Measuring Usage and Usability of Online Databases at Hartnell College: An Evaluation of Selected Electronic Resources

by

Jennifer Lagier

A formal dissertation submitted in partial fulfillment
of the requirements of Doctor of Philosophy

Graduate School of Computer and Information Sciences
Nova Southeastern University

2002

We hereby certify that this dissertation, submitted by Jennifer Lagier, conforms to acceptable standards and is fully adequate in scope and quality to fulfill the dissertation requirements for the degree of Doctor of Philosophy.

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The purpose of this study was to collect and examine statistical and survey data in an effort to determine whether three electronic resources made available by the Hartnell College library are actually being used by the target population for whom they were acquired. The second goal was to significantly advance understanding of how selected online database products collect and report usage statistics, how usable students find existing electronic resources, and whether usage levels justify the costs of renewing online resource subscriptions.

The major problems examined within the study include a lack of common measurement standards and the absence of a universally agreed upon definition of what constitutes usage. Additional problems included a lack of comparative data to evaluate similar electronic resources and the absence of any prior analysis of database use at Hartnell College.

Data for this study was obtained from two sources: server log files and user surveys. Each month, log files containing electronic resource usage statistics were downloaded, analyzed and stored in spreadsheets by the Hartnell College Systems Librarian. This information was supplemented by data collected during a usability study and user satisfaction study conducted in Spring 2002. Test participants were drawn from two Hartnell College classes: one section of English 253 and one section of English 101. There was a total of 25 participants.

Findings from the completed study indicated EBSCOhost and ProQuest databases were used more than CQ Researcher, with EBSCOhost receiving the most use. Despite this finding, usability and user satisfaction surveys indicated that students participating in this study found CQ Researcher the most effective tool in helping them perform directed research. Students also rated CQ Researcher highest in user satisfaction, followed by EBSCOhost and then ProQuest.

The factual statistical data derived from this study will assist decision-makers at Hartnell College as they prepare the 2003-2004 Library materials budget. An awareness of usability and user satisfaction ratings of existing electronic resources by students have resulted in planned revisions to existing bibliographic instruction courses.

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Chapter 1

Introduction

Low-cost computers and faster Internet connections have increased the accessibility of Web-based resources, making it possible for students and researchers to work from the convenience of their own homes. Electronic resources such as digital libraries continue to evolve and proliferate, offering on-campus and distance learners a multitude of information sources such as Web-based catalogs, online full-text databases, indices, an entire plethora of electronic and digital objects. Virtual library services that include access to online reference librarians, electronic texts and full-text databases are now a reality. Existing models include the collaborative effort involving the Library of Congress and sixteen other partner libraries offering a twenty-four hour a day, seven days a week, world-wide online reference service (Reference 24/7, 2000). The increased availability of Internet-based services and resources has fueled a corresponding acceleration in the expectations of library users (Rader, 2000).

At the same time, libraries find an expanding chunk of their annual budgets earmarked for licensing fees to provide full-text database access to students and their instructors. In the California Community College system, Telecommunications and Technology Infrastructure Program (TTIP) grants that used to allow purchase of print

materials, as well as technology, are now restricted to the acquisition of electronic resources. Recently awarded Title V grant monies also include funds dedicated to expanding the library's online full-text database offerings. Hartnell College Library now spends approximately $40,000 per year on full-text databases to support on-site and distributed instruction.

Problem Statement

As electronic resources become an increasingly essential component of online learning environments, researchers and educators find themselves grappling with ways to measure the availability, usage and usability of digital library components, such as full-text database products. The importance of obtaining accurate usage data relates to the increasing need for institutions to justify the use of public funds to obtain and maintain online resources. Effective program, budget and curriculum planning are reliant upon an accurate understanding of how members of the learning community are making use of electronic databases (DeCandido, 1999).

While this proposition sounds straight forward, those attempting to capture and analyze usage statistics quickly discover the following roadblocks:

1. What constitutes usage?
2. How should this usage be measured?

While there exists a body of literature describing transaction log analysis for online public access catalogs (Blixrud, 2001; Chen & Cooper, 2001; Greenstein & Troll, 2000), few have performed similar research to examine usage of digital library resources. Now that the usage level of various electronic databases has increased, researchers are

starting to explore ways to examine user search behavior by means of transaction log analysis (Cooper, 2001; Tenopir & Read, 2000; Tenopir, 2001).

Unfortunately, there are currently no standard metrics established to accommodate capture of usage statistics for electronic databases (ICOLC, 2001; McClure & Eppes, n.d.). Some products, such as the RAND California database, offer nothing more than a total number of searches performed with statistics generated on a monthly basis by the vendor and then e-mailed to subscribers. Others, such as ProQuest and EBSCOhost (Masterfile), allow library administrators to generate usage statistics on demand, reporting the total number of search sessions initiated during a user-defined time period, duration of each search session, and the total access requests for various journal titles. Some electronic databases also report what types of materials searchers have accessed: abstracts, full-text articles, images, or sound files. Overall, however, there is no industry standard dictating what constitutes usage or how to measure and then report patterns of user behavior.

Usability studies offer a way to examine how individuals are using products, such as online databases, to quickly and easily accomplish their work (Dumas & Redish, 1999). Unlike log files that provide a static measure of the number of times a database has been accessed, usability testing offers a means to analyze how users interact with online database functions to achieve specific research goals. Usability testing involves observation and surveys of real end-users attempting every-day tasks, recording the problems they encounter as they perform hands-on work.

Goals

This study had two specific goals. The first goal was to determine whether the

target population for whom full-text databases were acquired is actually using electronic resources made available by the Hartnell College Library. To identify any problems or barriers encountered during use of selected electronic resources, representative members of the target population participated in a usability study that examined three online databases: CQ Researcher, EBSCOhost, and ProQuest. The information gathered during this study now provides documentation that verifies the college is appropriately expending Title V funds awarded by the federal government to enhance learning for Hispanic students and has identified obstacles to effective student access and use.

The second goal was to significantly advance understanding of how selected online database products collect and report usage statistics, how usable students find existing electronic resources, and whether usage levels as well as usability ratings justify the costs of renewing online resource subscriptions. In this era of reduced funding, it is critical that the Library be able to document usage levels and explain to decision-makers why the addition and maintenance of electronic resources is an important service for Hartnell students. This study provides baseline documentation addressing these issues.

Relevance

Without some way to capture and analyze use, librarians are unable to ascertain whether they are making wise expenditures to obtain and maintain pricey electronic resources (Tenopir & Read, 2000). The situation is exacerbated for community college libraries in the state of California. Community colleges and state universities have experienced even deeper cuts in their already inadequate budgets. This reality is complicated by the special needs of diverse populations and their preferred learning styles and characteristics.

Without conducting a usability study, librarians have no way of knowing whether students find expensive online databases easy to learn and effectively use. Evaluation of usability offers a way to identify obstacles student might encounter while attempting to perform routine research tasks. These barriers may be related to interface design, functionality, cultural disconnects, or outside factors such as hardware, software, or network failures.

Until a user satisfaction survey was completed, there was no way to ascertain whether students found existing database offerings suitable for the information needs of the Hartnell College learning community. Obstacles to user satisfaction may have nothing to do with the database product. But, without soliciting feedback from the target population of users, there was no credible method for determining what problems students typically encounter during the process of completing every-day, information-seeking tasks (Dumas & Redish, 1999).

Significance

Since purchasing access to its first electronic full-text database in 2000, the Hartnell College Library has now expanded its digital library collection from a single title to eight database offerings. Expenses for these resources have grown to an annual budget of $39,710 for fiscal year 2001-02. The ongoing costs to maintain existing database subscriptions will continue to increase during 2002-2003. Yet, since originally implementing access to online databases, the Library has, up until now, conducted no surveys to determine how usable students find these electronic resources and collected no data to measure actual online database usage. Throughout the year, librarians are working on collection development and considering the materials budget for the coming year.

Each purchase decision is carefully weighed and justified as selection of one item translates to the inability to acquire another. Without access to statistical data measuring student use of the most expensive of the Library's resources, there is no means to determine the cost-effectiveness and fiscal sense of maintaining existing online subscriptions.

The results of this study provide documentation indicating usage levels of existing electronic resources and which full-text databases are receiving the most use. In addition, usability and user satisfaction studies have supplied information signifying whether the selected online databases offered by the library actually serve the informational needs of Hartnell students.

Barriers and Issues

At the current time, there exists no universally accepted metrics for collecting or reporting statistical measures of usage of Web-based full-text resources. Nevertheless, groups such as the Association of Research Libraries (ARL), Digital Library Federation (DLF) and the International Coalition of Library Consortia (ICOLC) are in the process of developing a series of recommended measurement guidelines (ICOLC, 1998). The DLF guidelines will enable institutions to effectively collect and maintain or convert existing materials to digital format, following standards and best practices as they evolve. ICOLC has developed guidelines for the selection and purchase of electronic information as well as a guide to the statistical measures for Web-based electronic resources. Standards being developed by the ARL will help libraries more accurately determine which electronic resources are being used, how often usage statistics are reported, what usage elements will be included, and recommended reporting procedures.

For example, the Hartnell Library currently subscribes to eight full-text electronic databases provided by commercial vendors at an annual cost of $39,000. Until September 2001, no transaction log data had been captured and examined to determine whether these resources were actually being accessed or used. At this time, the systems librarian collects and reports usage statistics based on log file reports on a monthly basis.

Because each commercial full-text database vendor collects different usage elements such as number of sessions, length of session, number of searches, types of searches, types of electronic resources retrieved, search terms used, and number of items downloaded, printed, e-mailed or viewed, any meaningful comparison of usage levels is nearly impossible. Figures 1-3 illustrate the different usage components measured by commercial vendors for the three electronic databases evaluated within this study.

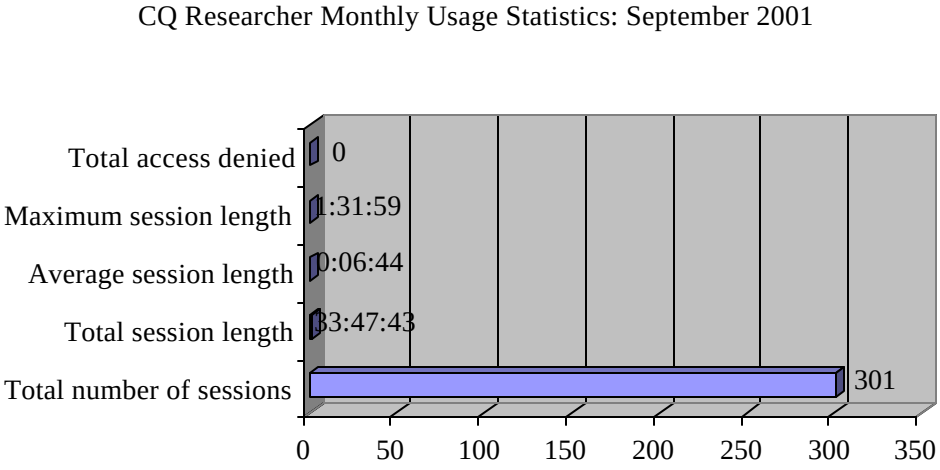

Figure 1. September 2001 Usage Statistics for CQ Researcher

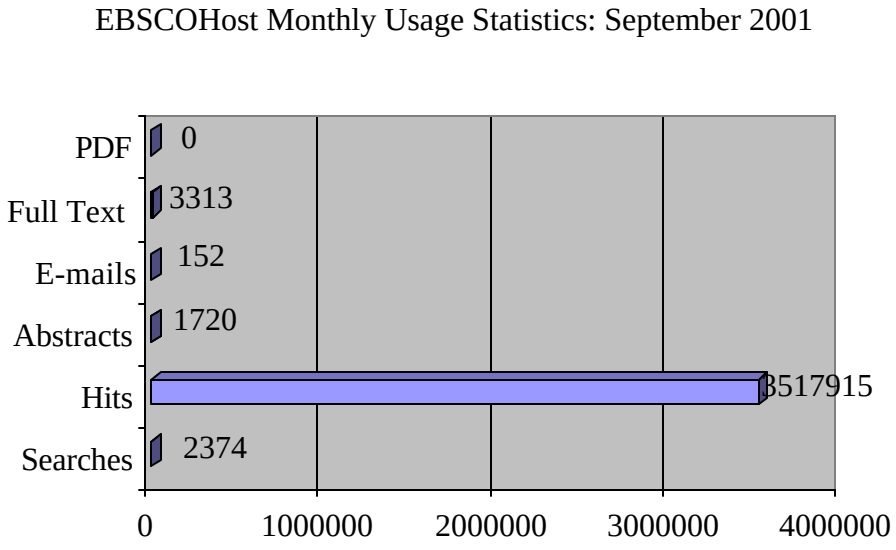

Figure 2. September Usage Statistics for EBSCOhost (Masterfile)

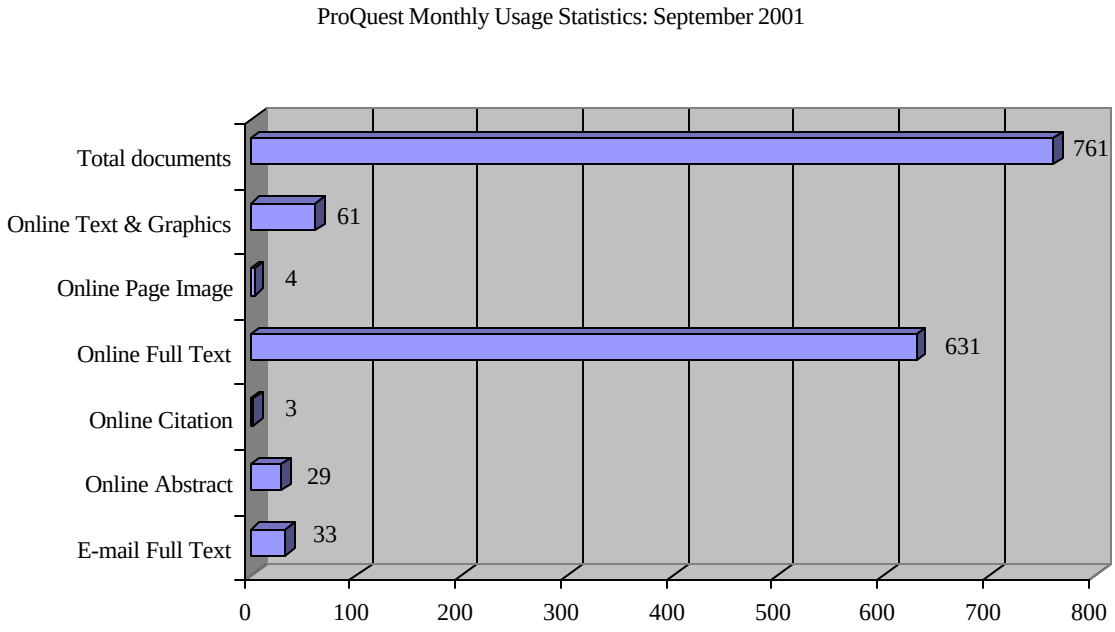

Figure 3. September 2001 Usage Statistics for ProQuest

Initial efforts to develop appropriate measurement guidelines have suggested further exploration of these approaches:

1. Transaction-based measures
2. Time-based measures
3. Cost-based measures
4. Use-based measures.

Transaction-based measures include counts of search sessions, number of hits, and types of searches performed as recorded within transaction logs. Log files can be used to calculate time-based measures such as length of search sessions, available service hours, and system or server peak levels. Cost-based measures analyze service in terms of expenditures, examining actual costs of hardware, software, networking, staff, and training and site licenses. Use-based measures examine number of simultaneous users or sessions, number of hits per patron, user satisfaction, and local vs. off-site usage (Young, 1997).

In May 2000, the Association of Research Libraries (ARL), under the auspices of its New Measures Initiative, began Phase I of its E-Metrics Project. Having discovered a lack of consistent and comparable data to evaluate electronic resources, project participants were tasked with the need to define a common set of statistics and performance measures. Phase 1 would gather information about ARL libraries' best practices in statistics, measures, processes and activities relating to online resources. Phase II activities would include concentrating on developing and testing a methodology to examine the feasibility of data collection and whether collected data is comparable among participating libraries. During Phase III, refined measures would be proposed to ARL and would include standardized data descriptions as well as guidelines for data collection, analysis and use (Blixrud, 2000).

Proposed Association of Research Libraries statistical measurement standards outlined in Phase 1 of the ARL E-Metrics Project addressed the development of separate and specific metrics for each of the following areas:

1. Electronic resources and services
    a. Number of electronic full-text journals made accessible by library
    b. Number of librarians assigned to provide electronic reference services
    c. Number of virtual visits to online library resources
    d. Number of electronic reference transactions
    e. Number of public-access workstations
2. Electronic database
    a. Number of electronic full-text journal subscriptions
    b. Number of online sessions initiated
    c. Number of online search queries
    d. Number of electronic objects viewed, downloaded, e-mailed or printed
    e. Number of online requests turned away due to simultaneous user limitations
    f. Total user connection time to commercial online databases
3. Instruction
    a. Number of participants in user instruction on electronic resources
4. Cost of electronic databases and services
    a. Cost of electronic database subscriptions

b. Cost of internal digital collection building

c. Cost per items examined from subscription databases.

Suggested measures proposed (Shim, 2000) would include calculating the percentage of electronic reference transactions as compared with total reference transactions, the percentage of electronic materials use as compared with total library materials use, and the percentage of remote library visits as compared with all library visits. An additional measurement would compare the ratio of public access workstations to the total number of faculty, staff and students.

The ARL Phase II E-Metrics Report issued in October 2001 reiterated the above recommendations. One of the Phase II deliverables included a manual designed to identify specific key statistics and measures that could be used to describe use and users of electronic resources, establish definitions and standardize procedures to collect measurement data, and increase awareness of major issues related to the collection, analysis and reporting of data to produce meaningful statistics and measures.

The conceptual framework offered within the Phase II E-Metrics Report assists libraries in the selection, use and understanding of usage statistics and performance measurements while providing a rationale for collecting and managing usage data. At the same time, it identifies issues libraries must consider in the course of statistics collection and reporting activities (Shim, McClure, Fraser, Bertot, Dagli & Leahy, 2001).

Minimum reporting requirements for usage statistics as outlined within the December 2001 revision of ICOLC Guidelines for Statistical Measures of Web-based Information Resources (http://www.library.yale.edu/consortia/2001webstats.htm) call for the following data elements:

1. Number of sessions
2. Number of queries
3. Number searches based on alphabetic and subject menu options in addition to basic searches
4. Number of electronic items examined, downloaded, e-mailed or printed.

Unfortunately, gathering and reporting these specified statistical measures are dependent upon access to transaction logs. At this time, few commercial electronic database vendors appear willing to share this detailed level of information tracking database usage.

Research Questions

The study addresses the following questions:

1. What do usage statistics tell us about how members of the Hartnell learning community make use of the existing electronic resources?
2. What is an effective procedure to compare database usage statistics to determine which electronic resources receive the most use?
3. To what extent do students find the interfaces provided by these commercial electronic databases usable?
4. Based on statistical measures such as an analysis of monthly log files, is the purchase of access to Web-based full-text databases a cost-effective expenditure of limited library funding?
5. To what extent do students from this particular learning community rate their satisfaction level with three currently available full-text database products?

Details provided by selected transaction logs reveal which journal titles students are most likely to access during full-text database searches. Log files also record and report types of searches Hartnell students employ when seeking online information, thus providing clues related to user behavior (Cooper, 2001; Tenopir & Read, 2000).

Despite differing usage elements measured and then reported by various full-text electronic database vendors, an examination of common categories such as the number of searches per month indicate which electronic resources are receiving the most use. Standards developed by ICOLC and the ARL E-Metrics project offer definitions and metrics for measuring and comparing usage statistics (Shim, McClure, Fraser, Bertot, Dagli, & Leahy, 2001; International Coalition of Library Consortia, 2001).

Usability studies supply additional data, helping librarians to determine whether students consider existing electronic resources to be usable and effective research tools. In addition, these studies identify barriers to usability so that a course of corrective action can be developed and implemented. Existing models of similar usability studies were adapted for use in the Hartnell College study (Theng, Mohd-Nasir, & Thimbleby, 2000; Dumas & Redish, 1999; Mayhew, 1999).

Results of this study will assist collection development librarians as they weigh the costs of new materials acquisitions against the price to maintain existing electronic database subscriptions. Cooper (2000) offers a design framework suitable for the compilation of cost comparison statistics. Finally, user satisfaction studies indicate if these selected online databases are easy to learn and meet user needs (Franklin & Nitecki, 1999; Mayhew, 1999).

Limitations

Twenty-five students in one section of English 253 and one section of English 101 participated in the evaluation. Because of the decision to eliminate random selection of test participants and work with pre-existing groups of students, external factors could not be completely controlled. These sections were chosen based on the instructor's willingness to participate in the study and the availability of the Technology Learning Classroom, hardware and software resources, test administrator and test participants.

The English 253 class is a remedial course made up of students with poor reading and writing skills. They are extremely representative of the target population Title V grant funds are designed to assist. As many of the electronic database subscriptions are being funded by Title V, involving these students as test participants helped address the question of whether this particular learning community is actually benefiting from these library expenditures.

Hartnell College is composed of primarily Hispanic students. Students from these classes who participated in the study are representative of the demographics of the majority of Hartnell students. Generalizations derived from these surveys may not be applicable to other demographic or ethnic populations.

Monthly usage statistics are derived from server log files. Not all databases measure the same components of usage, making consistency difficult to maintain. For purposes of this study, usage was based on the number of monthly accesses logged for each of the three databases being evaluated.

Delimitations

Students enrolled in English classes held at night or at the King City campus were not included. This was because students at the King City campus had no access to a testing facility or online resources at the temporary site where they attend classes. Students in the night English classes were not included due to lack of access to the Technology Learning Center or computer classrooms during evening sessions.

Students enrolled in the online English 101 class were not included. This was the first time Hartnell had ever offered an online English class. The instructor was new to Hartnell College. The online course materials and instructional curriculum had just been developed and never used before the Spring 2002 semester. Lack of access to these students for an in-person orientation session as well as the absence of a suitable testing facility were factors that resulted in their exclusion.

Due to scheduling problems or instructor preferences, students enrolled in English classes taught by instructors other than Lourdes Villarreal were not included. While other instructors may have wished to have their classes participate, lack of access to the Technology Learning Center or a computer lab prevented this from occurring.

The Hartnell Online Catalog and electronic databases other than CQ Researcher, EBSCOhost (Masterfile) and ProQuest were excluded from the usability study and user satisfaction survey. The three databases selected for examination were ones recommended for use by the majority of Hartnell instructors.

Definitions of Terms

Digital Library/Online Database/ Electronic Resource

Digital library is a phrase often used to define anything from a library's Web page portal to online public access catalogs or digitized collections of various electronic objects (Feldman, 1999). Guenther (2000) defines the digital library as a compilation of digitized resources and online services offered in tandem with traditional in-person, on-site, physical library materials and programs. Arms et al. (1997) explain that digital objects may be discrete electronic documents or groups of digitized objects. Access to this virtual collection is made possible by means of metadata and unique identifiers.

Whichever term one chooses to describe it, the digital library/online database/electronic resource embodies the following common elements:

- It represents a collection of digitized objects.
- These electronic objects are grouped based on relationships.
- Access to the collection of digitized objects is made possible through Internet or networking technologies.
- The user searches and interacts with digitized content by means of a graphical interface.

From a technical standpoint, one could describe the digital library as an electronic entity composed of virtual objects organized into grouped sets of information categories (Arms et al., 1997). Others view the digital library in the more inclusive terms of a composite entity that mirrors the functions of a traditional library, offering users access to electronic resources and a variety of online services (Leiner, 1998). Still others consider commercial full-text databases accessible through Internet technologies as a form of digital library.

For the purposes of this study, electronic resources included the Hartnell Library's Web-based public access catalog, Web site and online full-text databases. The specific online databases evaluated for usability and levels of user satisfaction were CQ Researcher, EBSCOhost (Masterfile), and ProQuest.

Usage

Young (1997) suggests a variety of usage measurements that might employ a combination of approaches including transaction-based measures, time-based measures, cost-based measures, or use-based measures. Tenopir (1997, 2000) argues that transaction logs provide only a partial picture of true database usage as specific environmental variables might also influence online database use.

An examination of usage reports available for the electronic resources offered by the Hartnell College Library revealed one common measure-- all count the number of times the database has been accessed during a specific period. Accordingly, for purposes of comparison, usage statistics reported within this study reflect the number of times per month each database was accessed.

Usability Testing

Walbridge (2000) defines usability testing as a method of observing users completing tasks using a product or service, then describing the users' experiences. Usability testing methods can include formal laboratory testing as well as field studies conducted in relative simplicity.

Battleson, Booth & Weintrop (2001) define usability as an interface, which is simple to learn, remember and use. Usability testing is the means by which an online resource's accessibility may be determined.

Dillon (1999) states that basic usability measures as defined by the majority of researchers include the following:

- The time it takes to perform a specific task
- The error rate
- The users' subjective satisfaction.

Dumas and Redish (1999) provide a slightly different perspective. By their description of usability, they mean that people are able to quickly and easily use a product to achieve their tasks. For purposes of this study, usability was determined based on the Dumas and Redish criteria. The usability questionnaire and user satisfaction survey developed for the Hartnell College study was an adaptation based on both the Middlesex and WAMMI questionnaires, supplemented by sample questions adapted from Dumas and Redish (1999).

User Satisfaction

Franklin & Nitecki (1999) define user satisfaction in terms of how well the library's services and resources meet user needs. Kirakowski and Claridge (1998) created a five-factor model of user-perceived satisfaction that measured whether users found a Web site pleasant to use, easy to navigate, responded at an acceptable speed, enabled them to effectively search and retrieve information, and provided an easily learnable interface.

This study adopted Mayhew's definition of user satisfaction. Her criteria include meaningful online help utilities, degree of user control, learnability, and ease of use. The user satisfaction questionnaire was developed based on a template provided by Mayhew (1999). Participants assigned ratings from a five point scale ranging from Strongly

Satisfied to Strongly Dissatisfied in response to a series of questions soliciting feedback about how well each database provides online instructions, permits user control, offers ease of learning, and allows the user to efficiently complete tasks.

Summary

Until very recently, information specialists have focused on developing the architecture of digital library design. The implementation of various digital library projects and accompanying growth in online resources such as electronic full-text databases have created a need to step back and evaluate digitized collections in terms of cost-effectiveness and usability.

Troll (2001) describes the problem of comparing usage statistics from commercial electronic databases due to the lack of common evaluative criteria or measurement standards. She explains that commercial vendors are reluctant to provide clear, complete usage data because they may fear low usage might lead to cancellation of online subscription.

This problem is exacerbated by vendors of online databases who generate reports of user activity based on disparate units of measurement and differing concepts of what constitutes usage. This makes it difficult, if not impossible, for librarians to compare usage levels of multiple electronic resources. It also prevents any meaningful analysis of user behaviors.

The establishment and adoption of common standards and usage measurements of electronic resources are currently under development. Organizations such as the Association of Research Libraries (ARL), Digital Library Federation (DLF) and the

International Coalition of Library Consortia (ICOLC), are working to draft, test, promote, and implement recommended measurement guidelines.

The ARL's E-Metrics project was designed to develop statistical and performance measurements to describe Electronic Information Services and Resources. During three phases of activity, project participants would compile an inventory of best practices related to statistics gathering among ARL libraries, develop statistics and performance measures, then institutionalize these measures, producing a short, concise manual to assist others in this effort (Blixrud, 2000).

Phase I activities included data collection using survey questionnaires, site visits to selected libraries, sample vendor reports, sample library-generated reports and follow-up interviews (Shim, McClure & Bertot, 2000). Phase II activities resulted in the drafting of suggested metrics for analyzing electronic resources. Recommended measures include statistic gathering to determine the number of electronic resources, the number of logins to online databases, the number of database queries, and the number of items requested in online databases (Shim, McClure, Fraser, Bertot, Dagli & Leahy, 2001).

The Phase III E-Metrics project report emphasizes the need for research libraries to develop the necessary measurements to accurately assess electronic services and resources. Participants in the project have created products to help address some of these needs. These include a report and procedures manual now available from the Association of Research Libraries (McClure & Eppes, n.d.).

The Hartnell College Library currently spends approximately half of its materials budget to provide access to electronic resources. This study examined a combination of log files, monthly usage statistics, vendor reports, and queried a sample of students to

evaluate usability and the level of user satisfaction with three electronic databases: CQ Researcher, EBSCOhost (Masterfile) and ProQuest.

The findings of this study enable librarians at the Hartnell College Library to make more informed choices about instructional activities and collection development decisions. An analysis of usage statistics, usability evaluations and user satisfaction surveys have provided hard data which can be used to justify the selection of specific electronic resources to include within bibliographic instruction sessions and which database subscriptions should be dropped, added or retained. This information will assist librarians forced to make difficult budget decisions. Results of the user satisfaction and usability surveys also helped librarians determine whether the three databases that were examined effectively serve the needs of Hartnell College students.

Chapter 2

Review of the Literature

Historical Overview

Arms, Blanchi and Overly (1997) examine the architectural design of a digital library system, analyzing discrete components of the digital library, digitized objects and metadata. They explain digital objects may be individual electronic documents or groups of digitized objects. Metadata and unique identifiers are used to describe and help users access electronic objects.

Dillon (n.d.) provides background information describing the evolution of digital libraries. He outlines the emergence of hypermedia and how this development advanced instructional technologies. With the advent of new applications, HCI researchers found themselves evaluating these hypermedia formats. Dillon reviews principles of interface design, then discusses how digital libraries and HCI are intertwined in that each new development in one arena foster a reciprocal advance in the other. He concludes with a vision of potential future directions for both digital libraries and HCI studies. This article contributed to an understanding of how HCI and digital libraries initially interacted with one another and the direction in which this relationship is moving.

More recently, Gaunt (2002) provides a good overview of the planning and potential of digital library development. Citing the experience of Rutgers University Library, Gaunt describes the steps involved in preliminary planning, determining needs, and establishing data standards. The section that discusses the process of digital

collection development includes information about copyright and intellectual property rights in relation to digitization. Gaunt also talks of the need to continuously assess usage and usability of digital library collections, referring readers to the Association of Research Libraries New Measures Initiative Web site. This information serves to supplement material gathered from other sources, all confirming the need to evaluate existing electronic resources.

Expanding upon this theme, George (2002) reports discussions that took place during a recent Digital Library Federation (DLF) forum. New technologies have changed users' expectations about the services library offer. As a result, more libraries are beginning to measure use and usability of their online resources. Troll (2001) is currently conducting a survey to determine what obstacles stand in the way of effective assessments and resulting implementation of changes. Like many other researchers, George and Troll urge continuing studies evaluating digital libraries, citing this as an area of research in which there is a current lack of statistical data.

Blixrud (2000) outlines the need for ARL libraries to gather consistent and comparable data to effectively evaluate their electronic resources and services. The E-Metrics project was designed to address these needs. During three phases of activity, project participants would compile an inventory of best practices related to statistics gathering among ARL libraries, develop statistics and performance measures, then institutionalize these measures, producing a short, concise manual to assist others in this effort.

Prior to Blixrud's findings, DeCandido (1999) discussed a variety of reasons why libraries need to collect and analyze usage statistics. Primarily, service measures assist in

determining who is being served, to what to degree, to plan and budget for future resources, and to gain an understanding of what levels of service are desirable. DeCandido cites guidelines for statistical measures of usage produced by the International Coalition of Library Consortia (ICOLC) as well as the work of Bertot (1999).

The ARL E-Metrics project identified three phases of activity to be completed between May 2000 and December 2001. During that time, participants produced a Knowledge Inventory of ARL libraries, organize a working group on Database Vendor Statistics, and develop necessary statistical measurements and performance measures to enable implementation of common standards at the project's conclusion. The E-Metrics project helped document the need for the establishment of evaluative standards and measurement tools to assess the usage and usability of electronic resources(Blixrud, 2000; Shim el al., 2000; Shim et al., 2001).

Recognizing the lack of consistency in the way vendors collected and reported usage statistics, the International Coalition of Library Consortia (ICOLC) came together to draft a series of guidelines relating to the statistical measurement of electronic database usage (ICOLC, 1998). Standardized measurements were essential in the ongoing comparison of various online database products.

As part of the Digital Library Initiative, those evaluating the newly developed digital library projects also discovered the lack of common measures and methods. Neumann and Bishop (1998) describe early struggles to create methods and tools for examining usage, usability and online user behavior.

Like other researchers working in this area, Young (1997) and Tenopir (1999) further documented the difficulties of developing standard definitions and metrics to measure and compare usage of electronic resources, finding that the analysis of transaction logs provided only a partial picture of true database usage. Later studies by Cooper (2001) as well as Miller and Schmidt (2001) advance Young's suggestion of reconceptualizing traditional library measures to employ a variety of approaches to capture and convey a true picture of electronic database usage.

Research Literature

Needs of Minority Learners

Coupled with the problem of determining levels of electronic database usage is the reality of implementing resources that address the specific needs of minority learners. Currently, 67 percent of the Hartnell College student population is composed of ethnic minorities, primarily Latino (52%), Filipino (5%), Asian/Pacific Islanders (5%), African Americans (3%), American Indians (1%), and other minorities (1%) (Hartnell Fact Book, 2001).

As a Hispanic Serving Institution, Hartnell College receives federal funds tied to a mandate to enhance services to Latino students. Portions of these funds are channeled into the purchase of electronic resources. Are members of the intended target population actually using these products?

Aragon et al. (2000) discuss the special needs of minority students, especially in terms of motivation, and cultural learning preferences, describing the often-traumatic impact technology, such as electronic resources, can have upon student learning. Grasha and Yangarber-Hicks (2000) concur, finding that those who prefer and benefit from

technology enhanced learning usually display a high degree of independence and abstract thinking skills.

Effective use of electronic database resources assumes a certain level of technological proficiency, autonomy and self-directed motivation. Yet, according to Sanchez (2000), Hispanic students exhibit a marked preference for collaborative activities and intense human contact. If it continues replacing traditional print materials with online databases, is the Hartnell Library serving the needs of minority students or placing another obstacle across the road of academic success?

Duncker, Theng & Mohd-Nasir (2000) point out that for many years the focus of research in digital libraries has been on technical issues, not usability. They describe the three levels at which digital libraries cross cultural boundaries: during the process of design, when incorporating content, and at the time users attempt to interact with the system. The most common cross-cultural disconnects occur over the misunderstanding of colors, forms, symbols, metaphors, language and use. Duncker et al. stress that these disconnects indicate cultural bias may not only affect the use of a digital library, it can also be embedded within the very design.

Studies at Middlesex University in the United Kingdom revealed that students with differing cultural backgrounds demonstrate differing color preferences. In addition, students from international backgrounds did not wish to be perceived as different from their British classmates.

Dunn (1993) discovered that there are specific learning styles common among various cultures. She found if instructors teach learners in a manner that complements their learning styles, their scores on standardized achievement and attitude tests increase

significantly. Dunn also concluded that learning differences may also be influenced by urban, rural, and suburban living as well as by gender.

The diverse student population at Hartnell College also fits the profile of adult learners. Fidishun (2000) discusses the problem of library instruction in the use of electronic resources that has been designed without regard to the special needs of adults. Using principles developed by Patricia Lawler, she explains six considerations to take into account when designing classes for adult students: recognizing and reducing anxiety, soliciting and using student expectations, taking advantage of the adult student's experience, encouraging participation, using real-life situations to make lessons relevant, and helping learners grow by treating them with respect and encouragement.

Ross and Schulz (1999) argue that the Internet provides a versatile learning environment, permitting instructors flexible options in offering online courses designed to address multiple learning style preferences. Students who process information by means of visual, auditory and kinesthetic learning styles will find online courses and, by extension, online databases, that include animation, hypertext links, and multimedia more conducive to their preferred mode of learning. An examination of electronic database products at Hartnell College indicates that each of these resources employs navigation and presentation elements that would indeed address the specific needs of visual, auditory and kinesthetic learners.

In 1999, Theng published a report that indicated that most users are still lost when it comes to effective interactions with online resources. Race, culture, gender and class can erect additional obstacles. Duncker, Theng & Mohd-Nasir (2000) provide pertinent background information and supportive evidence that cultural differences do indeed

impact digital library usability. As a result, these considerations were addressed during the design of the usability evaluation questionnaire, task scenarios and scripts that were used for this study.

Tracking Database Use

Tenopir (1999) conducted a study to determine patterns of online database use within multiple academic libraries. One pattern that quickly emerged is that a majority of students access electronic databases at times they would most typically use the library. In addition, she found that close ties with specific course assignments and prior demonstrations of particular databases during library instruction both increased database usage. Academic libraries reported the most database use occurring between 10 a.m. and 5 p.m. on Mondays and Tuesdays in November, April and May, the time period during which most research papers or projects would normally fall due in the academic year.

Rader (2000) examined the cost of full text database services at the University of Louisville, thus providing a model for determining cost effectiveness of electronic resources. He also provided a list of recommendations for reporting of usage statistics as well as guidelines for assessing patterns of database use.

A comparison of Rader's article with the information provided by reports from the E-metrics project indicates a future trend of employing electronic database usage statistics in conjunction with the results from additional evaluative surveys to gain a clearer understanding of the cost effectiveness of digital library services. Accordingly, the Hartnell College study analyzed usage based on statistics derived from server logs, then conducted usability and user satisfaction evaluations in an effort to obtain a more complete picture of online database use.

Usability and Usability Testing

Battleson, Booth, and Weintrop (2001) stress the need for human-centered interface design and cite the International Standards Organization (ISO) definition of usability as it applies to Web technology, arguing that an interface must be simple to learn, remember and use. Usability testing is the means by which accessibility of online resources, such as electronic databases, may be determined.

Bishop (1998) describes an early usability test that was conducted on the DeLIver digital library collection of online journal articles hosted by the University of Illinois. Initial testing uncovered obstacles that users encountered while attempting to perform routine searching tasks using the DeLIver resources. Bishop explains the need to insure users are not thwarted during their initial attempt to use a system. Usability testing provided a way to detect and address accessibility issues.

Frokjaer, Hertzum and Hornbaek (2000) explain that correlations between usability factors are dependent upon application domain, use context, user experience and the intricacy of the task. The authors cite studies performed by Nielsen (1994) that tie preferences with efficiency. Interestingly, however, this study found that 25 percent of the users surveyed were not satisfied with the system with which they were more efficient using, indicating that proficiency does not necessarily lead to user satisfaction.

Nielsen (2001) offers the possibility of collecting and analyzing extremely specific metrics, also recommending measurements be collected separately for novice and expert users. To address the dilemma of performance versus satisfaction, Nielsen suggests factoring in both measurements to assist in formulating an overall conclusion of usability.

Borgman et al. (2000) rely on Nielsen's general criteria for usability, detailing the need to identify user groups to participate in usability studies and how to develop lists of measurable tasks and learning outcomes based on user needs. They stress the development of appropriate benchmarks for each digital library based on evaluations with members of the end-user community and comparisons to similar applications.

Citing the model of a usability study conducted on the Alexandria Digital Earth ProtoType (ADEPT) digital library, Borgman et al. argue that extremely little research has been performed in the area of evaluating usability in relation to digital libraries. Research questions examined in the ADEPT usability evaluation included an analysis of what factors must be evaluated as well as what evaluation methods used.

Shneiderman (1998) explains the practical steps involved in organizing a usability study, offering sample survey forms and detailing the many forms of testing that have been used in other studies. He examines reliability, availability, security, integrity, consistency, accommodation of human diversity, design and usability testing, offering examples of good and bad interface design. Guenther (2001) also offers information regarding the determination of user profiles and characteristics, a first step in correlating statistical evidence with usability studies to gain a better picture of how users go about navigating the interface of an electronic resource.

Mayhew (1999) describes usability in terms on an ongoing process that occurs throughout a product's lifecycle. She explores each stage of user interface design, documenting each step of decision-making within a series of comprehensive flow-charts. Her discussions of usability goals, creation of task lists and sample work products and templates provide a thorough guide to the art of planning and conducting usability and

user satisfaction surveys. Mayhew also examines analysis of statistical data and effective reporting.

Dumas and Redish (1999) state that usability means that people are able to quickly and easily use a product to achieve their tasks. They stress that usability means paying attention to the end-users, understanding that people are busy and make use of products to increase productivity and accomplish their goals, and that the user is the ultimate decision-maker when determining whether a product is usable or not.

Dumas and Redish (1998) describe the setting of usability goals, mechanics of usability testing, principles of usability and general principles of Human Computer Interactions. They offer a practical guide to task analysis, planning for usability testing, selecting tasks to include in the usability test script, how to create task scenarios, usability test materials, how to measure usability, and sources for developing usability test questionnaires.

Theng, Mohd-Nasir, and Thimbleby (2000) describe a tool they developed to evaluate the usability of digital libraries. Using a combination of heuristic evaluation and questionnaire techniques, this prototype tool was used to evaluate the usability of the Networked Computer Science Technical Reference Library, the New Zealand Digital Library and the ACM Digital Library. Each digital library contained computing technical materials in digitized form.

The researchers employed this online usability questionnaire to identify problems encountered by users as they performed standard searches for information and to compare usability factors among multiple digital library implementations. This data was then made available online. An example of sample results may be viewed in Figure 4.

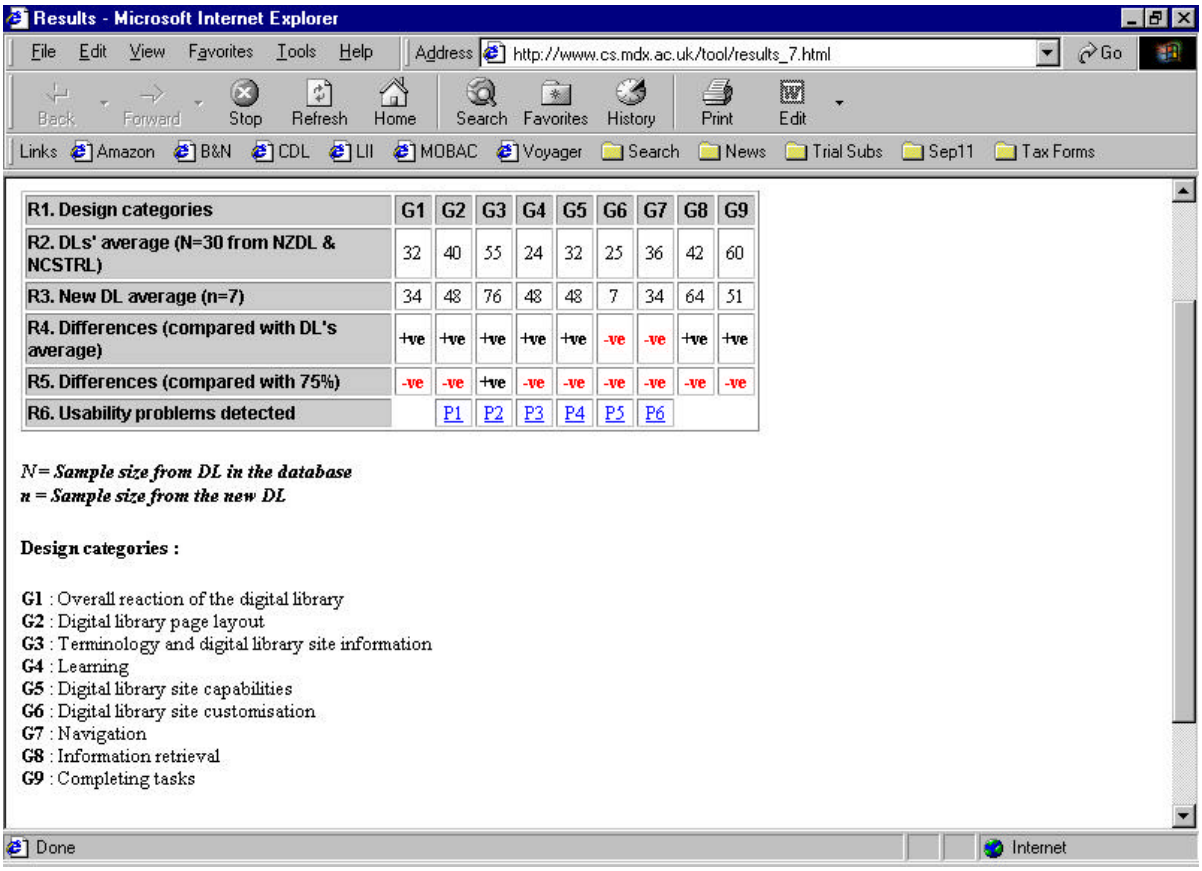

Figure 4. ACM Digital Library Usability Test Results

User Satisfaction Studies

In 1999, Franklin & Nitecki co-authored a white paper on the topic of assessing user satisfaction with service at research libraries as part of ARL New Measures Group activities. The authors start by offering a variety of definitions to help pinpoint what is meant by satisfaction. Do the same indicators used to measure user satisfaction with traditional library service translate effectively to evaluate user satisfaction within the virtual realm?

Franklin & Nitecki (1999) define user satisfaction in terms of how well the library's services and resources meet user needs. But, when the resource being evaluated is an online database, are users rating their satisfaction with software functionality,

interface maneuverability, network speed and reliability, or some other aspect of usability? Again, the researcher discovers a lack of common definitions and measurement criteria.

In 2000, Frokjaer, Hertzum, & Hornbaek published results of a study that analyzed the relationship between efficiency and user preference. They compared users' effectiveness in browsing versus other forms of inquiry in seeking and retrieving online information. The information retrieved was presented in both an online and text version. Five modes of retrieval were defined: browse, logical, Venn, all, and paper. Each subject performed twenty tasks that used all modes of retrieval.

The findings of this study revealed that users did not prefer the retrieval mode that they performed best. The authors concluded that user satisfaction is not directly correlated to performance measures. Does this mean that levels of usability do not necessarily correspond to user satisfaction ratings? How do these findings compare with results of the usability and user satisfaction evaluations performed at Hartnell College?

Theng (1999) examined how users at three sample digital libraries used online interfaces to search and retrieve information. Study participants completed questionnaires that elicited user satisfaction ratings and user impressions of digital library usability. Her findings indicated that most users are still lost when it comes to effective interactions with online resources.

Dickstein & Mills (2000) conducted a series of usability studies to improve the design of the University of Arizona Library's information gateway. During this process, they gathered information from users by administering a user satisfaction survey and by

also conducting a series of focus groups involving various constituent groups as participants.

Clearly, any real understanding of user satisfaction and usability ratings of Hartnell College Library electronic resources is dependent upon multiple modes of evaluation. For this reason, data from log files, questionnaires and observation were all considered in determining usage and usability factors.

Summary of Knowns and Unknowns

In short, researchers attempting to evaluate the usage and usability of existing electronic resources have found themselves hampered by a lack of standardized data elements and an absence of measurement criteria. While usability measures do exist for Web-based interfaces, there are limited studies relating to the usability of specific online databases.

Tools to evaluate the usability of digital libraries are still being developed. Some preliminary models have been created and employed, such as the online questionnaire employed in the Middlesex University study. To date, no one has examined use or usability of specific commercial online databases or, until this study, the electronic resources at Hartnell College.

Usage Statistics and the Lack of Standard Metrics

As several researchers have explained, one difficulty in collecting and comparing usage statistics for electronic resources is the lack of any common or consistent measurement criteria (Shim et al., 1998). Each vendor uses a differing range of data elements to capture varying kinds of information, adding to the complexity of correlating

overall usage and use patterns. Some count the number of logins or sessions during a specific time interval; others count the number of discrete searches.

In 1998, Neumann and Bishop wrote about early efforts to evaluate usability and usage at the digital library implemented at the University of Illinois as one of the Digital Library Initiatives test projects. The authors found themselves navigating uncharted waters, attempting to discover new ways to examine usage of a digital library and eventually developing different means of capturing snapshots of online user behavior.

The researchers employed quantitative as well as qualitative methods, using a variety of methods to collect data, including observation, surveys, interviews, focus groups, exit polls and usability testing. Statistical information from transaction logs was also used to obtain a more comprehensive picture of user behaviors. Based on the information they gathered, they learned more about obstacles preventing users from accessing digital library resources.

One significant finding documented in this study is the problem of interpreting transaction log data. What constitutes a search session and parsing individual actions proved difficult to identify. Another problem was trying to differentiate among users searching full text as opposed to users choosing differing search methods (Neumann & Bishop, 1998).

Any understanding of how digital library users interact with electronic resources hinges on the accurate and consistent gathering of statistical data. Guenther (2001) asserts that characteristics of remote library users may be discovered through collection and analysis of server logs and statistics. By tracing a user's electronic path through the digital library, the researcher may answer the following questions:

- Where are users coming from?
- Where do people spend the majority of their time?
- Where do they spend the least amount of time?
- What did users find frustrating?
- What information do users value the most?

In her explanation of the significance of correlating statistical evidence with ergonomic usability indicators, Guenther establishes a methodology for determining how users navigate the digital library interface. While her emphasis focuses on how to interpret and then apply findings to improve digital library services rather than how to construct and implement an evaluation model, she still offers a list of usability criteria worth further investigation.

Jewell (2001) examines the selection, acquisition and integration of commercial online database resources into research library collections. She also explores ongoing evaluation, supporting the consistent tracking of database usage and urges libraries, vendors and publishers to come to an agreement on standardized definitions and reporting standards. Kohun (2001) not only repeats this call for common standards and measures, he views their absence as one of the barriers to global implementation of digital library technologies.

In their report detailing Phase III accomplishments of the ARL E-metrics project, McClure & Eppes (n.d.) emphasize the need for research libraries to develop the necessary measurements to accurately assess electronic services and resources. Products to help address some of these needs have been created as part of the E-Metrics project. These include a report and procedures manual now available from the Association of

Research Libraries. Recommendations offered by McClure and Eppes include the collection of statistics and performance measures to assess the number of electronic resources available to users, usage of online resources, and expenditures for electronic resources. The manual provided suggestions to assist in the identification of statistics and measures applied during the Hartnell College electronic resources evaluation study as well as issues involved in the analysis of usage data.

A preliminary examination of available usage statistics for each of the electronic resources offered by the Hartnell College Library indicates that all databases count the number of times the database has been accessed. From this point on, however, the level and complexity of use statistics collected varies widely.

In addition, online database usage is dependent on specific information needs that, in turn, are driven by class assignments. For example, usage of the RAND California database will most likely show a marked increase during the month that an instructor directs students to search and download information from this source as part of a required assignment. In contrast, CQ Researcher will most likely show increased use during those months students are tasked with the responsibility of researching controversial or cutting edge topics for English and Speech classes.

Access issues may also influence levels of database use. All commercial database access offered by the Hartnell College Library relies on one of two methods of authentication—on-site usage from a workstation within a proscribed range of IP addresses or remote logon. If students have not attended one of the bibliographic orientation sessions scheduled by an instructor, they may not be aware of the user IDs or

Chapter 3

Methodology

Research methods employed

Standards and metrics to measure online database usage are in the early development stage. Materials published by the International Coalition of Library Consortia (2001) and products developed within the context of the ARL E-Metric project (Shim et al. 2000; Shim et al. 2001) provide basic guidelines.

The majority of sources consulted offered general usability testing methodologies and procedures, primarily to analyze software interfaces or Web sites. Mayhew (1999) outlines a variety of methods designed to solicit user feedback, beginning with the basics of analyzing end-users' needs, setting usability goals, as well as defining platform capabilities and limitations. Battleson, Booth, & Weintrop (2001) provide a description of usability engineering, concentrating on Human-Computer Interaction and effective principles of Web design. They stress the need for human-centered interface design and cite the International Standards Organization (ISO) definition of usability as it applies to Web technology, arguing that an interface must be simple to learn, remember and use. A report of the usability testing performed on the University of Buffalo Libraries Web site outlines the process of setting usability testing goals, designing the actual usability test, conducting the test, evaluating the results, and reporting their findings (Battleson, Booth, & Weintrop, 2001).

passwords required to achieve off-campus access to commercial databases such as CQ Researcher, EBSCOhost or ProQuest.

Finally, usage statistics may be skewed based on unplanned database down time or a campus network failure. In this situation, on-campus users may not have access to the Internet or any web-based resources until hardware or network problems have been resolved.

Contribution to the Field

The Association of Research Libraries and a variety of researchers have documented the need to clear, consistent, and meaningful measures to evaluate electronic resources in terms of use, usability, and cost effectiveness. At this time, preliminary standards drafted as a result of efforts such as the ARL E-metrics project address some of these issues.

The E-metrics project was designed to explore ways to define and collect data measuring the use and value of electronic resources. Miller and Schmidt (2001) explain that a growing concern for fiscal accountability and the need for accurate information to form collection development decisions have fueled an expanding interest in the collection of digital resource usage statistics.

Saracevic and Cord (2000) argue that current digital library initiatives have concentrated on developing electronic resources and enabling technologies for the purpose of facilitating research. Evaluation components have been noticeably absent. Rather, researchers have focused on establishing criteria for creating digital libraries, not measuring the effectiveness or usability of the resulting electronic collection.

A report of the ARL E-Metrics project phase two findings suggests metrics for analyzing electronic resources, including the gathering of usage statistics such as the number of logins to online databases, the number of database queries, and the number of items requested in online databases (Shim et al., 2001). Nevertheless, despite evolving standards, Tenopir (2001) points out that not all electronic database vendors report use statistics in the same ways or measure the same usage components. She refers to the ICOLC *Guidelines for Statistical Measures of Usage of Web-Based Indexed, Abstracted, and Full Text Resources* as a guide for what elements of usage should be measured. Unfortunately, these standards have not been widely adopted. Some commercial database vendors are unwilling to adhere to standards due to concerns about how usage data will be interpreted and used by library decision-makers. There remains a great disparity in vendor reports that makes it difficult for libraries to compare usage of electronic resources.

Sections of the *ARL E-Metrics Phase II Report* define what activities should be measured to determine patron accessibility and use of electronic resources. The accompanying manual includes definitions, rationale, procedures and other database usage related issues; it also suggests ways collected data might be used to support the achievement of specific educational outcomes.

Models to collect, report, and analyze usage, usability, and user satisfaction with commercial online database products are still in the early development stage. The few examples that do exist concentrate on evaluations of library portal services or online catalog interfaces and functionality.

This study offers a model of evaluation suitable for analyzing commercial electronic databases in terms of use, usability and user satisfaction. It provides Hartnell College with valuable information indicating whether students find three major electronic resources usable and an effective means to serve their informational needs. It provides statistical data to assist in the formation of budget decisions as well as offering an opportunity to revise existing course content.

The results of the usability evaluation and user satisfaction survey provide a model that could be used to analyze other electronic resources. The questionnaire developed for this study could be used by other libraries that wish to evaluate their own database products or digital library collections. Findings could be forwarded to the appropriate database vendors, providing them with data about user perceptions of their product. This, in turn, could trigger future product modifications.

As the Hartnell College Library study involved evaluation of three commercially produced digital library products, case studies detailing usability evaluations and user satisfaction surveys performed on other digital libraries were sought to determine comparable testing methods and available evaluative tools. Borgman, Gilliland-Swetland, Leazer, Mayer, Gwynn, Gazan, and Mautone (2000) authored a study reporting on the overall usability of the Alexandria Digital Earth ProtoType (ADEPT) digital library. As they explain within their report, extremely little research has been performed in the areas of evaluating usability and assessing learning outcomes in relation to digital libraries. Measuring the usability of electronic resources such as digital libraries is closely related to evaluating usability of Web sites in that both types of analysis involve an examination of Web-based interfaces in terms whether these tools facilitate the accomplishment of tasks by the target population of intended users.

Employing a variety of qualitative and quantitative methods, Borgman et al. analyzed the impact of ADEPT in undergraduate instruction. After defining five skill sets needed to engage in scientific thinking, the study then analyzed how well digital library resources contributed to the development of each set of skills.

The ADEPT usability study relied on general usability principles that were determined by considering how the end-users would actually employ ADEPT to complete everyday research tasks. The methodology for the study was developed based on educational evaluation, cognitive psychology, human factors, systems analysis and user-centered design.

The ADEPT case study model describes how to approach design of an evaluation tool, identify user groups for the study, and how to develop lists of measurable tasks and

learning outcomes based on user needs. Bishop (1998) offers a case study of usability testing performed on the DeLIver digital library collection of online journal articles hosted by the University of Illinois. Unlike the test goals of the usability study of the ADEPT digital library, the study of DeLIver concentrated on barriers to accessibility, finding that technical requirements, such as logons, presented obstacles to users. Chen and Cooper (2001) adopt a research methodology more similar to that of Borgman et al., testing functional usability of the digital library rather than the DeLIver model which examines technical usability features.

While Borgman, Bishop and Cooper provide models of earlier usability test procedures, the Hartnell study adopted metrics and methodology that examined functional usability of three digital library products, observed user behavior, measured user satisfaction with key features of each electronic resource, then correlated this information with usage statistics obtained from monthly log files.

For the Hartnell College Library study, Dumas and Redish (1999) offered the most effective blueprint for conducting effective usability testing and was used extensively to help develop the Usability Evaluation and User Satisfaction questionnaires, Test Administrator's Log and Test Administrator Script found in Appendices D-H. Specific questions within each survey were adapted from the Middlesex University evaluation tool, the WAMMI tool, and sample tools found within the Dumas & Redish text.

Specific Procedures Employed

Dumas and Redish (1999) describe the necessary planning required to implement usability testing, covering everything from defining test goals, to selecting participants,

creating task scenarios, preparing test materials and environments, and conducting an initial pilot test. These were the instructions followed to develop a test plan, select groups of students to participate in the testing, prepare test materials and conduct a trial test. The actual task scenarios were drawn from existing bibliographic instruction exercises currently used by the librarians at Hartnell College to train students in English classes in the use of electronic resources.

Twenty-five test participants were selected from English classes as these students are routinely required to attend library orientation sessions and complete research assignments that necessitate use of electronic resources such as the online catalog, CQ Researcher, EBSCOhost, and ProQuest. Lourdes Villarreal, a Hartnell College English instructor, volunteered her English 253 and English 101 students to participate in the study. Students in Ms. Villarreal's classes were representative of the multi-cultural, inter-generational demographics found on the Hartnell College campus. At the time the researcher sought permission to work with these students, total class enrollment was approximately fifty. By the time the study was actually performed, the number of participants dropped to 25. Dumas and Redish (1999) cite prior studies that found three test participants were sufficient to detect major usability problems and indicate typical usability tests include 6 to 12 participants.

Usage statistics based on log files are available for the majority of the electronic resources maintained by the Hartnell College Library. At this time, all but two of the full-text databases provide some means of capturing monthly usage statistics. Most permit the systems technology librarian to generate reports on demand. Informe and RAND California: An Online Source for California and U.S. Statistics send monthly usage

reports generated by the vendors. RAND lists nothing more than the number of searches. Informe indicates the total number of search sessions initiated, the duration of each session and titles of journals accessed.

CQ Researcher, EBSCOhost, and ProQuest offer administrative tools that allow the generation of usage reports. While each vendor measures differing elements of usage, all count the total number of search sessions initiated within library-defined time intervals. For purposes of this study, the researcher tracked and analyzed usage of these three online full-text databases for the duration of the Fall 2001 and Spring 2002 semesters.

Comparative usage statistics for CQ Researcher, EBSCOhost and ProQuest were collected on a monthly basis for the duration of the academic school year, September 2001-May 2002. The results of the usability and user satisfaction evaluations supplement data from the log files to help provide a better understanding of user preferences.

At this time, the only common data element that appears on usage reports for all electronic databases is the total number of searches. Two databases report the names of journal titles accessed and the number of accesses per unique title. Three databases report the duration of each search session. One database reports kinds of searches performed. Two databases report the number of items displayed, downloaded or printed. Given the lack of uniformity among electronic database vendors, this study compared the one common element in all usage reports—total number of monthly searches per database.

The systems technology librarian created a series of spreadsheets to record monthly usage statistics for all electronic resources. Monthly graphs were produced to

illustrate the relative levels of usage among existing electronic resources. Usage data for this study was drawn from these sources.

The usability test and user satisfaction survey were drafted, based on the principles outlined by Mayhew (1999) and Dumas and Redish (1999). The Technology Learning Center within the library was reserved to conduct initial test participant orientations and the actual testing. Task scenarios were developed, based on actual research questions from current bibliographic instruction exercises. A usability questionnaire, user satisfaction survey, informed consent form, test administrator's script and log were created, based on adaptations of the Middlesex University, WAMMI and Dumas and Redish models (see Appendices D-H).

The School of Computing Science at Middlesex University in London has developed and tested usability test questionnaires for digital library resources. Once the researchers were contacted, they gave permission to reuse their forms (see Appendices A & B). Unfortunately, this usability test has not been validated. WAMMI (Web site Analysis and MeasureMent Inventory) is one of the sources used by Middlesex University in the development of their usability evaluation questionnaire. Validity was established and documented by Kirakowski and Cierlik (1998). The usability questionnaire and user satisfaction survey developed for the Hartnell College study was an adaptation based on both the Middlesex and WAMMI questionnaires, supplemented by sample questions adapted from Dumas and Redish (1999). Two sample pages from the Middlesex University usability test questionnaire are displayed in Appendix I.

The Hartnell College usability questionnaire collected information about each participant's age, ethnicity, gender, and whether the student had ever used any of the

electronic databases provided by the Hartnell College Library before. Eighty per cent of the participants were 18-25 years old. Seventy-six per cent were Hispanic, sixteen per cent White, eight per cent Asian/Pacific. Seventy-two per cent of the participants had never previously used an online database.

Participants were asked to complete a series of everyday search tasks on each of the online databases in turn. After completing the tasks, participants rated various elements of usability, assigning values from a five-point scale that ranged from Strongly Agree to Strongly Disagree. Each participant was offered an opportunity to provide additional written comments explaining any difficulties encountered.

The user satisfaction questionnaire was developed based on a template provided by Mayhew (1999). After completing the usability evaluation, each participant had an opportunity to rate satisfaction with various characteristics of each electronic database. Participants assigned ratings from a five point scale ranging from Strongly Satisfied to Strongly Dissatisfied in response to a series of questions soliciting feedback about how well each database provides online instructions, permits user control, offers ease of learning, and allows the user to efficiently complete tasks.

Permission to conduct research using human subjects was requested and granted by the Nova Southeastern University IRB. A confirmation of this may be found in Appendix C. Dr. Ed Valeau, President/Superintendent of Hartnell College and Dr. Chris Meyers of the Hartnell College Office of Institutional Research verbally granted permission to conduct this study. Lourdes Villarreal, Hartnell College English Instructor, verbally granted permission to conduct this study with students from her English 253 and English 101 classes.

Study participants attended a one-hour orientation during which the systems librarian provided an overview of each electronic resource to be evaluated. This preliminary session was held in the Technology Learning Center, giving all participants an opportunity to become familiar with the test environment prior to actual testing. Participants were briefed on their role in the upcoming study and assured that they were not the test subjects, rather they would be evaluating three electronic resources.

Two one-hour blocks of time on two different weekdays were set aside to conduct the actual testing. After signing consent forms, each group of test participants was issued individual copies of the test packets and allowed to choose any workstation within the Technology Learning Center. Each workstation was already been logged onto the network and had Netscape launched, with the library Web page set as the default home page within the browser preferences. Hypertext links to available electronic resources, including the three databases being evaluated, were displayed on the Hartnell Library home page (Figure 5).

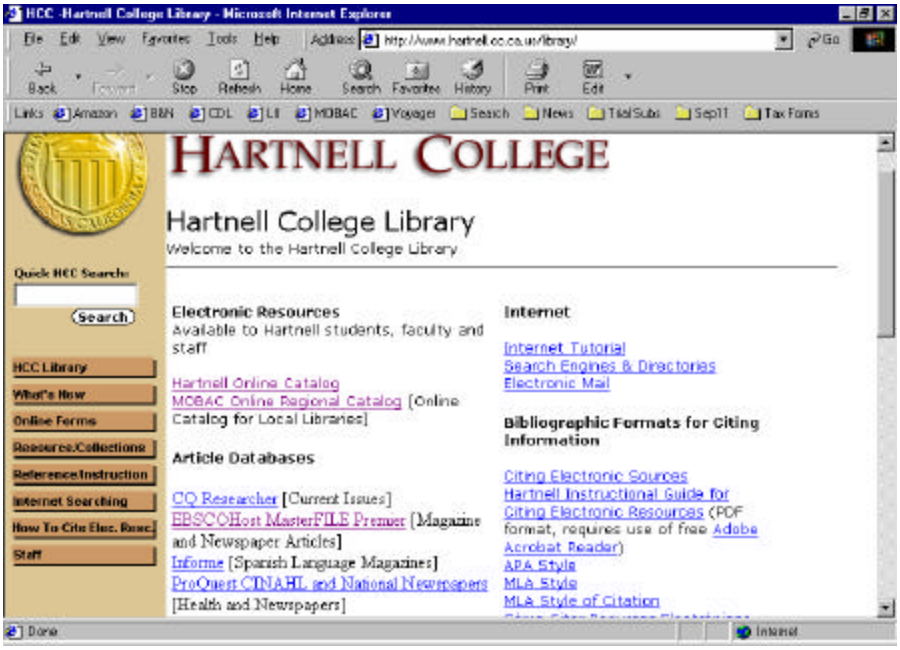

Figure 5. Screen shot of Hartnell College Library Home Page

The systems librarian followed the Test Administrator's script and again stressed that the individual databases, not the participants, were the subject of these tests and that the identify of each participant would be held in strictest confidence. Participants were encouraged to think aloud and ask questions throughout the test session. During the actual test, the Test Administrator circulated throughout the classroom, observing and recording questions, comments and difficulties encountered.

Participants were asked to complete a series of research tasks for each database, then rate various elements of usability (Appendix E). Following the completion of the usability portion of the survey, participants rated each database in term of user satisfaction (Appendix F). A series of screen shots (Appendices L-U) illustrate the sequence of screen displays each participant viewed during the sequence of task completion using all three online databases.

Following the evaluation sessions, the Test Administrator collected all completed test packets. Information derived from the usability tests and the user satisfaction surveys were entered into a series of Excel spreadsheets for analysis and the generation of graphs.

Formats for Presenting Results

Once data from the usability tests and user satisfaction surveys were transferred to spreadsheet format, this information was carefully analyzed to determine if the results obtained answered the research questions posed by this study. Graphs were generated to illustrate comparative monthly use of the electronic resources examined and to present findings of the usability study and user satisfaction survey. Information collected on the Test Administrator's log sheets was analyzed and reported.

Transaction logs from all electronic resources reveal the total number of user searches. These usage statistics are collected and reported on a monthly basis. Results indicated that EBSCOhost recorded the most user searches per month, followed by ProQuest, then CQ Researcher. A chart depicting monthly use of CQ Researcher, EBSCOhost and ProQuest for the 2001-2002 academic year (September 2001-May 2002) is displayed in Appendix J.

This final report detailing a complete analysis of the data collected, all findings, conclusions, recommendations and implications has been distributed to Dr. Ed Valeau, President/Superintendent of Hartnell College; Dr. Chris Meyers, of the Hartnell College Office of Institutional Research; Gary Hughes, Director of the Hartnell College Library; and Lourdes Villarreal, the instructor whose students participated in the usability evaluations and user satisfaction surveys. In addition, copies of the final report will be submitted to professional scholarly journals to be considered for publication. Findings may also be presented at selected professional conferences and shared with the commercial database vendors whose products will be examined.

Projected Outcomes

This study was intended to improve and enhance service to the Hartnell College learning community. A thorough examination of usage logs, supplemented by information collected during a series of usability studies and user satisfaction surveys has helped create a more comprehensive picture of how Hartnell College students are making use of three full text electronic database resources.

The usability evaluations have helped identify obstacles encountered by learners as they attempt to complete their assignments and perform routine research tasks. By

revealing the source of student problems or confusion when using each of the three databases, librarians will now be able to revise the content of bibliographic instruction sessions and handouts to address these issues. Data collected from the user satisfaction surveys indicate the degree to which this representative sampling of Hartnell College students was satisfied with the self-descriptiveness, user control, learnability, and ease of use associated with each database evaluated.

Notes from the Test Administrator's log (Appendix K) identified a pattern of problems multiple test participants encountered during actual testing. The analysis of obstacles or difficulties recorded during the testing indicate a need to include clearer explanations of the terminology each database vendor uses to identify data elements within the information retrieved and displayed. Notes from the Administrator's log also suggest each orientation session should include instructions of how students should respond to and report network or software problems.

The results of this study have provided Hartnell librarians and faculty an understanding of how minority students rate the usability of major electronic research tools. By sharing this information with the vendors who produce CQ Researcher, EBSCOhost and ProQuest, this study could contribute to future enhancements or developmental modifications to the existing database functionality or interface design to address a repetitive pattern of specific problems.

As the library currently expends half its material budget to maintain subscriptions to online databases, the findings of this study will affect future budgeting and collection development decisions. During the upcoming budget cycle, librarians may wish to consider alternative electronic resources that students find more user-friendly.

Resource Requirements

The test participants included twenty-five students from one English 253 class and an English 101 class at Hartnell College. Dr. Ed Valeau, Hartnell College President/Superintendent, Dr. Chris Meyers, Director of the Office of Institutional Research, and Lourdes Villarreal, the instructor of these two classes, granted permission to conduct usability tests and a user-satisfaction survey with these groups of students. As this research did involve human subjects, Nova IRB approval was requested and granted (see Appendix C).

Students attended an hour-long orientation session prior to participation and then accessed the electronic resources to be evaluated from workstations located within the Hartnell College Library Technology Learning Center. The workstations in this center were configured to access the Internet and all the Hartnell College Library electronic resources through an Ethernet network. Prior to the actual test sessions, the Test Administrator logged all workstations onto the network, started up Netscape Communicator, and displayed the Library Home Page, which contains hypertext links to each of the online databases tested (see Figure 5).

The Systems Technology Librarian generated and maintained a log of online database usage statistics. A usability evaluation tool adapted from the WAMMI Web Usability Questionnaire and a user-satisfaction survey adapted from the Middlesex University questionnaire in combination with samples provided by Mayhew (1999) were be used to collect the appropriate data. A Statement of Informed Consent, Test Administrator's Script and Test Administrator's Log were developed based on existing models offered by Mayhew (1999) and samples provided by the NOVA IRB. Examples

have been included with Appendices D-H.

The Learning Technology Center, where testing took place, is located within the Hartnell Library and is equipped with new Pentium IV workstations and flat screen monitors. Each contains a network card and Ethernet connection to the library network. This network provides direct access to the Internet through a T1 line. Each workstation is equipped with Microsoft Internet Explorer 5.5 and Netscape Navigator 4.79. For purposes of this study, participants used Netscape to first access the library's home page, then each of the online resources evaluated (Appendices L-U). During the testing process, some students also started up Microsoft Internet Explorer and used this software interchangeably with Netscape as they completed the questionnaires and surveys.

Reliability and Validity

Gay and Airasian (1999) define a reliable test instrument as one that provides consistent measurements. They explain that a valid test instrument collects measurement information about what it is supposed to measure. Kirakowski (n.d.) states that a reliable questionnaire is one that provides similar results throughout multiple testing sessions. He also asserts that a valid questionnaire elicits and reports the data it was designed to collect.

To insure the reliability and validity of usability test data collected during the test sessions with Hartnell College students, a questionnaire based on the WAMMI test instrument was used. Kirakowski and Cierlik (1998) describe the validation process used to test the WAMMI instrument. During the testing process, the WAMMI questionnaire was administered to test participants via the Internet. Data was collected from fourteen sites, providing around 300 responses. Tests indicated no difference between paper and

electronic versions or Swedish or English language versions of the WAMMI tool. The five factors of usability examined within the test rated as illustrated in Figure 6.

Reliability of the Website Analysis and MeasureMent Inventory (WAMMI) questionnaire was computed using Cronbach's Alpha coefficient and measured 0.96 for the total questionnaire. An adaptation of this tool was used to conduct the Hartnell Library electronic resources usability study.

Scale	Average	StdDv	Alpha
Attractiveness	4.79	1.21	.90
Control	4.92	0.80	.70
Efficiency	5.33	1.00	.83
Helpfulness	5.01	1.14	.89
Learnability	5.41	1.10	.86

Figure 6. WAMMI Parameters from 1997 data

Summary

Data for this study was obtained from two sources: server log files and user evaluation surveys. Each month, log files containing electronic resource usage statistics were downloaded, analyzed and stored in spreadsheets by the Hartnell Collage Systems Librarian. This information was supplemented by data collected during a usability study and user satisfaction study conducted in mid-April 2002. Test participants were drawn from one section of English 253 and one section of English 101 classes.

Testing procedures, instrumentation, scripts and questionnaires were developed based on samples provided by Mayhew (1999), and modified versions of the Middlesex University and WAMMI instruments. The usability testing instrument that was used in this study is an adaptation of the WAMMI questionnaire. User satisfaction levels were

determined through the administration of a modified version of the Middlesex questionnaire. Copies of both forms have been included within Appendixes E and F.

This study provided information that is being used to improve and enhance service to the Hartnell College learning community by demonstrating which online resources are receiving the most use, identifying obstacles to usability that were encountered by learners attempting to perform research activities, and documenting the cost-effectiveness and suitability of current digital library offerings. Based on this information, the librarians are currently adjusting the content of future library orientation sessions and revising bibliographic instruction curriculum to ensure students understand how to access and make effective use of electronic resources. Future collection development decisions, such as which database subscriptions to add, maintain or drop, can now be based on documented statistical evidence of use rather than guesswork. This study provides those responsible for administering Title V funds with statistical evidence that the intended target population is using electronic resources financed from these monies.

Chapter 4

Results

Introduction

To establish accountability and justify budget expenditures, it is critical that the Hartnell College Library be able to document usage levels and explain to decision-makers why the addition and maintenance of electronic resources is an important service for Hartnell students. The purpose of this study was to examine usage of electronic resources by the target population for whom these databases were acquired, identify any problems or barriers encountered during selected database use, and to significantly advance understanding of how selected online database products collect and report usage statistics. To achieve these goals, data was gathered from server log files as well as from usability and user satisfaction surveys.

This chapter first examines data elements and usage statistics collected from monthly statistical reports generated by CQ Researcher, EBSCOhost, and ProQuest. As explained in chapters one and two, the lack of common standards and metrics make it difficult to compare usage statistics as each vendor collects and reports differing kinds of statistics. The common element measured for this study is the number of searches. The next section of this chapter describes the characteristics of participants taking part in usability testing and user satisfaction surveys. Within the third section of this chapter the results are presented from usability testing and user satisfaction surveys.

Chapter 4

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Chapter Five

Conclusions, Implications, Recommendations, and Summary

Introduction

Chapter Five is composed of four sections that follow this introduction. The Conclusion section responds to the research questions outlined in Chapter One of this study, listing the results of usage statistic logs, usability studies, and user satisfaction surveys. It also reiterates limitations of the study. Section two examines the implications of the research described within this dissertation. The Recommendations section contains suggestions for additional inquiry and future research opportunities. The final section of Chapter Five summarizes the content of this complete dissertation.

Conclusions

Research Question #1:

What do usage statistics tell us about how members of the Hartnell learning community make use of the existing electronic resources? An analysis of usage logs compiled and maintained throughout the 2001-2002 academic year revealed that EBSCOhost recorded the largest number of online searches (19, 241). ProQuest recorded the next highest level of search requests (10,101), followed by CQ Researcher (2,968). Figure 18 illustrates the percentage of total search requests tallied for each of the three subject databases. In addition, overall usage statistics reflected increased usage during the end of each semester, when the majority of term papers and final projects are due, a finding consistent with research described in Tenopir's 1999 study.

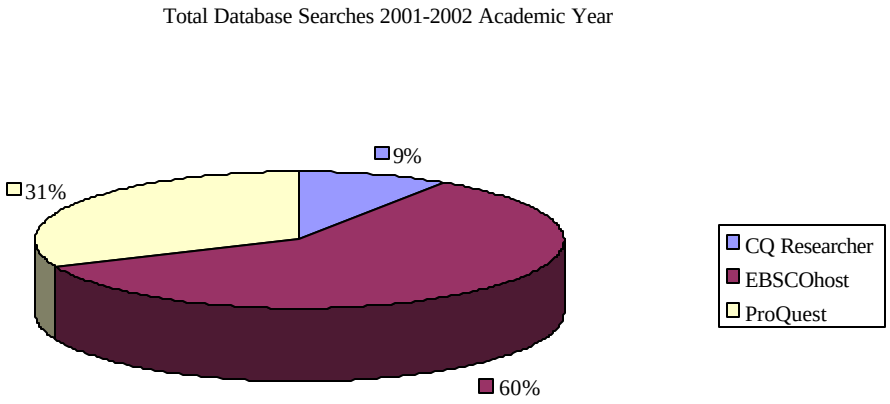

Figure 18. Total Database Searches 2001-2002 Academic Year

Research Question #2:

What is an effective procedure to compare database usage statistics to determine which electronic resources receive the most use? An examination of literature on this subject revealed that common metrics and definitions are still evolving. Young (1997) and Tenopir (1999) documented the difficulties of developing standard definitions and metrics to measure and compare usage of electronic resources, finding that the analysis of transaction logs provided only a partial picture of true database usage. Later studies by Cooper (2001) as well as Miller and Schmidt (2001) suggest a variety of approaches to capture and convey a true picture of electronic database usage.

Research Question #3:

To what extent do students find the interfaces provided by these commercial electronic databases usable? Usage statistics were found to provide only a partial view of actual user behavior. Usability and user satisfaction surveys employed in conjunction with testing that involved a representative sampling of Hartnell students performing everyday research tasks allowed a deliberate examination of online database use within

the actual learning community environment. Participants were selected from two remedial English classes and offered a representative sampling of typical Hartnell College students.

The findings of the Hartnell study would appear to differ from Aragon et al. (2000) and Duncker, Theng and Mohd-Nasir (2000) who concluded that technology can present a significant barrier to minority cultures. Students taking part in the study were seventy-six per cent Latino. Seventy-two per cent had never used an online database before. Despite being confronted with new technology and a learning environment that required independent inquiry and activity, all participants demonstrated the ability to enter search terms and retrieve an index list of corresponding article entries. The majority of participants were also able to retrieve full text articles and determine various elements of information necessary to correctly cite online materials they had discovered.

A series of tests demonstrated thirty-six per cent of participants were Strongly Satisfied or Slightly Satisfied with the usability of CQ Researcher in relation to performing research, closely followed by thirty-five per cent who preferred ProQuest. Despite usage statistics showing heaviest usage, EBSCOhost rated last (twenty-nine per cent) in terms of overall usability (Figure 19).

Results of the Hartnell College usability studies indicate students do find the interfaces provided by these commercial databases usable, however some of the terminology used for citation component labels was unfamiliar and, thus, confusing. In addition, some students found navigation schemes and index sort utilities inconsistent and, unclear. Of the three databases examined, CQ Researcher was rated highest in facilitating learning.

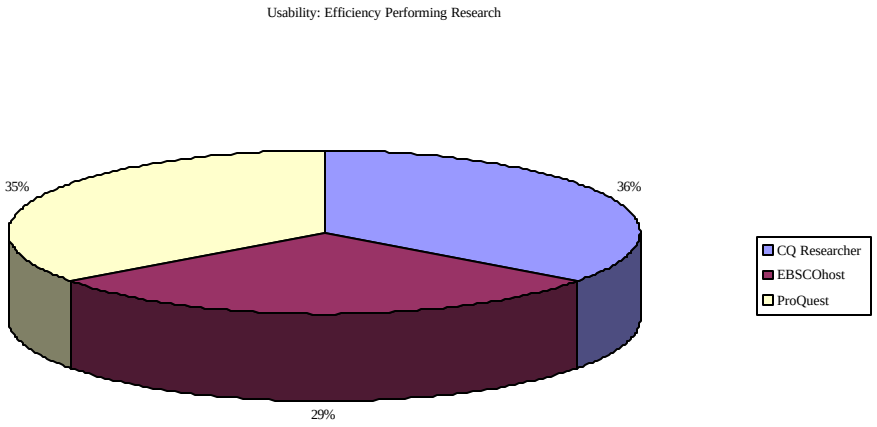

Figure 19. Comparative Usability: Efficiency Performing Research

Research Question #4:

Based on statistical measures such as an analysis of monthly log files, is the purchase of access to Web-based full-text databases a cost-effective expenditure of limited library funding? At this point, there is not enough information collected over a long enough span of time to make a definitive judgment. Usage statistics document the number of searches requested of each electronic resource, reporting this data on a regular basis. The results of this study have established a usage baseline against which collection development librarians can compare future measures.

Usability studies and user satisfaction surveys have identified barriers to online database access. These include lack of awareness that online databases exist and unequal access to library instruction sessions where students would normally learn about these resources. In some instances, software failures or an unfamiliarity with computers could discourage potential database users. Finally, many instructors are unaware of all the online databases to which the Hartnell College Library subscribes. Because they do not

know they exist, they fail to inform their students or include exercises requiring the use of such resources within their assignments.

Research Question #5:

To what extent do students from this particular learning community rate their satisfaction level with three currently available full-text database products? The findings of the Frokjaer, Hertzum, and Hornbaek study (2000) revealed that users did not prefer the retrieval mode that they performed best. The authors concluded that user satisfaction is not directly correlated to performance measures. Nevertheless, the Hartnell College study found a close relationship between usability and user satisfaction ratings. CQ Researcher rated highest in usability and user satisfaction. Figure 20 illustrates satisfaction rankings assigned by study participants.

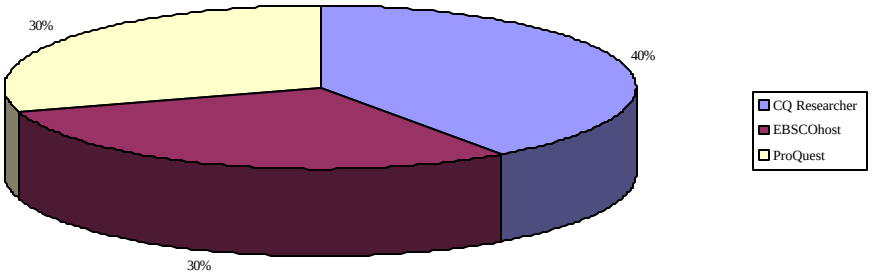

Figure 20. Comparative User Satisfaction Ratings

Limitations of the Study

Participants in this study were limited to 25 students from two English classes taught by Lourdes Villarreal on the main Hartnell campus. Students from other classes, those attending classes at the King City facility, and distance-learning students were not

involved in the study. The Hartnell Online Catalog and electronic databases other than CQ Researcher, EBSCOhost (Masterfile) and ProQuest were excluded from the usability study and user satisfaction survey. The three databases selected for examination were ones most frequently recommended for use by the majority of Hartnell instructors.

Implications

This study provides models of evaluation suitable for analyzing commercial electronic databases in terms of use, usability and user satisfaction. It also offers Hartnell College valuable baseline information concerning usage levels, usability and user satisfaction ratings of three popular electronic resources. The compilation of statistical and survey data can be used to justify future collection development and budget decisions. Survey responses also offer an opportunity to revise existing course content in an effort to address problems identified during the usability study.

The results of this study establish a precedent and provide a model that will be used to analyze other electronic resources. The questionnaire developed for this study could be used by other libraries wishing to evaluate their own digital library collections. Identified problems can also be documented in a manner suitable for forwarding to the appropriate database vendors, providing them with data about user perceptions of their product. This, in turn, could trigger future product modifications.

Recommendations

Hartnell College would benefit from additional studies that would evaluate all its electronic resources, especially newly added Spanish language databases. The Hartnell Library Web site, Voyager Online Catalog, and other online databases could be tested for usability and user satisfaction. These additional studies would raise public awareness

about available online resources provided by Hartnell College and provide ongoing information about usage levels and user behaviors. This information, in turn, could be used to guide collection development decisions and revision or expansion of existing library course content. Task lists and findings could be used as a framework for developing new Information Competency tutorials, helping to shape instructional design and build improved information seeking skills among Hartnell students.

Usage statistics for all electronic resources should be collected and maintained from this point forward. Monthly reports, generated by the Systems Librarian, would document patterns of usage and provide the basis for historical trends and comparative statistics. This data would be used to provide evidence to support future budget requests or increased levels of bibliographic instruction.

Additional studies could be performed, this time involving faculty as study participants to learn how instructors make use of electronic resources on campus and what unique problems they encounter. This would not only address the specific needs of instructors, but also provide more information about how electronic resources could be used to support existing and evolving curriculum and programs.

Finally, the results of this and future studies could be submitted for publication to share the Hartnell College study experience with a broader audience. Findings from this study could be compared with results from other colleges who may have other issues and special populations. Usability studies and user satisfaction ratings of the same databases by other academic libraries could provide further insights regarding user needs and information seeking behaviors.

Summary

This study had two specific goals. The first goal was to determine whether the target population for whom full-text databases were acquired was actually using electronic resources made available by the Hartnell College Library. In an effort to identify any problems or barriers encountered during use of selected electronic resources, representative members of the target population were selected to participate in a usability study that examined three online databases: CQ Researcher, EBSCOhost, and ProQuest. Participants taking part in the study rated each database in terms usability and user satisfaction. The information gathered during this study has provided baseline documentation that verifies the college is appropriately expending Title V funds awarded by the federal government to enhance learning for Hispanic students. At the same time, study results have helped identify potential obstacles to effective student access and use, thus offering librarians an opportunity to address these issues during bibliographic sessions and curriculum design.

The second goal of the study was to significantly advance understanding of how selected online database products collect and report usage statistics, how usable students find existing electronic resources, and whether usage levels as well as usability ratings justify the costs of renewing or acquiring additional online resource subscriptions. As the State of California continues to cut community college funding in an attempt to balance the state budget, it has become increasingly critical for the Hartnell College Library to document database usage levels and be able to justify the addition and maintenance of electronic resources as an important service for Hartnell students. These findings provide the necessary statistics to bolster future database acquisitions and increases in funding.

Young (1997) suggests a variety of usage measurements that might employ a combination of approaches including transaction-based measures, time-based measures, cost-based measures, or use-based measures. Tenopir (1997, 2000) argues that transaction logs provide only a partial picture of true database usage as specific environmental variables might also influence online database use. Accordingly, the Hartnell College study combined monthly usage statistics derived from server logs with the results of usability and user satisfaction surveys to gain a more complete picture of online database usage.

Dumas and Redish (1999) describe usability as people being able to quickly and easily use a product to achieve their tasks. This study adopted Mayhew's definition of user satisfaction. Her criteria include meaningful online help utilities, degree of user control, learnability, and ease of use.

Test participants were selected from English classes as these students are routinely required to attend library orientation sessions and complete research assignments that necessitate use of electronic resources such as the online catalog, CQ Researcher, EBSCOhost, and ProQuest. Lourdes Villarreal, a Hartnell College English instructor, volunteered her English 253 and English 101 students to participate in the study. Students in Ms. Villarreal's classes were representative of the diverse, multi-cultural student population found on the Hartnell College campus.

Participants attended an initial orientation session, then returned on another day to participate in the actual testing sessions. Each student was provided with a network-enabled workstation that had been logged on and had Netscape started. The initial screen

display was that of the Hartnell Library Home Page which contains hypertext links to each test database.

Students were asked to complete a series of everyday search tasks on each of three online databases in turn. After completing the tasks, participants rated various elements of usability, assigning values from a five-point scale that ranged from Strongly Agree to Strongly Disagree. Each participant was offered an opportunity to provide additional written comments to explain any difficulties encountered. After completing the usability evaluation, participants had an opportunity to rate satisfaction with various characteristics of all three electronic database products.

Findings of this study included the following discoveries:

1. EBSCOhost was the database used most heavily during the 2001-2002 Academic Year.
2. Students ranked CQ Researcher highest in terms of both usability and user satisfaction.
3. Database usage at Hartnell College follows an established trend of increasing at the end of each semester and in conjunction with related research assignments.
4. Cultural differences and lack of prior database use do not significantly hamper database usability.

Since purchasing access to its first electronic full-text database in 2000, the Hartnell College Library has now expanded its digital library collection from a single title to eight database offerings. The ongoing costs to maintain existing database subscriptions

will continue to increase in the future. Demand for new online resources has now expanded to include requests for Spanish language databases.

Up until now, the Library has conducted no surveys to determine how usable students find these electronic resources and collected no data to measure actual online database usage. Without access to statistical data measuring student use of the most expensive of the Library's resources, there is no means to determine the cost-effectiveness and fiscal sense of maintaining existing online subscriptions.

The results of this study provide documentation indicating usage levels of existing electronic resources and which full-text databases are receiving the most use. In addition, usability and user satisfaction studies have supplied information signifying whether the selected online databases offered by the library actually serve the informational needs of Hartnell students. User comments, evaluations, and test administrator log observations have identified potential barriers to access and usability of electronic resources.

Recommendations for further study include a thorough evaluation of all electronic resources acquired and maintained by Hartnell College. Such an examination should be conducted on a regular, ongoing basis. Comparative statistics should be maintained and shared with others. Future studies should test usability of the Hartnell Library Web site, Voyager online catalog, and additional online resources, especially new Spanish language database products. More research is needed and more direct lobbying necessary to establish consistent measurement criteria and standards among commercial database vendors.

Appendix A

Subject:
Digital library projects
Date: Thu, 14 Mar 2002 10:41:00 -0000
From:Bob Fields <B.Fields@mdx.ac.uk>
To: “"pcmc@igc.org"' <pcmc@igc.org>, "'jlagier@hartnell.cc.ca.us"' <jlagier@hartnell.cc.ca.us>

Hi Jennifer,
I don't know if Colin Tully told you, but both Yin Leng and Norliza have left this university (and the country!) recently. The project that you probably heard about (the Kids DL project) finished a while ago, and there hasn't been a direct follow on. However, there is still a strong digital library group here at Middlesex, whose focus is mainly on usability, and plenty of related work is continuing.

You are, of course, more than welcome to use the survey questionnaire - I'll find out whether Yin Leng is still interested in this kind of work, and ask her to get in touch with you. Although I have taken over some of Yin Leng's research after her departure, I'm not really familiar with the work that went on around this questionnaire.

Anyway, any feedback or comments you have about the questionnaire and the use you put it to would be interesting - please let us know!

regards,
bob fields.

Bob Fields email: b.fields@mdx.ac.uk
School of Computing Science phone: 020 8411 2272
Middlesex University
Trent Park, Bramley Road
London, N14 4YZ, UK. http://www.cs.mdx.ac.uk/staffpages/bobf/

http://www.usabilitynews.com http://www.bcs-hci.org.uk

Appendix B

Hi Jennifer,

>I replied saying that she is welcome to use the questionnaire, that we'd be >interested in any feedback and to hear about what she does with it, but that I >don't know anything about its validation. Can you help her?

I received this email from my ex-colleague at Middlesex University. You are welcomed to use the online survey. I would be interested in what you have discovered. The questionnaire has not been validated.

If you have any queries, pls feel free to come back to me. Just curious, where are you doing your dissertation?

All the best,
Yin Leng

****

Theng Yin Leng (Dr.)
Assistant Professor
Nanyang Technological University
School of Communication and Information
Division of Information Studies
31 Nanyang Link, Singapore 637718
Email: tyltheng@ntu.edu.sg
Tel : 790-5834 Fax : 791-5214

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Appendix C

Jennifer,

After reviewing your IRB Submission Form and Research Protocol I have approved your proposed research for IRB purposes. Your research has been determined to be exempt from further IRB review based on the following conclusion:

> Research using survey procedures or interview procedures where subjects' identities are thoroughly protected and their answers do not subject them to criminal and civil liability.

Please note that while your research has been approved, additional IRB reviews of your research will be required if any of the following circumstances occur:

1. If you, during the course of conducting your research, revise the research protocol (e.g., making changes to the informed consent form, survey instruments used, or number and nature of subjects).

2. If the portion of your research involving human subjects exceeds 12 months in duration.

Please feel free to contact me in the future if you have any questions regarding my evaluation of your research or the IRB process.

Dr. Cannady

James Cannady, Ph.D.
Assistant Professor
Graduate School of Computer and Information Sciences
Nova Southeastern University
954.262.2085
404.312.2374 (mobile phone)
cannady@nova.edu
PGP public key fingerprint:
8169 6D03 680E EF6C 899C
8C42 B4A3 DC9F 9F6B 4075

Appendix D

INFORMED CONSENT FORM
Hartnell College Library
Electronic Resources Usability Study

Jennifer Lagier
143 Cypress Grove Ct.
Marina, CA 93933
(831) 883-9640
lagierje@nova.edu

Description of the Study:

In this study, we are measuring the usability of selected online full-text databases: CQ Researcher, EBSCOhost and Proquest. Students will also have an opportunity to rate their satisfaction with each of these tools.

You have been selected as a participant based on your enrollment in a Hartnell College English class.

In this study we ask for some background information and then ask you to perform some tasks using three online databases. The tasks are similar to the activities you would perform while researching a class assignment. We are not evaluating you, rather we are studying how easy these online databases are to use. All information you provide and all data collected will be held in strict confidence. The information will be used for statistical and summary purposes only. Your name will not be associated with your records.

To the best of our knowledge, there are no physical or psychological risks associated with the procedures in this study.

The experimenter will assist you and answer any questions you have. You are completely free to stop participating in the experiment at any time.

If you are willing to participate, please sign the following statement:

"*I have read the above description of the experimental procedure and of my rights as a subject and I have agreed to participate in the study on usability of and user satisfaction with three Hartnell College Library electronic full-text databases: CQ Researcher, EBSCOHost Masterfile Premier and Proquest."*

Signed:

Date:

Appendix E

1. What is your age?

2. What is your gender? Male____ Female____

3. What is your ethnic background?
   Latino___Filipino___ Asian/Pacific Islander___
   African American___ Native American___ Caucasian___ Other___

4. Have you ever used electronic databases at the Hartnell Library before this exercise? YES___ NO___

CQ Researcher Usability Evaluation

Please complete the following tasks, then answer the questions about CQ Researcher.

1. Search for articles about **deregulation** and **energy.** Select one recent article, then list the information below:

2. What is the title of the article?

3. Who is the author?

4. Find the Pro/Con section of your report. What question is being debated in the report you selected?

Now answer the following questions to the best of your ability. Rate your agreement with each of the five questions listed, using the scale from Strongly Agree to Strongly Disagree.

1. I can quickly find what I want on this Web site.

	Strongly	Slightly	Neutral	Slightly	Strongly	
Agree	○	○	○	○	○	Disagree

2. It is difficult to move around on this Web site.

	Strongly	Slightly	Neutral	Slightly	Strongly	
Agree	○	○	○	○	○	Disagree

3. If you found the site difficult to move around on, please tell us why:

4. This Web site is easy to use.

	Strongly	Slightly	Neutral	Slightly	Strongly	
Agree	○	○	○	○	○	Disagree

5. If you found this site difficult to use, please tell us why:

6. This Web site needs more instructions.

	Strongly	Slightly	Neutral	Slightly	Strongly	
Agree	○	○	○	○	○	Disagree

7. What additional instructions would you recommend?

8. This Web site is too slow.

	Strongly	Slightly	Neutral	Slightly	Strongly	
Agree	○	○	○	○	○	Disagree

9. Do you have any additional comments you would like to share?

EBSCOhost Usability Evaluation

Please complete the following tasks, then answer the questions about EBSCOHost.

1. Search for articles about **energy crisis** and **California**.
2. Locate one **full text** article, then complete the following:
3. What is the title of the article?

4. Who is the author?

5. What is the title of the magazine in which the article appeared?

Now answer the following questions to the best of your ability. Rate your agreement with each of the five questions listed, using the scale from Strongly Agree to Strongly Disagree.

1. I can quickly find what I want on this Web site.

	Strongly	Slightly	Neutral	Slightly	Strongly	
Agree	○	○	○	○	○	Disagree

2. It is difficult to move around on this Web site.

	Strongly	Slightly	Neutral	Slightly	Strongly	
Agree	○	○	○	○	○	Disagree

3. If you found the site difficult to move around on, please tell us why:

4. This Web site is easy to use.

	Strongly	Slightly	Neutral	Slightly	Strongly	
Agree	○	○	○	○	○	Disagree

5. If you found this site difficult to use, please tell us why:

6. This Web site needs more instructions.

	Strongly	Slightly	Neutral	Slightly	Strongly	
Agree	○	○	○	○	○	Disagree

7. What additional instructions would you recommend?

8. This Web site is too slow.

	Strongly	Slightly	Neutral	Slightly	Strongly	
Agree	○	○	○	○	○	Disagree

9. Do you have any additional comments you would like to share?

ProQuest Usability Evaluation

Please complete the following tasks, then answer the questions about ProQuest.

1. Search for articles about **deregulation** and **energy** and **California**.
2. Locate one article, then complete the following:
3. What is the title of the article?

4. Who is the author?

5. What is the title of the newspaper or magazine in which the article appeared?

Now answer the following questions to the best of your ability. Rate your agreement with each of the five questions listed, using the scale from Strongly Agree to Strongly Disagree.

1. I can quickly find what I want on this Web site.

	Strongly	Slightly	Neutral	Slightly	Strongly	
Agree	○	○	○	○	○	Disagree

2. It is difficult to move around on this Web site.

	Strongly	Slightly	Neutral	Slightly	Strongly	
Agree	○	○	○	○	○	Disagree

3. If you found the site difficult to move around on, please tell us why:

4. This Web site is easy to use.

	Strongly	Slightly	Neutral	Slightly	Strongly	
Agree	○	○	○	○	○	Disagree

5. If you found this site difficult to use, please tell us why:

6. This Web site needs more instructions.

	Strongly	Slightly	Neutral	Slightly	Strongly	
Agree	○	○	○	○	○	Disagree

7. What additional instructions would you recommend?

8. This Web site is too slow.

	Strongly	Slightly	Neutral	Slightly	Strongly	
Agree	○	○	○	○	○	Disagree

9. Do you have any additional comments you would like to share?

Appendix F

User Satisfaction Questionnaire

CQ Researcher

1. How would you rate your level of satisfaction when using CQ Researcher?

	Strongly	Slightly	Neutral	Slightly	Strongly	
Satisfied	○	○	○	○	○	Dissatisfied

2. How well does CQ Researcher prompt you, so you always know what the application expects you to do next and what your options are?

	Strongly	Slightly	Neutral	Slightly	Strongly	
Satisfied	○	○	○	○	○	Dissatisfied

3. How well does CQ Researcher allow you to bypass irrelevant steps and get efficiently to the field, function or page that you want?

	Strongly	Slightly	Neutral	Slightly	Strongly	
Satisfied	○	○	○	○	○	Dissatisfied

4. How well does CQ Researcher facilitate learning about it and using it with minimal assistance?

	Strongly	Slightly	Neutral	Slightly	Strongly	
Satisfied	○	○	○	○	○	Dissatisfied

5. How well does CQ Researcher help you perform your research assignments more efficiently and effectively?

	Strongly	Slightly	Neutral	Slightly	Strongly	
Satisfied	○	○	○	○	○	Dissatisfied

EBSCOhost

1. How would you rate your level of satisfaction when using EBSCOhost?

	Strongly	Slightly	Neutral	Slightly	Strongly	
Satisfied	○	○	○	○	○	Dissatisfied

2. How well does EBSCOhost prompt you, so you always know what the application expects you to do next and what your options are?

	Strongly	Slightly	Neutral	Slightly	Strongly	
Satisfied	○	○	○	○	○	Dissatisfied

3. How well does EBSCOhost allow you to bypass irrelevant steps and get efficiently to the field, function or page that you want?

	Strongly	Slightly	Neutral	Slightly	Strongly	
Satisfied	○	○	○	○	○	Dissatisfied

4. How well does EBSCOhost facilitate learning about it and using it with minimal assistance?

	Strongly	Slightly	Neutral	Slightly	Strongly	
Satisfied	○	○	○	○	○	Dissatisfied

5. How well does EBSCOhost help you perform your research assignments more efficiently and effectively?

	Strongly	Slightly	Neutral	Slightly	Strongly	
Satisfied	○	○	○	○	○	Dissatisfied

ProQuest

1. How would you rate your level of satisfaction when using ProQuest?

	Strongly	Slightly	Neutral	Slightly	Strongly	
Satisfied	○	○	○	○	○	Dissatisfied

2. How well does ProQuest prompt you, so you always know what the application expects you to do next and what your options are?

	Strongly	Slightly	Neutral	Slightly	Strongly	
Satisfied	○	○	○	○	○	Dissatisfied

3. How well does ProQuest allow you to bypass irrelevant steps and get efficiently to the field, function or page that you want?

	Strongly	Slightly	Neutral	Slightly	Strongly	
Satisfied	○	○	○	○	○	Dissatisfied

4. How well does ProQuest facilitate learning about it and using it with minimal assistance?

	Strongly	Slightly	Neutral	Slightly	Strongly	
Satisfied	○	○	○	○	○	Dissatisfied

5. How well does ProQuest help you perform your research assignments more efficiently and effectively?

	Strongly	Slightly	Neutral	Slightly	Strongly	
Satisfied	○	○	○	○	○	Dissatisfied

Appendix G

Hartnell College Library
Electronic Resources Usability Test – Administrator's Log

User	Database	Task	Comment

Appendix H

Usability and User Satisfaction Study Script

Workstations in the Technology Learning Classroom will be booted up and logged onto the network, before the arrival of test participants. Upon arrival, each participant will be provided access to a workstation that is displaying the library's home page, containing links to all three databases. At this point, the test administrator will:

1. Thank participants for taking part in the study
2. Inform them that the electronic databases are being evaluated, not them.
3. Inform them that they are free to stop and leave at any time.
4. Inform them that their identities will not revealed—only the results of the tests are what will be reported.
5. Distribute Informed Consent forms and obtain signatures.
6. Explain the process.
    a. Participants will be provided 45 minutes to complete the tasks listed on the usability evaluation forms.
    b. Each database will be tested by having participants perform tasks commonly required during research.
    c. After completing each task, participants will answer a series of questions rating usability.
    d. At the conclusion of the usability test, participants will rate their levels of satisfaction with each database.
7. Start the test.
8. Throughout the test, the administrator will circulate throughout the classroom, taking notes, answering questions, and observing participants.
9. At the conclusion of the test, the test administrator will collect all forms and again thank participants.

Appendix I
Excerpts from Middlesex University Usability Questionnaire

1. Do you find the digital library site responds fast enough?

	Extremely	Quite	Slightly	Neutral	Slightly	Quite	Extremely	
Slow	○	○	○	○	○	○	○	Fast

2. Do you find the digital library site reliable? (e.g: able to complete tasks without it breaking down, etc?)

	Extremely	Quite	Slightly	Neutral	Slightly	Quite	Extremely	
Unreliable	○	○	○	○	○	○	○	Reliable

3. How easy does the digital library site enable you to correct your mistakes?

	Extremely	Quite	Slightly	Neutral	Slightly	Quite	Extremely	
Difficult	○	○	○	○	○	○	○	Easy

4. Any other comments on site capabilities :

Proceed Reset

1. Are the links to external web sites from the digital library site clearly displayed and highlighted?

	Extremely	Quite	Slightly	Neutral	Slightly	Quite	Extremely	
Unclear	○	○	○	○	○	○	○	Clear

2. Are there sufficient information on the screen such as the use of title, subtitle, page, etc. to help you know where you are in relation to the structure of the digital library site?

	Extremely	Quite	Slightly	Neutral	Slightly	Quite	Extremely	
Insufficient	○	○	○	○	○	○	○	Sufficient

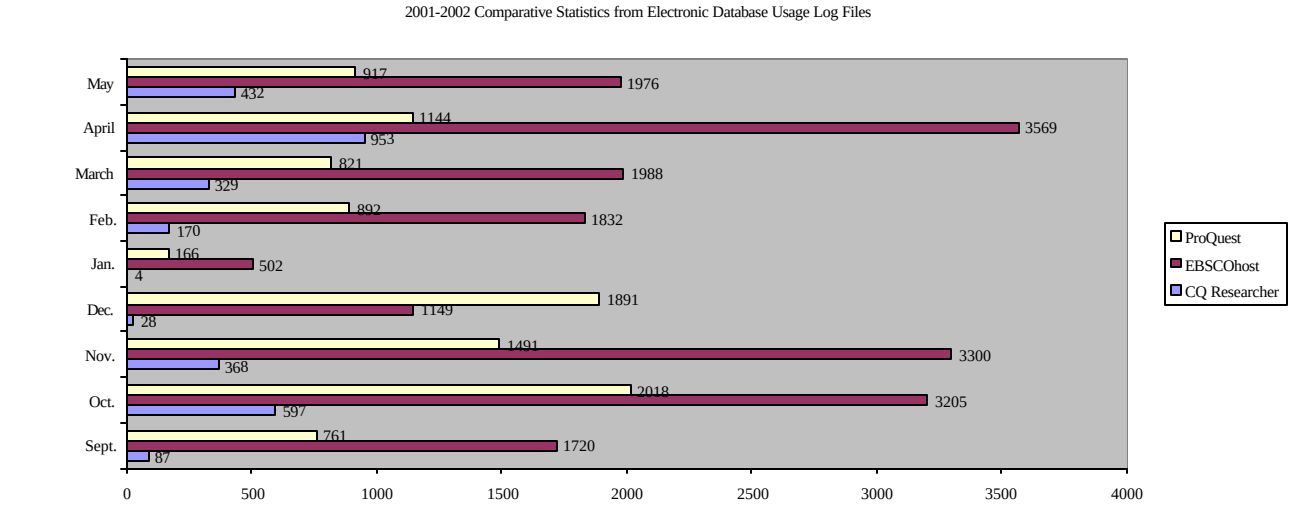
3. Does the digital library site provide sufficient information such as graphical document browsers, maps, document finders, table of contents, references, etc. to help you assess the structure of the digital library site?

	Extremely	Quite	Slightly	Neutral	Slightly	Quite	Extremely	
Insufficient	○	○	○	○	○	○	○	Sufficient

4. Does the digital library site provide good features/facilities to help you remember the main areas covered?

	Extremely	Quite	Slightly	Neutral	Slightly	Quite	Extremely	
Poor	○	○	○	○	○	○	○	Good

APPENDIX J



	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May
ProQuest	761	2018	1491	1891	166	892	821	1144	917
EBSCOhost	1720	3205	3300	1149	502	1832	1988	3569	1976
CQ Researcher	87	597	368	28	4	170	329	953	432

Number of searches

Appendix K

Hartnell College Library
Electronic Resources Usability Test – Administrator's Log Notes

Database	Task	Comment
CQ Researcher	1	User puzzled by Netscape alert about transmission of information, unsure whether to click and continue process
CQ Researcher	1	What is a database?
CQ Researcher	1	How do I start a search?
CQ Researcher	1	How do I start a search?
CQ Researcher	1	How do I start a search?
CQ Researcher	1	Where do I type in search?
CQ Researcher	2	Where do I find title?
CQ Researcher	1	How do I retrieve article?
CQ Researcher	4	How do I navigate to Pro/Con section?
EBSCOhost	1	How do I navigate from CQ Researcher to EBSCOhost?
CQ Researcher	1	How do I sort results by date?
EBSCOhost	5	How do I find magazine title? (EBSCO uses term *source* for this data)
EBSCOhost	5	How do I find magazine title? (EBSCO uses term *source* for this data)
CQ Researcher	3	Netscape locked up and had to be restarted.
ProQuest	1	Netscape locked up and had to be restarted.
EBSCOhost	1	How do I enter search terms?

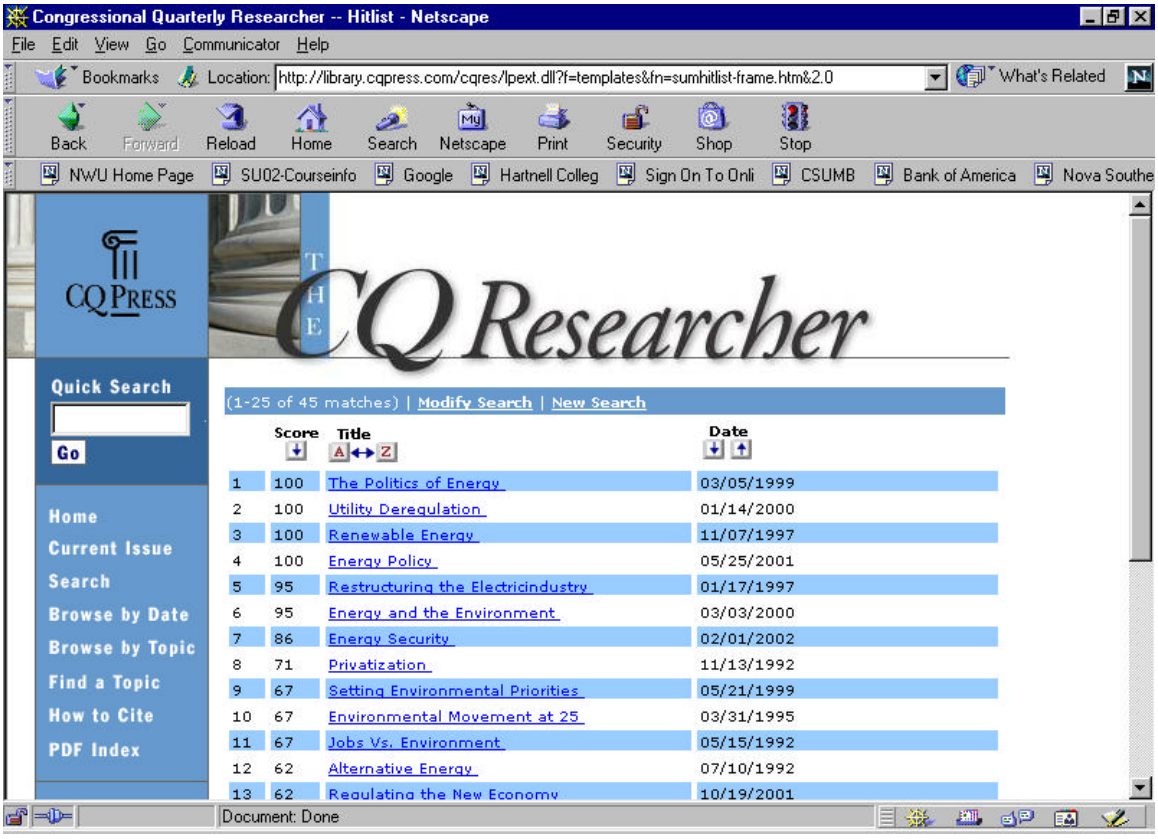
Database	Task	Comment
EBSCOhost	2	How do I sort by date? (EBSCOhost does not contain this utility)
EBSCOhost	1	User was attempting to enter search terms in Hartnell web site search input field rather than within EBSCOhost.
EBSCOhost	5	How do I find magazine title? (EBSCO uses term *source* for this data)
EBSCOhost	3	How do I retrieve full text of article?
EBSCOhost	4	How do I mark selections in the hit list of results?
ProQuest	1	Why doesn't my search work? (User had misspelled terms term.)
ProQuest	1	Where is the article text? (User had retrieved web site of the California Energy Commission rather than ProQuest article.)
EBSCOhost	5	How do I find magazine title? (EBSCO uses term *source* for this data)
CQ Researcher	3	Where do I find the title of the article?
EBSCOhost	5	How do I find magazine title? (EBSCO uses term *source* for this data)
ProQuest	1	Netscape locked up and had to be restarted.
ProQuest	1	Netscape locked up and had to be restarted.
ProQuest	1	Netscape locked up and had to be restarted.

APPENDIX L

CQ Researcher Search Screen One:

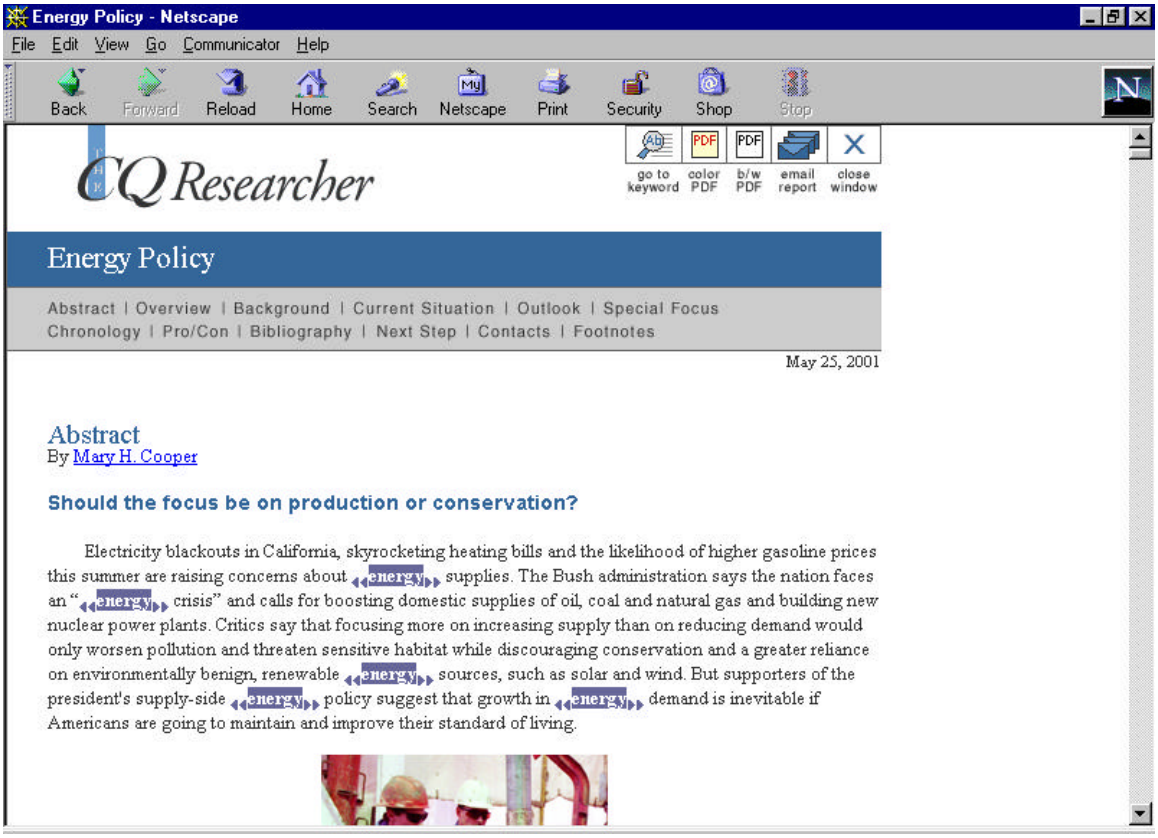
APPENDIX M

CQ Researcher Search Screen 2:



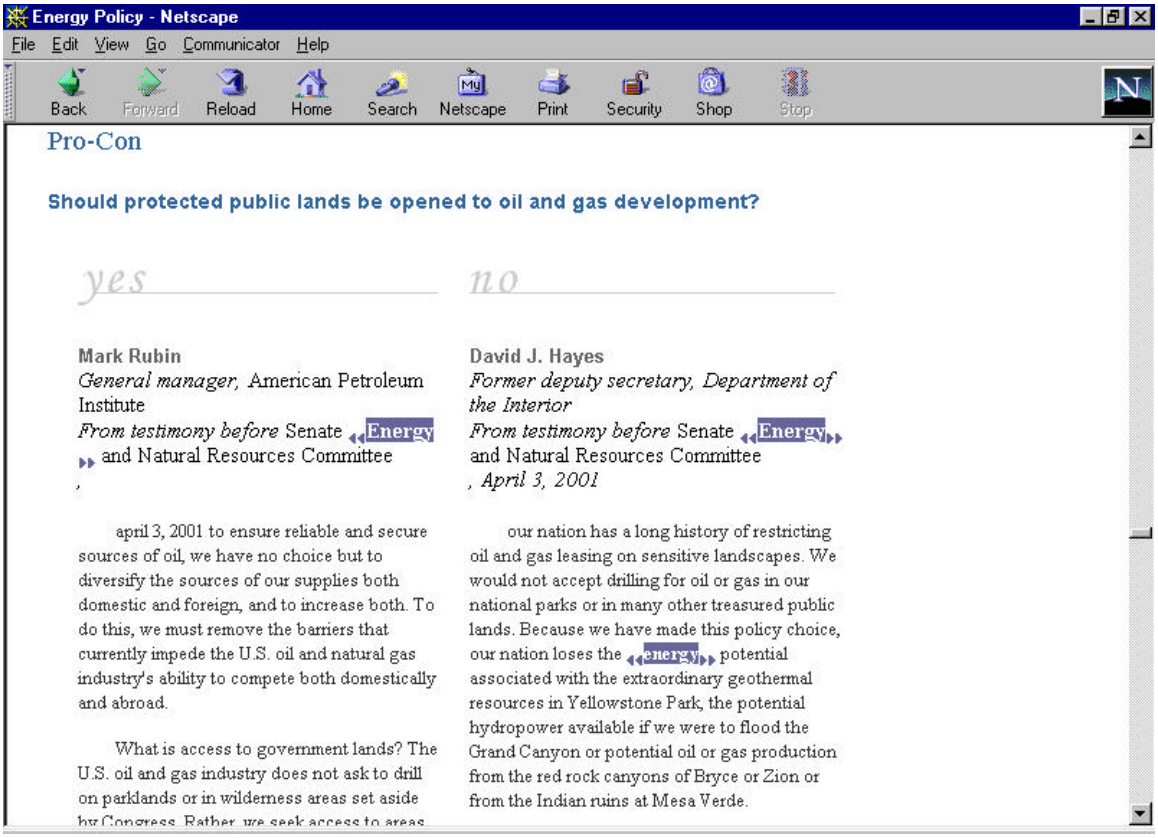
APPENDIX N

CQ Researcher Search Screen 3:



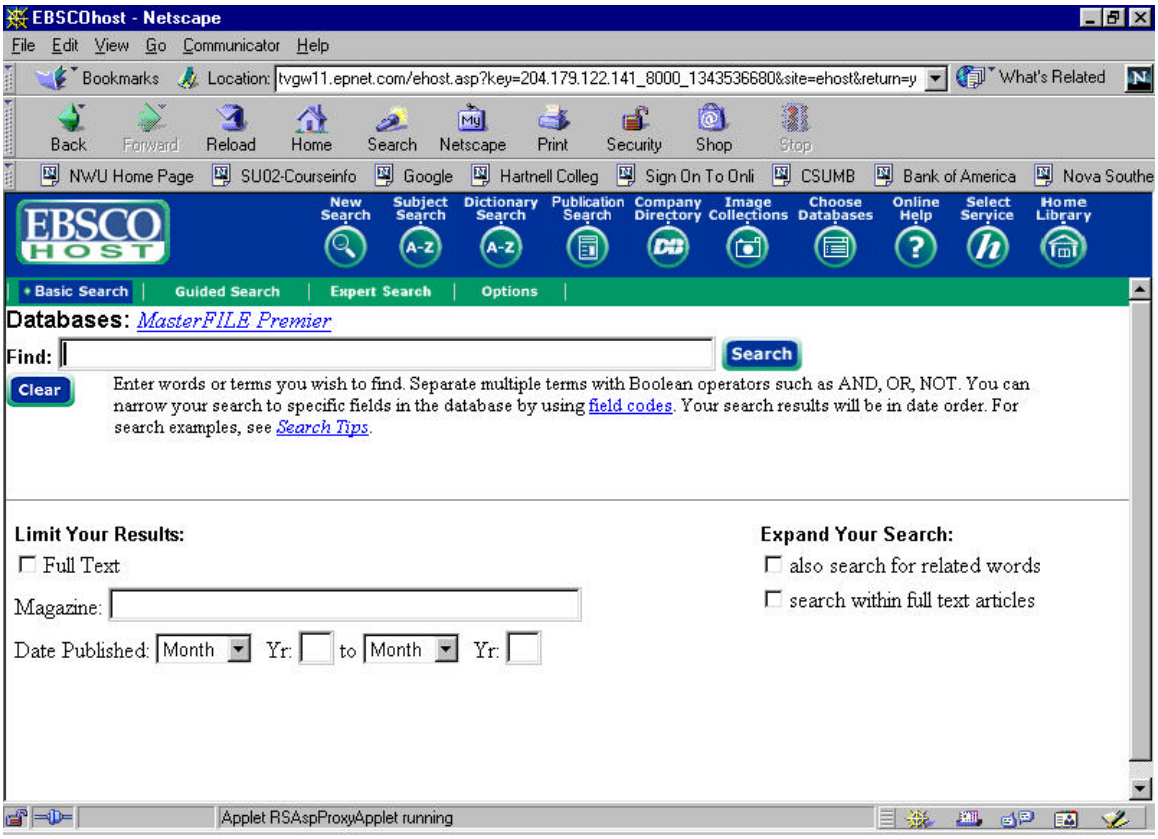
APPENDIX 0

CQ Researcher Search Screen 4:



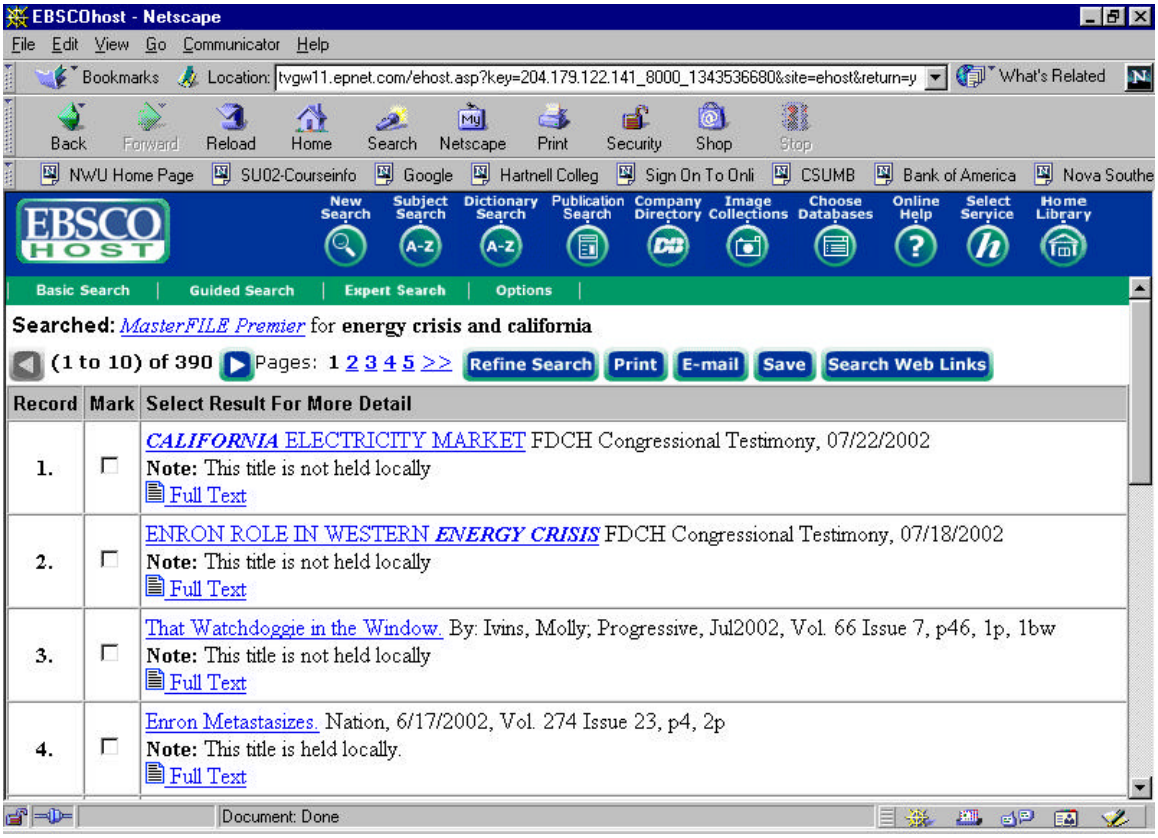
APPENDIX P

EBSCOhost Search Screen 1:



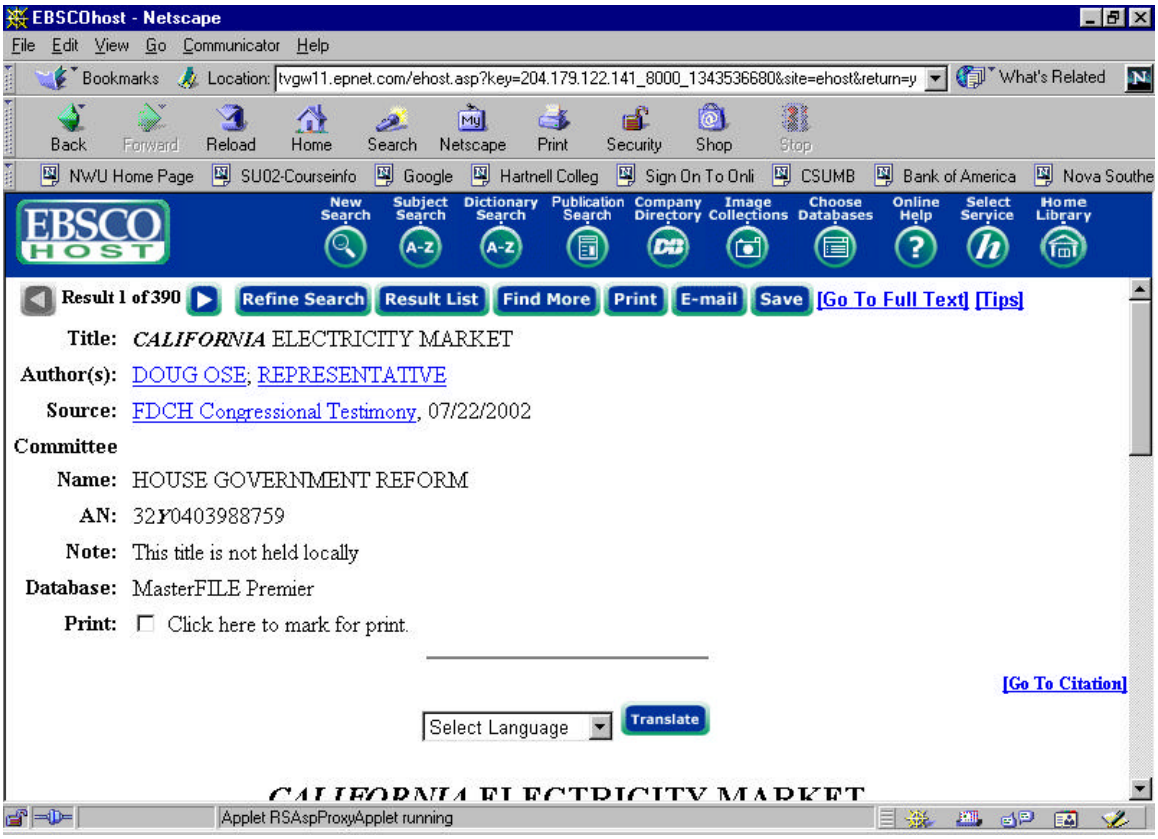
APPENDIX Q

EBSCOhost Search Screen 2:



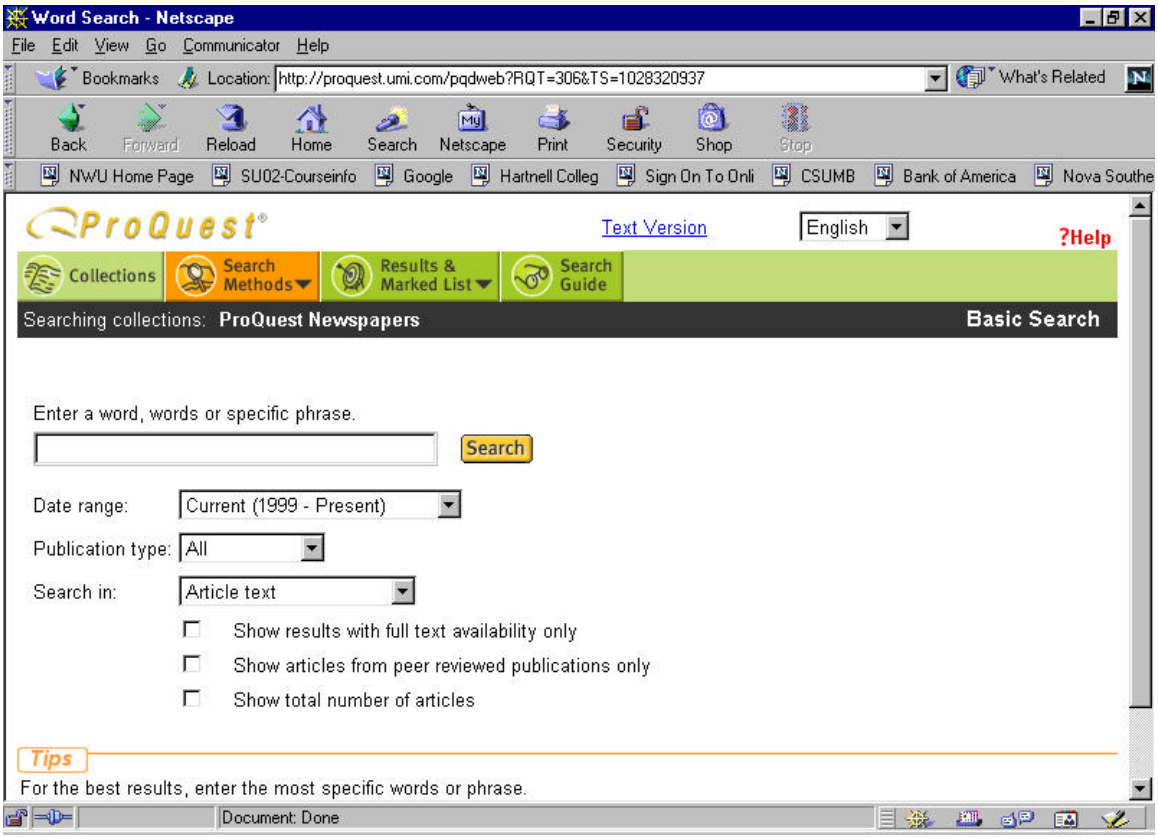
APPENDIX R

EBSCOhost Search Screen 3:



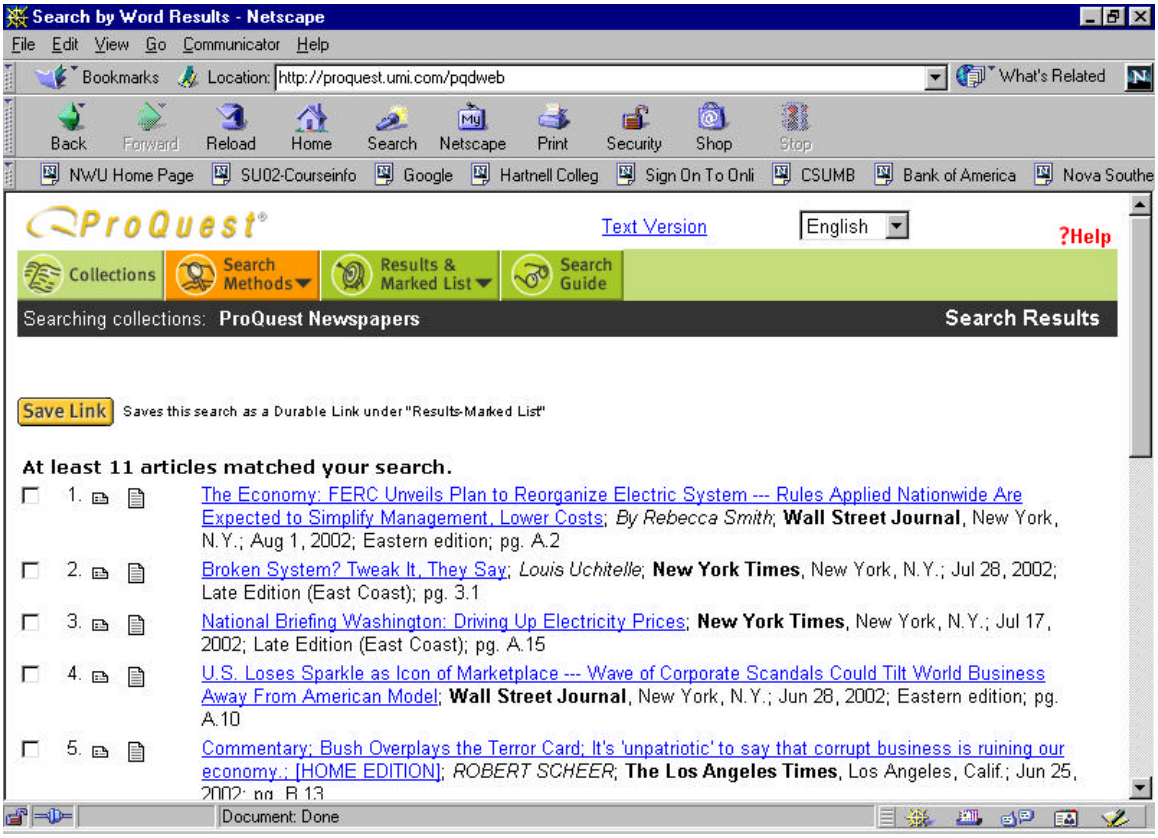
APPENDIX S

ProQuest Search Screen 1:



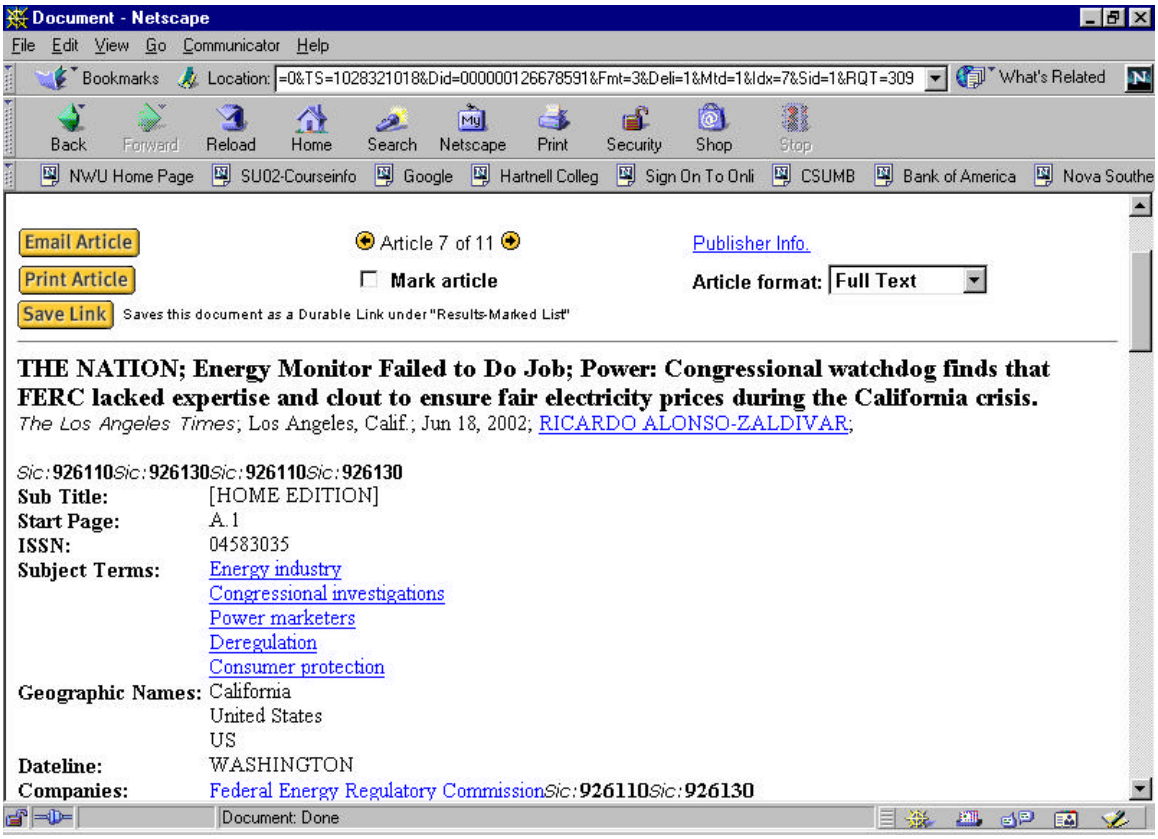
APPENDIX T

ProQuest Search Screen 2:



APPENDIX U

ProQuest Search Screen 3:



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