Usability Assessment of Integrated Cataloging and Metadata Services: An Exploratory Study of the OCLC Connexion System

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USABILITY ASSESSMENT OF INTEGRATED CATALOGING AND METADATA SERVICES: AN EXPLORATORY STUDY OF THE OCLC CONNEXION SYSTEM

By

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TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Tables</td>
<td>viii</td>
</tr>
<tr>
<td>List of Figures</td>
<td>x</td>
</tr>
<tr>
<td>Abstract</td>
<td>xi</td>
</tr>
<tr>
<td>1. INTRODUCTION TO THE RESEARCH AND THE RESEARCH QUESTIONS</td>
<td>1</td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>The Concept of Metadata</td>
<td>2</td>
</tr>
<tr>
<td>Definition of Metadata</td>
<td>2</td>
</tr>
<tr>
<td>The Emergence of Metadata</td>
<td>3</td>
</tr>
<tr>
<td>Usability Testing</td>
<td>5</td>
</tr>
<tr>
<td>Usability Defined: Various Approaches to Evaluating Information Systems</td>
<td>5</td>
</tr>
<tr>
<td>Concepts and Developments in Usability Testing</td>
<td>6</td>
</tr>
<tr>
<td>Definition of Usability Testing</td>
<td>7</td>
</tr>
<tr>
<td>Current Issues in the Development of Metadata Standards</td>
<td>7</td>
</tr>
<tr>
<td>Metadata Systems Development</td>
<td>8</td>
</tr>
<tr>
<td>Connexion</td>
<td>9</td>
</tr>
<tr>
<td>Lack of Interoperability: Crosswalks Metadata Mapping, and Interoperability</td>
<td>9</td>
</tr>
<tr>
<td>Creation, Use and Maintenance of the Metadata System</td>
<td>10</td>
</tr>
<tr>
<td>Usability Testing to Evaluate an Integrated Cataloging and Metadata</td>
<td></td>
</tr>
<tr>
<td>Services System</td>
<td>11</td>
</tr>
<tr>
<td>Research Questions</td>
<td>14</td>
</tr>
<tr>
<td>Study Goals</td>
<td>14</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>15</td>
</tr>
<tr>
<td>Problem Statements</td>
<td>16</td>
</tr>
<tr>
<td>Significance and Limitations of the Research Design</td>
<td>16</td>
</tr>
<tr>
<td>Summary of the Chapter</td>
<td>17</td>
</tr>
<tr>
<td>2. REVIEW OF THE RELATED LITERATURE</td>
<td>18</td>
</tr>
<tr>
<td>Introduction</td>
<td>18</td>
</tr>
<tr>
<td>Integrated Cataloging and Metadata Services</td>
<td>18</td>
</tr>
<tr>
<td>A Broader View of Metadata</td>
<td>18</td>
</tr>
<tr>
<td>The Origin of Metadata in Information Organization</td>
<td>19</td>
</tr>
</tbody>
</table>
## 3. DATA COLLECTION AND ANALYSIS METHODS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>54</td>
</tr>
<tr>
<td>The System under Study: OCLC Connexion</td>
<td>54</td>
</tr>
<tr>
<td>Participants</td>
<td>56</td>
</tr>
<tr>
<td>Demographic</td>
<td>57</td>
</tr>
<tr>
<td>Setting for Usability Testing</td>
<td>59</td>
</tr>
<tr>
<td>The Tests and Data Collection</td>
<td>59</td>
</tr>
<tr>
<td>Pretest Phase</td>
<td>59</td>
</tr>
<tr>
<td>Introduction Phase</td>
<td>59</td>
</tr>
<tr>
<td>Testing Phase</td>
<td>60</td>
</tr>
<tr>
<td>Debriefing Phase</td>
<td>60</td>
</tr>
<tr>
<td>Tasks</td>
<td>61</td>
</tr>
<tr>
<td>Introduction to the Data Analysis</td>
<td>64</td>
</tr>
<tr>
<td>Summary of the Chapter</td>
<td>65</td>
</tr>
</tbody>
</table>

## 4. DATA ANALYSIS AND RESULTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>67</td>
</tr>
<tr>
<td>Overview of Collected Data</td>
<td>68</td>
</tr>
<tr>
<td>Accuracy and Number of Errors</td>
<td>68</td>
</tr>
<tr>
<td>Completion Time and Number of Keystrokes</td>
<td>72</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>73</td>
</tr>
<tr>
<td>Relationships between each measure</td>
<td>75</td>
</tr>
<tr>
<td>Effectiveness by searching experiences</td>
<td>75</td>
</tr>
<tr>
<td>Efficiency by searching experiences</td>
<td>76</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 1.1: Different Types of Metadata (Gilliland-Swetland, 1998, p.3)............ Page 4
Table 3.1: Participants Profile................................................................. Page 58
Table 3.2: Types of Questions, Topics and Provided Tasks......................... Page 62
Table 3.3: Data Collection and Analysis Methods ...................................... Page 65
Table 4.1: Accuracy ............................................................................. Page 69
Table 4.2: Mean of Completion Time Per Task (h:mm:ss) ......................... Page 70
Table 4.3: Number of Errors ............................................................... Page 71
Table 4.4: Keystrokes used (N=10) ..................................................... Page 73
Table 4.5: Satisfaction (N=10) ............................................................ Page 74
Table 4.6: Correlation between subjects in Satisfaction measure ............... Page 75
Table 4.7: Pearson’s Correlations between Effectiveness and Efficiency....... Page 77
Table 4.8: Pearson’s Correlations between Effectiveness and Satisfaction ...... Page 78
Table 4.9: Pearson’s Correlations between Efficiency and Satisfaction ........ Page 79
Table 4.10: Frequency Ranking of Usability Problem Codes ..................... Page 81
Table 4.11: Usability problems in User Assistance .................................. Page 82
Table 4.12: Usability problems in Navigation.......................................... Page 84
Table 4.13: Usability problems in Information Grouping and Structure........ Page 87
Table 4.14: Usability problems in Color and Visual Clarity ....................... Page 87
Table 4.15: Usability problems in Error Prevention and Correction............. Page 88
LIST OF FIGURES

Figure 3.1: Homepage of the OCLC Connexion ................................................ Page 55
Figure 4.1: The screenshot of the main search page............................................ Page 83
Figure 4.2: The screenshot of submenu example ................................................ Page 85
Figure 4.3: The screenshot of field option examples ........................................... Page 86
ABSTRACT

The goal of this study was to examine the relationships between usability and the searching experience, and to uncover where an integrated cataloging and metadata system lay the usability problems of its primary users, catalogers.

This study showed that the most important aspect of usability in Connexion lay in the experience of information retrieval system. Also, it showed there are seventeen usability problems to be improved in Connexion. Needless to say, it is most important to note that usability is not an exclusive goal of such an integrated cataloging and metadata system. Other goals such as quality of catalogs, and the reliability of its cataloging and metadata system are equally its concern.

This study also suggested more testing on diverse cataloging systems and specific user groups, especially catalogers. Much work remains to fully understand the application of these results within integrated cataloging and metadata systems and usability testing.
CHAPTER 1

INTRODUCTION TO THE RESEARCH
AND THE RESEARCH QUESTIONS

Introduction

The emergence of the World Wide Web in the 1980s enhanced the rapid changes already occurring in the means by which information was accessed throughout the world. The cataloging world has responded to such changes with many attempts to properly describe and manage the wide range of information resources. Metadata is a primary tool in this work, and an important link in the knowledge economy, even if there is still much confusion about how to integrate metadata into information systems (Duval, Hodgins and Sutton, 2002).

The rapid growth and dissemination of online information resources, such as the World Wide Web (Gray, 1997), has caused the concept of metadata to mean different things to different information communities. Fundamentally, metadata is designed to support interaction between an end-user and an online retrieval system, providing users access to the information in the system by labeling its contents consistently regardless of the format of the information object. Interest in metadata has increased significantly in the emerging digital library context since the effective organization of networked information clearly depends on the effective management, organization, and control of metadata (Burnett, Ng and Park, 1999).
This chapter presents a brief overview of this field of research, which explores the usability of an integrated cataloging and metadata service system in facilitating access to records stored in the system. The chapter begins with a discussion of the major concepts to be covered, and includes definitions of the concepts of metadata and usability testing. For the purposes of this study, usability will be defined in terms of effectiveness, efficiency, and user satisfaction. The current status of metadata development in the context of cataloging also will be reviewed, and examples of metadata development within a specific integrated cataloging and metadata service system will be provided. This chapter will also discuss several issues that must be taken into account when evaluating existing integrated cataloging and metadata service systems.

The Concept of Metadata

Definition of Metadata

Although the term metadata emerged alongside the rapid growth of the Internet, the foundation of the metadata concept is simply “data about data.” (Wendler, 1999) Even if that definition is considered a weak one, it conveys the basic concept of representation and organization of information. Thus, catalogs which have for centuries led end-users to data in traditional library environments can be considered metadata. Various metadata standards have been created for various formats of resources from books through electronic materials. Metadata standards are ways of structuring content, and this content is held by and delivered by one or more carriers such as various markup languages to MARC (Chapman, 2002). Library catalog is one form of metadata, involving specific processes utilizing tools like the Anglo-American Cataloging Rules and USMARC. Although metadata is the data, like cataloging records, that aids resource discovery, it is not directly linked to specific processes, tools, or
information retrieval environments. Metadata considered records represented by the process of information organization. Other definitions of metadata such as process, container, and record content will not be discussed in this study. For purposes of this study, metadata is operationally defined as: data that characterize source data, describe their relationships, and support their discovery and effective use (Burnett, Ng and Park, 1999).

The Emergence of Metadata

Although the use of the term metadata has been very popular within electronic information communities for the last several years, the concept itself has long been integral to the work of information specialists. Catalogs and indexes may be considered types of metadata, for example, and these have existed for a very long time in library and information environments. As Intner (Intner, 1998) noted in her short editorial in Technicalities, if library materials can be considered “data,” then catalog records can be considered data about data, or metadata. Even Charles Cutter (1837-1903), who structured the general outline of the first class of the Library of Congress classification, understood the fundamental idea represented by metadata (Immroth, 1980), and although he did not use the term, he did embrace the concept. Since Cutter’s time, catalogers have occupied their days creating metadata for library materials.

Metadata provides "hooks" by which resources can be extracted from or discovered within a database. Gilliland-Swetland (Gilliland-Swetland, 1998) identified five different types of metadata. (See Table 1)
Table 1.1
Different Types of Metadata (Gilliland-Swetland, 1998)

<table>
<thead>
<tr>
<th>Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative</td>
<td>Metadata used in managing and administering information resources</td>
</tr>
<tr>
<td>Descriptive</td>
<td>Metadata used to describe or identify information resources</td>
</tr>
<tr>
<td>Preservation</td>
<td>Metadata related to the preservation management of information resources</td>
</tr>
<tr>
<td>Technical</td>
<td>Metadata related to how a system functions or metadata behaves</td>
</tr>
<tr>
<td>Use</td>
<td>Metadata related to the level and type of use of information resources</td>
</tr>
</tbody>
</table>

The traditional library catalog index card is a classic example of metadata, and a MARC (MAchine Readable Catalog) record is the equivalent example for automated cataloging workplaces. The author, title, DDC (Dewey Decimal Classification), etc., are metadata elements within a clearly defined metadata scheme (Shabajee, 2002). Even if these elements have different formats of description, it is not difficult to accept that each of the elements is part of a larger metadata system.

When the term “metadata” first appeared, it usually was applied to resources accessed electronically and online. If we accept the assertion that the concept of metadata can be extended to traditional cataloging services, however, it is clear that cataloging and indexing services may be integrated to improve resource discovery across different format types. It is worth noting here that in the FAQ section on the Online Computer Library Center, Inc. (OCLC) Connexion website, MARC is described as "metadata"(OCLC, 2002).

Cataloging and metadata are essential keys to the actualization of Digital Library construction. Current digital libraries may be understood as very complicated systems involving various technical issues and tools. Because of the
complicated nature of such libraries, many technical problems have arisen from attempts to join contrary digital repositories. The efforts of computer science and information professionals to conduct usability testing to improve various interfaces and products may eventually contribute to the construction of a successful Digital Library.

Usability Testing

Usability Defined: Various Approaches to Evaluating Information Systems

The evaluation of information systems has been a widely discussed subject in the Information Science (IS) literature. No consensus has emerged, however, on the best means for conceptualizing and operationalizing such evaluations (Janes, 1994; Zmud and Boynton, 1991). Usability testing has become a popular means for evaluating the effectiveness of information systems from the user's point of view. For several decades before usability testing appeared, relevance and user satisfaction were the two most prominent measures for user-based performance evaluations of information systems (Gluck, 1996). In recent years, however, researchers in the Library and Information Studies field have emphasized evaluating systems in terms of their usability (Oulanov and Pajarillo, 2002), because such evaluations can provide crucial information central to a user-focused design process.

The purpose of most websites is to attract users and promote and distribute information or products. Losing users because of a poor design could be catastrophic for a commercial venture. Even in the absence of direct financial considerations, an organization may find that the cost of user support, such as calls or e-mail to a help desk, is directly related to a site’s ease of use. Usability testing originated in the industrial sector to improve commercial success (Stanton and Baber, 1996); it was adapted to the LIS academic sector to improve and
provide better service to users for the specific information retrieval system (Campbell, 2001). Since the ultimate goal of an information retrieval system is to provide end-users with speed and facility, usability testing that competently measures effectiveness, efficiency, and user satisfaction is an effective method for evaluating the design of such systems from a user’s perspective.

**Concepts and Developments in Usability Testing**

The International Standards Organization (ISO, DIS and 9241-11) defines usability as the “extent to which a product can be used by specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (p.10). As common sense would indicate, usability typically focuses on how end users interact with a certain product or system as they perform actual tasks. In addition, the concept of usability tends to focus on how successfully users manipulate the system or product to achieve their desired results. Usability testing then, is the process of determining to what extent a system has satisfied the needs of the user, and therefore met its goals. With roots in computer science and engineering, usability testing has been applied most directly by researchers and practitioners seeking a user-centered approach in system and product design (Campbell, 2001). This user-centered approach has been called many names, such as user-centered design, ergonomics, Human-Computer Interaction (HCI), and human factors and usability engineering. Since usability testing makes allies of the system and the user, it may be understood as an evaluation method that focuses on the interaction between end users and a system or product. In order to evaluate the usability of a system, then, researchers need to seek a coordinated understanding of the users’ needs, desires, and abilities as they relate to the goals, functions, and limitations of the product or service (Morgan, 1999).

During the 1990s, software companies began to address the needs of their users more seriously and to design products and services for usability rather than just function (Battleson, Booth and Weintrop, 2001). Currently, most usability
testing appears to focus on website design, but a user-centered evaluation method also has been adopted by the LIS professions in order to test the usability of many other library services-related systems and products (Battleson, Booth and Weintrop, 2001; Campbell, 2001; Head, 1999; Hert, Jacob and Dawson, 2000; Kim, 2002; Oulanov and Pajarillo, 2002).

Definition of Usability Testing

For the purposes of this study, usability testing is operationally defined as:

A method that tests how a user interacts with a system. The participant is given a list of pre-defined tasks to accomplish using the system and asked to “think out loud” about their thoughts, reactions and feelings. (Campbell, 2001)

Since the system and the end user may be regarded as the two most important factors in LIS research, usability testing is an important measurement tool for evaluating an information system.

Current Issues in the Development of Metadata Standards

A significant amount of research involving metadata has been conducted since 1997. A good deal of this research has focused on crosswalks, frameworks and supermetadata issues. In addition, issues related to the practitioner's use of metadata concepts, the application of metadata to empirical studies, and metadata and commercialization of the Internet have appeared more frequently in metadata studies (Burnett and Lee, 2000). As Chilvers and Feather (Chilvers and Feather, 1998) observed, however, corporate metadata users are likely to resist adopting a uniform standard since many utilize existing in-house standards. Publishers, for example, were still in “a defensive crouch” with regard to the adoption of metadata (Lichtenberg, 1997).
In light of these considerations, the evaluation of the usability of an existing integrated cataloging and metadata services system is an important step toward establishing a possible bridge among various metadata information systems. The initial step in this endeavor is clarifying how an existing integrated cataloging and metadata services information system works and to what extent it can be described as usable.

The concept of metadata can be used as a more structured and descriptive approach to the formats of electronic and other resources, thus making possible improved information search and retrieval. Many metadata standards are in current use, from a simple structure, such as Dublin Core (DC), to a more comprehensive structure, such as MARC (MAchine-Readable Cataloging). Further description of various metadata standards as well as usability testing can be found in Chapter 2.

**Metadata Systems Development**

Among the many metadata standards, MARC is a traditional metadata structure that has been widely adopted by the library community. First introduced in the 1960s for the exchange and communication of bibliographic data, MARC has been expanded to facilitate the communication and exchange of many formats of information, such as books, sound recordings, and even World Wide Web publications. MARC fields and subfields contain various types of bibliographic information. Its comprehensive scope and the availability of a wide range of metadata elements have made MARC one of the most distinguished features in the library environment.

The Dublin Core metadata element set was the outcome of a workshop sponsored by OCLC and the National Center for Supercomputing Applications (NCSA) in 1995. Subsequent workshops have extended the scope of the Dublin
Core effort. Dublin Core is intended to be a basic collection of metadata elements -- a lingua franca for metadata (Milstead and Feldman, 1999). The Dublin Core development effort is still ongoing and is expected to continue indefinitely.

The database records of another production system, Connexion, are primarily encoded in MARC. The WorldCat service in Connexion has been important to the cataloging sector of the LIS community as a records-generator and resource locator. Connexion also includes a metadata service that was developed to aid resource discovery on the WWW. Together, these elements provide a rich source for resource discovery – but a question remains: is this source usable?

**Connexion**

Connexion is a production system that was developed by OCLC to provide access to cataloging records through WorldCat, the world’s largest online union catalog and bibliographic database. Connexion is accessible via a web browser and can be loaded with no additional software. OCLC Connexion is based on CORC, CatExpress, CatMe, and Passport, and the knowledge that OCLC has gained from working with users over many years. Connexion reflects OCLC’s intention to take the best features of each of the aforementioned tools and integrate them into the new cataloging service. Further description of Connexion will be provided on Chapter 2 as well as Chapter 3.

**Lack of Interoperability: Crosswalks, Metadata Mapping, and Interoperability**

The Information Science literature is replete with studies dealing with metadata standards. The studies mainly center on crosswalks, frameworks and
supermetadata (Bearman, Miller and Rust, 1998; Fichter, 1999; Fietzer, 1998),
concepts and uses of metadata (Dempsey and Heery, 1998; O'Neill, Lavoie and
McClain, 1998; Wool, 1998), empirical studies of metadata application (Jenkins,
Jackson, Burden and Wallis, 1999; Wheatley and Armstrong, 1997), and metadata
with commercial usage (Caplan and Guenther, 1996; Chilvers and Feather, 1998;
Desai, 1997; Desai, Shinghal and Shayan, 1999; McCue, 1997).

Yet current research lacks evidence of the effectiveness of systems related
to the cataloging services that the information community has provided for a long
time. With any metadata application, there is the question of usefulness. Is it
worth the resources required to add metadata to existing resources? Does
structured metadata provide a basis for increased effectiveness of search and
retrieval? (Quam, 2001)

Recent metadata development has led to mechanisms for navigating
between various resources, or “crosswalks”, that result from analyzing and
mapping the similarities of each metadata system (Cromwell-Kessler, 1998). The
implementation of such “crosswalks” in integrated systems such as Connexion,
needs to be studied for current usability in order to determine the directions that
are most promising for future development.

**Creation, Use and Maintenance of the Metadata System**

Metadata is complex to create and maintain (Gilliland-Swetland, 1998). Nevertheless, it is possible to plan new ways to satisfy the needs of many users if consistent metadata has been created. A number of studies have introduced the creation and use of specific metadata systems, however, improvements to metadata systems can best be achieved through the consistent maintenance of the systems. In order to make metadata systems maximally effective, information professionals must resolve some key questions such as deciding how much is enough and how much is too much in regards to the metadata element structure.
Usability testing may provide a direction for the creation and maintenance of metadata systems. Even though it may not be possible to reveal the perfect metadata element structure at this stage, usability testing can provide a starting point for improvement.

**Usability Testing to Evaluate an Integrated Cataloging and Metadata Services System**

Since the ultimate goal of this study is to evaluate the usability of a current integrated cataloging and metadata services system, it is necessary to clarify how the usability testing will be executed in this study.

Cataloging and metadata services traditionally enable catalogers or information professionals to retrieve appropriate records providing information they need to create cataloging records to represent items in their own collections. A better system means easier access to clear data that facilitate retrieval of information appropriate to the creation of the new record. Thus, usefulness and ease of use may be the primary factors to evaluate regardless of the details of the system. No research has been published to date on the ease of use of integrated cataloging and metadata services for the primary users of these services that is, the catalogers or information professionals who actually use the systems in their work places. Therefore, this study will be breaking new ground, exploring several issues related to the usability of such systems for its intended users.

Usability may be a collective term for all aspects of an activity’s performance that can be affected by the use of technology (Whiteside, Bennett and Holtzblatt, 1988). The individual aspects are known as usability factors or
attributes and are evaluated together to measure a product’s usability (Campbell, 2001).

This study uses three prominent factors in usability testing: effectiveness, efficiency, and user satisfaction.

- **Effectiveness** in usability testing looks at whether users can accomplish tasks completely and accurately. The accuracy and completeness with which users achieve specified goals will be measured as they perform tasks that the researcher will provide. Indicators of effectiveness in this study include the quality of solutions achieved and number of errors encountered.

- **Efficiency** in usability testing analyzes the amount of resources used to complete tasks effectively. Resources expended in relation to the accuracy and completeness with which users achieve goals will be measured as they perform tasks that the researcher will provide. Indicators of efficiency of this study include task completion time and number of keystrokes.

- **Satisfaction** deals with a user’s attitude towards the product. Freedom from discomfort, and positive attitudes towards the use of the product based on typical users executing typical tasks are the major foci for this factor. User’s satisfaction can be measured by attitude rating scales such as SUMI (Kirakowski and Corbett, 1993). In this study, satisfaction will be measured by a questionnaire that the researcher will provide at the end of the session.

These three prominent factors of usability will be compared with the searching experience of users to see the relationship between each factor of usability and each variable of searching experiences.
Searching experience deals with previous computer experience of the participants such as familiarity with information retrieval system, experience of computerized library catalogs, experience of commercial online databases and etc.. In order to extract appropriate variables for searching experiences, many other existing questionnaires are examined. After careful examination, a few variables are extracted which are relevant with cataloger’s daily work. In this study, searching experiences are referred a few factors such as the experience of assisting users, experience of computerized databases, experience of computerized catalogs and etc.

The other important term in this study will be different formats of metadata. Yet current research lacks evidence of the effectiveness of systems related to the cataloging services that the information community has provided for a long time. Like Quam’s discussion (Quam, 2001), there is the question of usefulness with any metadata application. Then, what about the integrated cataloging and metadata services system? Is it usable to search all different formats of metadata such as from book formats through electronic resources? It is going to be worthy of studying how the primary users are searching the integrated system for different formats of metadata and how the system is usable in terms of searching different formats of metadata. In this study, different formats of metadata are considered as similar as different formats of information provided from Connexion. It is including traditional book records to electronic resources records which are regarded as new format of information.

Currently, many institutions and areas are involved in metadata researches. With all those research efforts and projects involved, there are significant practical developments in the study too. However, the study of human aspects of metadata system is virtually ignored. This study can provide a starting point of metadata system, based on an integrated cataloging and metadata system to see human aspects of the system usability.
Research Questions

The purpose of this study is to examine the usability of a current existing cataloging and metadata services system. Usability testing on Connexion, an existing integrated cataloging and metadata services system, will be conducted for this purpose.

The study will attempt to answer the following research questions, all of which refer to the integrated cataloging and metadata services system Connexion:

1. How is effectiveness related to the user’s searching experience of retrieving different formats of metadata in the integrated cataloging and metadata services system?
2. How is efficiency related to the user’s searching experience of retrieving different formats of metadata in the integrated cataloging and metadata services system?
3. How is satisfaction related to the user’s searching experience of retrieving different formats of metadata in the integrated cataloging and metadata services system?
4. How is usability related to searching in the integrated cataloging and metadata services system, particularly in terms of different formats of metadata?
5. How can the thoughts and perceptions of users be used to improve integrated cataloging and metadata services systems?

Study Goals

In order to answer these research questions, several study objectives have been established:
1. To gain experience in conducting usability testing on an integrated cataloging and metadata services system.
2. To foster the search for knowledge and understanding of integrated cataloging and metadata services system.
3. To compare various measures of efficiency, effectiveness and satisfaction across several variations of an integrated cataloging and metadata services system.
4. To investigate and evaluate the usability issues of an integrated cataloging and metadata services system.
5. To determine how effectively the integrated cataloging and metadata services work in terms of usability issues.

**Hypotheses**

Four hypotheses are proposed to examine the research questions.

1. A significant relationship exists between users’ searching experience and the effectiveness of the search at retrieving different formats of metadata when using Connexion, an integrated cataloging and metadata services system.
2. A significant relationship exists between users’ searching experience and the efficiency of the search at retrieving different formats of metadata when using Connexion, an integrated cataloging and metadata services system.
3. A significant relationship exists in users’ searching experience and their satisfaction about retrieving different formats of metadata when using Connexion, an integrated cataloging and metadata services system.
Problem Statements

This study also proposed to examine whether;

1) Effectiveness, efficiency and satisfaction from this test are related to participants’ background status (educational status, searching experience etc.);

2) Overall usability from this study is related to participants’ background status (educational status, searching experience, etc.);

3) There are common features in the system that cause difficulties in users searching.

Significance and Limitations of the Research Design

Information systems, regardless of whom or what they serve, must reconcile performance with the needs of users. For several decades, information professionals have sought to achieve this goal by seeking ways to better satisfy their users.

This study can add to a deeper understanding of the concept and role of metadata as it relates to the traditional concept and practice of cataloging. Further, the results of this study may provide clues for constructing a consensus for better integrated systems in the context of digital library construction.

This study is limited to evaluating an integrated cataloging and metadata services system, and is also limited to assessing only those components that the Connexion system permits. Therefore, it will not be possible to address the usability issues of other standards and systems, or the role of different components in detail. Further, this study is limited to evaluating three usability factors: effectiveness, efficiency, and user satisfaction. Other factors such as system performance, cost, etc. are beyond the scope of the study.
Summary of the Chapter

This chapter includes a discussion of major issues surrounding the understanding and use of the metadata concept in relation to traditional cataloging services, of other issues related to metadata, and of usability testing within a particular system. This study focuses on that particular integrated cataloging and metadata services system and testing method with the hope that the analysis of its usability will lead to the improvement of the integrated system and to a consensus, on the semantic level about the integrated system’s structure.

The next chapter will review the literature related to cataloging in a broad sense, to metadata, and to usability testing. It includes an overview of changes in cataloging concepts led by technological developments, metadata standards and integrated systems, and usability testing methods. Chapter 2 also reviews previous efforts to apply usability testing to evaluate information retrieval systems, and explores the potential usefulness of usability testing for evaluating an integrated cataloging and metadata services system.
CHAPTER 2

REVIEW OF THE RELATED LITERATURE

Introduction

This review provides the historical and empirical background for the present study. First, historical perspectives on integrated cataloging and metadata services are reviewed. Second, concurrent issues and developments related to integrated cataloging and metadata services are reviewed to uncover trends and provide further insight into the significance of the study. Finally, the research on usability testing, which is applied in this study as a measure of system usefulness, is surveyed briefly.

Integrated Cataloging and Metadata Services

A Broader View of Metadata

Cataloging and indexing are both forms of metadata that have been used by information professionals for more than a century. Because the term metadata has appeared in recent years in reference to online information retrieval systems, it may be seen as an innovation in data organization. In fact, however, the notion of metadata has been integral to the library environment since long before the introduction of electronic information organization (Intner, 1998; Milstead and Feldman, 1999). Thus, a full discussion of metadata must reach back several centuries.

The concept of metadata has long been behind the creation of tools like indexes, catalogs, and other organizational systems, even if the term itself has not
been used until recently. Though generally applied to electronic resources in modern usage, the term metadata includes indexing and cataloging and thus may extend to traditional information representations in the library environment, such as MARC records (Milstead and Feldman, 1999).

The Origin of Metadata in Information Organization

The use of the term metadata can be traced to the 1960s, although it more frequently appeared in the literature on database management systems (DBMS) in the 1980s. The term was used to describe the information that documented the characteristics of the information included in a database (Phillips, 1995). Although the term metadata is relatively new to the library environment, the work of metadata has been a part of the library and information community since it began to classify and organize information (El-Sherbini, 2000; Milstead and Feldman, 1999). In the library cataloging world, the terms “bibliographic data” and “cataloging data” have long been used to represent this idea. Library catalogs and indexes are good examples of metadata in use.

The history of tools for information representation and organization, such as indexing, abstracting, and cataloging, may be closely related to the history of writing and the collection of information records (Cleveland and Cleveland, 2001). According to Cleveland, the systematic gathering and organizing of written records was developed in conjunction with the development of writing and the collection of information records. With the creation of the first printing press, the rapid growth of printing and the proliferation of books led to a great increase in book indexes. The problems of storage and access to information created a need for the development of tools that would help to manage and maintain the enormous amount of information newly available.

When catalogers began to organize networked electronic resources using the same type of bibliographic data, the library and information communities developed new terminology that changed the MARC record, and information
professionals suddenly recognized MARC as metadata (Vellucci, 2000). Of course, the premise on which the development of these tools was based is the need to keep numerous records. More recently, researchers have proposed expanding the use of the term metadata in library and information communities (Brown, 2000; El-Sherbini, 2000; Hammer, 2000; Vellucci, 2000; Weibel and Koch, 2000).

Vellucci (Vellucci, 2000) has discussed the usefulness of the term metadata, and made suggestions to researchers and professionals in library and information communities:

The term metadata already had the connotation with an electronic environment that was lacking with the term cataloging; but more importantly, as catalogers expanded their own worldview of information organization, metadata provided a common term to use when communicating with other information organizers in the computers and information science world. The term allowed everyone to interact equally in the continuum of information organization. … A broader perspective of both resource and information organization must be adopted by all constituencies in order to avoid perpetuating this type of segmentation, and the term metadata should applied to data for all types of resources. (p. 34)

**Traditional Cataloging in the Library Environment**

Over the past 150 years, library and information communities have developed modern descriptive cataloging theory and practice in order to better represent and organize information in libraries. As collections of bibliographic records that describe published materials, library catalogs exemplify traditional metadata use in a library environment. The published materials represented in
catalogs are usually printed books, but can also include manuscripts, cartographic materials, and music scores. The standards and cataloging codes developed to support this traditional manner of information organization have expanded to keep pace with newer published media, such as sound recordings, microforms, films, and video recordings. Thus, a traditional library catalog is typically viewed as a list of books and other published materials. Each entry within the catalog contains an item description and a reference identifier that makes it possible to find the item.

With the development of computer technology and the current widespread use of computer networks for publishing, new bibliographic standards and formats employed by libraries are being used increasingly to describe newer types of materials (Chapman, Day and Hiom, 1998). In the library environment, the original computerized bibliographic format was MARC. Extracting several semantic parts of the materials, such as author and title, MARC plays the role of a surrogate by describing specific materials in a computerized manner. Though MARC introduced library and information communities to a new era of electronic information representation and organization, the use of the Internet as a publishing medium and an information retrieval tool has posed new challenges for libraries and information communities, who are now faced with classifying information with the unique characteristics of mobility, rapid dissemination, and wide accessibility.

The Development of Internet Resources

The Internet grew out of an experiment carried out by the United States Department of Defense in the 1960s. The objective of the experiment was to determine if government scientists could develop a national computer network that would continue to function after a national catastrophe. The computer
network that was set up was called ARPANET and it opened the way for the development of the Internet (Cleveland and Cleveland, 2001).

Since its conception, the widespread use of the Internet has led to an increase in electronic documentation. Accurate statistics about the current size and growth of the Web are almost impossible to obtain. Even the most conservative estimates show an incredible rate of growth. According to Gray’s (1997) Web Growth Summary, the number of websites on the Internet grew from just 130 in June 1993 to 650,000 in January 1997, an increase of 500,000 percent in 42 months. Further, Gray's estimate was based on a very conservative definition of the term "website." Gray counted those websites with unique URLs (Uniform Resource Locator) only, thus he considered http://www.fsu.edu/~lis to be the same site as http://www.fsu.edu/~library or http://www.fsu.edu/~irc, since they are all under the unique URL (http://www.fsu.edu, Florida State University), although http://webmail.fsu.edu was considered a separate site.

The increase in computer usage and the amount of information held in machine-readable form brought about some interest in the preservation of electronic information as early as the 1970s (Chilvers and Feather, 1998). In our time, however, because the Internet allows a user to gain access to large amounts of information (with more added every day), information communities have been confronted with the inescapable, though daunting, task of organizing Internet resources. Concerns of time and the cost suggest that a traditional, centralized approach to information organization does not seem to adequately address this challenge. Some researchers even have suggested that the Web is just getting too big for any single organization or service to catalog (Gill, 1998). According to recent estimates from the Web Characterization Project (WCP), the size of the Web reached 3,080,000 sites in June 2002 (OCLC, 2003).
The Function of Metadata in the Library Environment

Metadata contains the characteristics of and relationships within source data, allowing information seekers to obtain concise information about source data that may not be recorded in the source itself due to its nature (Desai, 1990). The nature of metadata has been an intensely debated issue in the information communities. According to Desai (1997), metadata should meet several requirements if it is to be considered useful in the library and information field. For example, metadata should serve as an instrument for describing the semantic content of a resource, for supporting retrieval by content, and for expressing semantic dependencies that are inherent in a collection of objects. While the Web provides a convenient venue for publishing and disseminating information, it lacks a mechanism for negotiating a publicly shared agreement about the meaning of fundamental information (Brasethvik, 1998). For any metadata scheme, information professionals must decide which attributes to use, what each attribute means, and how it is to be instantiated and used. Just as with any knowledge representation scheme, a metadata scheme is subject to the user’s perceived conceptualization of the domain to which the metadata statements refer (Gruber, 1995). According to Smith (Smith, 1996), the concept of metadata applied in the contemporary digital or traditional library environment refers to information that:

- provides a (usually brief) characterization of the individual information object (IO)s in the collections of a library;
- is stored principally as the contents of library catalogs in traditional libraries;
- is used principally in aiding users to access IOs of interest.

(p. 1)
As Smith noted, Dublin Core is an example of the use of metadata in the
digital library, just as USMARC is an example of metadata used in the traditional
library.

Wendler (Wendler, 1999) also recently put forward his own definition of
metadata in the library context: "the information needed to identify, locate,
manage, and access materials the library wishes to make available to its users" (p.
43). According to Wendler, cataloging can be considered metadata but not all
metadata can be considered cataloging. In addition, Wendler noted that many
characteristics of electronic resources make them hard to describe, such as
variability of presentation, unfamiliar form of issuance, ill-defined relationships to
materials in other forms, mutability, mobility, and absence of physical receipt.
Disparate types of resources, then, must be assembled in a coherent information
environment. Further, while simpler metadata formats like Dublin Core have
been developed catalogers should be able to understand how metadata standards
can be executed in libraries in order to enrich the library's services.

**Information Overload on the Web and the Need for Metadata Standards**

The Internet currently allows users to gain access to information clusters,
and more information is being added everyday. Numerous online indexes and
search engines are available to organize this vast amount of data. Yet even
though various types of information can be discovered via the Web, it is still
difficult to make sure that resources can be obtained and to assess the quality of
that which is found (Gregg, 2000). According to Lynch (Lynch, 1997), the fact
that “much of the information on the Internet is quirky, transient, and chaotically
‘shelved’” is the most serious, long-range problem for the Internet. Many indexes
and search engines can be used to find information on the Internet, but they may not represent the best way to organize information or evaluate its quality.

The dramatic growth of electronic information resources has proven to be a tremendous challenge to effective access. First, the scope and quantity of information is increasing because more information is generated in digital form or “born digital.” In addition, institutions and agencies are digitizing existing analog forms of resources. Publishing this information electronically is more cost-effective, and can potentially provide improved access for citizens (Mullen, 2001). Although there is no doubt that the Internet is easily accessible to millions of people and can help them to find what they want, Iannella and Waugh (Iannella and Waugh, 1997) found that the ability to find relevant material has decreased dramatically as the quantity of information on the Internet grows. Also, Hahn (Hahn, 1998) commented that few users understand how to manipulate a query in order to maximize the results of their retrieval process. For this reason, even though the Web holds a vast amount of information, most users still find documents that have little or nothing to do with the information they set out to locate. With over three million unique Web pages (OCLC, 2000), any given Web-based resource may be hard for users to find. The abundance of digital information leads to several significant problems that are still largely unresolved. As noted by December (December, 1994), the ease of creating Internet resources means that “information space” – that is, the finite area of servers, network connections, storage capacity, and software provided by a given Internet protocol and utilized by a broad and global audience – is both saturated and polluted with information, effectively hiding significant resources in the course of both casual as well as highly-organized and focused searches (Henshaw and Valauskas, 2001).

As Thornely (Thornely, 1998) argued, the Internet needs to have a standardized way of describing resources to enhance the process of resource discovery, thus, we find the re-emergence of an old concept of cataloging in the
new cyber era – metadata. According to Dempsey and Heery (Dempsey and Heery), it is inevitable that diverse approaches to metadata study will continue and new formats will be created to fit new user communities and market opportunities. Jul (Jul, 1997) summarized the brief history of standard library cataloging of Internet resources and discussed some of the issues confronting this effort. He posed three critical questions:

1) Are Internet resources worth cataloging?
2) Is traditional MARC/AACR2 cataloging appropriate for Internet resources?
3) How can resources that change location be cataloged?

Jul concluded that all resources should be treated with the same importance regardless of format, that traditional cataloging is a useful way to catalog Internet resources despite some hindrances, and that cataloging moving objects (resources that change location e.g. websites) is very important in order to satisfy user needs. This last point makes obvious the advantage of the PURL system, which traces moving objects.

Importantly, metadata offers a mechanism that can facilitate both the location of specific Web content and the assessment of its quality. In order to ensure the effectiveness of a metadata system for Web resources, three general requirements have been identified by a variety of researchers (Resnick and Miller, 1996). First, the metadata system must provide specific data related to the page type, subject area, and source of a resource; second, the metadata should be designed to meet the specific needs of the target user population; and third, the metadata must have a consistent format so that autonomous agents can readily use it when processing user search requests. Given these general requirements, a Web-related metadata system can provide information in a concise, uniform manner and along an easily interpretable path for the user.
Metadata involves many hundreds of different characteristics for bibliographic cataloging and related disciplines. Of these and hundreds of other descriptive metadata, however, just a few characteristics are almost always pertinent to all information resources, such as title, author, subject, date, and place. These few characteristics are used traditionally for the citations of books and are the same characteristics now found in metadata on the World Wide Web. The use of these basic characteristics in a Web-based metadata system provides a foundation for common searching of the metadata regardless of the types and formats of the information being sought. Metadata schemes have the potential to more precisely organize electronic information, and can protect the ownership of information. Given the longstanding use of metadata in basic library cataloging, it stands to reason that librarians need to be meaningfully involved in this groundbreaking effort.

Different Views of Metadata Standards

As Gritton (Gritton, 1994) has noted, metadata is a heavily overloaded term for which many definitions have been developed. Although the term “metadata” has been applied in a variety of contexts (Smith, 1996), it is generally thought of as data about data, and has been described as closely related to cataloging. Two researchers have articulated different views of metadata standards. Weibel (Weibel, 1997) has discussed constructing metadata standards that are as simple as possible, and Clarke (Clarke, 1997) has argued for metadata that are as comprehensive as possible.

Gorman (Gorman, 1999) has asserted that the problem of choosing between metadata and cataloging in the bibliographic control of electronic resources is overstated. The more relevant question, Gorman has suggested, is how much information should the metadata format represent? Gorman cites two
different approaches to metadata, one from Weibel and the other from Clarke. Weibel (Gorman, 1999) wrote:

The Minimalist point of view reflects a strong commitment to the notion that DC (Dublin Core)’s primary motivating characteristic is its simplicity. This simplicity is important both for creation of metadata ... and for the use of metadata by tools.... The goal...can only [be] achieved if there is a simple core of elements that are understood to mean the same thing in every case. (p. 18-19)

Conversely, according to Clarke (Gorman, 1999):

The proponents’ priorities have been expressly oriented towards simplicity, and away from sophisticated structures.... The...desire for simplicity has resulted in a mechanism that is incapable of representing the richness of the real-world challenges that present themselves... a richer, more sophisticated model need not be uncomfortable or inconvenient. (p. 19)

Regardless of one's position on these opposing views, it is clear that more abstract standards for information structure and content need to be established, standards that will allow interoperability on the semantic level (Gill, 1998).

For the past several years, metadata developers have endeavored to construct metadata standards that would permit maximum interoperability from one metadata system to another. One popular approach involves constructing a map between two diverse standards, such as Dublin Core, which has a simple structure, and MARC, which does not (Caplan and Guenther, 1996). Despite some progress, however, there have been many hindrances to creating such a map. Simply stated, information specialists are confronted with a World Wide Web that is almost too big to catalog. In addition, consensus on the most appropriate structure and content for metadata has been slow in coming, despite the
significant efforts of various segments of different academic communities. Furthermore, a useful metadata system is difficult to build and needs to be evaluated properly.

Many researchers have no doubt that Dublin Core serves an important role for relatively simple uses, but there are still compelling arguments that more complex and powerful metadata standards are needed as well (Tennant, 2003).

The recent appearance of Connexion from OCLC may be regarded as an important turning point in the quest for a widely accepted metadata standard because:

1) it is integrated with a traditional cataloging service, called WorldCat; and with an experimental metadata service for online resources, the Corporative Online Resource Cataloging (Helfer, 2002).1

2) it has the potential to challenge the library and information field to integrate traditional cataloging services with “newer” information objects.

**A Prelude to Integrated Cataloging and Metadata Services**

In addition to the conflicting approaches to optimum metadata standards offered by researchers, other information specialists have made various proposals for integrating traditional cataloging services and metadata services.

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1 CORC had been developed by OCLC. CORC was optimized to identify, select, describe, and maintain Web-based electronic resources and to create. CORC offered support of multiple metadata schemes e.g. MARC and Dublin Core, authorities, automated URL maintenance. Over 500,000 Web resources were added to the database in the year of 2002.
Such approaches are worthy of consideration because they present an opportunity to reconcile metadata services with traditional cataloging services as well as resolve the conflicts inherent in the different views of optimum metadata standards.

Shen and colleagues (Shen, Mukkamala, Wadaa, Zhang, Abdel-Wahab, Maly, Liu and Yuan, 1994), for example, proposed a three-layer interoperability architectural model for digital information resources in a library system. The three layers included a user interface layer, an interoperability layer, and a resource repository layer. For these researchers, the notion of a uniform interface that would meet all the needs of the library system was almost inconceivable. They instead foresaw the development and utilization of a variety of commercially developed interfaces. Researchers also have made several attempts to integrate metadata with legacy systems, such as the Online Public Access Catalog (OPAC) in libraries (Thomas, 2000; Xu, 1998). In 1997, Xu conceptualized a metadata conversion system that would be built into library OPACs for metadata integration and display. She saw both local metadata and incoming metadata as part of the library collection that can be captured via automatic metadata extraction, mapping, conversion, and integration as a result. In essence, Xu sought to utilize the full functionality of the library OPAC to accommodate newly integrated metadata.

The last part of the metadata integration process proposed by Xu provides an interface to facilitate a metadata search of both the metadata repository and existing library resources and to display the search results in a user-specified metadata format. Xu emphasized that the use of a library OPAC as a metadata interface preserves the sophisticated search features and powerful linking models of the library OPACs and provides integrated searching of heterogeneous information in various metadata formats.
Although Xu focused on metadata conversion rather than integrated cataloging and metadata services, her work exposes issues related to the integration of two very different resource formats.

Thomas (Thomas, 2000) has proposed a metadata integration concept similar to Xu’s, entitled “Catalog as Portal to the Internet.” Thomas examined the potential of the catalog to serve as a portal to the Internet. She noted that a key catalyst for the development of more uniform cataloging was the MARC format, created in the 1960s. MARC enabled electronic dissemination of bibliographic records and engendered networks of libraries. Since its inception, MARC’s potency has increasingly derived from unleashing the potential of the large-scale union catalog for resource sharing, and its power has been evident in the economies realized through copy cataloging, first of records from the Library of Congress and subsequently from original cataloging contributed through thousands of libraries, large and small, in the last two decades. The catalog can serve as a portal to the Internet if it is reinterpreted in the form of an information service which systematically registers publications and documents of interest to a particular community regardless of the form or location in which they originally appeared. In the near future it is likely that a hybrid will emerge, one that adopts some of the superior features of the catalog but employs an increasingly sophisticated technological infrastructure that increases the yield for information seekers. Such an information management tool will have evolved from the catalog and will be influenced by what is now called the portal, though it is probable that a newly-coined name will be developed to represent this new concept.

McCallum (McCallum, 2000) has also emphasized the importance of integrating Web resources into the traditional MARC format. The challenge for today’s information specialists, according to McCallum, is to create appropriate tools for finding and retrieving the burgeoning number of Web resources. To this
end, she has proposed extending MARC to include Web resources with several alternatives, such as Dublin Core, XML, and others.

The ideas proposed by researchers like McCallum and Xu are based on the reality inherent in the modern workplace, that is, the tremendous amount of Web resources in existence. As Web resources become larger and more complicated, information professionals are faced with the dilemma of managing the great proliferation of electronic information using traditional resources. The OCLC’s CORC was an experimental operational system designed to control Web resources, and Connexion is an updated effort to control resources regardless of the format of the materials.

Dempsey and Heery (Dempsey and Heery, 1998) have offered yet another preliminary definition of metadata:

…metadata is data associated with objects which relieves their potential users of having to have full advance knowledge of their existence or characteristics. It supports a variety of operations. (p.149)

This definition stresses the need for metadata to support effective resource usage and emphasizes the concept of metadata as knowledge that promotes the intelligent behavior of humans and automated users (Dempsey and Heery, 1998). Lide (Lide, 1995) mentioned that metadata is auxiliary information needed to utilize the actual data properly and reduce the possibility that actual data will be misinterpreted.

**Concurrent Issues in Metadata Research**

Since the inception of the World Wide Web, then, information communities have faced the challenge of accommodating information organization and delivery to the rapid growth of Internet resources. Metadata can
play a significant role in addressing this challenge. An examination of concurrent issues related to metadata is potentially helpful in achieving the primary goal of information communities: to provide better information to their users.

In the Internet environment, the user community is so diversified that it is hardly possible to specify a single predominant use or user (Burnett, Ng and Park, 1999). Considering the diversity of user communities, information specialists must be careful not to limit or hinder the development of various metadata formats appropriate for serving each community. Further, information professionals must understand and agree upon the extent of information that needs inputting in order to satisfy general user needs. For example, although it is the intention of the Dublin Core group to create simple, usable metadata standards, problems arise when metadata is created by untrained people and operated across different implementations. Burk has discussed another group working to develop metadata standards who is concerned about Dublin Core’s lack of precision. This group believes there must be the ability to qualify DC’s data elements for effective search and retrieval (Burk, 1999). At the November 1998 Committee on Institutional Cooperation (CIC) Metadata Conference, Clifford Lynch brought up several interesting issues related to metadata (Bregman and Sandore, 1999). He focused on three major topics: the nature of metadata, interoperability, and infrastructure. First, Lynch asserted that the information community ought to identify the goals it wants to achieve through the interoperation of entities, determine what processes it wants to carry out, and then decide how the interoperability of metadata systems can further these ends. Second, Lynch noted that three categories of metadata have begun to emerge, all critical to the discovery of networked resources: administrative metadata, structural metadata, and descriptive metadata. According to Lynch, the diversity of information resources in today's world calls upon information professionals to devise multiple approaches to metadata. The final issue that Lynch discussed involved the
enormous need for information professionals to think about an infrastructure for
metadata. Turner and Brackbill (Turner and Brackbill, 1998) have suggested that
metadata can be thought of as one solution to the problem of retrieving
information about a stored collection of digital information. According to Burnett
and Lee (Burnett and Lee, 2000), a significant amount of research about metadata
has been published during the limited period of 1997 to 2000. A significant
number of articles have concerned crosswalks, frameworks, and supermetadata.
Bearman and his colleagues (Bearman, Miller and Rust, 1998) have reported on
efforts to bring the traditions of DC metadata and MARC into a closer
relationship through the harmonization of DC metadata and Rights Management
Metadata. These researchers have pointed out that changes in metadata inevitably
cause uncertainty, and uncertainty leads to instability. The benefits and costs of
such changes must be considered carefully, and if changes are to be made, they
must be introduced with the minimum possible disruption to existing applications.
Fietzer (Fietzer, 1998) has raised two concerns related to metadata: data integrity
and rights management. His work has explored new paradigms related to
metadata as well as current efforts to merge metadata crosswalks and frameworks.
Fichter (Fichter, 1999), at Northern Light Internet Solutions, has discussed
metametadata (also known as supermetadata,) an administrative and factual
metadata for intranet environments. Further, The Bulletin of the American Society
for Information Science included a series of comprehensive articles on metadata
issues in a special section in late 1997. These articles discussed experiments,
frameworks, crosswalks with Dublin Core, Uniform Resource Identifiers, and
other efforts to explore metadata issues (Efthimiadis and Carlyle, 1997).

In the present case, we may be encouraged somewhat by the fact that the
semantics of what we hope to be able to say about resources do not appear to be
changing significantly. Rather, it is the structure of how assertions are made that
is in question. Our real goal would be to create a structured metadata using a
general model with greater flexibility than the implicit unprepared model of the past. There have been a few efforts to complete this goal e.g. qualified Dublin Core sets which extend the element sets with flexibility (Weibel and Koch, 2000). Simple resource description was among the primary motivations for embarking on the development of the Dublin Core. The potential benefits of reconciling these closely related sets of requirements are great. However, there also have been arguments for the necessity of complex and comprehensive metadata schemes such as MARC (Tennant, 2003). In this stage, we must put our efforts into clarifying common frameworks for exchange of information and recognizing the requirements. Even if the needs of various stakeholders are different and conflicting, all may benefit when the frameworks are interoperable (Bearman, Miller and Rust, 1998).

**Further Research on Metadata**

Researchers have identified two directions for further study, both of which involve the creation of metadata systems for electronic documents. The first approach is to embed the metadata descriptions into the <HEAD> portion of an HTML document using the META tags. This is the easiest method for conveying the metadata information to the user. Weibel (1997) noted that this technique has several advantages. No additional system must be in place to use it, and because the metadata is integral to the resource it can be harvested by Web indexing agents. A second method for using metadata to organize electronic resources involves creating a database to collect and manage metadata records. In this case, the metadata is not embedded in the resource itself, but is generated by the document owners and stored separately from the resource it describes in a Web database system.
Another promising area for research concerns interoperability. Over five years ago, Tennant (Tennant, 1997) studied interoperability, or the capacity of a user to treat multiple digital library collections as one. Tennant believed that interoperability was the key challenge facing digital libraries. Tennant (Tennant, 2000) recently wrote of an effort to establish interoperability, the Open Archives, an initiative aiming to specify the methods by which several various individual archives can interoperate. According to his previous article, he suggested that such interoperability can be achieved by specifying: a) a protocol for gathering or “harvesting” metadata from participating archives; b) a criteria to selectively harvest metadata; and c) a common metadata format for archives to use in responding to harvesting requests (Tennant, 2000). In his book, Berners-Lee (Berners-Lee, 1999) described his notion of a Web populated with rich metadata that is machine-readable, semantically flexible, and derived from trusted sources. In a related vein, Medeiros (Medeiros, 2000) argued that a trusted, structured mechanism is needed in order to parse context relationships across all semantic schemes.

One alternative to a single system containing both Dublin Core and MARC was CORC, an OCLC research project designed to provide cooperative cataloging of electronic resources using a variety of metadata standards. Users of CORC could choose to view records in either the Dublin Core or the MARC format. At the Metadata Preconference in 2000, Weibel (Weibel and Koch, 2000) predicted that CORC would become the prism system for the Internet. Malone noted, however, that the requirement that participating libraries devote the equivalent of a half-time staff person to the project might prevent smaller libraries from joining (Weibel and Koch, 2000).

Semantic mapping is a method for indicating the equivalence between concepts. Systems that utilize semantic mapping do not require searchers to know all the different and unique characteristics of the metadata representations in
different collections, but only the common concepts (Christian, 2001). The semantic mapping of search terms enables almost any information search service to offer a high degree of interoperability. The Global Information Locator Service (GILS) represents one attempt to construct and realize this kind of interoperability between different collections (Christian, 2001).

According to Heery and her colleagues (Heery, Powell and Day, 1998), interoperability can exist at a number of levels. From the user’s point of view, interoperability can be more or less effective depending on how closely the various services are integrated in regard to semantics, query language, indexing, and management of results (Heery, Powell and Day, 1998). Dempsey and Heery (Dempsey and Heery, 1998) have noted that, metadata will assist individuals to more effectively use existing resources and prove to be essential for effective systematic use of resources. From Dempsey's point of view, metadata must not merely be considered a tool for the organization of Internet information, but a form of knowledge that allows automated as well as human users to behave intelligently.

Usability

With the unparalleled access to information made possible by the World Wide Web, library and information professionals now have a vast new information environment with which to support users. In addition to dealing with print materials, library work has come to include digitizing special collections, journals, and data sets as well as creating and managing online public access catalogs (OPACS) and World Wide Web (WWW) sites. As Web services and content increase, the complexity of the information options that must be digested and navigated by the user also increases (Palmquist, 2001).
Yet despite the explosion of information technology and the growing
dependence on computers throughout the world, it was not so long ago that
libraries began to devote serious attention and physical resources to the creation
of Web sites (Battleson, Booth and Weintrop, 2001). Aware that the user is one
of the most important factors in the library and information science environment,
information specialists have made a great effort to create easily usable Web-based
interfaces and effective systems for communicating with users. One of the best
ways to determine how well an information system performs is to measure its
usability. In information sciences research, usability refers to the extent to which
a user can negotiate a product or system quickly and easily in order to complete
the tasks given to him or her. Accordingly, the concept of usability emphasizes
the user's understanding of what he or she wants and needs to achieve (Veldof,
Prasse and Mills, 1999).

According to Kim (Kim, 2002), most usability studies suffer from three
fundamental problems – first, the concept of usability is ill-defined; second,
usability measures are restricted to checklists or guidelines that reflect only
certain aspects of usability issues of concern to the researcher; and last, the focus
of most studies is primarily with the outcomes of user-system interactions, such as
user performance, preference, and attitude toward the system. Even with these
problems, usability testing is essential because the user is the one of the most
important factors in library and information science. The need to make the
system work well in terms of communication with the user is so important that
information professionals must continue to improve the means by which they
evaluate the usability of systems from user’s point of view.

As the features and functions of products that we use at home and in our
workplaces become ever more complex, the notion of usability becomes
increasingly relevant. Above all, product designers must consider the needs and
limitations of users. Otherwise products created with the intention of delivering
some benefit can end up being more trouble than they are worth. Users are becoming more sophisticated with respect to their expectations about product performance. These expectations include ideas about a product’s desired usability (Landauer, 1995). With the growth of the Internet, the usability of websites has become an increasingly important area of research as well. In the words of Palmquist (Palmquist, 2001), "Usability is not a new idea, but its application to the Web is relatively new" (p.124).

The Emerging Importance of Usability

According to Palmquist’s (2001) study of the 1960s database INSPEC, the term usability can carry a variety of meanings, such as the usability of certain physical materials. The appearance of the term "usability" came about in conjunction with the term “user” in the mid-1980s, when the "user-centered" approach to systems design began to develop. Similarly, the term “user friendly” was associated with a host of vague and subjective connotations by the early 1980s (Bevan, Kirakowski and Maissel, 1991). Even though traditional managers and developers initially resisted making the users' perspective the first priority, the successful outcomes of projects emphasizing usability eventually convinced managers and developers of its importance (Shneiderman, 1998).

In the early days of PC software, functionality or usefulness was considered the most important aspect of the software. As more applications acquired the same capabilities, however, the relative importance of usefulness as a feature of the software decreased.

In the mid-1980s, the increasing value of usability to consumers of software products was highlighted with the introduction of the Apple Macintosh, the success of which demonstrated that people were willing to pay more for a computer that was easy to use, even if the functionality of the software had not
essentially changed. The importance of usability was further underlined by the introduction of Windows 3.0 in the early 1990s. Around this time, the integration of usability testing into software development became a priority for many companies. Companies began hiring usability specialists and creating new divisions, such as a Human Factors Group or Usability Engineering Team. Apple and Microsoft have long been two industry exemplars in the area of usability. Both employ usability professionals and are actively engaged in product development (Veldof, Prasse and Mills, 1999).

Usability is one of the focuses of the Human-Computer Interaction (HCI) field as well. As the name suggests, in Human-Computer Interaction studies, usability refers to bridging the gap between the computer's capabilities and its use by an actual individual. A user interface (or human-computer interface) refers to the parts of a hardware and/or software system that enables a person to communicate with a computer, including output devices (the means by which a computer communicates with a user) and input devices (the means by which a user communicates with the computer). Typical output devices are computer monitors and windowing systems, but also include speakers and other devices that make possible feedback to users. Input devices include peripheral devices such as keyboards, mice, and joysticks, but also include microphones and even eye movement devices and voice recognition devices. Each of these interface components has devices corresponding to the visual (sight), aural (sound), and haptic (touch) channels of the human brain. Usability engineering field studies explore these elements of the user's experience in communicating with computers.

The notion of usability is the primary concern of a great number of books, articles, websites, conferences, and consultants. Usability is also the focus of a class of ergonomics called user-centered design (UCD), or, in the realm of computers, human-computer interaction (HCI). Throughout its development, the concept of usability has always been understood as the interaction between a user
and a product or service. To adequately measure usability, it is necessary to begin with a combined understanding of the user’s needs, desires, and abilities, as well as the goals, functions, and limitations of the product or service. In order to understand the user, usability studies must consider factors such as the user’s experience, domain knowledge, cultural background, and disabilities, as well as age and gender. In regard to the product or service, usability research must examine how easily it may be learned, experimented with, and even re-used after periods of nonuse, and must also consider the limitations of the product or service as well as the limitations of even experienced users (Morgan, 1999). In order for a tool (a product or a service) to be effective, then, it must allow its intended users to complete their tasks in the best way possible. The same principle applies to computers, websites, and other software. In order for these systems to work well, users must be able to employ them effectively. The perceived usability of a system depends on a number of factors, including how well the functionality fits user needs, how well the application fits the user’s task flow, and how well the reaction of the application fits user expectations.

The user's perception of usability is important because it can influence whether the user performs a task accurately and completely, and enjoys the process or ends up frustrated. The developer's perception of usability also is important, because it can mean the difference between the success or failure of a system. From the point of view of management, software with poor usability employed in work settings can reduce the productivity of the workforce to a level lower than that achieved prior to the implementation of the software. In these cases, the poor usability of a computer system can cost individuals and companies time and effort, and determine the system's success or failure. Given a choice, people will tend to buy systems that are user friendly.

In the 1980s, software developers began to test the software product’s interface with the user when it became apparent that such testing with actual users
could improve customers’ satisfaction and the profitability of the final product (Palmquist, 2001). Since that time, the use of the word usability has become very common in product and system development. Still, many different approaches to making a product more usable exist, and no one definition of the term usability has been agreed upon by information specialists as yet.

At face value, usability refers to the workability and intuitiveness of any interface, from a user’s point of view (Head, 1999). The working definition of usability adopted in this study is derived from a wide number of views on the subject. Three of these views relate to the way in which usability should be measured:

- **Product-oriented view:** usability can be measured in terms of the ergonomic attributes of the product.
- **User-oriented view:** usability can be measured in terms of the mental effort and attitude of the user toward the product.
- **User performance view:** usability can be measured in terms of the way the user interacts with the product, with particular emphasis on ease-of-use (how easy the product is to use) or acceptability (whether the product will be used in the real world.)

These aspects of usability are complemented by a contextually oriented view, that is, one that sees the usability of a product as a function of the particular user or class of users being studied, the tasks they perform, and environment in which they work (Bevan, Kirakowski and Maissel, 1991).

Many trace the concept of usability to Jacob Nielsen, who attracted the Web spotlight through his usability experiments at Sun and his Web design column “alertbox” (http://useit.com/alertbox). Nielsen’s work resulted in the phenomenal success of systems that had undergone extensive usability testing. One explanation for this success is that such test results could be translated quite accurately into users’ point of view toward the product.
Within Human-Computer Interaction (HCI) circles, where user-centered
design has been around for more than 20 years, the full meaning of usability
extends beyond a site’s intuitive virtues. In his technical writings about usability,
Nielsen (Nielsen, 1993) provides one of the most complete definitions around,
identifying five attributes of a usable interface:
1) easy to learn;
2) efficient to use;
3) easy to remember;
4) causes few errors; and
5) pleasant to use. (p.281)

Seen from an HCI perspective, however, the notion of usability has a
meaning other than “user-friendliness.” Usability is rooted in cognitive science –
the study of how people perceive and process information through learning, the
use of memory, and attention (Head, 1999). Usability experts like Nielsen, on the
other hand, tend toward simpler categorizations of user differences. According to
Nielsen (Nielsen, 1995), simpler, less cognitively oriented categories can be more
easily identified and still account for a fairly large degree of performance variance
even if a variety of factors may affect a user’s performance.

**Usability Testing**

Despite the explosion of information technology and growing dependence
on computers in all facets of society, it has not been long that “user needs” have
been part of software and interface development. During the 1990s, software
companies began to address the needs of their customers seriously and design
products for usability rather than just functionality (Nielsen, 1995).

Nielsen’s *Usability Engineering* is the most comprehensive and practical
discussion of usability engineering and testing to date, covering the usability
engineering life cycle from product conceptualization to design and evaluation
(Nielsen, 1993). Usability testing, the component of usability engineering that
involves the testing of an interface/system to determine whether or not it meets the precepts of HCI, has been explored by other authors as well, most notably Rubin (Rubin, 1994) and Dumas and Redish (Dumas and Redish, 1993). Research has demonstrated that iterative testing of three to five users will uncover most problems in terms of usability (Nielsen, 2000). The key principle for maximizing usability is to employ an iterative testing strategy, which gradually refines the design from the early stages of design through evaluation. The evaluation stage encourages designers and developers to incorporate user and client feedback until the system reaches an acceptable level of usability (Battleson, Booth and Weintrop, 2001).

**Usability Testing and Library and Information Science**

Compared to computer companies like Apple and Microsoft, libraries and information specialists have been slow to address issues related to the usability of computers used by library patrons. Unlike computer professionals, library and information professionals have not worked closely with producers of software or computer interfaces, although the means by which users seek information in an automated environment has always been one of the most important concerns of information specialists. Recently, this concern has led library and information professionals to provide better service by removing barriers to the use of various online products for library patrons and recommending design changes to vendors (Veldof, Prasse and Mills, 1999).

With the predominance of information technology (e.g. tools, gadgets, hardware, software, and program applications) in the library and information environment, information professionals have begun to turn more to the evaluation of systems using usability testing. The software market is suffering from an overflow of different products, resulting from the rapid growth of local and international competition. Information proprietors, specialists, and practitioners recognize the value of efficient and effective information retrieval systems, and
usability evaluation has become an essential requirement in product design, development, and acceptance. Because usability focuses on the users and an understanding of what they want and need to accomplish when they use the product, usability simply means that the people who use a product can complete their tasks quickly and easily (Oulanov and Pajarillo, 2001; Veldof, Prasse and Mills, 1999).

According to Veldof and colleagues, adapting to a user-centered focus is an excellent way for information professionals to begin to find answers to such questions as: How do people look for information? How would they prefer to get it? How would they prefer to see it displayed, delivered, and processed? Many libraries have already moved into a user-centered paradigm, challenging themselves on all fronts to create services that are user-focused. At the University of Arizona, for example, teams are expected to conduct needs assessments, collect data on library processes, and measure success with tools that solicit customer satisfaction ratings (Mills and Dickstein, 2000; Veldof, Prasse and Mills, 1999).

A good deal of recent research has explored usability issues in the library and information environment. Much of this research has consisted of experiments on specific facets of the library and information environment, and though it is more practical than philosophical, it reveals a good deal about usability issues in the library environment. Usability is particularly relevant to librarians as their roles change from traditional librarians to information specialists and system designers. More libraries, for example, have initiated knowledge management projects, such as designing electronic journals and online exhibits that supplement their special collections. Further, with the development of digital libraries on a large scale, information specialists have taken real steps towards becoming “designers.” Libraries are now creating Web gateways to the library, its resources and the entire world of Internet resources.
Many studies of usability in the library and information environment have focused on end-user behavior in automated systems, online catalogs, networked databases, and CD-ROMs (Borgman, 1996; Hert, 1996; Nahl and Tenopir, 1996). The overall focus of these studies has been the ease with which users are able to employ the tools at their disposal, and in what ways library systems can be improved to help users better achieve their aims. Other related usability studies have examined Web usability and user-computer interfaces. The LIS literature also contains studies in which usability testing methods have been employed to assess users. This research has dealt with user factors such as the human cognitive process in information seeking in the library and information environment.

Spool’s (1997) book, *Web Site Usability: A Designer’s Guide* was the first published study to explore Web usability in the context of information retrieval. The book covered general usability issues as well as usability testing methods in detail (Spool, 1997). Veldof (Veldof, Prasse and Mills) also explored usability as it relates to Web applications in libraries. Using examples from OCLC and the University of Arizona, Veldof described how usability evaluations might be incorporated into the library setting.

Shneiderman, Byrd, and Croft (Shneiderman, Byrd and Croft, 1997) studied information retrieval interfaces, and devised a set of eight guidelines for the design of a usable information retrieval interface:

1. Be consistent.
2. Provide shortcuts for experienced users.
3. Offer feedback to help improve the search.
4. Design for closure.
5. Error handling.
6. Permit easy reversal of actions.
7. Support user control.

Even if a consistent guide for usability testing does not exist, the guidelines above are worthy of consideration. Using these guidelines, video-based usability testing methods were described in the late 1980s in OCLC’s *Annual Review of Research* (Prasse, 1990).

According to Gluck (Gluck, 1998), usability frequently can be understood by the other terms it modifies. Usability testing, for example, is often used to assess a completed (or nearly completed) product in some fairly realistic user setting. Bringing in the user at the “about to be released” stage creates a combination of usability testing and what also has been called “acceptance testing.” In regard to a commercial product, this involvement of the user near the completion of the design typically is of great interest to the sales and marketing divisions as well as usability specialists.

Allen (Allen, 1996) has observed that after many years of electronic information systems design and user studies, most systems are still far less usable than the user has every right to expect. Allen’s expertise in testing user cognitive abilities in information-retrieval experiments lends credence to his advice about the need for more usability-sensitive software development. Both Marchionini (Marchionini, 1995) and Dillon (Dillon, 1994) have addressed user-centered factors (individual differences) as well as external factors that can impact the user’s information-seeking experience in electronic environments. They reviewed the research on various user-centered aspects of electronic information environments, shedding light on the factors involved in creating truly usable software systems. A few studies have addressed individual differences in assessing a system’s usability (Bellardo, 1985; Borgman, 1996; Dillon and Watson, 1996). Of these, Dillon and Watson have provided the most cogent overview of the research concerning the impact of individual differences on users’ computer interaction with the system. Both Borgman (Borgman, 1989) and
Bellardo (Bellardo, 1985) provided an introduction to the study of individual user differences and information systems. Bellardo looked at factors like creativity, verbal and quantitative ability, and self-esteem as they affect the quality of an online searcher’s final results. Borgman examined academic orientation and a variety of personality characteristics in terms of their impact on information-retrieval performance. In both cases, the authors provided helpful reviews of the literature on individual differences and how these differences might affect the users’ use of a system.

Despite their limitations, library websites are evolving into information gateways, opening access to library resources and services as well as electronic indexes and databases, primary research materials, and the Internet in general. Yet the staggering amount of information available via these sites can produce an “information overload” that can bewilder, confuse, and even discourage users. A fundamental need exists for “usability” in library websites, to create systems with enough ease of use that library patrons actually use the wealth of resources available to them through such sites. This basic assumption—that the function of libraries is to enable patrons to make use of resources—makes usability testing an invaluable tool for evaluating the effectiveness and ease of use of interfaces that exist in libraries (Battleson, Booth and Weintrop, 2001).

Despite the relatively long history of studying and responding to user behavior through end-user studies, the relative lack of literature on the topic reveals that libraries are only beginning to apply usability testing to their websites.

Several studies have examined the use of library websites in order to explore usability issues in the library and information field. Eliasen, McKinstry, and Fraser (Eliasen, McKinstry and Fraser, 1997) tested students’ ability to navigate online menus and correctly select databases from the library homepage at the University of Washington. Similarly, Chisman, Diller, and Walbridge (Chisman, Diller and Walbridge, 1999) conducted formal usability testing of the
Washington State University Libraries’ online public access catalog and indexes. Veldof, Prasse, and Mills conducted case studies which yielded much useful information about usability testing in general. The testing methods described include heuristic and formal usability testing with paper and online prototypes at the University of Arizona and OCLC (Veldof, Prasse and Mills, 1999). Battleson (Battleson, Booth and Weintrop, 2001) conducted usability testing on an academic library website. This case study reviewed the concept of usability and explored the application of usability testing to library Web sites at the University at Buffalo libraries. McGillis (McGillis and Toms, 2001) assessed the usability of an academic library website at the Memorial University of Newfoundland (www.mun.ca/library) and examined how faculty and students completed typical library tasks. These studies are important because they involved applied usability testing with actual users of library websites.

Efthimiadis (Efthimiadis and Carlyle, 1997) noted that researchers and information practitioners continue to seek to organize Web-based resources and improve the ability of search engines to find documents, as well as participate in initiatives to develop thesauri or generate metadata standards. Given that attempts to organize resources using indexes, thesauri, and other representation structures have continued to engage significant resources, the effectiveness of traditional indexing theory and practice within the Web-based environment must be explored as well (Hert, Jacob and Dawson, 2000). Within the last decade, researchers in library and information sciences, as well as other areas, have sought to adopt a user-centered approach to the investigation of information seeking behaviors and the development of better information tools (Dervin and Nilan, 1986). Hjorland and Albrechtsen (Hjorland and Albrechtsen, 1995) and Albrechtsen (Albrechtsen, 1993), for example, focused on the need for a user-centered approach to the development of representational structures. They argued that the development of effective organizational tools (such as indexes and thesauri) depends upon an
analysis of language usage within a particular discourse community or knowledge domain. Although only a handful of studies have addressed the indexing preferences of selected groups of individuals (Babu, 1992; Diodato, 1994a; Diodato, 1994b), even fewer studies have dealt with the actual functionality of indexes (Milstead, 1994).

Only two studies have addressed such questions about indexing. Liddy and Jorgensen (Jorgensen and Liddy, 1996; Liddy and Jorgensen, 1993) conducted exploratory studies investigating how individuals actually use indexes. According to their findings, the structure of back-of-book indexes is not intuitive for users, nor is the organization of information imposed by the professional indexer necessarily in accord with the way the user thinks about finding that information. Hert (Hert, Jacob and Dawson, 2000) later extended the conclusions of these authors, suggesting that synthetic references such as “see” and “see also” may not be the most effective means for indicating relationships between terms and/or concepts. A library website, then, might be considered a complex application integrating access to and interaction between a diverse set of information products and services and various user groups. Usability testing represents a means to ensure that the satisfaction of the user in the library setting can be achieved.

**Current Issues for Further Research on Usability Testing**

Although studies of metadata and usability testing do exist, researchers need to continue to address related issues for further theoretical and applied development in both of these areas. In the words of Spool (Spool, 1997), “The Web is a whole new ball-game, and we’re still learning how to play. We don’t know how to design for finding information” (p.12).
Veldof (Veldof, Prasse and Mills, 1999) has argued that the ongoing application of usability testing in libraries is one way to ensure the development of electronic services and resources "chauffeured" by the user. Veldof's discussion was offered in the hope that LIS (Library and Information Sciences) faculty considering the prospect of developing usability courses or modules will find this information useful in furthering their efforts. As the LIS field continues to improve an understanding of Web-based delivery of information services and resources, the effort to provide some degree of user testing can produce better Web-design effort. This clearly has been a high priority for many in the e-commerce and for-profit business community for a while. In the nonprofit sector as well, such as in libraries as well, the Web has given real meaning to the importance of applying user-centered design practice.

The Web certainly provides a valuable communication channel between the user and LIS professionals who seek to serve the user’s information needs from beyond the physical environment of the library or information center. Web sites have become an integral part of the information access mission of academic libraries. It is challenging to develop a usable and effective site as well as maintain and redesign that site to meet the constantly changing needs of the user. Usability testing is very appropriate for this task since it not only identifies user-interface problems, but also suggests ways for attacking those problems. As Battleson (2001) argued, the importance and applicability of usability testing to library websites cannot be understated. Whether through simple inspection, inquiry, or formal usability testing, libraries can employ usability testing methods to inform and evaluate design changes, especially as librarians strive to meet the increasing information demands of users.

Usability is much more than just creating an aesthetically pleasing interface. Factors such as aesthetics, functionality, user satisfaction, and ease-of-use all play important roles in creating usable systems. At the same time, there
are many aspects of gathering, analyzing, and synthesizing information into knowledge that cannot very well be automated into a tool. Even if libraries had the most usable of all systems, information seeking might still prove challenging or frustrating for some users, depending on their perspectives. Overcoming such challenges and frustrations might be regarded as one of the most important public services libraries provide (Morgan, 1999).

For future library and information science professionals, an understanding of users in electronic environments will be a definite requirement for better service. In some ways, the function of helping the user adjust to a variety of different commercial interfaces is changing according to the development of technology and the product itself. Usability testing can lead library and information science professionals to better understand the user and make contributions as designers or trainers for nonprofit information services or for-profit information product developers (Palmquist, 2001). Further, usability testing can be applied as an inexpensive means for assessing important library systems and products, and the results can lend credibility to the creation or updating of more user-friendly library OPACs, websites, and the like (Walbridge, 2000).

Over time, technology has improved information retrieval and increased human expectations of information retrieval systems. Although information specialists may be confident about a product or service at a particular time, such confidence may not extend to different user groups or different times. If the user cannot easily locate a resource or understand what he or she is seeing when using standard library tools, the tools cannot really be thought of as tools. Usability testing should be applied to all the many facets of the library and information environment because of this very premise. If barriers to effective information seeking are continuously confronted and overcome, then information professionals can feel satisfied that they are doing their jobs.
Summary of the Chapter

This chapter provided a review of the historical and empirical literature related to the present study of metadata standards and usability testing. An overview of the fundamental concepts underlying the notion of cataloging and their relationship to metadata was provided. The need for metadata standards was discussed, and a prelude to integrated cataloging and metadata services was presented. In addition, the concept and importance of usability testing was discussed and the appropriateness of usability testing for this study of an integrated cataloging and metadata services system was explored.

The next chapter will describe the methodology for the present study, including the data to be used and the method of data analysis to be implemented.
CHAPTER 3

DATA COLLECTION AND ANALYSIS METHODS

Introduction

The overarching goal of this study is to explore usability issues and problems related to integrated cataloging and metadata services.

Usability testing is established as a compounding of a variety of methods and techniques. Because methods of data collection and analysis should be correlated in order to answer research questions, researchers agree that the ideal approach is a combination of quantitative and qualitative methods.

This chapter begins with an introduction to the system under study, OCLC Connexion. Connexion is an integrated cataloging and metadata services system developed and maintained by OCLC (Online Computer Library Center, Inc.). This is followed by the reports on the participants in this study, the tasks and materials given to the participants, the searching setting, procedures for data collection, and finally by data analysis.

The System under Study: OCLC Connexion

Connexion is a production system that was developed by OCLC to provide access to cataloging records through WorldCat, the world’s largest online union catalog and bibliographic database. Libraries use Connexion to create and edit quality bibliographic and authority records, which help users find the
materials they need more quickly. Connexion facilitates sharing of records with the entire OCLC cooperative, which benefits libraries worldwide (http://www.oclc.org/connexion/). Connexion combines the most useful features of OCLC’s web browser-based system. OCLC Connexion is based on CORC, CatExpress, CatMe, and Passport, and the knowledge that OCLC has gained from working with users over many years. Connexion also automates input of data, and aligns records with the authoritative WorldCat database. First released in July 2002, Connexion provides general cataloging functionality for all types of library materials (Lindlan and Mering, 2002). Connexion reflects OCLC’s intention to take the best features of each of the aforementioned tools and integrate them into the new cataloging service. According to OCLC, Connexion is OCLC’s flagship cataloging service, a powerful, flexible suite of tools with built-in access to WorldCat, the world’s largest bibliographic database. The Connexion provides several mechanisms for getting in; the main menu composed of five different search options with a few sub categories (see Figure 3.1). Such a variety of options is helpful when observing users’ diverse interactions with the system.

Figure 3.1  Homepage of the OCLC Connexion (http://connexion.oclc.org/)
Participants

The purpose of the Connexion system is to provide an integrated cataloging service to its members. Thus, the primary users are cataloging experts who catalog materials on a daily basis. Therefore, it would be fair to state that Connexion’s representative users are mainly those who work in general area of cataloging, - including faculty teaching cataloging classes, catalogers, and technical services librarians.

A thought provoking question in usability testing is: What number of subjects will be sufficient for this study? Generally, it is assumed that the major advantage of usability testing is that very few test subjects are actually required. According to Nielsen (Nielsen, 1989, 1993) approximately five subjects may uncover roughly 90% of the global usability problems inherent in any design. However, the “proper” number of required test subjects for establishing a minimum level of statistical confidence in usability testing is often a source of controversy.

Virzi (1992) concludes that four to five users will reveal 80% of the findings from a test, with the major findings being discovered early in testing. Others deny that such an experimental design would sustain any statistical validity and reliability.

Recent articles have looked at what is really meant regarding the 7 + or – 2 number (Dumont, 2002), and a similar re-examination is now a much-discussed topic regarding the viability of applying the number 5 to web usability testing. In general, the proper number of subjects really depends on the research design and the purpose. Logistical convenience also inevitably affects sampling methods.

In the Tallahassee area, where there are approximately 12-15 cataloging experts in the field, and this research recruited 10 of them for the test. This is a
generous sample size when it is compared with the actual pool of cataloging experts in the geographic area where the testing took place.

Participants were recruited throughout the Tallahassee area by letter. The invitation letters were sent to all local cataloging related sectors. A $10.00 honorarium was offered for participation. All of the subjects participated on a voluntary basis.

Demographic

A total of 10 cataloging experts participated in the study. As presented in Figure 3.2 Subjects Profiles, 6 women and 4 men participated in the usability testing. 70% of the participants spend more than 5 hours for searching information in an average week. 80% of the participants spend more than one hour at a time in a setting. When asked to report what kind of computer users they thought they were, 90% of the participants said they were experts and only one of the participants said “intermediate.” 80% of the participants have been in a position to assist actual end users, and 90% of them reported that they use computerized library catalogs in a daily basis.

Most of the participants know how to use commercial online databases such as Dialog or FirstSearch even if they do not use them in a daily basis. Only one participant had never used OCLC Passport or Connexion. However, it turned out from the test that most of them have used Passport or other products of OCLC rather than Connexion.

The pre-search questionnaire gathered information about the participants’ computing and searching experience. Their searching experience with different information systems ranged from 1 to 7 (1 = Never; 2 = Once a year; 3 = Quarterly; 4 = Once a month; 5 = Once a week; 6 = 2 to 3 time a week; 7 = Daily) with a mean of 6.10 ($SD=.59161$). In detail, the participants declared that they had the most experience with Search Engines ($M= 6.80, SD=.422$), Computerized Library Catalogs ($M= 6.80, SD= .632$), OCLC Passport or Connexion ($M= 5.60,$)
SD= 2.271), and had the least experience in Commercial online databases (M= 5.20, SD=1.317), in that order. It is of particular value to note that most participants have experienced a variety of databases and information retrieval systems and they rated themselves as better than intermediate users.

Table 3.1
Participants Profile

<table>
<thead>
<tr>
<th>Participant’s Profile</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Demographic (Gender and Age)</td>
<td>Female = 6 (60%); Male = 4 (40%)</td>
</tr>
<tr>
<td></td>
<td>31- 40 = 3 (30%); 41- 50 = 3 (30%); Over 51 = 4 (40%)</td>
</tr>
<tr>
<td>Hours spent searching for information per week</td>
<td>Less than 2 hours = 1 (10%); 3 – 5 hours = 2 (20%); More than 5 hours = 7 (70%)</td>
</tr>
<tr>
<td>Hours spent searching in one setting</td>
<td>30 min – 1 hour = 2 (20%); More than 1 hour = 8 (80%)</td>
</tr>
<tr>
<td>Familiarity with an Information Retrieval System (Self-evaluated)</td>
<td>Intermediate = 10 (10%); Expert = 9 (90%)</td>
</tr>
<tr>
<td>Experience assisting end users</td>
<td>YES = 8 (80%); NO = 2 (20%)</td>
</tr>
<tr>
<td>Frequency of use of computerized library catalogs</td>
<td>Once a week = 1 (10%); Daily = 9 (90%)</td>
</tr>
<tr>
<td>Frequency of use of commercial online databases (e.g. Dialog, FirstSearch)</td>
<td>Quarterly = 2 (20%); Once a week = 3 (30%); 2 to 3 times a week = 4 (40%); Daily = 1 (10%)</td>
</tr>
<tr>
<td>Experience with OCLC Passport or Connexion</td>
<td>Never = 1 (10%); Once a year = 1 (10%); Once a week = 1 (10%); 2 to 3 times a week = 1 (10%); Daily = 6 (60%)</td>
</tr>
</tbody>
</table>
Setting for Usability Testing

The usability testing took place in the Usability Center in the Louis Shores Building, School of Information Studies at Florida State University. The Center consists of a two-room suite with an evaluation room in which to conduct and record usability tests and an observation room in which to monitor recording equipment and make real-time observations about the user's experience. An IBM-PC compatible computer with a 15” color monitor was used for this test. Using a synchronized data capture of the screen, screen activities were recorded the entire session, with the participants’ voices and with time stamps added. A desk-mounted microphone was placed near the PC so as to record the user’s verbal protocol during the searching. Internet Explorer browser v. 5.0 was installed into the machine and used for this test.

The Tests and Data Collection

There were four phases for the test: pretest phase, introduction, testing phase, and debriefing phase. All the sessions were videotaped with the participants’ consent. The entire test for each participant took about an hour in general.

Pretest Phase

Once a participant was introduced and the consent form (see Appendix A) was signed, the participant was requested to fill out a pretest questionnaire to capture demographic information, participant experience with computers, computerized library catalogs, search engines, commercial databases, and experiences with OCLC Passport or Connexion (see Appendix B).
**Introduction Phase**

Written instructions were read aloud to every participant. The subjects were provided the opportunity to ask questions, and then a brief introduction of the Connexion interface was given to each participant. They were also encouraged to think aloud during the searching. The participants were reminded that this activity was not a test evaluating their performance, but that of the system interface. Finally, the participants were reminded that the entire search process would be recorded and videotaped throughout the session.

**Testing Phase**

The participants were asked to execute four searches (see Table 3.3). After the participants completed each task, they were asked to write down the answer they found from their search. The four tasks took about 1 hour. 8 minutes and 21 seconds were spent per task (SD=3 minutes and 25 seconds). Each participant’s interaction with the system was observed by the researcher and noted by the researcher while the participants executed the searches. The participants were encouraged to think out loud, and thereby express any problems they encountered, any thoughts or emotions that came up. There was no time limit for each task and the participants were requested to say loudly “begin task #” or “end of task #” when they began or finished each task.

**Debriefing Phase**

After the main testing session, participants were requested to complete an Exit Interview questionnaire (See Appendix C). In the questionnaire, the participants were asked to assess their overall satisfaction and familiarity with the topic in a 9-level Likert scale. In addition, they were asked to make comments about the system interface using several open questions that allowed them to explain any particular problems or thoughts resulting from the system interface. These questions were expressly intended to uncover any difficulties the participant had experienced during their searches and how the participant resolved
those difficulties. The researcher encouraged specific recall of certain moments during the session. Each participant was asked to make detailed answers for these specific questions. A typical question was “I’ve noticed that at one point you seemed to ________________. Was there any specific reason for that? ”

Tasks

Two important things were considered in the design of these searching tasks. First, the tasks should reflect the users’ real information needs in their workplaces. Given that Connexion is the system for cataloging experts, a task scenario was created that attempted to reflect the cataloger’s daily jobs in their workplaces. The participants were asked to complete the tasks based on the assumption that they were similar to those required in their workplaces. Connexion is a system that catalogers find more than one appropriate records to create a local catalog for their institutes. The work usually includes from finding book records and sometimes records for online resources to make a decision of the best record for their institutes. Tasks in this study created by regarding the characteristics of the decision making process.

Second, the type of the tasks was considered. Spool used two categories of task types: task complexity and topicality (Spool, 1997). Task complexity referred to distinguishing tasks from easiest to hardest. According to Spool, a simple fact finding question is the simplest type of task, while a judgment question is more difficult because the user must locate the answer as well as analyze the information. A comparison question asks users to compare more than two facts in order to get an answer. A comparison of judgment question offers the most complexity, requiring both comparison and judgment.

For this research, Spool’s task types were adapted to create four tasks as well as careful review of cataloger’s daily work.
A set of four tasks was created (See Table 3.2) based on these two considerations. Tasks 1 and 2 were judged to be simple fact-finding questions and tasks 3 and 4 were considered as the questions asking a comparison and judgment from the users. Tasks 1 and 2 were to find a book record using the information provided by the question. For tasks 3 and 4, the participants were expected to find a few records which would help in creating a catalog record related to the topic and to make a judgment from the records they found. In addition to the consideration of the task types, Task 3 also included searching different format of metadata, in this case online resources.

Table 3.2
Types of Questions, Topics and Provided Tasks

<table>
<thead>
<tr>
<th>Question Type</th>
<th>Topic</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple fact finding</td>
<td>Standard book search</td>
<td>T1. Your library recently bought new editions (2003-2004) of some books. Among them, there is a book written by Ben Shneiderman. Your boss told you that you must create a catalog record for this book before it can be shelved. Prior to creating this catalog record using the Connexion system, you will need to explore Connexion to locate an appropriate record. You have only the following limited information on the book to use when searching for this record. Title: Designing the User Interface Author: Ben Shneiderman Publication Year: not sure but you are sure it should be 2003 or 2004 Using this information, please explore the Connexion system and find most appropriate existing record to use as a basis for creating a record for your library. Which search terms and fields will you use? Please write down the search terms and fields you intend to use in detail.</td>
</tr>
</tbody>
</table>
Table 3.2 Continued

<table>
<thead>
<tr>
<th>Simple fact finding</th>
<th>Standard book search</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2. You were walking around the library and found a book written by Dagobert Soergel that has been missing for years. Since it has been presumed missing for such a long time, the record has been removed from your library catalog. Your boss told you that you need to create a new catalog record for the book using the Connexion system. Title: Organizing Information Author: Dagobert Soergel Publication Year: not sure but you are sure it is more than 10 years ago Using this information, please explore the Connexion system and find most appropriate existing record to use as a basis for creating a record for your library. Which search terms and fields will you use? Please write down the search terms and fields you intend to use in detail.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comparison of facts</th>
<th>Electronic information search</th>
</tr>
</thead>
<tbody>
<tr>
<td>T3. Recently, your library has undertaken the challenge of cataloging electronic information to make it more accessible to the patrons of the library. This week, your assignment is to create some records for electronic information about metadata and especially about the Dublin Core. Your boss wants you to find information about the metadata element set of Dublin Core to create records. Please explore the Connexion system and find the information that you believe will be most helpful to your patrons on this subject. You may find a record that you can copy or modify to create your own record. Which search terms and fields will you use? Please write down the search terms and fields you intend to use in detail.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comparison of judgment</th>
<th>Search for records for an original cataloging</th>
</tr>
</thead>
<tbody>
<tr>
<td>T4. It is graduation season. As usual, your library has many dissertations to be cataloged. A dissertation comes to you today and your boss tells you that you have to create a catalog record for the dissertation. You know that his particular dissertation will not appear in the Connexion system since it is a new dissertation approved by your university only recently. Thus, you decide to try and</td>
<td></td>
</tr>
</tbody>
</table>
Table 3.2 Continued

<table>
<thead>
<tr>
<th>Comparison of judgment</th>
<th>Search for records for an original cataloging</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>locate a similar record for a different dissertation that will help you to begin the process of creating an original record for this dissertation. You have the following information regarding the dissertation for which you need to created an original record: Title: Child abuse living with single parent: a case study of Orlando regional area Author: Angela McKenny Publication Year: surely it is 2004 Please explore the Connexion system and find the record that you feel will be most helpful in creating your original record. You may find one that you can modify for your new record. Please write down your search terms and fields for use for more in detail.</td>
</tr>
</tbody>
</table>

Introduction to the Data Analysis

Table 3.3 contains data collection, methods of data analysis, and a result presentation for each research question.

Data collected for Research Questions 1 through 4 are analyzed by correlation and descriptive statistics using each measure introduced from the Chapter 1.

Content Analysis and Classification method is used to analyze the qualitative data gathered from videotaped records, recorded think-aloud remarks, and videotaped logs of the participants’ interaction with the system.
Table 3.3
Data Collection and Analysis Methods

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Data Collection</th>
<th>Data Analysis</th>
<th>Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ 1: Effectiveness</td>
<td>Accuracy and Number of Errors Completion Time and Number of Keystrokes used</td>
<td>Correlation</td>
<td>Pearson’s Correlation Matrix</td>
</tr>
<tr>
<td>RQ 2: Efficiency</td>
<td></td>
<td>Correlation</td>
<td>Pearson’s Correlation Matrix</td>
</tr>
<tr>
<td>RQ 3: Satisfaction</td>
<td>Exit Interview</td>
<td>Descriptive Statistics</td>
<td>Descriptive Statistics Table</td>
</tr>
<tr>
<td>RQ 4: Usability of different format of metadata</td>
<td>Effectiveness, Efficiency and Satisfaction Combined Logs and Exit Interview</td>
<td>Descriptive Statistics</td>
<td>Descriptive Statistics Table, Correlation Matrix Coding Table of User Perception of Usability Problems and Classification Table of Usability Problems</td>
</tr>
<tr>
<td>RQ 5. Identification and classification of Usability Problems of the Connexion</td>
<td></td>
<td>Content Analysis and Classify Usability Problems</td>
<td></td>
</tr>
</tbody>
</table>

Summary of the Chapter

In this chapter, the system under study, OCLC Connexion was introduced first. It was followed by demographic and descriptive information about the participants in this study. The test setting was described in detail and the searching procedures were delineated according to the phases of the test. The tasks given to the participants were introduced and the types of tasks and types of questions actually used in this research were discussed more in detail. Finally, data collection, methods of data analysis, and the result presentation for each research question were summarized as an introduction to data analysis.
The next chapter reports the findings of the searching and discusses issues related to them as well as discussing the Research Questions related to the findings.
CHAPTER 4

DATA ANALYSIS AND RESULTS

Introduction

This chapter reports the results of the test, which was conducted according to the methodology described in the previous chapter. The report starts with an overview of data collected by analyzing trends. Correlation was measured by Pearson’s Correlation process of SPSS 11.0.

The effectiveness measure includes task completion time and number of errors. The efficiency measure includes completion time and number of keystrokes. The satisfaction measure includes responses by the participants to an exit interviews for which the possible responses ranged from 1 to 9 on a Likert Scale. These measures are analyzed for correlations such as familiarity with information retrieval systems, experience with computerized library catalogs, experience with commercial online databases (e.g. Dialog, FirstSearch), experience with OCLC Passport or Connexion, etc.. Results of content analysis of the identification of usability problems are presented, as are the results of a classification of usability problems using content analysis methods are presented.

This chapter ends with a summary of the results of this research related to several issues introduced by the participants during the searching and exit interviews.
Overview of Collected Data

A total of 10 people participated in this test. Thus, the sample size (N) was 10. All of the participants were working in a cataloging department or were cataloging experts in specific organizations. Since Connexion is a system designed for catalogers who create and use catalog records as part of their daily routines, it is fair to say the participants’ experience reflects that of target users’ of the system. Descriptions and correlations of each variable are provided as well as evaluations of effectiveness, efficiency, and participants’ overall satisfaction.

Accuracy and Number of Errors

Accuracy of task performance was calculated consistently in the following manner. Task 1 and Task 2 were fact-finding tasks, and Task 3 and Task 4 were comparison and judgment tasks. For each task, 10 points were given when the subject found the correct answer(s) and completed the task requirement(s), while 0 points were given to those who failed to find the correct answer(s). For Task 1 and 2, there were no participants who could not find the answer. In order to calculate the accuracy of Tasks 3 and 4, the researcher made a list of correct records before the test and compared participants’ answers to the list. For Task 3, 7 points of a possible ten were given to four participants who found the list of correct answers but were not able to identify the most reasonable records among them. 3 points were given to the one participant who was able to find the list, but failed to search the records from the list and went to another list. For Task 4, 7 points of a possible 10 were given to the four participants who found the list of correct answers but were not able to identify the most reasonable records among them. 3 points were given to the three participants who were able to find the list, but failed to search the records from the list and went to other lists rather than utilize the list for getting a correct answer.
As presented in Table 4.1, two out of 10 participants (20%) demonstrated high performance by scoring perfectly (40 points), while another 40% of the participants scored in the middle range. The other 40% of the participants demonstrated low performance by receiving half or less than 30 points.

<table>
<thead>
<tr>
<th>Performance</th>
<th>Participant Number</th>
<th>Task1</th>
<th>Task2</th>
<th>Task3</th>
<th>Task4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>001</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>009</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Middle</td>
<td>002</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>7</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>004</td>
<td>10</td>
<td>10</td>
<td>7</td>
<td>7</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>006</td>
<td>10</td>
<td>10</td>
<td>7</td>
<td>7</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>007</td>
<td>10</td>
<td>10</td>
<td>7</td>
<td>7</td>
<td>34</td>
</tr>
<tr>
<td>Low</td>
<td>003</td>
<td>10</td>
<td>10</td>
<td>7</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>005</td>
<td>10</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>008</td>
<td>10</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>010</td>
<td>10</td>
<td>10</td>
<td>3</td>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>10</td>
<td>10</td>
<td>6.10</td>
<td>3.843</td>
<td>30.60</td>
</tr>
<tr>
<td>SD</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>3.843</td>
<td>4.012</td>
<td>7.589</td>
</tr>
<tr>
<td>Min.</td>
<td></td>
<td>10</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Max.</td>
<td></td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>40</td>
</tr>
</tbody>
</table>

Table 4.1 also shows that the mean of the participants’ overall accuracy score was 30.60 ($SD=7.589$) in a range of 20 to 40 points. The average score was highest in Task 1 and Task 2 (M=10, $SD=0$), then Task 3 (M=6.10, $SD=3.843$), and Task 4 (M=3.843, $SD=4.012$) in that order. In the cases of Task 1 and 2, all
ten participants were able to find the correct record even though there were large
differences in the time spent completing the specific task.

As to the averages of the participants’ completion time (see Table 4.2) the
participants spent the longest time (26 minutes and 33 seconds) on Task 3, and the
shortest time (2 minutes and 43 seconds) on Task 2 (see Table 4.2). For the
simpler tasks (Task 1 and Task 2), participants spent less time than they did for
the more complicated tasks (Task 3 and Task 4).

### Table 4.2
Mean of Completion Time Per Task (h:mm:ss) (n=10)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Min.</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td>0:05:37</td>
<td>0:02:25</td>
<td>0:03:21</td>
<td>0:10:25</td>
</tr>
<tr>
<td>Task 2</td>
<td>0:04:33</td>
<td>0:02:53</td>
<td>0:02:43</td>
<td>0:12:35</td>
</tr>
<tr>
<td>Task 3</td>
<td>0:11:29</td>
<td>0:07:18</td>
<td>0:03:04</td>
<td>0:26:33</td>
</tr>
<tr>
<td>Task 4</td>
<td>0:11:45</td>
<td>0:04:24</td>
<td>0:04:57</td>
<td>0:19:06</td>
</tr>
<tr>
<td>Total</td>
<td>0:33:25</td>
<td>0:13:42</td>
<td>0:20:09</td>
<td>1:03:58</td>
</tr>
</tbody>
</table>

Pearson’s product-moment correlation analysis was conducted to see if the
participants’ total accuracy points and total completion time were related. The
result showed that accuracy and completion time were not significantly related to
each other, indicating that the participants who were good at finding answers did
not finish their jobs more quickly than the others did.

Number of errors were counted by the researcher during the searching and
reviewed using the recorded videotapes. Activities such as misuse of a specific
field, using a different search option, etc. were considered as errors and counted in
the total number of errors. However, misspellings, mistakes caused by clicking,
etc. were not considered as errors because those were deemed “conditional,” or purely situational. The number of errors is displayed in Table 4.3. The Table shows that the mean of the subjects’ overall number of errors was 5.50 ($SD=3.308$) in a range of 3 to 14. The average number of errors was highest in Task 4 ($M=2.10$, $SD=0.876$), then Task 3 ($M=2.00$, $SD=1.333$), Task 2 ($M=0.30$, $SD=0.675$) and Task 1 ($M=1.20$, $SD=0.789$) in that order. In the case of Task 2, 8 participants were able to find the correct record without any error. Tasks 1 and 2 were very similar types of tasks. Participants seemed to have learned from the difficulties they experienced in finding book information in Task 1. This appears to have considerably reduced the number of errors in Task 2 as compared to Task 1. Only one participant (participant number 109) made no errors in either Task 1 and 2.

Table 4.3
Number of Errors (N=10)

<table>
<thead>
<tr>
<th></th>
<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Task 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min.</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Max</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Mean</td>
<td>1.20</td>
<td>0.30</td>
<td>2.0</td>
<td>2.10</td>
<td>5.50</td>
</tr>
<tr>
<td>SD</td>
<td>0.789</td>
<td>0.675</td>
<td>1.333</td>
<td>0.876</td>
<td>3.308</td>
</tr>
</tbody>
</table>

Pearson’s product-moment correlation analysis was conducted to see if the participants’ total accuracy points and number of errors were related. The result showed that overall accuracy and total number of errors were not significantly related to each other, even if there is a significant negative relationship at the 0.05 level in between a few tasks and accuracy rates.
The Pearson’s Correlation analysis is included in Appendix D. Among the correlations, there are significant relationships between the number of errors and accuracy for Task 3, and between number of errors and overall accuracy in Task 1. These results indicate that the participants who were good at finding answers made a smaller number of errors in Task 1, and the participants who were good at finding answers for Task 3 had a smaller total number of errors.

**Completion Time and Number of Keystrokes**

Completion time and the number of keystrokes required are the two factors used for measuring efficiency in this research.

An average of 33 minutes and 25 seconds per participant was taken to complete the four tasks. However, there was much variation among the 10 participants for example, the fastest participant took only 20 minutes 9 seconds and the slowest took 1 hour 3 minutes 58 seconds which is about three times longer. The longest time (26 minutes and 33 seconds) spent by a participant on any task was spent on Task 3, and the shortest time (2 minutes and 43 seconds) spent by a participant on any task was spent on Task 2 (See Table 4.2).

In order to complete the four tasks, an average 13.90 keystrokes were used (M=14.40 SD=3.921). However, here again there was much variation among the 10 participants in number of keystrokes. One participant took only 9 keystrokes to complete one task, whereas another used 22 keystrokes. Table 4.4 displays descriptive statistics of keystrokes used in this test. The participants used the most keystrokes (5.50) on Task 4 and the least strokes (1.50) on Task 2.

Another Pearson’s product-moment correlation analysis was conducted to see if the participants’ completion time and number of keystrokes were related. The results showed that total completion time and total number of keystrokes were independent.
Table 4.4  
Keystrokes used (N=10) 

<table>
<thead>
<tr>
<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Task 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min.</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Max.</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Mean</td>
<td>2.10</td>
<td>1.50</td>
<td>5.30</td>
<td>5.50</td>
</tr>
<tr>
<td>SD</td>
<td>0.738</td>
<td>0.707</td>
<td>1.494</td>
<td>1.780</td>
</tr>
</tbody>
</table>

The Pearson’s Correlation analysis for total completion time and total number of keystrokes is included in Appendix E.

As demonstrated in the correlation matrix, there are correlations between completion time and keystrokes for both Task 1 and Task 2. For these, the participants took more keystrokes and spent more time to complete the tasks. This seems very reasonable to assume that this correlation would also appear in Tasks 3 and 4, but this is not the case.

The difference can be explained by analyzing the types of tasks. In simpler tasks such as 1 and 2, the most time was consumed by clicking or hitting Enter keys to find search sets for the specific task. In the more complex tasks, such as Tasks 3 and 4, the participants spent more time examining and comparing the specific records from the list in order to make their decisions, than they spent clicking or hitting Enter keys.

**Satisfaction**

In this research the satisfaction measure explores comfort, ease of use, understandability, and user perceptions of satisfaction, as measured from 1 to 9 on a Likert scale.

The overall satisfaction rate is displayed in Table 4.5. The table shows that the mean of the subjects’ overall satisfaction was 6.70 (SD=1.508) in a range of
4.50 to 8.75. There is not much difference in means between individual measures, even though there are big differences between minimum and maximum for each measure.

Table 4.5
Satisfaction (N=10)

<table>
<thead>
<tr>
<th>Comfort</th>
<th>Understandability</th>
<th>Easiness</th>
<th>Perceived Satisfaction</th>
<th>Overall Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min.</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Max.</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Mean</td>
<td>6.40</td>
<td>6.80</td>
<td>6.80</td>
<td>6.80</td>
</tr>
<tr>
<td>SD</td>
<td>2.171</td>
<td>1.874</td>
<td>1.687</td>
<td>1.549</td>
</tr>
</tbody>
</table>

Note: 1 (Min.) to 9 (Max.) Likert Scale

It appears the overall satisfaction rate with Connexion is not very high. The average overall satisfaction was located just a little above neutral (neutral; 5 in the 1 to 9 Likert scale). Assuming participants in this research already have experienced other cataloging systems, Connexion’s satisfaction rating should be of concern to OCLC.

Table 4.6 presents the correlation among satisfaction measures. Among those four subjects, two sets such as perceived satisfaction and comfort, and understandability and easiness are related to each other.

This means that participants who thought the system was easy to use also thought the system was understandable, and those who felt comfortable on the system were more satisfied with using Connexion than those who did not feel comfortable.
Table 4.6
Correlation between subjects in Satisfaction measure (N=10)

<table>
<thead>
<tr>
<th></th>
<th>Comfortable Satisfaction</th>
<th>Understandability Satisfaction</th>
<th>Easiness Satisfaction</th>
<th>Perceived Satisfaction</th>
<th>Overall Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfortable</td>
<td>1</td>
<td>.596 (.069)</td>
<td>.480 (.161)</td>
<td>.753* (.012)</td>
<td>.872** (.001)</td>
</tr>
<tr>
<td>Understandability</td>
<td>1</td>
<td>.865** (.001)</td>
<td>.406 (.245)</td>
<td>.871** (.001)</td>
<td></td>
</tr>
<tr>
<td>Easiness</td>
<td>1</td>
<td>.323 (.362)</td>
<td>.804** (.005)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfaction</td>
<td>1</td>
<td></td>
<td></td>
<td>.744** (.014)</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
(Sig.) Significance level

Relationships between each measure

The Correlation between each measure and participants’ searching experience was evaluated using Pearson’s product-moment correlation analysis to see the relationship.

Effectiveness by searching experience

Accurancy and number of errors are the two factors used to measure effectiveness in this research. Descriptive information for each measure is presented at Table 4.1 and Table 4.2.
According to the correlation matrix (See Appendix F), only “Hours spent in one setting” has a correlation with accuracy, meaning participants who spent more time in one setting got better accuracy rates. Ironically, experiences with computerized library catalogs, search engines, commercial online databases, and OCLC products such as Passport or Connexion do not appear to have any relationship to accuracy rates.

The other measure for effectiveness is number of errors. It appears that the number of errors is negatively related to familiarity with the information retrieval system (See Appendix G). This means that participants who thought they were more familiar with an information retrieval system made fewer errors during this test than participants who thought they were less familiar with an information retrieval system.

Other searching experience such as experiences with computerized library catalogs, search engines, commercial online databases, and OCLC products such as Passport or Connexion do not have any significant correlations with the number of errors.

**Efficiency by searching experience**

Completion time and number of keystrokes are the two factors used for measuring efficiency in this research.

According to the correlation analysis (See Appendix H), completion time is negatively related to the participants’ familiarity with an information retrieval system. This means that participants who thought they were more familiar with an information retrieval system completed the tasks faster than others.

Other searching experiences do not have any significant correlations with the number of errors.

Efficiency by keystrokes is related two other factors such as hours spent in one setting and familiarity with information retrieval systems. Both factors are negatively related to the keystrokes. For the correlation matrix of these factors,
see Appendix I. As the correlation matrix shows, those participants more familiar with the information retrieval system and spent less time in one setting completed the tasks using fewer keystrokes than others.

**Satisfaction by searching experience**

Among all factors, only experience with computerized library catalogs is related to the satisfaction in some ways. However, this factor is related only through easiness and understandability satisfaction measures. This means that the participants who were familiar with computerized library catalogs thought that Connexion was easy and understandable but did not necessary think using the Connexion system was comfortable or satisfactory (See Appendix J).

**Effectiveness, Efficiency and Satisfaction**

In order to see the relationships between the three measures, another Pearson’s correlation analysis was conducted. As presented in Tables 4.7 through Table 4.9, only effectiveness and efficiency show in between correlations. However, accuracy is independent from all other factors. Among three measures such as effectiveness, efficiency and satisfaction, the satisfaction measure appears to be independent from others, which means satisfaction is not related to any effectiveness or efficiency factors.

Table 4.7
Pearson’s Correlations between Effectiveness and Efficiency (N=10)

<table>
<thead>
<tr>
<th></th>
<th>Number of errors</th>
<th>Accuracy</th>
<th>Time</th>
<th>Keystrokes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of errors (Sig.)</td>
<td>1</td>
<td>-.584</td>
<td>.649*</td>
<td>.737**</td>
</tr>
<tr>
<td></td>
<td>(.076)</td>
<td>(.043)</td>
<td>(.015)</td>
<td></td>
</tr>
<tr>
<td>Accuracy (Sig.)</td>
<td>1</td>
<td></td>
<td>-.221</td>
<td>-.954**</td>
</tr>
<tr>
<td></td>
<td>(.539)</td>
<td></td>
<td>(.000)</td>
<td></td>
</tr>
<tr>
<td>Time (Sig.)</td>
<td>1</td>
<td></td>
<td></td>
<td>.442</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(.201)</td>
</tr>
</tbody>
</table>
Table 4.7 Continued

<table>
<thead>
<tr>
<th>Keystrokes (Sig.)</th>
<th>1</th>
</tr>
</thead>
</table>

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

(Sig.) Significance level

Table 4.8
Pearson’s Correlations between Effectiveness and Satisfaction (N=10)

<table>
<thead>
<tr>
<th>Overall Satisfaction</th>
<th>Accuracy</th>
<th>Number of errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Satisfaction</td>
<td>1</td>
<td>.375 (.285)</td>
</tr>
<tr>
<td>(Sig.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>1</td>
<td>-.584 (.076)</td>
</tr>
<tr>
<td>(Sig.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of errors</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

(Sig.) Significance level
Table 4.9
Pearson’s Correlations between Efficiency and Satisfaction (N=10)

<table>
<thead>
<tr>
<th></th>
<th>Overall Satisfaction</th>
<th>Time</th>
<th>Keystrokes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Satisfaction</td>
<td>1</td>
<td>-.376</td>
<td>-.471</td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.285)</td>
<td></td>
<td>(.170)</td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td></td>
<td>.442</td>
</tr>
<tr>
<td>(Sig.)</td>
<td></td>
<td></td>
<td>(.201)</td>
</tr>
<tr>
<td>Keystrokes</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
(Sig.) Significance level

Identification and Classification of Usability Problems

Identification of Usability Problems

From the combined logs, the participants’ perceptions of usability problems were coded. Coding rules were set prior to coding. Problems caused by a simple mistaken click or typing error, etc. were not included in the coding. The code covered only problems that resulted from some feature or function of Connexion itself. For example, one of the participants was trying to use the “Pathfinder” option rather than the “Search” option for Task 1. She was not conscious of her mistake because the option was set to “Pathfinder.” That mistake was caused by a clicking error during her exploration of the interface at the beginning. She said “what am I doing?…it looks so different from what I want to do”…(and looking at the researcher she said) “I didn’t mean to…I thought I was under the Search option.” This kind of problem is eliminated from usability problem coding. From the combined logs and the exit interview data, a total of

79
172 usability problems were found. Among them, 17 unique usability problems were identified. Following identification, the usability problems were classified with reference to several areas of Connexion features, in order to summarize overall usability problems. The 17 unique usability problems and their frequency ranking are displayed at Table 4.10.

More problems were found in Task 1 (n=38) and Task 3 (n=37), as compared to Task 4 (n=26) and Task 2 (n=14). The usability problems found in Task 2 are mostly duplicated in Task 1 since the tasks are very similar in type.

The top six most frequently found usability problems were:

- The error message is not easily recognized;
- Only one term per one search box seems inconvenient;
- Quick tips are too vague or not specific enough;
- It is hard to understand the terminology or syntax;
- Help is not helpful; and
- Options for manipulation of results are limited.

Among these six usability problems, three are related to the Help or Support features of Connexion system.
Table 4.10
Frequency Ranking of Usability Problem Codes

<table>
<thead>
<tr>
<th>Rank</th>
<th>Usability Problems</th>
<th>Task1</th>
<th>Task2</th>
<th>Task3</th>
<th>Task4</th>
<th>Interview</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The error message is not easily recognized (UP 17)</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Only one term per one search box seems so inconvenient (UP12)</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>Quick tips are too vague or not specific enough (UP11)</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>It is hard to understand the terminology or syntax (UP13)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>5</td>
<td>Help is not helpful (UP10)</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>Options for manipulation of results are limited (UP14)</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>7</td>
<td>Labels are not insightful (UP 02)</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>Instruction is lacking on how to use each option (UP 03)</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>Explanation of the main options on the top is lacking (UP 01)</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>9</td>
<td>It is hard to understand the organizing scheme (UP 04)</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>9</td>
<td>The submenu is hard to find and lacks description (UP 05)</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>9</td>
<td>Reading is difficult (UP 06)</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>9</td>
<td>It is hard to distinguish next record from the next record groups (UP 15)</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>14</td>
<td>Search options have too similar features (UP 09)</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>14</td>
<td>Authority files are very cumbersome and confusing – no instruction (UP 16)</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>16</td>
<td>The location of search is unclear (UP 07)</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>16</td>
<td>Field option buttons are too complicated (UP 08)</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>38</td>
<td>14</td>
<td>37</td>
<td>26</td>
<td>57</td>
<td>172</td>
</tr>
</tbody>
</table>
Classification of Usability Problems

Based on the identification of usability problems in the test, six areas are emerged in the classification of usability problems. The six areas are: User Assistance, Error Prevention and Correction, Color and Visual Clarity, Navigation, Information Grouping and Structure, and Language Usage. Usability problems and possible recommendations are included for each area.

Usability problems in user assistance. Four usability problem codes were identified in the User Assistance area of Connexion.

Table 4.11
Usability Problems in User Assistance

<table>
<thead>
<tr>
<th>Usability Problems in User Assistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick tips are too vague or not specific enough (UP 11)</td>
</tr>
<tr>
<td>Help is not helpful (UP 10)</td>
</tr>
<tr>
<td>Lack of instruction on how to use each option (UP 03)</td>
</tr>
<tr>
<td>Lack of explanation of the main options on the top (UP 01)</td>
</tr>
</tbody>
</table>

Two of the problems were about lack of information on options. The examples include “I am curious about what the main option can do for each…about what Pathfinder means.” (Participant 005) Help and Quick tips are the other two codes identified in this area. These areas are specific and helpful enough when the cataloger had been trained well before using the Connexion. However, when they were not accustomed to use Connexion frequently, even a skillful cataloger showed irritation. For example, “In Task 1, I tried to use command search, I think I remember doing that but…in one part, I got confused, using the Scan command and Quick Tips but it didn’t give me much” (Participant
Another example says, “What am I going to use? “Search” or “Browse”? They are under “Cataloging”…so maybe one of them?” (Participant 002)

The screenshot of the main search page of Connexion is included in figure 4.1.

Figure 4.1 The screenshot of the main search page. (http://connexion.oclc.org)
Usability problems in navigation. A total of five usability problem codes were identified and classified in the Navigation area as presented in Table 4.12.

Table 4.12
Usability Problems in Navigation

<table>
<thead>
<tr>
<th>Usability Problems in Navigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labels are not insightful (UP 02)</td>
</tr>
<tr>
<td>It is hard to understand the organizing scheme (UP 04)</td>
</tr>
<tr>
<td>The submenu is hard to fine and lacks description (UP 05)</td>
</tr>
<tr>
<td>Authority files are very cumbersome and confusing (UP 16)</td>
</tr>
<tr>
<td>The location of search is unclear (UP 07)</td>
</tr>
</tbody>
</table>

The navigation area is central to the actual searching process of the test. The most important problem is summed up by this statement. “It’s hard to understand how to do something.” For example, one participant said, “I was under “Cataloging” and there are “Search, Browse, Create and Show” options…I thought I was using Search since that option was what I was used for Task 1 and for searching the WorldCat database, but suddenly a different interface came and I found out I was in a different database. (Looking at the researcher, he grumbles) I went go too far, I guess.” (Participant 101) Another example says, “I don’t get it. I am accustomed to use “Passport” but these options don’t seem really particular for cataloging. I know “Cataloging” and “Authorities” but what do I do with “Express” and “Pathfinders”? ” (Participant 002)

The screenshot of a submenu example is provided in Figure 4.2.
Usability problems in information grouping and structure. Four usability problem codes were identified in the Information Grouping and Structure area. This area is related to the final results structure because it contains features which might affect the final result and the manipulation of it. As may be seen in Table 4.18, two of the problems are about final result and the manipulation of it. For example, “I got more than 80 electronic records. Wow…it’s too many. OK, is there anything to help me set the limit using this set? Something…putting more keywords or…Oh oh.. I think they don’t, (looking at the researcher) Do they?” (Participant 009) Another example says, “What’s wrong? Oops, I clicked the wrong button. I am supposed to click “Next page” not “Next group page”. That’s doesn’t really make sense anyway… even though it might be convenient in some ways.” (Participant 008)
Too many complicated field option buttons are another usability problem coded in this area. Sometimes, it is helpful for users to have access to as many field options as the information system developer can provide. However, sometimes having too many brings difficulties of use. For example, “I am using Keyword searching. OK, what kind of options do I have? Author, title, LCSH, Library of Congress Classification Number…There is another search option, using numeric numbers only, right under this keyword search… They may want to cut and simplify these options. It is taking long time to find the right option and click it.” (Participant 006)

The screenshot showing the field option examples is included in Figure 4.3.

![Figure 4.3 The screenshot of field option examples.](image-url)
Table 4.13
Usability Problems in Information Grouping and Structure

<table>
<thead>
<tr>
<th>Usability Problems in Information Grouping and Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited options for manipulation of results (UP 14)</td>
</tr>
<tr>
<td>Hard to distinguish next record vs. next record groups (UP 15)</td>
</tr>
<tr>
<td>Field option buttons are too complicated (UP 08)</td>
</tr>
</tbody>
</table>

Usability problems in color and visual clarity. Two usability problem codes were classified into the Color and Visual Clarity area (See Table 4.14). For example, “I may be out of the line but they could use different colors for different searching options. Every part has the same color, blue or navy, whatever… It looks consistent but it is little bit confusing - hard to know which one I am using” (Participant 009)

Table 4.14
Usability Problems in Color and Visual Clarity

<table>
<thead>
<tr>
<th>Usability Problems in Color and Visual Clarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading is difficult (UP 06)</td>
</tr>
<tr>
<td>Features for each search options are too similar (UP 09)</td>
</tr>
</tbody>
</table>

Usability problems in error prevention and correction. Two usability problem codes were designated in the Error Prevention and Correction area of the system. For example, “In Task 1, I made two errors. I didn’t know what I did wrong. After the two errors, I saw the message on the top of the keyword search option part saying I have to use only one keyword in each box. I also noticed that it was in the Quick Tips a long time later when I was doing Task 3. This is not
good. Most other information retrieval systems let the user put in more than two
terms. I think I am too used to using a general information system rather than a
cataloging systems.” (Participant 005) Table 4.15 contains the usability problems in Error Prevention and Correction.

<table>
<thead>
<tr>
<th>Usability Problems in Error Prevention and Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>The error message is not easily recognized (UP 17)</td>
</tr>
<tr>
<td>Only one term per one search box seems so inconvenient (UP 12)</td>
</tr>
</tbody>
</table>

Usability problems in language usage. There is one usability problem code in the Language Usage area as presented in Table 4.16. For example, “I read the Quick Tips and typed something in the command search. It didn’t work. I have used another cataloging system. It seems to be using different words… or am I confused?” (Participant 005)

<table>
<thead>
<tr>
<th>Usability Problems in Language Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard to understand the terminology or syntax</td>
</tr>
</tbody>
</table>

Table 4.15
Usability Problems in Error Prevention and Correction

Table 4.16
Usability Problems in Language Usage
Summary of the Results

This chapter presented the results of a study whose purpose was to find any relationships among different searching experiences, in terms of effectiveness, efficiency and satisfaction. A brief summary of the major findings of this study completes this chapter.

Accuracy and number of errors are evaluated to measure effectiveness. Participants who spent more time in one setting tended to get better accuracy rates and participants who thought they were more familiar with an information retrieval system made fewer errors during this research.

Efficiency was measured by evaluating completion time and the number of keystrokes used in this test by each participant. Participants who thought they were familiar with information retrieval systems in general tended to use less time and fewer keystrokes to complete their tasks.

The satisfaction measures included participants exit interview responses as reported on a 1 to 9 Likert Scale. Only one experience that of working with computerized library catalogs, had significant relationships with easy of use and understandability, but it did not seem to affect overall satisfaction.

Among the three main categories, effectiveness and efficiency seem to have been related in some ways but the satisfaction measure were not dependent with either effectiveness or efficiency. Descriptive statistics and correlation matrices were provided for usability in searching different metadata formats.

A content analysis was performed after identification and classification of usability problems, and the results were presented. Seventeen coded usability problems were divided into six classifications, which were in turn presented and analyzed.

The next chapter explores the direction of future research that might spring from the conclusions and interpretations of this study.
CHAPTER 5

CONCLUSIONS AND IMPLICATIONS

Chapter Overview

This chapter provides conclusions and discusses the implications of the results discussed in Chapter Four. The chapter revisits the research questions presented in Chapter One, and answers them based on the results presented in Chapter Four. The implications of the research include interpretation of the results, indicating issues of usability testing, and suggest future research directions.

Research Questions Revisited

A review of the research data produced by the test provides the following answers to the questions presented in Chapter 1.

Relationship between effectiveness and the searching experience

- How is effectiveness related to the user’s searching experience of retrieving different formats of metadata in the integrated cataloging and metadata services system?

Effectiveness is related to participants’ familiarity with information retrieval systems. Other factors such as experience of computerized library catalogs, experience of search engines, experiences of OCLC Passport or Connexion, etc. are not related with effectiveness in this test. This conclusion
leads toward another discussion on training and learning issue in integrated cataloging and metadata systems, which will be addressed in this chapter.

**Relationship between efficiency and the searching experience**

- How is efficiency related to the user’s searching experience of retrieving different formats of metadata in the integrated cataloging and metadata services system?

Efficiency is related to familiarity with the information retrieval systems both in completion time and number of keystrokes used in this test. Participants who thought they were familiar with information retrieval systems in general tended to use less time and fewer keystrokes to complete their tasks. Other factors of searching experience were not significant in this test. A careful decision was made that familiarity with information retrieval systems is the one most important factor related to both effectiveness and efficiency. This also leads to another discussion on learning issues within integrated cataloging and metadata systems, which will be found later in this chapter.

**Relationship between satisfaction and the searching experience**

- How is satisfaction related to the user’s searching experience of retrieving different formats of metadata in the integrated cataloging and metadata services system?

There is only one experience, that of computerized library catalogs, which has shown significant relationship with easiness and understandability satisfaction measures. This relationship was not shown with regard to overall satisfaction. This means that the participants who felt Connexion was easy and understandable did not necessarily feel comfortable and satisfied in this test. Regarding those results from effectiveness and efficiency, it appears that even for those
participants who felt Connexion was easy and understandable, the most powerful factor was familiarity with information retrieval system. The experience with computerized library catalogs helped the participants to feel more at ease with understanding Connexion, but this did not effect their searching. Those who had been used to computerized library catalogs knew what the ordinary features of a cataloging system might be, but there was no evidence in the tests that this helped the participants to be effectiveness and efficient in searching. Once again, this finding has implications for learning and training that will be discussed later in this chapter

Usability of different formats of metadata

How is usability related to searching in the integrated cataloging and metadata services system, particularly in terms of different formats of metadata? No direct relationship between satisfaction and efficiency or effectiveness was founded in the test. Tables 4.12-4.14 indicate that effectiveness and efficiency were somewhat related. However, careful examination of the descriptive statistics related to effectiveness and efficiency is required to understand how this relates to different formats of metadata. As presented in Table 3.1, 3.2, 4.1 and 4.3, values for effectiveness and efficiency were drastically higher when the participants searched Task 3 and Task 4 compared to Task 1 and Task 3. It can be analyzed as resulting not only from the difference in types of tasks but also from the different formats of metadata encountered in searching. While Task 1 and Task 2 were searches for book information which is usual in their workplaces, Task 3 required a search for electronic information, which might be less familiar to them from their workplaces. Based on the results, it appears that there is a difference in searching different formats of metadata. The metadata format for electronic information was less familiar to the participants, and consequently they had more difficulty searching for information of this type.
**Usability Issues and Recommendations**

- How can the thoughts and perceptions of users be used to improve integrated cataloging and metadata services systems?

Through this study, 17 coded usability problems of consideration were developed. Six classified usability problems containing the 17 usability problems were presented and analyzed in Chapter Four. Connexion should make improvements in at least six of those areas in order to be more usable as an integrated cataloging and metadata system for its primary audience.

In terms of Error Prevention and Correction, there is a need for more easily recognizable messages for users. A pop-up window letting users know that they have made a mistake and should correct it would be most useful. Generally, a somewhat more simplified structure would be helpful for Navigation and Information Grouping & Structure; perhaps more obvious color differentiation among options would prevent some errors. Finally, instructions and explanations of each option need to be improved to reduce the costs of training and searching the database.

**Implications for Metadata and Usability Studies**

**Integrated cataloging and metadata systems**

The integrated cataloging and metadata system, Connexion, used in this study is still changing. OCLC is planning to quit other services such as Passport and services will be integrated into a single service using Connexion [http://www.oclc.org/connexion/migrating/default.htm](http://www.oclc.org/connexion/migrating/default.htm)

In order to serve better to its users, OCLC will need to implement two recommendations arising from this study.

First, there need to be major corrections made to the interface of Connexion. Most important among these are improving the user assistance and
navigation aspects. Searching and creating catalogs are activities that are essential to intellectual work in Library and Information Studies. More useful instruction and explanation of the interface will help to reduce searching efforts and save in training costs.

Second, the training for Connexion use needs to be redirected and refocused. Current training focuses on the features of the Connexion without placing these in the context of searching. Training only in the features of the Connexion is not currently enough for learning to make a better search in Connexion. Users also need to be trained in every aspect of the information retrieval system to increase their understanding of how such systems work. The results of this test demonstrate that users who were already familiar with information retrieval systems more satisfied with Connexion. The continued development of Connexion and its further integration with other databases affords a unique opportunity for such improvements to be implemented.

**Usability studies**

The results of this study provide two suggestions for usability studies of a cataloging system.

First, used along the effectiveness by completion time is a problematic in evaluating cataloging systems. In order to get the correct record, a cataloger searches through databases and make decisions regarding which record is the proper one for his/her work. As observed in this test, some catalogers used the strategy of a conducting a new search using different keywords to ensure that they had located the best record. In these cases, it took the participants more time to complete their tasks. Another way to look at this relates to task types involved in searches. It is clear that completion time is directly related to the type of task the searcher engages in (simple fact finding vs. judgment task). Cataloging work, for example, is always subject to the decision-making process, deciding whether a record is right or wrong, and therefore completion time may not be the best
measure for evaluating the usability of a cataloging system. Therefore, completion time should be split into two categories; time taking to search the information and time taking to evaluate and make a judgment especially when it used a measure of usability testing with cataloging systems.

Second, results of this study suggest that developers of cataloging systems need to be more active in soliciting and supporting usability studies designed to test the usability of the particular system for particular users. There have been many usability studies that test usability of a system in general as described in Chapter Two. There have also been usability studies of specific metadata systems. However, there have been no studies specifically designed to test the usability studies of cataloging and metadata systems for catalogers, their primary user population. It would be advisable to move the focus of usability testing into more specific systems at this point, with specific users in view.

**Future Research Directions**

The findings of this study provide a platform for expansion and establishment of a future research agenda.

First of all, testing of all other currently existing cataloging systems is necessary comparison with integrated cataloging and metadata systems. For example, the client version of Passport should be tested to reveal how useful the search options and menus are for the wider range of general cataloging system usage that this system receives as compared to the specific target audience for Connexion. Such efforts may support generalization of the results of this study. In addition, such efforts may provide better and more detailed understanding of usability problems encountered in cataloging systems.
Since the usability studies are grounded in user behaviors, it would be interesting to investigate these, with the goal of establishing possible models of specific user-group behaviors in our field, especially those of catalogers.

During the test, individuals used various numbers of keywords. Some used only two or three, but others used more than six keywords, including all the qualifiers located in the option box. An interesting topic for future research would be to see if catalogers demonstrate consistent patterns of keyword usage.

From this test, Tasks 1 and 2 were considered as very similar types of tasks. Participants seemed to have learned from the difficulties they experienced in finding book information in Task 1. This appears to have considerably reduced the number of errors in Task 2 as compared to Task 1. It might be reduced discriminating power of the result from these two tasks. For future study, it would be recommended to carefully consider the task types and arrangement of the tasks. In order to solve this problem, it would be recommended to adapt a few different sets of similar types of tasks to see the differences in terms of the types of tasks.

Last, but not least, the study of catalogers searching behavior is another interesting topic for future research. During this test, catalogers preferred to use Command search or Derived Search when they thought they knew how to use them. There are many information retrieval systems and search engines currently in popular use and more will certainly be developed for a wide range of user groups. Study of catalogers’ searching behavior might provide illuminating contrast with the searching behavior of ordinary end-users.

Conclusion

The goal of this study was to examine the relationships between usability and the searching experience, and to uncover where an integrated cataloging and
metadata system lay the usability problems of its primary users, catalogers. It was assumed that usability would be affected by the users’ previous search experience.

This research started by looking at three usability measures and their relation to users’ searching experience, and went on to examine the usability problems that Connexion, an integrated cataloging and metadata system was faced with.

This study showed that the most important aspect of usability in Connexion is the users’ prior experience with an information retrieval system. Also, it showed there are seventeen usability problems with Connexion, and that these can be grouped into six categories. Needless to say, it is most important to note that usability is not an exclusive goal of such an integrated cataloging and metadata system. Other goals such as quality of cataloging records, and the reliability of its cataloging and metadata system are equally its concern.

This study also suggested testing on more diverse cataloging systems and their use by specific user groups, especially catalogers, would be beneficial to increasing our understanding of the role that integrated cataloging and metadata system will play. Although application of the recommendation of this study will improve the usability of the Connexion system for its primary user group, much work remains to ensure that as this system develops its users are well served.
APPENDIX A: INFORMED CONSENT FORM
Title: Usability assessment of integrated cataloging and metadata services: a case study of the OCLC Connexion System

Investigator: Jeong-Mee Lee, Graduate Student, School of Information Studies
Florida State University, (850) 644-8117

Advisor: Kathleen Burnett, Associate Dean, School of Information Studies
Florida State University, (850) 644-5772

Description: The goal of this experiment is to identify problems and issues related to the usability of an integrated cataloging and metadata services system for users of that system. The three most prominent factors to be measured include effectiveness, efficiency, and user satisfaction. In usability testing, effectiveness looks at whether users can accomplish tasks completely and accurately. Accuracy and completeness with which users achieve specified goals will be measured as they perform tasks that the researcher will provide. In usability testing, efficiency analyzes the amount of resources used to complete tasks effectively. Resources expended in relation to the accuracy and completeness with which users achieve goals will be measured as they perform tasks that the researcher will provide. Satisfaction deals with a user’s attitude toward the product. Freedom from discomfort, and positive attitudes towards the use of the product based on typical users executing typical tasks are the major foci for this factor. It will be measured through a questionnaire that the researcher will provide at the end of each subject’s session. The experiment will last about 1 hour. You will be given a training session, a pre-test, a main test, and a survey to complete. You will be asked to search the information retrieval system using a browser and to printout the search results when your searching is completed.

Risks and Benefits: The methods used in this study will present no danger to you, and there will be no direct benefit from study participation.

Costs and Payments: You will be paid $10.00 for participation in the experiment. You must complete the entire experiment in order to receive the $10.00 payment.

Confidentiality: Individual performances will be kept confidential to the full extent allowed by law. No personally identifying information will be included with the data records for any individual. Published papers from the research will focus on group averages and refer to individual responses using codes (e.g. Subject 101, Subject 201) that preserve your anonymity.

Right to refuse or end participation: Participation is entirely voluntary. You may stop participation at any time for any reason. Your decision whether or not to participate in this study or to end participation will have no effect on your academic standing at the Florida State University, or any other benefits to which you are entitled.

Voluntary consent: I certify that I have read the preceding, or it has been read to me, and I understand its contents. Any questions I have pertaining to the research have been, and will continue to be answered by the investigators listed at the beginning of this consent form at the phone numbers given. I understand that my searching will be videotaped by the researcher. These tapes will be kept by the researcher in a locked filing cabinet. I understand that only the researcher will have access to these tapes and...
that they will be discarded by August 20, 2004. Any questions I have concerning my rights as a research subject will be answered by the Human Subjects Protection Advocate at the Florida State University IRB Office (850-644-8836). My signature below means that I have freely agreed to participate in this project.

X_____________________________________   ___________________
    Participant                             Date
Pre-Test Questionnaire.

Section I. Demographic Information.

Subject ID: ______________________

Please indicate your responses to the following items.

1. Gender:
   □ Male  □ Female

2. Age:
   □ 18-20  □ 21-30
   □ 31-40  □ 41-50
   □ over 51

3. Year
   □ Freshman  □ Sophomore
   □ Junior   □ Senior
   □ Graduate School

4. Major or field of study
Section II. Computer and Searching Experience of Users.

Subject ID: ____________________

Please indicate your responses to the following items.

1. How many years have you been using computers?
   - ☐ None
   - ☐ Less than 1 year
   - ☐ 2-4 years
   - ☐ More than 5 years

2. How long have you been using information retrieval systems such as Webluis or others?
   - ☐ Less than 6 months
   - ☐ 6 months – 1 year
   - ☐ 1 year – 2 years
   - ☐ More than 2 years

3. How many hours per week (on average) do you spend searching information?
   - ☐ Less than 2 hours
   - ☐ 3 – 5 hours
   - ☐ More than 6 hours

4. How much time (on average) do you spend searching information in one sitting?
   - ☐ 5 – 10 min
   - ☐ 30 min – 1 hour
   - ☐ More than 1 hour

5. Rate your familiarity with information retrieval systems.
   - ☐ Novice
   - ☐ Intermediate
   - ☐ Expert

6. How often are your information retrieval searches successful or return the expected results?
   - ☐ Never
   - ☐ Rarely
   - ☐ Occasionally
   - ☐ Often
   - ☐ Always

7. Have you ever been a position where you assisted an end-user in conducting a search (e.g., librarian, technician or other)?
   - ☐ Yes
   - ☐ No
8. Please check one box of each question

<table>
<thead>
<tr>
<th>How often do you…</th>
<th>Never</th>
<th>Once a Year</th>
<th>Quarterly</th>
<th>Once a Month</th>
<th>Once a Week</th>
<th>2 to 3 times a week</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search computerized library catalogs (e.g. WebLuis)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Search Internet search engines (e.g. Yahoo, Excite, Lycos)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Search commercial online databases (e.g. Dialog, Lexis-Nexis, Dow-Jones, FirstSearch)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OCLC Passport or Connexion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. List up to three purposes for which you use a specific information retrieval system

1)  

2)  

3)
APPENDIX C: EXIT INTERVIEW QUESTIONNAIRE
Section III. Exit Interview

Subject ID: __________________

Date: ________________
Time: ________________

Congratulations! You have completed the experiment tests successfully. Please indicate (circle) your responses to the following questions. Please circle only one number.

1. Indicate your level of overall comfort in using the integrated cataloging and metadata services system to perform your searching task.

   Uncomfortable       Very comfortable
   1  2  3  4  5  6  7  8  9

2. Rate the understandability of the integrated cataloging and metadata services system.

   Hard to understand       Easy to Understand
   1  2  3  4  5  6  7  8  9

3. Rate the ease of the use of the integrated cataloging and metadata services system.

   Not easy       Very easy
   1  2  3  4  5  6  7  8  9

4. Rate your satisfaction with the results of your searches.

   Not satisfied       Very satisfied
   1  2  3  4  5  6  7  8  9
5. To what extent were you familiar with the topic of the searches prior to participating in this experiment?

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<thead>
<tr>
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<th>Not familiar at all</th>
<th>Very familiar</th>
</tr>
</thead>
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<tr>
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</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>Task 2</td>
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<td></td>
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<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Task 3</td>
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<td></td>
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<td>1</td>
<td>2</td>
<td>3</td>
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Not familiar at all | Very familiar |
<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
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<td>Task 5</td>
<td></td>
</tr>
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<td>2</td>
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<tr>
<td>Task 6</td>
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<tr>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

6. Please recall any incidents or moments that you thought you made errors, you felt nonplussed, or that the system showed you what you were not really expecting, etc. How did it happen and what did you do? Were you able to recover from it? If so, how?

7. I’ve noticed that at one point you seemed to _______________________. Was there any specific reason for that?
8. How did you make sense of the search output?

9. How would you evaluate the interface?

10. Is there anything that you can recognize the difference between this system (Connexion) and other information systems?

11. Is there anything you want to mention about your experience today or about the given tasks?
APPENDIX D: PEARSON’S CORRELATIONS BETWEEN ACCURACY AND NUMBER OF ERRORS (N=10)
Pearson’s Correlations between accuracy and number of errors (N=10)

<table>
<thead>
<tr>
<th></th>
<th>Errors_ (Total)</th>
<th>Errors_ Task_1</th>
<th>Errors_ Task_2</th>
<th>Errors_ Task_3</th>
<th>Errors_ Task_4</th>
<th>Accuracy_ Task_3</th>
<th>Accuracy_Task_4</th>
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</thead>
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<td>Errors_ (Total)</td>
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<td>.921**</td>
<td>.957**</td>
<td>.901**</td>
<td>-.584</td>
<td>-.651**</td>
</tr>
<tr>
<td>Sig.</td>
<td>(.002)</td>
<td>(.000)</td>
<td>(.000)</td>
<td>(.000)</td>
<td>(.076)</td>
<td>(.041)</td>
<td>(.167)</td>
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<td>Errors_ Task_1</td>
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<td>.740**</td>
<td>.611</td>
<td>-.701*</td>
<td>-.704*</td>
<td>-.604</td>
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<tr>
<td>Sig.</td>
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<td>(.015)</td>
<td>(.060)</td>
<td>(.024)</td>
<td>(.023)</td>
<td>(.065)</td>
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<td>Errors_ Task_2</td>
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<td>(.025)</td>
<td>(.052)</td>
<td>(.040)</td>
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</tr>
<tr>
<td>Sig.</td>
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<td>(.002)</td>
<td>(.205)</td>
<td>(.123)</td>
<td>(.145)</td>
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<tr>
<td>Errors_ Task_3</td>
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<td>.857**</td>
<td>-.438</td>
<td>-.520</td>
<td>-.291</td>
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<tr>
<td>Sig.</td>
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<td>(.002)</td>
<td>(.020)</td>
<td>(.123)</td>
<td>(.145)</td>
<td></td>
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<tr>
<td>Errors_ Task_4</td>
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<td>-.631</td>
<td>-.478</td>
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<td>Sig.</td>
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<td>(.098)</td>
<td>(.051)</td>
<td>(.163)</td>
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<td>Accuracy_ (Overall)</td>
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<td>.954**</td>
<td>.945**</td>
<td>.828**</td>
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<td></td>
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</tr>
<tr>
<td>Sig.</td>
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<td>(.000)</td>
<td>(.000)</td>
<td>(.003)</td>
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<td>Sig.</td>
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</table>

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
(Sig.): Significance level
APPENDIX E: PEARSON’S CORRELATIONS BETWEEN COMPLETION TIME AND NUMBER OF KEYSTROKES (N=10)
Pearson’s Correlations between Time and Number of Keystrokes (N=10)

<table>
<thead>
<tr>
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<th>KS</th>
<th>KS_T1</th>
<th>KS_T2</th>
<th>KS_T3</th>
<th>KS_T4</th>
<th>Time</th>
<th>Ti_T1</th>
<th>Ti_T2</th>
<th>Ti_T3</th>
<th>Ti_T4</th>
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<td>.925**</td>
<td>.908**</td>
<td>.442</td>
<td>.461</td>
<td>.642*</td>
<td>.317</td>
<td>.175</td>
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<tr>
<td>(Sig.)</td>
<td></td>
<td>(.006)</td>
<td>(.159)</td>
<td>(.000)</td>
<td>(.000)</td>
<td>(.201)</td>
<td>(.179)</td>
<td>(.045)</td>
<td>(.372)</td>
<td>(.628)</td>
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<td>KS_T1</td>
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<td>.745*</td>
<td>.574</td>
<td>.550</td>
<td>.756*</td>
<td>.711*</td>
<td>.907**</td>
<td>.667*</td>
<td>.261</td>
<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td></td>
<td>(.013)</td>
<td>(.082)</td>
<td>(.099)</td>
<td>(.011)</td>
<td>(.021)</td>
<td>(.000)</td>
<td>(.035)</td>
<td>(.466)</td>
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<td>.558</td>
<td>.717*</td>
<td>.729*</td>
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<td>.109</td>
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<tr>
<td>(Sig.)</td>
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<td>.714*</td>
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<td>(.004)</td>
<td>(.000)</td>
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<td>Ti_T1</td>
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<td>(Sig.)</td>
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<tr>
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<td>Ti_T3</td>
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<tr>
<td>(Sig.)</td>
<td></td>
<td>(.017)</td>
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</table>

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
Note 1: KS: Keystrokes, KS_T#: Keystrokes for Task #
Note 2: Time: Completion time, Ti_T#: Completion time for Task #
(Sig.): Significance level
APPENDIX F: PEARSON’S CORRELATIONS BETWEEN ACCURACIES AND SEARCHING EXPERIENCES (N=10)
Pearson’s Correlations between Accuracies and Searching Experiences (N=10)

<table>
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<tr>
<th></th>
<th>Hours spent in one setting</th>
<th>Computerized library catalogs</th>
<th>Search engines</th>
<th>Commercial online databases</th>
<th>OCLC Accuracy Overall</th>
<th>Accuracy Task3</th>
<th>Accuracy Task4</th>
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<td>Hours spent in one setting (Sig.)</td>
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<td>.375</td>
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<td>-.325</td>
<td>.737*</td>
<td>.837**</td>
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<tr>
<td>Computerized library catalogs (Sig.)</td>
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<td>.375 (.286)</td>
<td>.826 (.360)</td>
<td>.015 (.003)</td>
<td>.034</td>
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<td>.061 (.867)</td>
<td>.151</td>
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<td>1.00</td>
<td>-.453 (.188)</td>
<td>-.084 (.817)</td>
<td>-.048 (.895)</td>
<td>.067</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OCLC (Sig.)</td>
<td>1.00</td>
<td>.016 (.964)</td>
<td>-.110 (.763)</td>
<td>.151 (.677)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy Overall (Sig.)</td>
<td>1.00</td>
<td>.954 (.000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy Task3 (Sig.)</td>
<td>1.00</td>
<td>.828 (.003)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy Task4 (Sig.)</td>
<td>1.00</td>
<td>.000 (.000)</td>
<td></td>
<td></td>
<td></td>
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</table>
APPENDIX G: PEARSON’S CORRELATIONS BETWEEN NUMBER OF ERRORS AND SEARCHING EXPERIENCES (N=10)
Pearson’s Correlations between Number of Errors and Searching Experiences
(N=10)

<table>
<thead>
<tr>
<th></th>
<th>Familiarity with information retrieval systems</th>
<th>Number of errors</th>
<th>Number of errors in Task1</th>
<th>Number of errors in Task2</th>
<th>Number of errors in Task3</th>
<th>Number of errors in Task4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiarity with information retrieval systems (Sig.)</td>
<td>1</td>
<td>-.903**</td>
<td>-.802**</td>
<td>-.885**</td>
<td>-.791**</td>
<td>-.762*</td>
</tr>
<tr>
<td></td>
<td>(.000)</td>
<td>(.005)</td>
<td>(.001)</td>
<td>(.006)</td>
<td>(.010)</td>
<td></td>
</tr>
<tr>
<td>Number of errors (Sig.)</td>
<td>1</td>
<td>.852**</td>
<td>.921**</td>
<td>.957**</td>
<td>.901**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.002)</td>
<td>(.000)</td>
<td>(.000)</td>
<td>(.000)</td>
<td>(.000)</td>
<td></td>
</tr>
<tr>
<td>Number of errors in Task1 (Sig.)</td>
<td>1</td>
<td>.918**</td>
<td>.740*</td>
<td>.611</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.000)</td>
<td>(.015)</td>
<td>(.060)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of errors in Task2 (Sig.)</td>
<td>1</td>
<td>.864**</td>
<td>.696*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.001)</td>
<td>(.025)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of errors in Task3 (Sig.)</td>
<td>1</td>
<td>.857**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.002)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of errors in Task4 (Sig.)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

(Sig.): Significance level
APPENDIX H: PEARSON’S CORRELATIONS BETWEEN COMPLETION TIME AND SEARCHING EXPERIENCE (N=10)
Pearson’s Correlations between Completion time and Searching Experiences 
(N=10)

<table>
<thead>
<tr>
<th></th>
<th>Familiarity with information retrieval systems</th>
<th>Time_T1</th>
<th>Time_T2</th>
<th>Time_T3</th>
<th>Time_T4</th>
<th>Time_Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiarity</td>
<td>1</td>
<td>-.692*</td>
<td>-.975**</td>
<td>-.725*</td>
<td>-.213</td>
<td>-.783**</td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.026)</td>
<td>(.000)</td>
<td>(.018)</td>
<td>(.555)</td>
<td>(.007)</td>
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</tr>
<tr>
<td>Time_T1</td>
<td>1</td>
<td>.757*</td>
<td>.306</td>
<td>-.236</td>
<td>.424</td>
<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.011)</td>
<td>(.391)</td>
<td>(.512)</td>
<td>(.222)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time_T2</td>
<td>1</td>
<td>.761*</td>
<td>.222</td>
<td>.821*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.011)</td>
<td>(.538)</td>
<td>(.004)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time_T3</td>
<td>1</td>
<td>.729*</td>
<td>.981**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.017)</td>
<td>(.000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time_T4</td>
<td>1</td>
<td>.714*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td></td>
<td>(.020)</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Time_Overall</td>
<td>1</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Note: Time_T#: Completion time for Task #
(Sig.): Significance level
APPENDIX I: PEARSON’S CORRELATIONS BETWEEN KEYSTROKES AND SEARCHING EXPERIENCES (N=10)
Pearson’s Correlations between Keystrokes and Searching Experiences (N=10)

<table>
<thead>
<tr>
<th></th>
<th>Hours spent in one setting</th>
<th>Familiarity with information retrieval systems</th>
<th>KS</th>
<th>KS_T1</th>
<th>KS_T2</th>
<th>KS_T3</th>
<th>KS_T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours spent in one setting</td>
<td>1</td>
<td>.667</td>
<td>-.753**</td>
<td>-.643*</td>
<td>-.373</td>
<td>-.600</td>
<td>-.740*</td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.035)</td>
<td>(.012)</td>
<td>(.045)</td>
<td>(.289)</td>
<td>(.067)</td>
<td>(.014)</td>
<td></td>
</tr>
<tr>
<td>Familiarity with information retrieval systems</td>
<td>1</td>
<td>-.681*</td>
<td>-.905**</td>
<td>-.745*</td>
<td>-.400</td>
<td>-.494</td>
<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.030)</td>
<td>(.000)</td>
<td>(.013)</td>
<td>(.252)</td>
<td>(.147)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KS</td>
<td>1</td>
<td>.791</td>
<td>.481</td>
<td>.925**</td>
<td>.908**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.006)</td>
<td>(.159)</td>
<td>(.000)</td>
<td>(.000)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KS_T1</td>
<td>1</td>
<td>.745*</td>
<td>.574</td>
<td>.550</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.013)</td>
<td>(.082)</td>
<td>(.099)</td>
<td></td>
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<td></td>
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<tr>
<td>KS_T2</td>
<td>1</td>
<td>.263</td>
<td>.132</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.463)</td>
<td>(.715)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KS_T3</td>
<td>1</td>
<td>.857**</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.002)</td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>KS_T4</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Note: KS: Keystrokes, KS_T#: Keystrokes for Task #
(Sig.): Significance level
APPENDIX J: PEARSON’S CORRELATIONS BETWEEN SATISFACTION AND SEARCHING EXPERIENCE (N=10)
### Pearson’s Correlations between Satisfaction and Searching Experiences (N=10)

<table>
<thead>
<tr>
<th></th>
<th>Experience of computerized library catalogs</th>
<th>Comfortable</th>
<th>Understandability</th>
<th>Easiness</th>
<th>Satisfaction</th>
<th>Overall Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experience of computerized library catalogs</td>
<td>1</td>
<td>.227</td>
<td>.713*</td>
<td>.792**</td>
<td>-.045</td>
<td>.512</td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.529)</td>
<td>(.021)</td>
<td>(.006)</td>
<td>(.901)</td>
<td>(.130)</td>
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</tr>
<tr>
<td>Comfortable</td>
<td>1</td>
<td>.596</td>
<td>.480</td>
<td>.753*</td>
<td>.872**</td>
<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.069)</td>
<td>(.161)</td>
<td>(.012)</td>
<td>(.001)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understandability</td>
<td>1</td>
<td>.865**</td>
<td>.406</td>
<td>.871**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.001)</td>
<td>(.245)</td>
<td>(.001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Easiness</td>
<td>1</td>
<td>.323</td>
<td></td>
<td></td>
<td>.804**</td>
<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.362)</td>
<td>(.005)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfaction</td>
<td>1</td>
<td>.744*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Sig.)</td>
<td>(.014)</td>
<td></td>
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</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

(Sig.): Significance level
REFERENCES


126


research challenge: Survey research methods (pp.149-184). Boston, MA: Harvard Business School.
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