259

WITHOUT COMPUTER EXPERIENCE - PERFORMANCE

			Conceptual N=38 Total	%	Procedural N=35 Total	%	Chi-Sq Significance
Pre-test	Q1	Author	13	34.2%	11	31.4%	0.80044
Pre-test	Q2	Title	13	34.2%	6	17.1%	0.09685
Pre-test	Q3	Subject / Synonym	3	7.9%	0	0.0%	0.08960
Post-test	Q4a	Author	30	78.9%	28	80.0%	0.91146
Post-test	Q4b	Title	29	76.3%	29	82.9%	0.48955
Post-test	Q4c	Browsing	26	68.4%	15	42.9%	0.02787
Post-test	Q5	Proximity	19	50.0%	15	42.9%	0.54106
Post-test	Q6	Truncation	28	73.7%	9	25.7%	0.00004
Post-test	Q7	Subject	23	60.5%	14	40.0%	0.07970
Post-test	Q8	Subject / Synonym	15	39.5%	4	11.4%	0.00637

ENGLISH 1st LANGUAGE - PERFORMANCE

			Conceptual N=13 Total	%	Procedural N=11 Total	%	Chi-Sq Significance
Pre-test	Q1	Author	8	61.5%	8	72.7%	0.56234
Pre-test	Q2	Title	5	38.5%	6	54.5%	0.43073
Pre-test	Q3	Subject / Synonym	2	15.4%	1	9.1%	0.64227
Post-test	Q4a	Author	12	92.3%	8	72.7%	0.19967
Post-test	Q4b	Title	11	84.6%	9	81.8%	0.85463
Post-test	Q4c	Browsing	8	61.5%	6	54.5%	0.72916
Post-test	Q5	Proximity	12	92.3%	7	63.6%	0.08484
Post-test	Q6	Truncation	12	92.3%	4	36.4%	0.00377
Post-test	Q7	Subject	11	84.6%	5	45.5%	0.04258
Post-test	Q8	Subject / Synonym	7	53.8%	3	27.3%	0.18827

ENGLISH 2nd LANGUAGE - PERFORMANCE

			Conceptual N=47		Procedural N=49		Chi-Sq
			Total	%	Total	%	Significance
Pre-test	Q1	Author	19	40.4%	23	46.9%	0.52018
Pre-test	Q2	Title	15	31.9%	13	26.5%	0.56178
Pre-test	Q3	Subject / Synonym	3	6.4%	4	8.2%	0.73734
Post-test	Q4a	Author	40	35.1%	42	85.7%	0.93277
Post-test	Q4b	Title	39	83.0%	42	85.7%	0.71212
Post-test	Q4c	Browsing	35	74.5%	25	51.0%	0.01768
Post-test	Q5	Proximity	28	59.6%	23	46.9%	0.2149
Post-test	Q6	Truncation	35	74.5%	14	28.6%	0.00001
Post-test	Q7	Subject	30	63.8%	24	49.0%	0.14259
Post-test	Q8	Subject / Synonym	19	40.4%	5	10.2%	0.00063

Appendix L

SUMMARY REPORT OF RESPONSES TO THE EVALUATION QUESTIONNAIRE

Summary report of responses to evaluation questionnaire

E1

Confident in using URICA	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
YES	54	90.0%	49	81.7%	103	85.8%
NO	6	10.0%	11	18.3%	17	14.2%

E2

Confident in using other OPAC systems	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
YES	55	91.7%	50	83.3%	105	87.5%
NO	5	8.3%	10	16.7%	15	12.5%

E3

Notes provided were helpful	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
YES	58	96.7%	59	98.3%	117	97.5%
NO	2	3.3%	1	1.7%	3	2.5%

E4

Lecture was clear	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
YES	55	91.7%	60	100.0%	115	95.8%
NO	5	8.3%	0	0.0%	5	4.2%

E5

Had difficulty with keyboard	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
YES	9	15.0%	15	25.0%	24	20.0%
NO	51	85.0%	45	75.0%	96	80.0%

E6

Had difficulty understanding instructions on URICA	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
YES	16	26.7%	14	23.3%	30	25.0%
NO	44	73.3%	46	76.7%	90	75.0%

E7

Had difficulty understanding worksheet	Conceptual		Procedural		Total	
	n=60	%	n=60	%	n=120	%
YES	10	16.7%	13	21.7%	23	19.2%
NO	50	83.3%	47	78.3%	97	80.8%