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University of Alberta

Effects of Instruction on Search Success and Satisfaction on the World Wide Web.

By

Brian L. L. Johnson

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfilment of the requirements for the degree of Master of Education in

Instructional Technology

Department of Educational Psychology

Edmonton, Alberta

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Date: June 5, 1997

Abstract

The purpose of this study was to determine if one hour of instruction in keyword selection + Boolean logic would increase high school students levels of keyword selection and Boolean knowledge, correct use of keywords and Boolean logic in constructing search statements, success in finding topic related documents and satisfaction while searching a world wide web database. One hundred and twenty five students from a Western Canadian High School participated. Instruction in keyword selection + Boolean logic significantly increased both student knowledge levels in using advanced search strategies (49.6% higher than control group), and correct student use of keywords and Boolean logic in constructing advanced search statements (39.5% higher). There was, however, no significant difference between the instructional treatment groups in the level of success or satisfaction experienced. Females experienced significantly higher levels of success than males, while both genders experienced similar levels of satisfaction.

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The successful completion of this study involved the consent of many volunteers who agreed to participate in this study, and the cooperation of Duncan Anderson in helping me to recruit those volunteers.

To my wife Diana, thank you for your continual support, patience, and encouragement in clearing the path necessary for me to complete this study.

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CHAPTER I

The Problem

Background of the Study

In North American classrooms an increasing number students are turning to electronic databases as an information resource. Students are being encouraged by their teachers to utilize independent research tasks requiring them to locate, gather, synthesize, and summarize information from several sources. Oley (1989) suggests that, "the increase in electronic storage of information indicates that information retrieval skills ... will become increasingly more relevant for students at all levels" (p. 591). However, there is often little guidance or structure given to the student, requiring them to utilize resources that have not been tailored to meet their specific information needs (Small & Ferreira, 1994).

Changing Information Sources

Previously students relied largely on text-based materials, then more recently on on-line and CD-ROM bibliographic databases. Now the World Wide Web (WWW) databases have appeared, offering potentially valuable sources of information. The increase in amounts, availability and usage of electronically stored information on the WWW databases suggests that effective search strategies are increasingly more relevant to students at all levels. According to Harris (1996):

> the variety of search engines (such as WebCrawler) on the World Wide Web, are certainly powerful, useful tools that can help our students locate large numbers of diverse and timely documents. In schools with the luxuries of easy access and flexible class schedules, students (and

> teachers) happily "surf the Internet," and are often impressed with the range, amount, and appearance of all that can be found that is related to a particular area of inquiry. (p.36)

However, decades of research into new technologies indicates that the presence of technology alone is not enough to ensure learning; learners must be adequately prepared for these new technologies (Kinzie,1990). With the new technologies being developed and applied in the WWW search engines and newer bibliographic databases, there is a need to reexamine effective search strategies while considering the levels of success and satisfaction being experienced by end-users. This is becoming more important at the grade school level where an increasing number of younger students are performing electronic searches.

Need for Study of Effective Search Strategies

The use of Boolean logic has been commonly introduced to most students at the undergraduate level when they first access large bibliographic databases. With the entrance of the WWW into most classrooms in North America, students of increasingly younger age are attempting to search the WWW databases. Studies of grade school students using bibliographic databases have shown that most students do not construct effective search statements or utilize successful search strategies as they lack the knowledge or skill, particularly at the elementary and junior high levels. Oley (1989), Neuman (1995), and Solomon (1993) found that students had problems conducting effective searches due to problems in; generating search terms, using a limited number of synonyms, and combining two or more terms into a single search. Even at the high school level Chen (1993) noted that high

school students are having some difficulty formulating proper search terms. Ala and Cerabona (1992) recommend that teaching Boolean search strategies should begin at the high school level. Clearly, there is a need for research into effective instruction on and application of search strategies by grade school students, particularly at the senior high levels. The aim of this research is to increase end-user success and satisfaction for those students who are starting to utilize the WWW databases as an information resource.

The Excite Database

One of the newest databases to join the WWW group is Excite, a database described by Courtois, (1996) as representing the next generation of search services for the WWW. Excite uses an automated spider to gather WWW resources and index the full text of Web pages. Comprehensive and in depth reviews are given by over thirty professional journalists constantly browsing the web. Searchers are given the option of using concept searches or Boolean logic. Relevancy ranking is used to increase the likelihood of finding the most relevant sites. The ability to combine Boolean logic with relevancy ranking allows searchers to utilize the old and the new in effective search features for powerful searching. All of these features make this database one of the premier search engines on the WWW at this time, and a worthwhile database for studying effective search strategies with high school students.

Instruction

To accomplish effective instruction of search strategies for databases, several researchers suggest the use of presearch worksheets that allow students to think through their search strategy. Presearch worksheets can provide search hint sheets that may help the students to create more effective

search statements, and plot more effective search strategies (Leverence, 1994; Nahl & Harada, 1996; Stripling & Pitts, 1988). The grade school student conducting a database search clearly needs instruction in analyzing research questions and in constructing effective search statements before going on-line. There is a need to determine the amount of instruction that is sufficient at the senior high school grade levels to establish competent searchers who experience success and satisfaction with their searches. There is also a need to determine if the type of instruction, (keyword versus keyword and Boolean logic combined) affects end-user success and satisfaction on a WWW database. As previous researchers have reported (Ankeny, 1991; Lepoer and Mularski, 1989; Mischo and Lee, 1987; Reese, 1988) end-users of bibliographic databases have higher levels of satisfaction than actual levels of success experienced. Does this also occur for end-users of WWW databases?

Statement of the Problem

The present study will examine the effects of instruction in keyword selection or keyword selection and Boolean logic on the success and satisfaction of grade ten, eleven, and twelve students using the Excite database. Students will receive instruction on either keyword selection or keyword selection and Boolean logic as compared to a control group that receives no instruction. Students will be tested for their acquired knowledge of keyword selection and Boolean logic. Students will then search the WWW for information on three different search topics using Excite. Effective statement construction, searcher success and satisfaction levels will be determined for both genders in all three treatment groups.

Research Questions

The present study attempts to address the following questions:

1. Can one hour of instruction on utilizing keywords or keywords plus Boolean logic increase a senior high school student's understanding and effective application of these search strategies, as determined by a posttest of keyword/Boolean logic knowledge?
2. Does one hour of instruction on utilizing keywords or keywords plus Boolean logic increase a senior high school student's success in constructing search statements utilizing these strategies when searching a WWW database that uses relevancy ranking?
3. Does one hour of instruction on utilizing keywords or keywords plus Boolean logic increase a senior high school student's search success in finding topic related documents when searching a WWW database that uses relevancy ranking?
4. Does one hour of instruction on utilizing keywords or keywords plus Boolean logic increase a senior high school student's satisfaction when searching a WWW database that uses relevancy ranking?
5. Will one hour of instruction on utilizing keywords or keywords plus Boolean logic have differing effects on subjects based on gender. If so, will that effect occur in either searcher success or searcher satisfaction?
6. Will subjects with higher levels of keyword/Boolean knowledge produce more search statements that correctly use keywords and Boolean logic than subjects with lower levels of keyword/Boolean knowledge?
7. Will subjects with higher levels of keyword/Boolean knowledge achieve higher levels of success in finding topic related documents than subjects with

lower levels of keyword/Boolean knowledge?

8. Will subjects constructing search statements with higher levels of correctly used keywords and Boolean logic experience higher levels of success in finding topic related documents than subjects constructing search statements with fewer correctly used keywords and Boolean logic?

Significance of the Study

This study examines the effect of a one hour lesson involving keyword selection and Boolean logic upon students' success and satisfaction in performing searches using Excite's WWW database. The importance of this study is addressed by the following questions:

How can teachers better help students become proficient searchers when utilizing the WWW? Are search strategies that are effective on a bibliographic database also effective on a WWW database? Is a one hour lesson a worthwhile undertaking in preparing students to search the WWW? Should teachers attempt to teach Boolean logic as a search strategy for the WWW or is instruction on keyword selection alone all that is required when using a database that uses relevancy ranking capabilities?

Should teachers weigh the benefits of teaching these strategies differently when considering gender? These findings may be of assistance to teachers contemplating effective instructional strategies to increase their students success and satisfaction with using the WWW as an information resource.

Definition of Terms

1. Keyword/Boolean logic knowledge: The subject's total score, determined using a twenty item short answer and multiple choice test that assesses

encoding skills used in identifying keywords, and decoding knowledge using Boolean operators to construct search statements.

2. Statement construction: How effectively the subject creates search statements as determined by analyzing their Excite database search statements for proper selection of keywords and application of Boolean logic, and expressed as the proportion of search statements correctly doing so.

3. Search success: The subject's relative accuracy in searching the WWW to find topic related documents, as determined by the number of correct (as determined by previous experienced searchers) topic related documents found in their search of the Excite database.

4. Search Satisfaction: The opinion of the end-user about the value of their individual search strategy as measured by their perceived success of the search, and their feelings generated by their search experience, expressed as the percentage of total satisfaction.

5. Keyword selection: The process of identifying appropriate search terms that best summarize the content of a document, in order for the search engine to effectively find that document.

6. Boolean logic: The use of AND, OR, and NOT Boolean operators, as well as parentheses, to combine, include, and exclude terms in a multiple term search statement.

7. Encoded search: Involves composing a search statement based on a written topical query, and often requiring the student to create an integrated search statement using Boolean operators.

8. Decoded search: Involves identifying main concepts for searching by extracting keywords directly from the query.

9. Search engine: The component of the database that determines how the database processes an inputted search statement in accessing the databases documents.

10. Database: A collection of documents indexed in a variety of possible ways, often accessible by an electronic search engine.

11. Uniform Resource Location: The address of any document found on the Internet, it includes the protocol, server identity, path to the file, and the name of the file to access.

Limitations of the Study

All search engines are not equal. Excite was not selected at random and does not represent a typical or average search engine. The findings from this study apply only to Excite's search engine. Others who wish to draw conclusions about other WWW databases and search engines from these findings should keep this in mind.

Data were gathered on subjects enrolled in regular grade ten and eleven classes in an Alberta High school. These classes were not randomly selected. Any attempt to generalize ecologically to other populations needs to take in to account the demographic differences between the two populations.

The data collected for this study were collected in two one-hour sessions. The instruction of search strategies was less than one hour, consequently one can not generalize what effect longer periods of instruction will have from these results. As well the type of instruction, teaching style of the instructor, and classroom climate were all unique to this study and any ecological generalizations of these findings should be considered with this in mind. Furthermore, the effects were measured in the subsequent class, usually twenty

four hours later, therefore it is not possible to generalize what effect teaching the search strategies will have when measured over a longer term.

Triplet matching based on previous computer experience and gender, and random assignment of students to the three groups (control, keyword selection, keywords plus Boolean logic) was done, allowing for stronger generalizations of these results.

Delimitations of the Study

This study is limited to the effects of teaching keywords and Boolean logic on end-user success and satisfaction on the Excite database. This study does not examine these effects for other WWW databases nor does it consider the effects of teaching other search strategies. This study does not examine, nor is it concerned with comparing the effectiveness of different WWW search engines and their databases.

CHAPTER II

Review of the Related Literature

This review examines literature related to the effectiveness and value of teaching and using keyword identification, and Boolean logic as strategies for searching electronic databases, as well as the influence of these strategies on end-user success and satisfaction. To place this information in context, literature relating to database-type studies that consider end-user success and satisfaction, as well as end-user search strategies utilized in both WWW databases and bibliographic databases (on-line and on-disk) are included.

Overview

Until the recent appearance of the WWW databases, database-type studies predominantly examined end-user success and satisfaction in using simple and advanced search strategies for bibliographic databases. Furthermore, most of this research was done at the college or university level, as this is usually when students first encounter large electronic databases, such as ERIC, PsycLIT and MEDLINE (Moore & St. George, 1991; Solomon, 1993). In general these studies indicate that many end-users are not successfully utilizing Boolean logic in their search strategies, even though research has shown Boolean logic to be a dominant and potentially effective search strategy (Chen, 1993; Chen, 1992; Ensor, 1992; Mischo & Lee, 1987; Neuman, 1995; Puttapithakporn, 1990; Siegrfied, Bates, and Wilde,1993). Furthermore, many new search features are appearing on the relatively new WWW databases which are challenging Boolean logic as the most effective search feature (Courtois, 1996). Few studies have been found that focus on end-user success, and satisfaction regarding WWW databases. Instead, research into WWW

databases has focused mainly on comparing the effectiveness of the various search features used by the different WWW database search engines (Courtois, 1996; Courtois, Baer & Stark, 1995; Zorn, Emanoil, Marshall & Panek, 1996) .

Bibliographic Databases: End-user Search Strategy Errors

Research on end-users of information systems has grown rapidly in recent years, as more and more databases, WWW and bibliographic, are being used by students and teachers, rather than by librarians acting as intermediaries. Bibliographic databases have become the dominant form of electronic information sources in colleges and universities over the past 15 years, with keyword and Boolean logic search capabilities being present and studied as early as 1982 (Ensor, 1992).

In considering the types of search strategies used, research has focused on problems encountered and mistakes made by searchers. Numerous studies point to the lack of general search strategies being used by end-users. Often end-users are not appropriately selecting search terms and are not effectively applying Boolean logic in their search strategies. Findings of the studies vary in regards to search strategies and errors made, particularly when the ages of the subjects are considered. I have presented these studies in chronological order, starting with elementary students and ending with a study that considers the search errors made by doctoral scholars.

Elementary School Studies

Studies done at the elementary level suggest that most students simply lack the cognitive skills required to develop complex search strategies. Moore and St. George (1991), studied the cognitive demands of library systems on sixth graders and found that "children have great difficulty generating

alternative terms and for nine- and ten-year-olds, 70% of the words selected would access no relevant information" (p. 164). Furthermore, few of these grade six students were able to "match keywords to information sources, to see relationships between differing aspects of the topic... to monitor the outcome of search strategies, and to regulate them accordingly" (p. 167). In a study of elementary children's information retrieval behaviour, Solomon (1993), observed over 900 Online Public Access Catalogues (OPAC) transactions performed by over 500 elementary students. In analyzing where their search strategies broke down, Solomon found that there were often mismatches between the children's natural selection of search terms, and the actual terms used in the online catalogues database, syntax errors, the ability to use nouns and plural forms of words, and an inability to combine 2 or more terms into a single search. Furthermore, as the searching became more advanced, students simply didn't have sufficient knowledge in the subject area to suggest synonyms.

In general these studies seem to suggest that elementary students are either not cognitively ready to learn and apply complex search strategies of an electronic database, or high quality instruction is needed to overcome cognitive weaknesses.

High School Studies

Studies at the high school level also found students lacking in many basic search skills and concepts. In a survey of 25 library media specialists from 22 secondary schools, Neuman (1995) found that the major problems the students encountered in using online and CD-ROM databases included: overcoming mismatches between personal ideas of how information is

organized versus actual ideas of how information is organized in databases, generating search terms, narrowing searches, designing effective search strategies, and designing searchable topics and questions. Chen (1993) also studied high school students use of an online catalogue. Chen noted that the students tended to use strings of words or major phrases taken directly from the search problem as their search term. These phrases frequently fell outside of the system's controlled vocabulary for the subject. As well, the students had difficulty extracting main concepts and expressing them using appropriate key words.

College and University Studies

Numerous studies have been done at the college level which attempt to identify common search strategies used for bibliographic databases, as well as determine end user success and satisfaction. Puttapithakporn (1990) identified and categorized problems that thirty three novice users encountered in a database searching task using ERIC on SilverPlatter. Puttapithakporn found that only two students at this level had troubles with Boolean logic. Their errors were experienced when they tried to combine many search concepts and used parentheses improperly in trying to separating their Boolean operators.

Ensor (1992) reviewed the literature regarding knowledge levels of users and nonusers of keyword/Boolean logic using OPAC's at several universities. Ensor concluded that most end-users perform searches using only one or two keywords, and that Boolean operators are used very little. Ensor also points out that several researchers found that when forming search statements, end-users did not understand the basic concepts of term and concept identification, the logic of Boolean operators, and how to limit their searchers.

Chen (1992) surveyed 104 graduate students and 91 undergraduates who were all non-repeat end-users. Chen examined the problems they encountered while conducting searches of bibliographic databases. In general, more of the graduate students did advance planning for their search strategies than undergraduate students. Only 18% of the total group took the university's end-user workshops and only 7% of the total group used Boolean logic to formulate their search statements.

In a review of the literature regarding end-user searching of bibliographic databases, Mischo and Lee (1987) concluded that for many end-users, applying Boolean logic operators was the most difficult aspect of retrieval and that often many end-users are not fully aware of the application of Boolean logic as an effective online search strategy. Consequently, many end-users are not performing effective searches.

Barbuto and Cevallos (1991) studied the search strategies utilized by 205 graduate and undergraduate students using predominantly ERIC, andPsycLIT databases at Hofstra University. They found that few repeat searchers used the thesaurus, most searchers did not understand the difference between descriptor and keyword searching, and few searchers attempted to limit their searches even though this advanced searching strategy was taught in their introductory session on utilizing the OPAC's.

Siegrfied , Bates, and Wilde (1993) found that post-graduate scholars using the DIALOG databases tended to use simple, one-word search terms and little or no Boolean logic after receiving one day's training. Further, they found that these scholars were satisfied enough with their results to continue to use this resource, but they did not search with the enthusiasm "of a scholar who has

just discovered a rich new resource" (p. 288). Their findings suggest that even at the post-graduate level, the effective use of Boolean logic is not overwhelming.

Bibliographic Databases: End-user Success and Satisfaction

A great deal of research into end-user success and satisfaction has been done on the increasing number of bibliographic databases installed at most major universities and colleges across North America. These studies measure end-user success and satisfaction when performing simple and advanced search strategies on bibliographic databases, either on-line or on-disk. Little attention has been given to studying these variables with the WWW databases as a search platform.

Faries (1992) surveyed 535 undergraduate, graduate and faculty/staff about their use of the Wilson-indexes, ERIC, PsycLIT, and Dissertation Abstracts International at Pennsylvania State University. Faries found several trends when considering the end-users by class status. The largest percentage of end-users were Juniors and seniors, representing 56% of the end-users. This group was followed by master's students, doctoral students, freshmen and sophomores, then faculty and staff representing the smallest group of end-users at 2%. Fifty-six percent of the respondents indicated they were satisfied with their search results. Eighty-six percent felt these databases were easy to use with 97% saying they would use them again. Only 48% planned their search in advance with most of these being graduate students. By class status, nearly all groups found instructional sheets useful, with doctoral students and freshmen and sophomores registering the highest rate of satisfaction.

A study of trained and untrained end-users by Jackson-Brown and

Pershing (1993) found that when using ERIC and PsycLIT databases the trained end-users expressed greater levels of satisfaction with search results than end users with no training. Education undergraduates were completely satisfied with their searches 77% of the time and partially satisfied 14% of the time. Only 5 of the 256 students surveyed indicated they would not search using ERIC or PsycLIT again.

Misperceptions of End-users

Studies have shown that end-users perception of success is not always an accurate indication of their actual success. Ankeny (1991) conducted two survey's of end-users of the OPAC's at Ohio State's University Business Library. The first survey of 190 end-users involved a yes-no response to the question: "Did you obtain the information you wanted?" (p. 354). Responses to this question indicated that 78% of the end-users felt their searches were successful. However, in his second survey of 600 end-users, stricter guidelines for success and a five-point Likert rating scale (the Wisconsin-Ohio Reference Evaluation Program) were used in determining overall end-user success. This time end-users felt that only 39% of their searches were successful. Ankeny concludes that evidence is accumulating that perceived success rates of end-user searches are quite low with 40% being a common level in several studies.

Studies have also shown that end-users have higher levels of satisfaction than actual success. Mischo and Lee (1987) conducted a major review of the literature regarding end users and information systems and found that when using bibliographic databases, end-users indicated an overwhelming satisfaction with searches, while an analysis of their search results shows that end -users are not performing particularly effective searches.

Reese (1988) measured end-users success and satisfaction when using two CD-ROM retrieval systems at Brookdale Community College. Undergraduate students were subjectively measured for satisfaction using a survey, and objectively measured for success by comparing their search results to those in a master guide. Like many other researchers she also found a contradiction between end-users satisfaction and success levels: End-users who had unsuccessful searches on the InfoTrac bibliographic database felt their searches had actually been satisfactory. The findings of Ankeny (1991) also support the contrasting results obtained when using subjective measures for satisfaction and success of end-users. In a survey of 600 end-users, 76% reported being satisfied with the OPAC's at Ohio State University Business Library while only 47% reported their searches as successful when using a three-criteria measure of success. Ankeny concludes that high levels of reported end-user satisfaction with computerized searches often do not reflect true success rates.

Lepoer and Mularski (1989) surveyed 65 end-users of the MEDLINE compact disk at Ohio State University. Their findings revealed that most of the end-users seemed to be satisfied with the availability of the system even though very few users were able to formulate totally efficient search statements due to an absence of important information or a lack of training and/or experience. Interestingly, Kinzie (1990) has shown that the end-users who perceive themselves as successful will have a higher levels of motivation to return to that situation, due to the promotion of their feelings of self-efficacy. In other words their initial satisfaction may be more important than their actual success in causing them to continue to utilize a particular system to accomplish

their learning goals.

WWW Databases Versus Bibliographic Databases: Search Features and Strategies

Bibliographic databases are organized hierarchically, whereas the WWW databases are organized, and searched by document title, URL, or content, or any combination of the three (Protherore & Wilson, 1994). Furthermore, WWW databases can differ remarkably in their approaches to indexing, searching and displaying results (Courtois, Baer, & Stark, 1995). Consequently different search strategies are often needed, with materials being searched in very different ways allowing for considerable potential to affect the end-users success and satisfaction. No studies were found in my search of the literature regarding end-user success and satisfaction in utilizing search strategies for WWW databases. Instead, research into end-user searching for the recently created WWW databases has focused mainly on comparing the different WWW databases in regards to their varying search features, and comparing these to bibliographic databases. As well, researchers have attempted to determine the most effective search strategies to effectively use with the different search engine features (Courtois, 1996; Courtois, Baer, & Stark, 1995; Zorn, Emanoil, Marshall and Panek,1996)

Search Engine Features: Past

Tenopir (1993) stated that:

> most of today's online systems and many CD-ROM systems operate with essentially the same software developed for the first online systems twenty years ago.... The major systems still reflect first-generation search techniques. They rely on exact match Boolean logic, structured

> commands or menu choices, and convoluted input syntax, features that may be advantageous to experienced searchers...but unsatisfactory for end user systems. (p.67)

Search Engine Features: Present

Bibliographic databases such as those provided by DIALOG and SilverPlatter share many similar features, however WWW databases differ remarkably in their approaches to indexing, searching, and displaying results. Some WWW databases accommodate Boolean operators, however many use relevancy ranking instead (Courtois, Baer, & Stark, 1995). Bibliographic databases rely on manual indexing and abstracting procedures to add records to their database. Many WWW databases rely on automated means to identify WWW pages and other Internet resources for indexing and addition to their databases. These automated programs or robots are termed spiders, crawlers, wanderers and worms. They crawl about the web indexing web sites by title, uniform resource locators (URLs), words in each document in a web site, or by any combinations of these (Eagan & Bender, 1996). The full-text indexing of web pages, including indexing of embedded links, creates huge databases of web sites that have hundreds of duplicate entries, resulting in large numbers of duplicate hits (Zorn, Emanoil, & Marshall, 1996). These automatically built indexes often rely on keyword searching as well as relevancy ranking, this poses a new set of information retrieval challenges as compared to past bibliographic based databases (Webster & Paul, 1996).

The appearance of innovative search features such as natural-language input, relevancy ranking, and automatic thesaurus features are now appearing in the newer search engines (Tenopir, 1993). Courtois (1996) describes

concept searching, a recent feature added to the Excite search engine. Concept searching broadens the search by generating terms related to the search term(s). Related terms are identified through a statistical analysis of the content of the documents then searched in addition to the original search term(s). However as Courtois points out, end-users would benefit more from search tools that refine and narrow a search, rather than broaden it. Zorn, Emanoil, Marshall and Panek (1996), and Tillotson (1995) also argue the need for narrowing basic keyword retrieval due to the increasingly large retrieval sets found in most databases.

Other search features as defined by Proceviat (1996) include proximity operators, stemming, and wildcard operators. Proximity operators such as NEAR, ADJACENT, and WITH determine how near the search terms must appear to each other. For example, entering the search terms blood NEAR pressure would cause the search engine to locate documents having these terms within ten words of each other. The maximum word distance between the search terms varies between search engines. Stemming takes the root stem of each query word and searches for all words that begin with that stem. For example, entering Singapore will also generate hits on single, sing, and singer. Wildcard operators are used to search for multiple forms of the search term. For example medic* will also search for medicine, medical, medicinal, and any other words containing medic. You can also position wildcard operators at the beginning, middle, or end of a query word, as well as combine them within a word ("Personal Library Software," 1995).

Another newcomer to search engines is natural language input. Tenopir and Cahn (1994) compared two databases offering (somewhat) natural

language input and describe this feature as requiring "no need for commands or logical operators" (p. 31), and that natural language input is often combined with probabilistic retrieval techniques to provide relevance ranking. Savoy (1994) explains relevancy weighting, a feature now found in many WWW databases. This search feature involves "representing documents by weighted index term vectors and by their relationships with others" (p. 532), allowing the end-user to evaluate the relative value of each hit from the database. In other words, relevance ranking arranges a set of retrieved records based on a measurement of similarity between your query and the content of each record so that those most likely to be relevant to your request are shown to you first. A benefit of using relevance ranking is that the end-user is relieved of having to use Boolean operators to construct a complex query, instead they can enter natural language queries. It does not matter how many records are retrieved, as long as you know that the best information is likely to be found in the first few hits with the highest relevancies ("Personal Library Software," 1995). Conversely, Savoy suggests that relevancy weighting is not a search feature designed to replace Boolean logic but to complement it, and that when relevancy weighting is combined with Boolean logic a powerful search system results. Relevancy weighting is seen increasingly in more WWW databases's, as an alternative to Boolean logic (Courtois, Baer, & Stark, 1995). Savoy (1994) believes that the commercial dominance of Boolean retrieval systems will continue and future efforts for improved search tools and strategies will continue in that direction.

Boolean Logic Versus Relevance Ranking

Tenopir and Cahn (1994) compared Boolean logic and relevance

ranking using two new bibliographic database search engines, both offering natural language search techniques. Six questions were searched on each of the four search systems. Natural language input combined with relevancy ranking had an average precision of 56% compared to 61% for Boolean, on the DIALOG database while NEXIS FREESTYLE's database's average precision was 53% for natural language input combined with relevancy ranking compared to 64% for NEXIS Boolean. They do however point out that the better overall precision with Boolean should be contrasted with the greater number of total documents retrieved through relevance searching. Tenopir and Cahn recommend that relevance searching should be used when: doing a subject search, searching full-text databases or databases with lengthy abstracts, when a Boolean search is too broad and retrieves too many items or is too precisely specified and retrieves too few items. Boolean searching should be used when: you are looking for a known item or known citation, you want everything by a particular author, non-subject fields are an important part of your search, or your search has concepts that are of equal weight and you want everything on the topic. Tenopir and Cahn conclude that both methods are powerful search techniques, with neither one offering strong advantages over the other. Furthermore, although Boolean has the advantage of over twenty years of testing in real world searching, relevance searching as the newcomer has many enhancements yet to come and may soon be the most effective search feature.

There does appear to be value in continuing to focus on Boolean logic as an effective search strategy for both database types even with the rapid introduction of new search features on the WWW databases.

Boolean Logic on the WWW

Another important difference between WWW's and bibliographic databases is the ability of end-users of bibliographic databases to use a "building block" strategy. The searcher breaks the query down into its distinct conceptual elements, or building blocks. Each building block is entered in a separate statement, then all the blocks are combined in a single, final statement using combinations of Boolean operators (Siegfried,Bates, & Wilde, 1993). This allows the end-user to keep the distinct concepts clearly in mind and reduces confusion with using Boolean logic. Zorn, Emanoil, Marshall & Panek (1996) suggest that even experienced researchers prefer to split concepts and operators into multiple search statements. Unfortunately, WWW databases do not provide for the reuse of previously numbered search statements or sets. The entire search strategy must be entered in one statement, unlike OPAC's and online periodical indexing tools (Courtois, Baer & Stark, 1995; Zorn, Emanoil, Marshall & Panek, 1996; Webster and Paul, 1996). This would suggest that using Boolean logic as a search strategy on WWW databases may seem easier but prove to be more difficult and less effective than on a bibliographic database due to the loss of the building block strategy. Further research into this area is needed.

Zorn, Emanoil, Marshall & Panek (1996) point out that although typical end-users may have no trouble browsing and locating information on uncomplicated topics, they can not effectively construct complex search queries using sophisticated WWW search engines. Furthermore, they suggest that despite the recent and rapid proliferation and development of WWW databases, "little attention has been devoted to the advanced features professional

searchers and librarians have become accustomed to in other online information resources" (p.15). Features such as proximity operators, nested queries and search set manipulation are often overlooked by the novice searcher.

The Need for Teaching Electronic Search Strategies

New technologies have created multimedia information resources that provide students with faster and easier access to potentially richer bodies of information than any single medium resource in the past. As a result, information skills such as finding, selecting, and extracting have become even more critical. Furthermore, students in today's schools are being assigned independent research tasks that require them to locate, gather, synthesize, and summarize information from one or more information resources containing large, and sometimes overwhelming amounts of information. Often these tasks are poorly-defined, requiring the learners to utilize resources that have not been properly designed to meet their actual information needs (Small & Ferreira, 1994). Moore and St. George (1991) echo these beliefs; "children as young as eleven years are often assumed to have many of the skills needed for the completion of independent research projects...the guidance provided from some children is likely to be inadequate" (p. 162).

Further enhancing the difficulty of students as information seekers is the rapid growth of the Internet into a complex, evolving information resource. Quartermann and Carl-Mitchell (as cited in Harris,1996) estimate that the Internet has been growing at a rate of 80%-100% per year. In a study comparing the effectiveness of seven WWW search engines, Venditto (1996) found that all of the engines delivered a high proportion of irrelevant information

when challenged with anything beyond a simple search on a well-represented topic. This also suggests the need for effective search strategies to help reduce the amount of irrelevant information encountered. Harris (1996) suggests that our students are becoming "Information Age hunters and gatherers in cyberspace, sharing news of the richest locations by exchanging addresses and URLs with members of your virtual clans. Yet it is here, at the point of information access, that many current knowledge creation efforts falter" (p. 36).

It is becoming increasingly apparent that among the life skills students are going to need as they head towards the twenty-first century is the ability to manage the ever-expanding amount of information they are encountering. High school is the right time for these students to learn how to do this (Ala & Cerabona, 1992). To successfully do this our students need to effectively utilize the new information sources, including the WWW databases. The ability to analyze problem statements, and adopt problem-solving strategies in constructing search statements is essential. Teachers need to give more time and attention to teaching students advanced searching techniques including the use of synonyms, Boolean operators, and truncation of search terms (Bellardo, 1985).

There is clearly a need for the teaching of electronic searches for the WWW databases which are increasing in size daily. Oley (1989) suggests that, "The increase in electronic storage of information indicates that information retrieval skills and an appreciation of database maintenance will become increasingly more relevant for students at all levels" (p.590). Oley points to the increasing numbers of end-users who are seeking training in online search techniques to support their information needs directly.

There is no limit to the number of databases and amount of information that students have access to. It is important that students realize they can find specific information without being buried in a data avalanche. To do this they must learn how to conduct an effective search using Boolean logic as a key tool (Ala & Cerabona, 1992). Chen (1993) agrees, stating: " For productive searches, students must be able to read search problems or statements, extract key concepts, use appropriate terms to express the concepts" (p. 38).

How and When to Teach Search Strategies

Numerous researchers have considered the value of teaching search skills to end-users with a focus on designing effective models of instruction which involve critical thinking. Stripling and Pitts (1988) developed a ten-step model for conducting research as a critical thinking process. A focus of their model is to help the students acquire a thinking frame. Ala and Cerabona (1992) further believe that the problem solving techniques used in a Boolean search need to employ critical thinking skills. They also recommend that teaching Boolean search strategies should begin at the high school level. Essential to Stripling and Pitts' model is the presearch phase that requires students to create effective search statements before going online.

To help with the presearch phase many researchers recommend using written worksheets which allow the students to plan their strategies before going online (Nahl & Harada, 1996; Stripling & Pitts, 1988). Presearch worksheets allow students to create effective search statements with some thought to modifications while making logical combinations more explicit (Stripling & Pitts, 1988). Ensor (1992) surveyed college students and faculty on their knowledge of keyword and Boolean logic searching. Ensor found that

end-users who "were aware of library handouts/announcements as a keyword instruction method gave significantly better responses... on nine of ten statements of keyword knowledge" (p. 69). A formal search strategy session followed by the opportunity to create search statements in writing before going on-line is the best way to teach twenty-five to thirty people the necessary tools they need to become successful searchers, and ensure logical, well thought out search strategies. (Leverence, 1994).

Conversely Ala and Cerabona (1992) believe that guided practice using the electronic sources available in the school library is an excellent method for teaching students how to conduct a Boolean search. However, this is not always feasible with large class sizes, a limited number of online computers and limited access to those computers. Steffey & Meyer (1989) conducted a study of 611 end-users of CD-ROM's found in the three libraries at Vanderbilt University. They found that faculty preferred to lean from flip-charts and manuals located near the workstations while undergraduates made less use of the self teaching methods and relied more on staff and the classes given by the staff at the individual libraries. Those who had classroom instruction reported a higher degree of satisfaction with the number of citations retrieved and placed a greater value on their results. Ala and Cerabona also suggest that following a formal lesson, students need a hands-on experience. This is a more realistic option for many schools since it can be done using small groups and a limited number of computers.

There are differing opinions on the best method of instruction of search strategies. Certainly there is no one right answer, each instructional situation is different requiring a unique solution. However, researchers do agree that

hands on application of learned search strategies is essential in producing realistic and effective learning.

CHAPTER III

Methodology

Introduction

This study examined the effect of differing instructional lessons on the success and satisfaction of senior high school students searching the WWW's Excite database. The instructional content involved keyword selection and Boolean logic search strategies. More specifically, the students received instruction on either keyword selection or keyword selection plus Boolean logic as compared to a control group that received no instruction on search strategies. This study employed an experimental approach to determine the effect of differing search strategy instructions on end-user search strategy knowledge levels, search statement construction, search success, and satisfaction when using a WWW database that uses Boolean logic, and relevancy ranking together. Random assignment was done for all three groups with each completing four posttests measuring keyword selection and Boolean knowledge levels, success in constructing search statements, success in finding topic related documents, and search satisfaction. The methodology is partly based on research done by Nahl and Harada (1996), Poohkay (1994), and Reese (1988).

Hypotheses

It was hypothesized that:

1. Subjects receiving instruction on keyword selection plus Boolean logic search techniques would score higher on a posttest of keyword/Boolean logic knowledge than those receiving instruction on keyword selection alone, as well as those receiving no instruction at all on database search techniques.

2. Subjects receiving instruction on keyword selection plus Boolean logic search techniques will score higher on their posttest of statement construction than those receiving instruction on keyword selection alone, as well as those receiving no instruction on database search techniques when searching the Excite database. 3. Subjects receiving instruction on keyword selection plus Boolean logic search techniques would experience higher levels of searcher success in finding topic related documents using the Excite database as compared to those receiving instruction on keyword selection alone, as well as those receiving no instruction on database search techniques.

4. Subjects receiving instruction on keyword selection plus Boolean logic search techniques would experience higher levels of searcher satisfaction with using the Excite database as compared to those receiving instruction on keyword selection alone, as well as those receiving no instruction on database search techniques

5. Gender will not influence the effects of the instructional treatment upon searcher success scores.

6. Gender will not influence the effects of the instructional treatment upon searcher satisfaction scores.

7. Keyword/Boolean knowledge levels will positively correlate with statement construction scores. Subjects with higher levels of keyword/Boolean knowledge will produce more search statements that correctly use keywords and Boolean logic than subjects with low levels of keyword/Boolean knowledge.

8. Keyword/Boolean knowledge levels will positively correlate with searcher success scores. Subjects with higher levels of keyword/Boolean

knowledge will achieve higher levels of success in finding topic related documents than subjects with low levels of keyword/Boolean knowledge.

9. Statement construction scores will positively correlate with searcher success levels. Subjects constructing search statements with higher levels of correctly used keywords and Boolean logic will experience higher levels of success in finding topic related documents than subjects constructing search statements with fewer correctly used keywords and Boolean logic.

A summary of the mean calculations to be performed for this study is given in Table 1, Figure 1, and Figure 2.

Table 1

Type of Instructional Treatment as a Function of Mean Posttest Scores for Knowledge, Statement Construction, Searcher Success, and Satisfaction

	Posttests		
Treatment Satisfaction	Knowledge	Statement Construction	Searcher Success
1. No instruction	$\underline{M}_{1.k}$	$\underline{M}_{1.c}$	$\underline{M}_{1.s}$ $\underline{M}_{1.a}$
2. Keywords	$\underline{M}_{2.k}$	$\underline{M}_{2.c}$	$\underline{M}_{2.s}$ $\underline{M}_{2.a}$
3. Keywords + Boolean	$\underline{M}_{3.k}$	$\underline{M}_{3.c}$	$\underline{M}_{3.s}$ $\underline{M}_{3.a}$

		Treatment			
		1 no instruction	2 keyword	3 keyword Boolean	
Searcher Success	Male	$\underline{M}_{1.s.m}$	$\underline{M}_{2.s.m}$	$\underline{M}_{3.s.m}$	$\underline{M}_{.s.m}$
	Female	$\underline{M}_{1.s.f}$	$\underline{M}_{2.s.f}$	$\underline{M}_{3.s.f}$	$\underline{M}_{.s.f}$
		$\underline{M}_{1.s}$	$\underline{M}_{2.s}$	$\underline{M}_{3.s}$	$\underline{M}_{.s.}$

Figure 1. Treatment and mean searcher success level by gender.

		Treatment			
		1 no instruction	2 keyword	3 keyword Boolean	
Searcher Satisfaction	Male	$\underline{M}_{1.a.m}$	$\underline{M}_{2.a.m}$	$\underline{M}_{3.a.m}$	$\underline{M}_{.a.m}$
	Female	$\underline{M}_{1.a.f}$	$\underline{M}_{2.a.f}$	$\underline{M}_{3.a.f}$	$\underline{M}_{.a.f}$
		$\underline{M}_{1.a}$	$\underline{M}_{2.a}$	$\underline{M}_{3.a}$	$\underline{M}_{.a.}$

Figure 2. Treatment and mean searcher satisfaction level by gender.

The following conditions were established for each of the treatments:

A. Treatment 1 was the control group, receiving no instruction in search strategies. Subjects in this group used a booklet that contained an essay about searching, but did not have any specific instructions on Boolean logic, keyword selection, or any other search strategies. As well, a two page worksheet was included.

B. Treatment 2 used a booklet that contained instructions on keyword selection using decoding strategies, part of the essay given to the control group, and a two page work sheet.

C. Treatment 3 used a booklet that contained instructions on keyword selection using encoding strategies with Boolean logic, in addition to a two page work sheet.

Upon completion of the worksheets, subjects in each group were given the correct answers for their specific booklet to allow for self correction.

The hypotheses that were examined in detail were:

1. Subjects who receive the instructional treatment that involves keyword selection plus Boolean logic will obtain higher keyword and Boolean logic knowledge level scores than those who receive the other treatments.

Y_K = knowledge, $H1.1$: (A) $\underline{M}3.k > \underline{M}2.k$, $H1.1$: (B) $\underline{M}3.k > \underline{M}1.k$

2. Subjects who receive the instructional treatment that involves keyword selection plus Boolean logic will obtain higher statement construction scores than those who receive the other treatments.

Y_C = statement construction, $H2.1$: (A) $\underline{M}3.c > \underline{M}2.c$, $H2.1$: (B) $\underline{M}3.c > \underline{M}1.c$

3. Subjects who receive the instructional treatment that involves keyword selection plus Boolean logic will obtain higher success in finding topic related documents than those who receive the other treatments.

Y_S = searcher success, $H3.1$: (A) $\underline{M}3.s > \underline{M}2.s$, $H3.1$: (B) $\underline{M}3.s > \underline{M}1.s$

4. Subjects who receive the instructional treatment that involves keyword selection plus Boolean logic will obtain higher satisfaction scores than those who receive the other treatments.

Y_a = searcher satisfaction, H4.1: (A) $\underline{M}_{3.a} > \underline{M}_{2.a}$, H4.1: (B) $\underline{M}_{3.a} > \underline{M}_{1.a}$

5. Males and females will score equally across the three treatment groups for searcher success.

H5: $\underline{M}_{.s.f} = \underline{M}_{.s.m}$

6. Males and females will score equally across the three treatment groups for searcher satisfaction

H6: $\underline{M}_{.a.f} = \underline{M}_{.a.m}$

7. Keyword/Boolean knowledge levels will positively correlate with statement construction scores.

H7: $\underline{r}_{k.c} > 0$

8. Keyword/Boolean knowledge levels will positively correlate with searcher success scores.

H8: $\underline{r}_{k.s} > 0$

9. Statement construction scores will positively correlate with searcher success levels.

H9: $\underline{r}_{c.s} > 0$

Independent Variables

The independent variables in this study were the instructional treatment or type of search strategy instruction given, and gender. Three levels of search instruction were given, as follows:

1. The control group received no relevant material on search strategies, and instead was given general information on the Internet with no explicit instructions on search strategies, and a two page worksheet.

2. The second group was given instruction on keyword selection using decoding strategies, and a two page worksheet.

3. The third group was given instruction on keyword selection using decoding strategies, as well as instruction on encoding strategies using Boolean logic to form their search statements, and a two page worksheet.

Two levels of subject gender were categorized

1. Male
2. Female

All three groups received their instructions in work booklet form.

Dependent Variables

Four dependent variables were measured in this study, keyword/Boolean logic knowledge, statement construction, searcher success, and searcher satisfaction. These were determined as follows:

1. Keyword/Boolean logic knowledge was measured using a twenty item short answer and multiple choice test that measured both encoding and decoding skills used in keyword selection, and Boolean logic application. A score of twenty was the maximum attainable by correctly answering all twenty items, while zero meant a subject correctly answered none of the twenty items.

2. Statement construction was measured by analyzing how effectively the subject creates their Excite database search statements. Factors considered in marking for correctness included the proper selection of keywords, and the application of Boolean logic. The final score was expressed as the proportion of search statements that correctly used keywords, and Boolean logic with zero being equal to no use of keywords or Boolean logic and six being equal to all search statements for each of the three searches

correctly using keywords and Boolean logic.

3. Searcher success was determined by totalling the number of topic related documents retrieved for each of the three separate searches on the Excite database, then averaging them. The final score was expressed as the number of subject identified sites that matched those chosen by four experienced database searchers with zero being a result of having no matching sites found and fifteen being equal to having identified five sites as matching those on the previously chosen list for each of the three topic searches.

4. Searcher satisfaction was determined using a twenty item likert-type scale, ranging from one (strongly disagree) to five (strongly agree) completed by the subject after the three searches were done. An overall percentage of searcher satisfaction was determined by summing their twenty scores with one hundred being equal to strongly satisfied in all areas and twenty representing strongly dissatisfied.

Subjects

Grade ten, eleven, and twelve students from a Senior high school in Alberta were used as subjects for this study. These high school grade levels were chosen for three reasons: (a) Increasingly, this age group is expected to effectively search the WWW as a potential source of information (Oley,1989), (b) previous researchers (Neuman,1995; Solomon, 1993; Ala & Cerabona,1992)) have suggested that most elementary age students lack the cognitive skills required to use Boolean logic effectively and that high school students are intellectually ready and needing this instruction, and (c) this age group has more access to the WWW as an information resource than younger grade levels.

The subjects were all registered and participating in regular science or social studies classes at the time of the study. Six classes of students were used as subjects. Over the two day period of instruction and testing 7 of the 132 students (5 %) did not complete the study due to absence from school that day bringing the total to 125. Of these subjects, 54 % (n = 68) were male and 46 % (n = 57) were female. The subjects were asked to volunteer for this study as a part of their course work, but not for extra credit. No students chose to opt out at any point during the study.

Subjects were informed that participation would involve a preliminary survey requiring no more than five minutes to complete, followed by two sixty minute class periods of treatment and testing. Subjects were also informed that they would be randomly assigned to one of three treatment groups. They were further informed about each of the studies separate components including; survey of previous computer experience, instruction on search strategies, posttest of keyword/Boolean logic knowledge, searching the Excite database, and posttests on statement construction, searcher success and searcher satisfaction. All subjects were required to sign a consent form (see Appendix A) stating that they agreed to participate in the study and were fully informed of all of the above information, and that their participation in this study was completely voluntary with the option to cease participating at any time.

Treatment Conditions

Survey of Previous Experience and Matching

Six classes of grade ten,eleven, and twelve students were purposely selected. All of the subjects were given a survey requesting information about their prior experience with computers, word processing, and electronic

searching. To ensure that equal levels of previous computer experience and gender occurred in each of the three treatment groups, subjects were placed by gender into one of two previous experience categories; high, or low as determined by the results of the initial survey. Subjects in each previous experience category were split into the two gender categories then randomly assigned from those four categories into one of the three treatment groups; no instruction, keyword selection, or keyword selection plus Boolean logic. This helped to ensure the treatment groups were balanced on gender and previous computer experience.

Subject Confidentiality

Subjects selected confidential identification numbers printed on adhesive labels which they used as identification labels for all four posttests collected in the study. Every attempt was made to maintain the confidentiality of these identification numbers throughout the study and the researcher had no way of identifying which group a subject belonged to from their identification number or which documents belonged to any particular student. After all posttests had been scored the confidential numbers were matched to student gender and treatment group to allow for analysis of the data.

Instruction Booklets

Subjects in each of the treatment groups were given topic specific work booklets consisting of two parts: a three page instruction section, followed by a two page worksheet. The booklets were identical in the appearance of the cover, thickness, and presentation format, varying only in instructional content. The control (no instruction) group's booklet contained an essay about searching on the Internet that provided no instruction or search strategies to aid

in searching the WWW. The key word groups three page search instruction section contained two pages on decoding strategies used in keyword selection, and a one page essay about searching the Internet. This was done to ensure they completed a comparable amount of work when compared to the other two group which had three pages of instruction. The keyword plus Boolean logic group received one page on keyword instruction as well as two pages of instruction on encoding strategies using Boolean logic concepts and operators.

Instruction

Subjects were given twenty minutes to complete the booklet. Prior to starting they were instructed verbally to follow all written instructions, and to complete every answer. Upon completion of their booklet, subjects were given the answers to the worksheet for self correction, allowing for a self check of their comprehension before writing the posttest. Subject's questions were answered privately between the instructor and that subject, purposefully excluding the rest of the classes attention.

Posttest of Keyword Selection and Boolean Knowledge

Following completion and self correction of the instructional booklets, subjects were given a twenty item test to measure their knowledge of keyword selection and Boolean logic. The quiz was designed to measure both decoding skills used in selecting key words as well as their knowledge and encoding skill in applying Boolean logic to construct search statements. The search statements were analyzed and scored blindly. The marker did not know who the posttest belonged to or which treatment group it came from.

Search Preparation

Subjects in all three treatment groups were then given a six page search booklet that included an introductory page with a practice section for recording search statements and URL's, and three separate pages for each of the three separate search topics with spaces to record their best search strategies, alternative search strategies, and the subsequent Uniform Resource Locations (URL's). The twenty item posttest of satisfaction was also included, forming the last two pages of the booklet. Subjects were given a total of five minutes to formulate one search statement for each of the three separate search topics, the booklets were then collected and returned at the start of the following class period.

Posttests on Success

At the start of the second session subjects were given their search statement booklets from the previous class, however, they were not given their keyword/Boolean knowledge posttest scores as this could potentially influence their subsequent posttest scores. Subjects then entered the computer lab where they were given fifteen minutes of instruction on how to access Excite's main search window, and utilize the basic search features including how to; follow a hypertext link to preview the information site then return to the search page, load up the next eleven to twenty search results, conduct consecutive searches using the same search window, and use the more like this feature. Subjects were told to search the entire web by selecting this option in the main search window if it was not already selected by default. Subjects were only encouraged to download a site for further preview if it appeared to be highly relevant to the topic and consequently had the potential to be in their list of the

most relevant sites. All subjects completed a practice search on black olives, and were asked to record this as a practice search statement as well as two URL's on the front of their booklet. These were checked by the researcher to ensure accuracy in completing this task before subjects proceeded to the actual searches.

The introduction to the software was followed by a thirty-five minute time period where subjects had to complete their three search tasks, recording any relevant URL's they found. This involved recording the URL's and relevancy percentages for any search topic related sites. Their results were marked using a predetermined list which contained the best sites previously found for each search topic by a team of four experienced database searchers, also using the Excite database.

Posttest on Satisfaction

At the completion of the four topic searches, subjects were given up to ten minutes to complete a twenty item likert-type posttest designed to measure their satisfaction with their searches. Questions were posed on a five point likert-type scale.

Research Design

Subjects were triplet matched based on previous computer experience, and randomly assigned to one of three treatment groups; no instruction (X_1), keyword selection (X_2), or keyword selection plus Boolean logic (X_3) (see Figure 3). A keyword/Boolean logic knowledge posttest was given (Y_k), after initial instruction. This was followed by posttests on statement construction (Y_c), searcher success using the Excite database (Y_s), and searcher satisfaction

using the Excite database (Y_a).

No R-S	triplet matched on previous computer experience and gender	R-A	X_0	Y_k	Y_c	Y_s	Y_a
		R-A	X_1	Y_k	Y_c	Y_s	Y_a
		R-A	X_2	Y_k	Y_c	Y_s	Y_a

Figure 3. Research design: Randomized, posttests only, control group.

Potential Threats to Internal Validity

Potentially confounding variables. The experimental design attempted to control several variables to prevent confounding the results of this study:

1. Instructional content of the three treatments was specific to searching the WWW, but varied on the content and amount of the instruction. To ensure that each of the three lessons required approximately the same amount of time for subjects to complete, and therefore give subjects equal feelings regarding the value of their treatment type, extra non-instructional material related to searching for information on the WWW was included in the treatments containing less treatment material.

2. The posttest on keyword/Boolean logic knowledge was given prior to subjects applying their search strategies with the Excite search engine to ensure that any differences in user success and satisfaction between the treatment groups could be shown to be a likely result of differences in the knowledge and skill levels obtained from the differing instructional treatments.

3. Posttest scores on the test of keyword/Boolean logic knowledge were not available for subjects to examine until the statement construction, searcher success and searcher satisfaction posttests were completed, as this could

potentially influence subject results on these measures.

4. Triplet matching was done for the variable of previous computer experience to ensure that subjects in the three groups had equal amounts of previous experience. This was done because this variable offers the greatest likelihood of potentially confounding the results.

5. The time of day the searches are conducted is a concern as WWW access and download times vary with fluctuating numbers of users. This could result in one group spending more time waiting to send and receive data to and from the search engine reducing the number of searches they conduct. Consequently, all three treatment groups were tested at the same time.

6. Development of the URL answer key for the searcher success posttest involved finding the best sites for each of the three search topics. This was done by four experienced searchers as closely as possible in time to the student searches to reduce the likelihood of the best sites disappearing or new, better ones replacing them due to the dynamic nature of the Excite database.

7. Other variables that could affect results were controlled by random assignment of subjects to the three treatment groups after matching on gender and previous computer experience.

Attempts to limit threats to internal validity. In choosing an experimental approach several potential threats to internal validity became apparent, all attempts were made to try and control them.

1. The John Henry effect occurs when members of a control group feel they are being neglected or misplaced as compared to those in the treatment group(s) . Consequently, control group subjects may alter their behaviour in an attempt to achieve the same results as the treatment group. In this study an

attempt to control this was done by giving pseudo-instructional materials to the control group and some pseudo-instructional materials to the key word group to ensure the subjects were occupied for the same duration of instruction, and felt they were receiving the same amount and quality of treatment as the keyword selection plus Boolean logic group. As well, all three treatment booklets had identical covers, and matched in general appearance.

2. Diffusion occurs when members from the control group acquire aspects of the treatment from a treatment group causing them to potentially be affected by the treatment as well. This could not be eliminated in this study, however an attempt to minimize it's effects was done by measuring the dependent variables as soon as possible after the treatments. Posttests were done either at the end of the first class of instruction (keyword/Boolean knowledge posttest) or during the subsequent class period which often occurred on the following day (statement construction, searcher success and searcher satisfaction posttests). As well subjects were asked not to discuss their instruction with other students from the class until all posttests had been completed.

3. Pretest test sensitization results when taking the pretest influences the effect of the treatment which in turn may influence results on the posttest. Posttest results may be due to a combination of the pretest and the treatment working together. This was purposely controlled in this study by not giving any pretests. In theory, pretests are not needed if true random assignment is used and the groups are greater than thirty subjects in number. Under these conditions one can assume all groups will be relatively equal on all characteristics. True random assignment of subjects to the treatment groups

was done in this study, after subjects were triplet paired on previous computer experience and gender. However having said this one could argue that the posttest of keyword/Boolean logic knowledge could act as a pretest to the statement construction posttest and the search success posttest. To try and limit this effect students were not given their scores or the correct answers to the keyword/Boolean logic knowledge posttest until the completion of the study. Furthermore this posttest was purposefully designed with questions which could not be used as instructional material by the students.

4. The effect of testing was also eliminated by not giving pretests that could have influenced posttest scores differently for any of the three groups.

5. Implementation threats occur when the quality or amount of implementation varies between the control and treatment groups. This was eliminated by using standardized written instructions and worksheets which were of comparable length and difficulty for each of the three treatment groups.

6. Data collector bias was guarded against for measuring statement construction, searcher success and keyword/Boolean knowledge posttests by using answer keys with previously determined objective answers. As well, all posttests were marked blindly using coded identification numbers.

Instrument Design

To implement this study, an initial survey of previous computer experience, instructional lessons for the three treatment groups, search topic sheets, and four posttests measuring keyword/Boolean knowledge level, statement construction, searcher success, and searcher satisfaction were designed. Material for the instructional lessons as well as the posttest of keyword/Boolean knowledge level was adapted from instructional booklets

and tests used by Nahl and Harada (1996), in their study of high school student's abilities to interpret and construct search statements. The statement construction posttest answer key was constructed following methods used by Nahl and Harada (1996) in evaluating encoding strategies used by high school students in constructing search statements. The methodology of the searcher success posttest was constructed following methods used by Reese (1987), however the actual design and content of the posttest was done by the researcher. The survey of previous computer experience was adapted from a similar survey conducted by Evans (1995).The searcher satisfaction posttest was adapted from satisfaction measures designed by Ankeny (1991), to measure end-user satisfaction when using on-line databases.

The Excite database/search engine was chosen over other WWW database/search engines for the following reasons; a clear and simple graphical user interface, the combination of Boolean logic operators and relevancy ranking, and a relatively large database to allow for easier discrimination between effective and ineffective searches in determining search success.

Survey of Previous Computer Experience

The survey of previous computer experience (see Appendix C) used a one page questionnaire containing a checklists for determining the subjects frequency of usage for various microcomputer applications. The questions were adapted from a similar survey conducted by Evans (1995) that had been pilot tested by twenty graduate students before being used in her study of end-user success and satisfaction with the ERIC database .

Instruction Booklets

Subjects in each of the treatment groups were given group specific work booklets consisting of two parts; a three page instruction section, followed by a two page worksheet. A copy of the instruction booklets given to each of the three groups has been included in Appendix B. Modifications were made to the original form of the booklets as designed by Nahl and Harada (1996).

The control (no instruction) groups booklet contained a three page essay about searching on the Internet. The essay provided context for the activity but lacked search instructions or strategies, serving as a placebo for effective search strategy instruction. The worksheets contained questions requiring recall of specific factual information from the essay to answer multiple choice and short answer questions.

The keyword groups three page search instruction section contained two pages of search instructions for identifying and selecting appropriate key words using encoding and decoding techniques. The third pages of instruction contained a shorter version of the same essay provided to the no instruction group. This was done to ensure they completed a comparable amount of work when compared to the other two treatment groups who had to complete three pages of instruction on searching.

The keyword plus Boolean logic group received the same first page on keyword instruction as the keyword group while the second and third pages involved instruction on using encoding strategies with Boolean logic concepts and operators.

Like the control group the keyword group and the keyword plus Boolean logic group were given two pages of worksheets related to their individual

topics of instruction. The question types included multiple choice and short answer as well.

Keyword/Boolean Logic Knowledge Posttest

Keyword/Boolean logic knowledge was measured using a twenty item short answer multiple choice posttest. See Appendix D for a copy of the posttest, and answer key. The test was adapted from a previously designed instrument created by Nahl and Harada (1996) that was used to measure encoding and decoding subskills involved in constructing search statements using keywords and Boolean logic. To measure decoding skills subjects were asked to extract keywords directly from a given natural language query. As well they were asked to identify the best keywords and alternate keywords from a natural language query. To measure encoding subjects had to construct search statements based on written topical queries. This task is more complex than decoding as it involves applying both keyword selection and Boolean logic skills simultaneously to create an integrated search statement involving multiple keywords . The search statements were analyzed and scored for correctness of keyword selection, correct application of Boolean logic, and the number of errors. Prior to the tests being written the answer key of acceptable term lists was developed with variable answers provided to guide the scoring of questions.

Statement Construction

Statement construction was measured by analyzing all of the subjects search statements recorded in their search booklets. Statements were analyzed for correct use of keywords, and Boolean logic, with two marks being rewarded if all statements on one topic contained both features. Part marks

were given for the percentage of statements on any one search that correctly used key words and Boolean knowledge. A sample answer key has been included in Appendix E.

Searcher Success

Searcher success was measured by having subjects record their URL's for each of their three search tasks. More specifically, this involved recording the sites which they felt provided the most relevant information of all the URL sites they previewed for each of the three search topics. Their results were marked using a predetermined list containing the previously identified sites that best related to that topic, as determined by a team of four experienced searchers. See Appendix F for the three search topics, the search statement recording sheets, and the experienced searcher generated URL lists.

Searcher success answer key. The predetermined list of sites for each of the three search topics was constructed by a team of four experienced database searchers, also using the Excite database. The experienced searchers were given the same topic requests as the subjects and asked to list what they believed were the ten most informative sites found on the Excite database for each of the four search topics. This was done as close in time as possible to the collection of subject data to ensure that none of these sites were lost or new more relevant ones added to the constantly changing Excite database. The four lists were then combined into one list containing the site titles and their corresponding URL's for each of the three topics.

Searcher Satisfaction

Searcher satisfaction was measured using an adapted version of the satisfaction questions used by Ankeny (1991) (See Appendix G). Upon

completion of the four search topics, subjects completed twenty posttest questions on their satisfaction with that particular search. The questions used a five point likert-type scale. These instruments were designed to measure the subjects personal feelings of satisfaction and self efficacy in regards to their search skills and success when using the Excite database as a search tool. The statements included both positive and negative statements towards search statement effectiveness, search strategy effectiveness, ease of use, amount of information retrieved, and relevancy of information retrieved.

Data Collection

Survey of Previous Computer Experience

The initial survey of previous computer experience was administered using a paper and pencil survey one class period prior to the instructional treatment. Subjects were asked to complete the one page questionnaire which included a checklist on the subjects frequency of usage for various microcomputer applications. Administration time was five minutes. All scores for each subject were manually summed. The subjects scoring in the top one-half were categorized as having high levels of previous computer experience while those subjects scoring in the bottom one-half were categorized as having low levels of previous computer experience.

Keyword/Boolean Logic Knowledge Posttest

Students completed the twenty item short answer and multiple choice posttest on Keyword/Boolean logic knowledge after completing the first two sections of their instruction booklet. The search statements were analyzed and scored for correctness of term selection, correct application of Boolean logic, and the number of errors made. Acceptable term lists were developed to guide

the scoring of questions with variable answers prior to the tests being written. Subjects were given one point for each correct answer. No points were given for incorrect answers. All tests were scored blindly by the researcher with secret identification codes being used to represent each subject. Total scores were calculated for each subject and recorded. Only after the subjects had completed the success and satisfaction posttests were they given the opportunity to view their scores. This was done because a subject's knowledge of their score could potentially influence their performance on any of the three remaining posttests.

Statement Construction Posttest

Each search statement used in the Excite search window was manually recorded by the subject while they waited for the results list to download from the Excite server. The statements were marked manually by the researcher for correctness of keyword selection and Boolean logic.

Searcher Success Posttest

End-user success was measured by having subjects manually record the most relevant URL's on a worksheet containing the search topic. Their results were marked manually using a predetermined list containing the best sites, as determined by four experienced searchers.

Subject chosen sites found on the answer key were scored according to the number of topic related documents they found that were on the answer key. Any URL's not found on the answer key scored zero points. The subjects total score for the three searches was summed to create an overall score. The maximum searcher success score is fifteen for selecting five correct sites for each of the three topics.

Searcher Satisfaction Posttest

Upon completion of the three searches, search subjects completed twenty posttest questions measuring their satisfaction with their searches. The questions consisted of twenty, five point, likert-type scales. A score of five represents very satisfied while a score of one represents very dissatisfied. The twenty scores were averaged, and converted into a percentage. Theoretically, the maximum satisfaction score is 100% satisfaction or five out of five on all twenty questions.

Data Analysis

To establish the reliability of the data collection instruments, reliability analysis of the posttests was conducted. No pretests were conducted, consequently test/retest reliability could not be determined for any of the instruments. Instead, reliabilities were determined using the KR20 formula for the keyword/Boolean logic posttest, and Cronbach's alpha for the statement construction posttest, and the satisfaction posttest. Inter-rater reliability was not determined for the answer key used in marking search success because of the different sites chosen by the four experienced searchers which made comparisons of rankings among similar sites unrealistic.

The survey of previous computer experience scores were divided equally into high, and low levels of previous experience using the median percentile score to determine the high and low groupings.

In testing the first hypothesis, means and standard deviations were calculated and examined for the keyword selection/Boolean knowledge scores obtained by each of the three treatment groups. An analysis of variance of the posttest scores to determine variation within and between each of the treatment

groups was conducted. Scheffe F-tests were conducted accordingly to determine if the differences between any of the posttest mean pairs were significant ($p \leq .05$). The same approach was used to analyze the posttest scores for statement construction, searcher success, and searcher satisfaction in testing the second, third, and fourth hypotheses.

To test the fifth hypothesis regarding the searcher success, scores of subjects receiving the three treatments grouped by gender, a two-factor analysis of variance was conducted to examine if the difference between the means of the gender pairs within each of the treatment groups was significant. The means and standard deviations of each gender pair within each treatment were also examined.

In testing the sixth hypothesis regarding the searcher satisfaction scores of subjects receiving the three treatments, grouped by gender, a two-factor analysis of variance was conducted to examine if the difference between the means of the gender pairs within each of the treatment groups was significant. The means and standard deviations of each gender pair within each treatment were also examined.

To test the seventh, eighth, and ninth hypotheses, scatter plots were examined for linear and non-linear relationships then simple linear regressions were calculated, along with one-way analyses of variance for each of the dependant variable pairs. The dependant variable pair relationships examined included; (a) keyword/Boolean knowledge scores and statement construction scores, (b) keyword/Boolean knowledge scores and searcher success scores, and (c) statement construction scores and searcher success scores.

CHAPTER IV

Results

This chapter presents the findings of this study. First, reliability of the measurement instruments, including the keyword/Boolean logic posttest, statement construction posttest and satisfaction posttest are established. Statistical analyses relating to each hypothesis are presented. For this research study, any statistic with a probability of occurrence below 95% ($p \leq .05$) was considered significant.

Subject data

Detailed demographic information for each subject was not required for the purpose of this study. All subjects were high school students enrolled in regular stream social studies or science classes in grades ten, eleven or twelve. A total of 132 students in six classes volunteered for the study; 7 of these (5 %) did not complete the study due to absence from school that day bringing the total to 125. Of these subjects, 54 % ($n = 68$) were male and 46 % ($n = 57$) were female.

Reliability

The reliability of the data collection instruments must be addressed because of the quantitative nature of this study and the subsequent statistical analysis involving the measures obtained from those instruments. Furthermore, the Boolean knowledge, satisfaction, and statement construction posttests used were either modified from others or created for the first time for use in this study. Consequently, the reliability of these three posttests needs to be established. The reliability of the instrument used to measure searcher success could not be determined due to the nature of the instrument.

Keyword/Boolean Logic Knowledge Posttest

The subjects' search statements were analyzed and scored for correctness of term selection, correct application of Boolean logic and the number and type of errors. Acceptable term lists were developed to guide scoring for questions with variable answers. The tests were scored blindly. The marker did not know who the test belonged to or which treatment group it came from.

One mark was awarded to a subject for a correct answer, and no marks were awarded for an incorrect answer. The total number of marks possible for the posttest was twenty.

An item reliability analysis was conducted for the posttest scores using the Kuder-Richardson 20 formula. The results are presented in Table 2. The KR20 reliability for this measure was found to be high ($r = 0.90$), suggesting that this measure is a reliable data collection instrument.

Table 2

Keyword/Boolean knowledge Posttest Reliability Analysis

Post Test Items	Mean	Std. Dev.	Cases
Item 01	0.45	0.50	125
Item 02	0.32	0.47	125
Item 03	0.70	0.46	125
Item 04	0.63	0.48	125
Item 05	0.42	0.50	125
Item 06	0.98	0.15	125
Item 07	0.56	0.50	125
Item 08	0.57	0.50	125
Item 09	0.99	0.09	125
Item 10	0.68	0.47	125
Item 11	0.99	0.09	125
Item 12	0.72	0.45	125
Item 13	0.73	0.45	125
Item 14	0.74	0.44	125
Item 15	0.35	0.48	125
Item 16	0.29	0.46	125
Item 17	0.36	0.48	125
Item 18	0.27	0.45	125
Item 19	0.38	0.49	125
Item 20	0.29	0.46	125

Note: N = 125

Reliability Coefficient for 20 items - KR20 = 0.90

Statement Construction Posttest

Subjects manually recorded all search statements entered into the Excite database for each of the three search topics. Statements were analyzed for the proportion of correctly used keywords and correctly utilized Boolean operators and parentheses. If all search statements entered for one search topic correctly used key words and Boolean operators the subject received a score of one for

each search. The maximum total score for all three searches for any one subject was six.

An item analysis was conducted on the posttest scores using Cronbach's alpha test. The results of this reliability are presented in Table 3. An Alpha level of 0.85 categorizes this posttest as a reliable data collection instrument.

Table 3

Statement Construction Reliability Analysis - Scale (Cronbach's Alpha)

Post Test Items	Mean	Std. Dev.	Cases
Item 01	0.85	0.32	125
Item 02	0.41	0.47	125
Item 03	0.82	0.35	125
Item 04	0.41	0.47	125
Item 05	0.80	0.37	125
Item 06	0.44	0.48	125

Note: N = 125

Reliability Coefficient for 6 items - Alpha = 0.85

Satisfaction Posttest

Students completed a twenty item Likert-type survey to asses their attitude towards finding information using the Excite database and the WWW as an information seeking tool (see Appendix G). The five point scale ranged from a score of one to five with one equal to strongly disagree. Eight positive and twelve negative statements, were randomly interspersed throughout the instrument. An item analysis was conducted on the posttest scores using Cronbach's alpha test (see Table 4).

Table 4

Satisfaction Posttest Reliability Analysis - Scale (Cronbach's Alpha)

Post Test Items	Mean	Std. Dev.	Cases
Item 01	4.22	0.55	125
Item 02	3.82	0.65	125
Item 03	3.90	0.75	125
Item 04	3.50	1.01	125
Item 05	3.71	1.15	125
Item 06	2.49	1.05	125
Item 07	4.13	0.70	125
Item 08	3.80	0.90	125
Item 09	4.00	0.87	125
Item 10	3.36	1.01	125
Item 11	3.69	0.88	125
Item 12	3.76	0.77	125
Item 13	3.72	0.98	125
Item 14	3.65	0.83	125
Item 15	4.22	0.72	125
Item 16	3.86	0.64	125
Item 17	3.66	0.88	125
Item 18	3.34	1.12	125
Item 19	3.73	0.96	125
Item 20	3.28	1.04	125

Note: N = 125
Reliability Coefficient for 20 items - Alpha = 0.89

An Alpha level of 0.89 categorizes this posttest as a reliable data collection instrument.

To check for spurious relationships between the dependent variables a correlation matrix was generated. Correlations for all two pair combinations of dependent variables were included (see Table 5).

Table 5.

Correlations Between dependent Variable Pairs

dependent Variable	keyword/Boolean knowledge level	Satisfaction	Statement Construction	Success
keyword/Boolean knowledge level	1.00			
Satisfaction	0.06	1.00		
Statement Construction	0.54* (50.86)	0.07	1.00	
Success	0.02	0.22* (6.42)	0.16	1.00

Note: * $p < .05$; values enclosed in parentheses represent F ratios.

A moderate, positive and significant relationship was found between statement construction scores and keyword/Boolean knowledge levels (r = 0.54), while a weaker but significant, positive relationship was found between satisfaction and success scores (r= 0.22). These findings suggest that statement construction scores and keyword/Boolean knowledge levels may not be completely independent of each other and may actually be measuring closely related learner outcomes. As well, subjects with higher searcher success scores are more likely to to have higher levels of searcher satisfaction, suggesting that these variables may not be completely independent of each other as well.

Hypothesis One: Keyword/Boolean Knowledge

Hypothesis one predicted that subjects who receive the instructional treatment involving keyword selection plus Boolean logic will obtain higher keyword and Boolean logic knowledge level scores than subjects who receive the other treatments.

A two way analysis of variance was conducted on posttest scores using treatment and gender as factors to examine if significant differences between the mean posttest scores of each treatment group existed, and check for independent variable interactions. These results are presented in Table 6.

Table 6

Two Way Analysis of Variance for the Keyword/Boolean Knowledge Posttest

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Treatment (A)	2	2343.35	1171.68	171.86	0.00 *
Gender (B)	1	3.12	3.12	0.46	0.50
AB	2	53.56	26.78	3.93	0.02 *
Error	119	811.32	6.82		

* $p < .05$.

The analysis of variance for Treatment (A) means yielded an F ratio of 171.86 which is statistically significant. Although not hypothesized it is worth noting that he F probability of 0.02 for interaction indicates there is a significant treatment by gender interaction. Figure 4 presents the treatment by gender interaction for keyword/Boolean knowledge posttest scores. The treatment does not affect both genders equally across all three treatments. The males had significantly higher mean keyword/Boolean knowledge posttest scores than the females for treatment one while the females had significantly higher mean keyword/Boolean knowledge posttest scores than the males for treatment three.

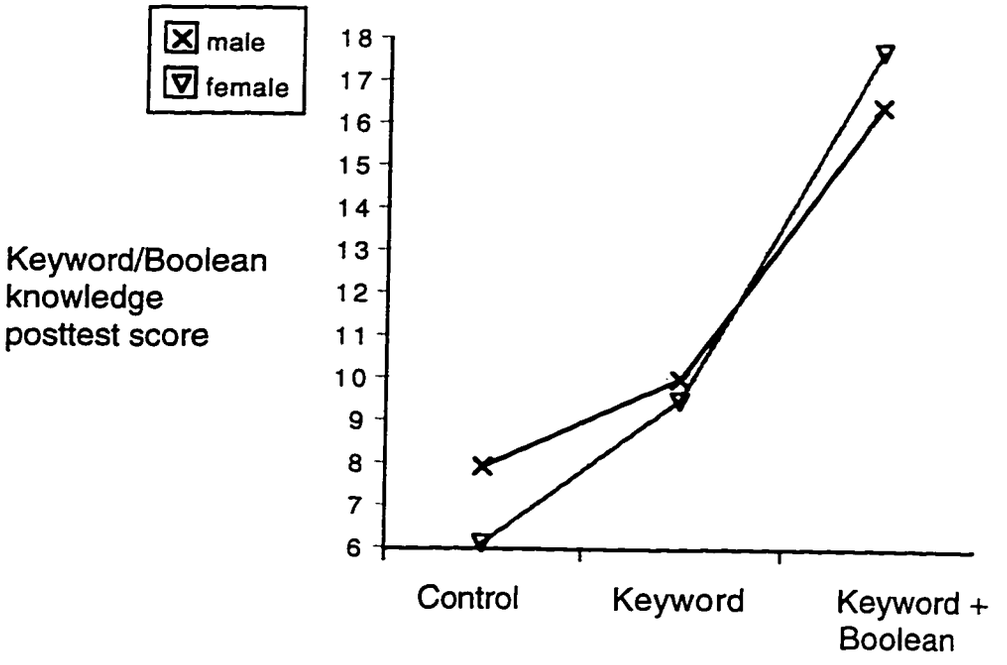

Figure 4. Treatment by Gender Interaction for Keyword/Boolean Knowledge Posttest Scores

An examination of sub-population posttest means and standard deviations was performed using the keyword/Boolean knowledge posttest scores for the three treatment groups. The findings are displayed in Table 7.

Table 7

Summary of Keyword/Boolean Knowledge Posttest Means

Treatment	Mean	Std. Dev.	Cases
Control	7.17	2.96	43
Keyword	9.79	2.22	38
Keyword + Boolean	17.09	2.71	44

Note: N = 125

Scheffé's F-tests were conducted to determine the statistical significance of the differences between the three treatment group means. The results of this analysis are presented in Table 8.

Table 8

Scheffé Test of Significance for

Keyword/Boolean Knowledge Posttest Scores

Comparison	Mean Difference	Scheffé F-test
Control vs. keyword	-2.67	10.14 *
Control vs. keyword+Boolean	-9.95	151.45 *
Keyword vs. keyword+Boolean	-7.28	75.96 *

* $p < .05$.

The control group had the lowest keyword/Boolean knowledge posttest score. The keyword group attained a higher mean keyword/Boolean knowledge posttest score than the control group, but lower than that of the keyword plus Boolean logic group.

The Scheffé test showed the differences between each of the groups to be significant. These findings are consistent with hypothesis one, that the keyword plus Boolean logic treatment group would score higher on the keyword/Boolean knowledge posttest than both the keyword treatment group and the control group.

Hypothesis Two: Search Statement Construction

Hypothesis two predicted that subjects who receive the instructional treatment that involves keyword selection plus Boolean logic will obtain higher statement construction scores than those who receive the other treatments.

A two way analysis of variance was conducted on posttest scores using treatment and gender as factors to examine if significant differences between the mean posttest scores of each treatment group existed, and check for independent variable interactions. These results are presented in Table 9.

Table 9

Two Way Analysis of Variance for the Statement Construction Posttest

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.	
Treatment (A)	2	128.88	64.44	25.1	0.00	*
Gender (B)	1	1.14	1.14	0.44	0.51	
AB	2	1.64	0.82	0.32	0.73	
Error	119	305.48	2.57			

* $p < .05$.

The analysis of variance for Treatment (A) means yielded an F ratio of 25.1 which is statistically significant. The F probability of 0.73 for interaction indicates there is no significant treatment by gender interaction.

An examination of sub-population posttest means and standard deviations was performed. The findings are displayed in Table 10.

Table 10

Summary of Statement Construction Posttest Means

Treatment	Mean	Std. Dev.	Cases
Control	2.72	1.98	43
Keyword	3.32	1.23	38
Keyword + Boolean	5.09	1.43	44

Note: N = 125

Scheffé's F-tests were conducted to determine the statistical significance of the differences between the three treatment groups (see Table 11).

The Scheffé test showed the differences between the keyword plus Boolean logic treatment group and the other treatment groups are significant, but the difference between the control group and the keyword treatment group is not significant.

Table 11

Scheffé Test of Significance for Statement Construction Posttest Scores

Comparison	Mean Difference	Scheffé F-test
Control vs. keyword	-0.60	1.45
Control vs. keyword+Boolean	-2.37	24.27 *
Keyword vs. keyword+Boolean	-1.77	12.66 *

* $p < .05$.

These findings are consistent with hypothesis two that predicted the keyword plus Boolean logic treatment group would score higher on the statement construction posttest than the keyword treatment group, and the control group.

Hypothesis Three: Searcher Success

Hypothesis three predicted that subjects who receive the instructional treatment that involves keyword selection plus Boolean logic will obtain higher search success scores than those who receive the other treatments.

A two way analysis of variance was conducted on posttest scores using treatment and gender as factors to examine if significant differences between the mean posttest scores of each treatment group existed, and check for independent variable interactions. These results are presented in Table 12.

Table 12

Analysis of Variance for the Searcher Success Posttest

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Treatment (A)	2	19.93	9.96	2.00	0.14
Gender (B)	1	23.11	23.11	4.64	0.03 *
AB	2	1.34	0.67	0.14	0.87
Error	119	592.40	4.98		

* $p < .05$.

The analysis of variance yielded an F ratio of 2.00 which is not statistically significant. The F probability of 0.87 for interaction indicates there is no significant treatment by gender interaction. An examination of sub-population posttest means and standard deviations was then performed. The findings are displayed in Table 13.

Table 13

Summary of Searcher Success Posttest Means

Treatment	Mean	Std. Dev.	Cases
Control	4.58	2.19	43
Keyword	5.50	2.53	38
Keyword + Boolean	4.68	2.04	44

Note: N = 125

These findings are not consistent with hypothesis three which predicted that the keyword plus Boolean logic treatment group would score higher on the searcher success posttest than the keyword treatment group, and the control group. Instead we find that none of the treatment groups performed significantly better on the measure of searcher success.

A further analysis into searcher success was performed by conducting a one-way analysis of variance for each of the three sub-tests of the searcher success posttest to examine if significant differences between the mean posttest scores of each treatment group existed within any of the sub-tests. The analysis of variance only found statistical significance for the first of the three sub-tests (Search Topic One). An F value of 0.01 was found for this sub-test. This finding is presented in Table 14.

Table 14

Analysis of Variance for the Search Success Posttest for Search Topic One

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	12.19	6.10	4.64	0.01 *
Within Groups	122	160.41	1.32		
Total	124	172.61			

* $p < .05$.

An examination of sub-population posttest means and standard deviations is displayed in Table 15.

Table 15

Summary of Searcher Success Posttest Means for Search Topic One.

Treatment	Mean	Std. Dev.	Cases
Control	0.81	1.07	43
Keyword	1.53	1.25	38
Keyword + Boolean	0.89	1.13	44

Note: N = 125

Both the control group and the keyword plus Boolean logic treatment group had lower mean statement construction posttest scores than the keyword treatment group for Search Topic One. Scheffé's F-tests were conducted to determine the level of statistical significance between the three treatment groups. The results of this analysis are presented in Table 16.

The Scheffé test showed the keyword treatment group scored significantly higher than control group and the keyword plus Boolean logic treatment group. This evidence further refutes hypothesis three.

Table 16

Scheffé Test of Significance for Searcher Success Posttest Scores for Search Topic One

Comparison	Mean Difference	Scheffé F-test
Control vs. keyword	-0.71	3.89 *
Control vs. keyword+Boolean	-0.07	0.04
Keyword vs. keyword+Boolean	0.64	3.18 *

* $p < .05$.

Hypothesis Four: Search Satisfaction

Hypothesis four predicted that subjects who receive the instructional treatment that involves keyword selection plus Boolean logic will obtain higher satisfaction scores than those who receive the other treatments.

A two way analysis of variance was conducted on posttest scores using treatment and gender as factors to examine if significant differences between the mean posttest scores of each treatment group existed, and check for independent variable interactions. These results are presented in Table 17.

Table 17

Two Way Analysis of Variance for the Searcher Satisfaction Posttest

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Treatment (A)	2.00	94.05	47.02	0.44	0.64
Gender (B)	1.00	26.09	26.09	0.25	0.62
AB	2.00	322.01	161.00	1.52	0.22
Error	119.00	12616.63	106.02		

The analysis of variance yielded an F ratio of 0.44 which is not statistically significant. The F probability of of 0.22 for interaction indicates there are also no significant treatment by gender interactions. An examination

of sub-population posttest means and standard deviations was then performed. The findings are displayed in Table 18.

Table 18

Summary of Searcher Satisfaction Posttest Means

Treatment	Mean	Std. Dev.	Cases
Control	73.54	10.31	43
Keyword	75.13	9.66	38
Keyword + Boolean	73.04	10.83	44

Note: N = 125

All three treatment groups had similar mean searcher satisfaction scores. Scheffé's F-tests were not conducted to determine the magnitude of difference between the three treatment groups due to the low F ratio. These findings are not consistent with hypothesis four that predicted the keyword plus Boolean logic treatment group would score higher on the searcher satisfaction posttest than the keyword treatment group, and the control group. Instead, none of the treatment groups performed significantly better on the measure of searcher satisfaction.

Hypothesis Five: Gender and Searcher Success

Hypothesis five predicted that males and females will have equivalent mean scores for searcher success.

The previously conducted two way analysis of variance on posttest scores using treatment and gender as factors was examined to determine if significant differences between the mean searcher success posttest scores for each gender exist. These results were presented earlier in Table 12. The two way analysis of variance yielded an F ratio of 4.64 for gender which is statistically significant. An examination of sub-population posttest means was

then performed. The findings are displayed in Table 19.

Table 19

Summary of Searcher Success Posttest Means By Gender and Treatment

	Gender			
	Male		Female	
Treatment	n	mean	n	mean
Control	24	4.25	19	5.00
Keyword	21	5.19	17	5.88
Keyword+Boolean	23	4.13	21	5.29
Totals	68	4.5	57	5.37 *

* $p < .05$.

Across all three treatment groups females had higher mean scores than males for searcher success. Total searcher success mean scores are significantly greater for the females. These findings are not consistent with hypothesis five that predicted there would be no significant differences between genders for searcher success.

Hypothesis Six: Gender and Searcher Satisfaction

Hypothesis six predicted that males and females will have equivalent mean scores for searcher satisfaction.

The previously conducted two way analysis of variance on posttest scores using treatment and gender as factors was examined to determine if significant differences between the mean searcher satisfaction posttest scores for each gender exist. These results were presented earlier in Table 17. The two way analysis of variance yielded an F ratio of 0.25 for gender which was not statistically significant. An examination of sub-population posttest means was then performed. The findings are displayed in Table 20.

Table 20

Summary of Searcher Satisfaction Posttest Means

By Gender and Treatment

	Gender			
	Male		Female	
Treatment	n	mean	n	mean
Control	24	74.71	19	72.05
Keyword	21	74.95	17	75.35
Keyword+Boolean	23	70.65	21	75.67
Totals	68	73.41	57	74.37

Females and males did not significantly differ in mean searcher satisfaction scores in any of the three treatment groups. The total mean searcher satisfaction score for females and males was also not significantly different. These findings are consistent with hypothesis six that predicted there would be no significant differences between genders when considering searcher satisfaction scores.

Hypothesis Seven: Keyword/Boolean Knowledge Search Statement Construction

Hypothesis seven predicted that subjects with higher levels of keyword/Boolean knowledge will produce more search statements that correctly use keywords and Boolean logic than subjects with low levels of keyword/Boolean knowledge.

Analysis of the scatter plot indicated a linear relationship. A simple linear regression and one-way analysis of variance was conducted for the relationship between keyword/Boolean knowledge and statement construction to determine the strength and magnitude of the relationship, and determine if it was significant. These results are presented in Table 21.

Table 21

Analysis of the Relationship Between

Keyword/Boolean Knowledge and Statement Construction Scores.

Source	r	df	Mean Square	F	p
Regression	0.54	1	128.77	50.86	0.01 *
Residual		123	2.53		
Total		124			

* $p < .05$.

The regression determined an r value of 0.54, and the analysis of variance yielded an F value of 50.86 which is statistically significant.

These findings are consistent with hypothesis seven. A significant, moderate, positive relationship exists between keyword/Boolean knowledge, and statement construction. In other words, subjects with higher levels of keyword/Boolean knowledge tended to construct more search statements that correctly used keywords and Boolean logic than subjects with lower levels of keyword/Boolean knowledge.

Hypothesis Eight: Keyword/Boolean Knowledge - Searcher Success

Hypothesis eight predicted that subjects with higher levels of keyword/Boolean knowledge will achieve higher levels of success in finding topic related documents than subjects with low levels of keyword/Boolean knowledge.

Analysis of the scatter plot did not indicate any type of relationship. A simple linear regression and one-way analysis of variance was conducted on the relationship between keyword/Boolean knowledge and searcher success to determine the strength and magnitude of the relationship, and determine if it

was significant. These results are presented in Table 22.

Table 22

Analysis of the Relationship Between Keyword/Boolean Knowledge and Searcher Success Scores.

Source	r	df	Mean Square	F	p
Regression	0.02	1	0.24	0.05	0.83
Residual		123	5.18		
Total		124			

The regression determined an r value of 0.02, and the analysis of variance yielded an F value of 0.05 which was not statistically significant.

These findings are not consistent with hypothesis eight. An insignificant relationship exists between keyword/Boolean knowledge and searcher success. In other words, subjects with higher levels of keyword/Boolean knowledge did not tend to experience any higher levels of success in finding topic related documents than subjects with lower levels of keyword/Boolean knowledge.

Hypothesis Nine: Search Statement Construction - Searcher Success

Hypothesis nine predicted that subjects constructing search statements with higher levels of correctly used keywords and Boolean logic will experience higher levels of success in finding topic related documents than subjects constructing search statements with fewer correctly used keywords and Boolean logic.

Scatter plot analysis indicated a weak linear relationship. A simple linear regression and one-way analysis of variance was conducted on the relationship between keyword/Boolean knowledge and statement construction

to determine the strength and magnitude of the relationship, and determine if it was significant. These results are presented in Table 23.

Table 23

Analysis of the Relationship Between Statement Construction and Searcher Success Scores.

Source	r	df	Mean Square	F	p
Regression	0.16	1	17.00	3.37	0.07
Residual		123	5.05		
Total		124			

The regression determined an r value of 0.16, and the analysis of variance yielded an F value of 3.37 which was not statistically significant.

These findings are not consistent with hypothesis nine. A non significant relationship exists between keyword/Boolean knowledge and statement construction. In other words, subjects who constructed search statements with higher levels of correctly used keywords and Boolean logic are not significantly more likely to experience higher levels of success in finding topic related documents than subjects constructing search statements with fewer correctly used keywords and Boolean logic.

Summary

In summary, the results of this study show that instruction in keyword selection plus Boolean logic is not a significantly more effective form of search strategy instruction in producing successful searches, or positively influencing searcher attitudes. These findings occurred even though instruction in keyword selection plus Boolean logic did significantly increase a subjects knowledge level of keyword selection and Boolean logic, and led to significantly more complex search statements that correctly utilized higher

proportions of keywords, and Boolean logic.

Subjects who received the treatment that involved instruction in keyword selection plus Boolean logic did have significantly higher keyword/Boolean knowledge posttest scores, and significantly higher statement construction posttest scores than subjects who received the other two treatments. Subjects who received instruction in keyword selection also had significantly higher keyword/Boolean knowledge posttest scores, but not significantly higher statement construction posttest scores than subjects whose treatment involved no instruction in search strategies.

It was also found that subjects who received the treatment that involved instruction in keyword selection plus Boolean logic did not have significantly higher searcher success scores for any of the searches, or significantly higher attitude scores than subjects who received the other two treatments. Subjects who received instruction in keyword selection had significantly higher search success than subjects receiving the other two treatments for one of the three searches, while there was no significant differences between the three treatment groups for the other two searches. Searcher satisfaction scores were not significantly higher for the keyword selection group as compared to the other two treatment groups.

In considering the effect of gender it was found that females had significantly higher searcher success scores than males with instruction in keyword selection producing the highest searcher success mean scores. In regards to the effect of gender upon searcher satisfaction scores no significant differences were found between males and females.

Analysis of the relationships between dependent variable pairs indicated that subjects with high levels of keyword/Boolean knowledge were more likely

to construct search statements that correctly used keywords and Boolean logic, but not more likely to experience high levels of success in finding topic related documents than subjects with low levels of keyword/Boolean knowledge. As well, subjects constructing search statements with higher levels of correctly used keywords and Boolean logic were not significantly more likely to experience high levels of success in finding topic related documents than subjects constructing search statements containing lower levels of correctly used keywords and Boolean logic.

Discussion of the results relating to the hypotheses, implications of instruction in keyword selection, and Boolean logic as search strategies for a WWW database, and recommendations for further research based on these results can be found in the subsequent chapter.

Chapter V

Discussion

The following discussion will consider the reliability of the instruments used, the correlation of the dependent variables, and each hypothesis in turn. The discussion will be based upon the findings of the data analysis presented in Chapter IV. The implications of instruction in database search strategies will also be discussed, as well as recommendations that can be made for further research in this area.

Reliability

The reliability of the keyword/Boolean logic posttest, statement construction posttest, and satisfaction posttest, are established were all high, suggesting that these instruments produced reliable measures of their respective dependent variables. Inter rater reliability could not be assessed for the URL answer key as the sites chosen by each of the experienced searchers were not the same, and inter rater comparisons could not be made. Consequently, the reliability of the searcher success scores in this study is questionable, particularly when no other research in this area could be found to substantiate this method.

Correlation of Dependent Variables

A correlation matrix of the dependent variables showed that statement construction scores and keyword/Boolean knowledge levels may not be completely independent of each other, and may actually be measuring closely related learner outcomes. As well, searcher success scores are not be completely independent of searcher satisfaction scores. This is consistent with the intent of these dependent variables which was to measure closely related learner outcomes. In fact, it was hypothesized that subjects with higher levels of

keyword/Boolean knowledge would be more likely to construct search statements that correctly use keywords and Boolean logic, and that subjects with higher searcher success scores will be more likely to to have higher levels of searcher satisfaction.

Hypothesis One: Keyword/Boolean Knowledge

Hypothesis one predicted that subjects who receive the instructional treatment involving keyword selection plus Boolean logic will obtain higher keyword/Boolean logic knowledge level scores than those who receive the other treatments. The treatment group receiving instruction in keyword selection plus Boolean logic outscored the treatment group receiving instruction in keyword selection by 36.5 % on the keyword/Boolean knowledge posttest. The keyword selection group outscored the control group by 13.1%. These differences are both significant.

Based on these results, the instructional methodology and practices used in teaching keyword selection plus Boolean logic are effective in improving subjects keyword selection knowledge levels and Boolean knowledge levels compared to other instructional treatments used in this study. This result supports the findings of Nahl and Harada (1996) that students receiving instruction in keyword selection and Boolean logic performed only slightly better (4.24%, $p=0.67$) on a posttest measuring decoding and encoding strategies that requires the use of keyword selection and Boolean knowledge than those not receiving this instruction. Support is also given to Leverence's (1994) suggestion that a formal search strategy session followed by the opportunity to create search statements in writing before going on-line is the best way to teach twenty-five to thirty people the necessary tools they need to become successful searchers, and ensure logical, well planned search

strategies.

Hypothesis Two: Search Statement Construction

Hypothesis two predicted that subjects who receive the instructional treatment that involves keyword selection plus Boolean logic will obtain higher statement construction scores than those who receive the other treatments. The treatment group receiving instruction in keyword selection plus Boolean logic outscored the treatment group receiving instruction in keyword selection by 29.5 % on the statement construction posttest. The keyword selection group outscored the control group by 10.0%. The statement construction scores for the treatment group receiving instruction in keyword selection plus Boolean logic were significantly higher than the scores for the other two treatment groups.

Based on these results, the instruction in keyword selection plus Boolean logic was more effective in improving a subject's correct use of keywords and Boolean logic in constructing search statements as compared to the other two instructional treatments. This finding lends support to the findings of Nahl and Harada (1996) who found that students receiving instruction in keyword selection and Boolean logic application produced search statements containing a higher percentage of correctly used Boolean operators.

Hypothesis Three: Searcher Success

Hypothesis three predicted that subjects who receive the instructional treatment that involves keyword selection plus Boolean logic will obtain higher success in finding topic related documents than those who receive the other treatments. The searcher success scores for the treatment group receiving instruction in keyword selection plus Boolean logic were not significantly higher than the mean scores for the other two treatment groups. In considering the

three subtests (individual topic searches) of searcher success, statistical significance between the mean differences was found for one of the three searches. For Search Topic One the group receiving instruction in keyword selection scored 12.9 %higher than the treatment group receiving instruction in keyword selection plus Boolean logic on the searcher success posttest. The keyword selection group also outscored the control group by 14.4%. These mean differences were significant. To summarize, instruction in keyword selection produced more successful searches than the other two instructional treatments in only one of the three searches.

Based on these results, the instruction in keyword selection plus Boolean logic was not more effective in improving subjects' success in finding topic related documents as compared to the other two instructional treatments. Furthermore, the treatment group receiving instruction in keyword selection actually achieved significantly higher levels of success than the keyword plus Boolean logic treatment group and the control group for one of the three topic searches.

These findings contradict the recommendations of Ala and Cerabona (1992), and Bellardo (1985). Ala and Cerabona suggest that high school students need to learn how to conduct effective searches using Boolean logic. Bellardo suggests that teachers need to give more time and attention to teaching students advanced searching techniques including the use of synonyms (keyword selection), and Boolean operators. Their argument was partially supported by the findings regarding keyword selection, but only for one of the three searches, with no support being given to the recommendation of teaching Boolean logic to increase effectiveness of searches.

These findings lend support to Chen (1993), and Tenopir and Cahn

(1994). Results from Search Topic One lend support to Chen (1993) who states "For productive searches, students must be able to read search problems or statements, extract key concepts, and use appropriate terms to express the concepts" (p. 38). The subjects receiving instruction in keyword selection achieved significantly higher searcher success scores than those receiving other treatments for this search topic. The results of all three searches support the recommendations of Tenopir and Cahn (1994) who suggest that Boolean searching should not be done when searching full-text databases (such as Excite), and instead searchers should rely on the relevancy ranking features of the search engine, which is what many of those in the control group lacking keyword/Boolean knowledge did.

It should be noted that most of the research into the use of keyword selection and Boolean logic that lends support to instruction in Boolean logic as a search strategy has occurred on bibliographic databases such as ERIC. WWW databases do not allow searchers to split concepts and operators into multiple search statements to determine their individual value then combine them into more complex search statements. Instead, searchers must enter their entire search strategy into one statement, unlike online periodical indexing tools (Zorn, Emanoil, Marshall & Panek, 1996). Consequently, searchers can not keep the distinct concepts separate in their mind which may increase their confusion when using Boolean logic. As a result Boolean logic may actually inhibit success when searching on a WWW database. The findings of this study would also support this conclusion as the keyword plus Boolean group did no better than the other two groups in two of the searches and significantly worse than the group receiving instruction in keywords only for one of the three searches.

Additional consideration must also be given to the notion that students in the control and keyword treatment groups spent less time constructing search statements and more time searching due to the simplicity of their search statements. This too may have had an unexpected effect on the results.

To summarize, these results contradict much of the earlier research but do lend some support to more recent researcher recommendations, particularly those researchers considering the use of Boolean logic on a WWW or full text search engine such as Excite.

Hypothesis Four: Search Satisfaction

Hypothesis four predicted that subjects who receive the instructional treatment that involves keyword selection plus Boolean logic will obtain higher levels of satisfaction than those who receive the other treatments. The searcher satisfaction scores for the treatment group receiving instruction in keyword selection plus Boolean logic were not significantly higher than the scores for the other two treatment groups.

Based on these results, the instruction in keyword selection plus Boolean logic was no more effective in improving a subjects satisfaction levels than instruction in keyword selection or no instruction on search strategies.

These findings contradict those of Jackson-Brown and Pershing (1993) who found that when using ERIC and PsycLIT databases, trained searchers expressed greater levels of satisfaction with search results than searchers with no training. Perhaps the differences in findings may relate to the length of training, amount of practice, or maturity of the subjects. These findings do lend support to Lepoer and Mularski (1989), and Ankeny (1991). Lepoer and Mularski's research revealed that most searchers in their study seemed to be satisfied with their searches regardless of their previous levels of training or

experience. Ankeny also found that most searchers report their searches as successful, even when these values do no reflect their true success rates, which are often lower.

Hypothesis Five: Gender and Searcher Success

Hypothesis five predicted that males and females will score equally within each treatment group for searcher success. Instead females scored significantly higher (5.8%) than the males for searcher success.

Based on these results, the females were significantly more successful than the males in finding topic related documents, regardless of the instructional treatment used. Due to the nature of the data collection and the subject confidentiality maintained in the study this researcher was not able to determine the mean previous computer experience scores for females and males in each of the three treatment groups to assess the potential of this variable in influencing the results. This contradicts the notion, or perhaps adds clarification to the conventional wisdom that boys do better at computer related activities than girls.

One possible explanation of this finding is that higher verbal ability levels in the females may have allowed them to generate a greater number of synonymous key words than the males. In a full text database such as Excite there is no controlled vocabulary or thesaurus to aid in searching. Consequently, females with higher verbal abilities may have been able to enhance their search success by providing the search engine with a greater array of synonymous search terms.

Hypothesis Six: Gender and Searcher Satisfaction

Hypothesis six predicted that males and females will score equally within each treatment group for searcher satisfaction. Females receiving instruction in

either keyword selection, or keyword selection plus Boolean logic did not achieve significantly higher levels of searcher satisfaction than males in these treatment groups. Males in the treatment group receiving no instruction did not achieve significantly higher levels of searcher satisfaction than females.

Based on these results, neither gender's satisfaction was significantly more affected by the treatments, regardless of the type of instructional treatment they received. Once again, information about the male advantage in computer related activities may be questioned.

Hypothesis Seven: Keyword/Boolean Knowledge - Search Statement Construction

Hypothesis seven predicted that Keyword/Boolean knowledge levels would positively affect statement construction scores. A significant, moderately strong, positive relationship was found.

Based on these results subjects with higher levels of keyword/Boolean knowledge have a greater likelihood of producing more search statements that correctly use keywords and Boolean logic than subjects with low levels of keyword/Boolean knowledge. This finding further substantiates hypothesis one which predicted that subjects who receive the instructional treatment that involves keyword selection plus Boolean logic will obtain higher statement construction scores than those who receive the other treatments. As well, the findings of Nahl and Harada (1996) are given support. They found that students receiving instruction in keyword selection and Boolean logic application produced search statements containing a higher percentage of correctly used Boolean logic and Boolean operators.

Hypothesis Eight: Keyword/Boolean Knowledge - Searcher Success

Hypothesis eight predicted that subjects with higher levels of

keyword/Boolean knowledge will achieve higher levels of success in finding topic related documents than subjects with low levels of keyword/Boolean knowledge. No significant relationship was found.

Based on these results subjects with higher levels of keyword/Boolean knowledge are no more likely to experience higher levels of success than subjects with low levels of keyword/Boolean knowledge. This supports the earlier finding in this study that students receiving instruction in keyword selection plus Boolean logic did not achieve significantly higher levels of searcher success. Together these findings further substantiate the recommendations of Tenopir and Cahn (1994), and the findings of Zorn, Emanoil, Marshall & Panek, (1996). Tenopir and Cahn suggest that Boolean searching should not be done when searching full-text databases such as those found on the WWW. Zorn et al. argue that the inability of WWW search interfaces to allow searchers to split concepts and operators into multiple search statements, then combine them into a more complex search statement leads to confusion when using Boolean logic. Consequently, Boolean logic may actually inhibit success when searching on a WWW database. This observation receives support from the results of this study which showed that subjects in the keyword only group experienced higher levels of success than those subjects who also received the same keyword instruction plus Boolean logic. If instruction in Boolean logic made no significant difference than the two groups should have scored the same. Instead, it would appear that the Boolean logic instruction may have negatively inhibited the benefits accrued by the keyword selection instruction.

Hypothesis Nine: Search Statement Construction - Searcher Success

Hypothesis nine predicted that subjects constructing search statements

with higher levels of correctly used keywords and Boolean logic will experience higher levels of success in finding topic related documents than subjects constructing search statements with fewer correctly used keywords and Boolean logic. An insignificant, weak, positive relationship was found.

Based on these results subjects constructing search statements with higher levels of correctly used keywords and Boolean logic are not significantly more likely to experience higher levels of success in finding topic related documents than subjects constructing search statements with fewer correctly used keywords and Boolean logic. This result agrees with the findings relating to hypothesis eight and supports the recommendations of Tenopir and Cahn (1994), and the findings of Zorn, Emanoil, Marshall & Panek, (1996) as mentioned previously.

Implications of Instruction in Keyword Selection and Boolean Logic

Based on the results of this study, it is recommended that teachers of high school students can increase student levels of keyword/Boolean logic knowledge by using work booklet based instruction on these search strategies. Furthermore, the students receiving this instruction will have a greater likelihood of being able to construct search statements that correctly use keywords combined with Boolean operators and parentheses.

The findings of this study do suggest that teachers of high school students planning to utilize full text WWW search engines as a resource tool should not spend instructional time teaching Boolean logic as a search strategy in the hope of increasing student success in finding topic related documents or increasing student satisfaction with that search engine. The value of instruction in keywords alone is questionable with mixed findings in this study. It is likely that students would better benefit from instruction in how to use the search

engine features rather than learn how to develop complex search strategies that utilize keywords combined with Boolean operators, as this does not increase their likelihood of experiencing success for a WWW search engine like Excite.

Recommendations for Further Research

Based on the outcomes of this research, and some of the literature currently available in this area of study, there are five recommended areas for further research.

This type of research should be replicated using other non-bibliographic WWW search engines available and accessed by students that offer keyword and Boolean searching. Each database is unique in the methods used by it's robots to search, analyze, and catalogue information from online documents as well as the algorithm used to analyze search statements before processing them. Consequently, keyword and Boolean searches may produce different outcomes for different WWW search engines.

Research of this type needs to be replicated with junior high and college or university level students. Like high school students, these two groups are increasingly being expected to utilize the WWW as an information resource. Is it worth their time to learn how to conduct keyword/Boolean searches? The junior high cohort is likely to have a control group that is less knowledgeable in keyword/Boolean knowledge search strategies while the college or university cohort is likely to have a control group that is more knowledgeable in keyword/Boolean knowledge search strategies. This difference may produce very different results.

Research needs to be conducted that determines the best way of measuring searcher success on a WWW database, where the number and

diversity of documents on any one topic is vast. How can one easily determine what is a successful search and apply this in measuring the success of others for future comparisons of search strategies? Replication of the methods used in this study with different topic searches will help to determine if previously determined lists of topic related database documents are an effective "answer key" in determining whether or not a search has been successful.

Further investigation into how the different genders benefit from instruction into search strategies, and how they conduct searches on the WWW is warranted. This study found a significant interaction between treatment and gender for keyword/Boolean knowledge posttest scores, and that females were significantly more successful at finding topic related documents than males, regardless of the instructional method received. A study into the differences between the search strategies used and the decisions made by both genders during the search process may yield valuable information about effective searching skills and strategies.

Research into the decisions students make in assessing whether or not a found document is highly related to the topic and worthy of further investigation would be of great value. Once a student learns how to search effectively it is important for them to be able to accurately assess how useful the information is.

Conclusion

This study found that instruction in keyword selection plus Boolean logic significantly increases keyword/Boolean knowledge levels, as well as the level of correctly used keywords and Boolean logic in constructing search statements as compared to those receiving instruction in keywords alone, and those receiving no instruction on search strategies. However, instruction in keyword selection plus Boolean logic did not significantly increase a subjects success in

finding topic related documents or their level of satisfaction with their searches as compared to those receiving instruction in keywords alone, and those receiving no instruction on search strategies.

This study further found that females experienced significantly higher mean levels of success in finding topic related documents as compared to males, but that male and female mean satisfaction levels were not significantly different, regardless of the type of instructional treatment received.

This study also found that subjects with higher levels of keyword/Boolean knowledge have a greater likelihood of producing more search statements that correctly use keywords and Boolean logic than subjects with low levels of keyword/Boolean knowledge, but that these search statements are not significantly more likely to increase their success in finding topic related documents. Consequently, subjects with higher levels of keyword/Boolean knowledge are no more likely to experience higher levels of success in finding topic related documents than subjects with low levels of keyword/Boolean knowledge.

From the findings of this research study and the lack of studies that have been done in the area of effective search strategies for WWW databases, it is clear that more research needs to be conducted to determine how effective keyword selection and Boolean logic are as WWW database search strategies. The increasing pressure for students to utilize WWW databases makes this research all the more timely and necessary. Researchers need to clearly establish if instruction in keyword selection and Boolean logic are worthwhile investments for the teacher and student planning to utilize a WWW database, or if these search strategies are only effectively utilized when searching bibliographic databases such as ERIC or PsycLIT.

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Appendix A

Subject Consent Form

Researcher: Brian Johnson, Graduate Student, Instructional Technology, Department of Educational Psychology, Faculty of Education, University of Alberta.

Title of Thesis: Effects of Search Strategy Instruction on Searcher Success and Satisfaction using a World Wide Web Database.

By signing this form, I hereby agree to participate in the above mentioned research study. Having been contacted by the researcher, I the student, understand the following:

A. The purpose of this study is to examine the effects of instruction in World Wide Web search strategies on learning outcomes.

B. I will be receiving instruction in search strategies, completing a worksheet, writing a test, and applying what I have learned to searches in a World Wide Web database.

C. My name is confidential and will not be disclosed at any time during this study, nor will it be used in the resulting thesis.

D. Scores collected in this study will have no effect on my course grade and are confidential.

E. Since my participation in this study is purely voluntary, I have the right to quit or stop participating at any time.

F. I may receive the results of the study from the researcher upon request.

G. I may examine the resulting thesis from this study by using the copy that will be available in the University of Alberta Library.

Printed name of participant _____

Signature of participant _____

Date signed by participant _____

Appendix B

Copy of: Instructional booklets given to the three treatment groups
Note: Only 1 copy of the Instructions page is provided
as it was the same for all three treatment groups

Searching the World Wide Web for Information.

Instructions:

There are 3 parts to this booklet. Please complete them in order from front to back.

Section 1: Search information about the World Wide Web (WWW).

You will find 3 pages of instructions on finding information on the WWW. You will have up to 10 minutes to carefully read these pages and learn the strategies.

Section 2: Worksheet.

A 2 page worksheet is provided for you to practice what you learned in Section 1.

You may start the worksheet as soon as you complete Section 1. Upon completion of the worksheet you will be provided with an answer sheet to correct your answers. You will have up to 10 minutes to complete and correct the worksheet.

Section 3: Quiz.

After everyone has completed their worksheets and corrected them, you will be given 15 minutes to complete a 17 item quiz related to searching for information on the World Wide Web. Place your identification sticker and record gender in this section.

Please wait for a start signal from the instructor before opening this booklet to begin section 1.

Section 1

Tips for Searching.

Did you ever have to use a computer (CD-ROM or Internet) to search for information and didn't know where to start?
Don't panic! Here are some tips to help you search smarter and faster.

Start with your question ...the topic you want to know more about.

Are you really sure you know exactly what topic you're going to research? Check again. The most common research time-waster, and the biggest one, is not having an exact fix on the topic. For example, if you were to research the topic: cars , it will take months and months. However, a research on the quality of 1995 corvettes will take less than 30 minutes on the World Wide Web (WWW).

To zero in on an exact topic, check different resources on your topic; encyclopedias, CDROM's, and the WWW are all good places to start. Ask yourself three questions as you do this exploring:

- Do you have just one main topic?
- Is your main topic specific enough?
- Is your research topic written as a question than can be answered with research?

Once you've done this exploring and thinking, and you have a topic you feel you can really work on , don't go tearing off to the library or your computer just yet. Research isn't just finding information. You must search with a purpose. If you aren't clear about that purpose before you begin, you'll waste a lot of time aimlessly reading and copying.

The following four purposes cover almost all research projects:

- To *find out* how to do something or describe how it's done (whether it's tying a knot or handling a problem to offer directions to others).

- To *discover* what happened at a particular time or place (whether it's history or personal experience or news) to report to others.

- To understand an idea well enough that you can *explain* it to others.

- To find enough evidence so that you're able to *persuade* on behalf of a viewpoint.

To help make your time in the library as efficient as possible, come up with questions you want to answer about your topic. This list is what you'll use as your basic research guide. The questions will keep you on track. it may seem like lots of extra work to prepare a comprehensive list of questions before searching, but the alternative is the kind of research we see all the time: spending hour after hour copying lists of references that duplicate each other or that contain fascination stuff that you won't be able to use.

Now you are ready to seriously search for information. The school library is a great place to start. Everyone usually rushes for the CD-ROM and other electronic information resources, but books and magazines can be just as useful.

When you search the WWW you are searching a database (a collection of articles) that was made from recently found articles on the WWW. Many WWW databases rely on **electronic robots** to identify WWW pages and other internet resources for addition to their databases. These robots are called **spiders, crawlers, wanderers** and **worms**. They crawl about the WWW finding and indexing web sites by title, uniform resource locators (URLs), words in each document, or by any combinations of these. WWW databases often contain **millions** of documents.

To access and search WWW documents you need to enter your search terms into a **search engine** window. The search engine users your search statement to **scan** all the articles in it's database, looking for a match between your search statement and the documents it contains.

The WWW database you will be using is called **Excite**. The Excite database's search engine uses **relevancy ranking**. Relevancy ranking arranges your retrieved articles based on a measurement of similarity between the search terms you entered and the content of each article. A benefit of using relevance ranking is that no matter how many articles are retrieved (even millions) you know that the best information is likely to be found in the first few articles with the highest relevancies.

To review: Each database has a search engine which allows you to search through these articles by entering a search statement about a topic you are interested in. The Excite database ranks the articles found for you, putting those most relevant at the top of the list.

If you are uncertain on any ideas presented please raise your hand or review the instructions before proceeding, otherwise you may proceed to Section 2.

Section 2

Please fill-in all of the blanks on this search worksheet.

Explore and focus

1. The most common research time-waster, and the biggest one, is not knowing your exact _____.

2. Which of the following is not a good question to ask yourself as you zero in on a topic.
a) Do you have just one main topic?
b) Is your main topic specific enough?
c) Is your research topic written as a question than can be answered with research?
d) Is your topic question expressed in five words or less?

Have a purpose

3. Before you begin searching for information about your topic you must be clear about your _____.

4. List the 4 words used to summarize the 4 purposes for conducting research projects.

_____, _____, _____,
_____,

Pose questions

5. What should you do to develop a basic research guide?

Start the search

6. Name two other sources of Information besides books and magazines in the school library.

WWW database robots

7. A WWW database is a collection of _____.

8. Electronic robots are used to find the articles for the database by searching article
a) titles
b) URL's
c) content
d) any combination of the above.

9. List three other names for electronic robots.

How a search engine works

10. A search engine looks for a match between two things, what are they?

Relevancy Ranking

11. If you find that there are 375, 600 articles that are related to your search topic where should you look to find the most relevant articles?

When finished, please raise your hand to get the answer sheet

Section 1

Key Word Search Strategies: Instructions for Searching.

Tips

Did you ever have to use a computer (CD-ROM or Internet) to search for information and didn't know where to start?
Don't panic! Here are some tips to help you search smarter and faster.
Start with your question ...the topic you want to know more about.

Main Words

Example 1: Your science class research team decides to try and answer the following: "Why do toads have warts?"

1. First, you need to determine what the main words (key words) are in your search question. In this example the key words are:

Key Word 1	Key Word 2
Toads	**Warts**

2. Sometimes the keywords are not enough to find all the information. It is a good idea to also think of alternate words that have the same meanings. In this example alternate words for Toads and Warts might be:

Alternate Words

Example A

Key Word 1	*Alternate Word 1*
Toads ◄►	***Frogs***

Example B

Key Word 2	*Alternate Word 2*
Warts ◄►	***Growths***

Related Alternate Words

3. Using alternate words in your search allows you to broaden your search of the World Wide Web for articles about **Toads** and **Warts**. You may find that some of the best articles use the word

Alternate Words

Frog to describe **Toads** or these articles may describe growths on **Toads** without using the keyword **Warts** to describe them.
If you had used only **Toads AND Warts** as your keyword search terms how many of the equally good articles that describe **frogs AND growths** would you have found? The answer is none, zero, zippo.

Poor Alternate Words

4. The more alternate words you have the better off you are, provided the alternate key words are very similar to the main key words. It does not make sense to use **Turtles** as an alternate key word for **Toads** or to use **Bumps** as an alternate keyword for **Warts**. Finding articles about **Turtles AND Bumps** would not help you to answer your original question... **Why do Toads have Warts**?

Example 2: Your social studies class research team decides to try and answer the following:
" When did the settlers first move to Alberta?"

The two most related key words are in this example are:

Key Word 1	Key Word 2
Alberta	**Settlers**

Some related or alternate keywords that may be just as effective in helping you to find articles on this topic are:

Typing a Search Statement

Alternate Key Words:

Immigration ***First*** ***Pioneers*** ***Prairies.***

5. When trying your searches always use the most related keywords first. Simply type in these key words leaving a space between them.
If you are not satisfied with the amount or quality of articles found than use the next best set of keywords.
You can use any number of keywords in a single search (from 1 to all of them) but it is best to start with only your most related 2 or 3 keywords.

Using the above example your best 3 word search statement might be: **First Alberta Settlers** or **Pioneers First Alberta**. The

order of the key words does not matter.

Review

6. To review keyword search strategies:
•Identify the main key words from your search question.
•Make a list of relevant alternate key words.
•Start your searches by using the most relevant key words.
•Try several searches using 2 - 4 of the keywords.

WWW database robots

When you search the WWW you are searching a database (a collection of articles) that was made from recently found articles on the WWW. Many WWW databases rely on **electronic robots** to identify WWW pages and other internet resources for addition to their databases. These robots are called **spiders, crawlers, wanderers** and **worms**. They crawl about the WWW finding and indexing web sites by title, uniform resource locators (URLs), words in each document, or by any combinations of these. WWW databases often contain **millions** of documents.

How a search engine works

To access and search www documents you need to enter your search terms into a **search engine** window. The search engine users your search statement to **scan** all the articles in it's database, looking for a match between your search statement and the documents it contains.

The Excite database

The WWW database you will be using is called **Excite**. The Excite database's search engine uses **relevancy ranking**.

Relevancy Ranking

Relevancy ranking arranges your retrieved articles based on a measurement of similarity between the search terms you entered and the content of each article. A benefit of using relevance ranking is that no matter how many articles are retrieved (even millions) you know that the best information is likely to be found in the first few articles with the highest relevancies.

Section 2

Please fill-in all of the blanks of this search worksheet.

For questions 1 and 2 your search question is: **Do volcanoes cause hurricanes?**

Main Key words

1. What are the main key words in this search question?
Write the main words in the spaces below.

Main word 1:_____ Main Word 2:_____

Alternate Key words

2. What would be a good alternate word for each of the main words listed above?
Write the alternate words in the spaces below.

Alternate for Main word 1:_____ Alternate for Main word 2:_____

Main Key words

For questions 3 and 4 your search question is: **What is the main export of the world?**

3. What are the main key words in this search question?
Write the main words in the spaces below.

Main word 1:_____ Main Word 2:_____

4. What would be a good alternate word for each of the main words listed above?
Write the alternate words in the spaces below.

Alternate for Main word 1:_____ Alternate for Main word 2:_____

5. What should you use first in a search statement the main key words or the alternate key words? _____

6. How many key words should you normally combine in a search statement?
a) 1-3 b) 2-4 c) 4 d) 1-6
7. Circle the type of word that should be tried first in a search statement.
a) related alternate key word
b) unrelated alternate key word
c) main key word
d) all of the above can be used.

For questions 8 your search question is: **How many grade 12 students continue on to complete a university degree?**

8. The main key words might be grade 12 students and university degree.

From each list below circle the best 2 alternate key words for each main word.

grade 12 students	university degree.
high school students	college degree
graduates	diploma
students	graduate
senior high students	post secondary degree
seniors	graduate student

For question 9 -11 refer to the third page of you search instructions on the WWW database known as Excite.

WWW database robots

9. List three other names for electronic robots.

How a search engine works

10. A search engine looks for a match between two things, what are they?

Relevancy Ranking

11. If you find that there are 375, 600 articles that are related to your search topic where should you look to find the most relevant articles?

Section 1

Key Word + Boolean logic Search Strategies: Instructions for Searching.

Tips

Did you ever have to use a computer (CD-ROM or Internet) to search for information and didn't know where to start?
Don't panic! Here are some tips to help you search smarter and faster.

Start with your question ...the topic you want to know more about.

Example: Your science class research team decides to try and answer the following: " Why do toads have warts?"

Main Words

1. First, you need to determine what the main words (key words) are in your search question. In this example the main key words are:

Main Key Word 1 Main Key Word 2

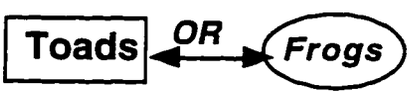
Toads **Warts**

2. Sometimes the keywords are not enough to find all the information. It is a good idea to also think of alternate words that have the same meanings. In this example alternate words for **Toads** and **Warts** might be:

Alternate Words

Example A

Main Key Word 1 *Alternate Key Word 1*



Example B

Main Key Word 2 *Alternate Key Word 2*

3. Now it's time to put these words together in a search statement which can be typed into your computer's search engine First., connect your alternate words by using the word **OR**

OR = More

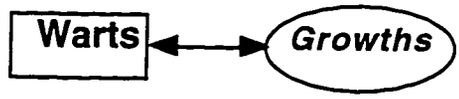
Using the word **OR** expands and broadens your search.
In example A using the search connector **OR** will get you anything that mentions either **Toads** or **Frogs.**

Example A

Main Key Word 1 *Alternate Key Word 1*

Example B

Main Key Word 2 *Alternate Key Word 2*



In example B, using OR will get you anything that mentions either **Warts** or **Growths.**

4. You may find using just **OR** makes your search too broad and you get too much information. It is not uncommon to find 200,000 articles for 1 search when using 3 or 4 keywords connected with **OR**.

AND= Fewer

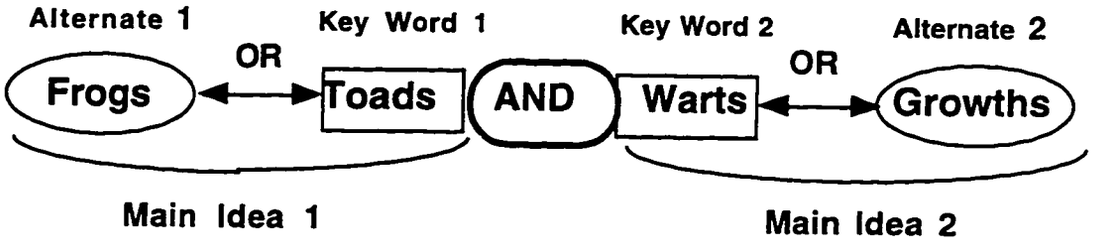
By using the connector **AND** to connect your main words, you can reduce or limit your search. Here's how you do it:

Key Word 1 **Key Word 2**

Using the connector **AND** in this example will get you information only if both **Toads** and **Warts** are mentioned **together** in the same article.

Now you are ready to combine everything you have learned into 1 powerful search statement using both **AND - OR** statements.

5. The most powerful search statements effectively combine main key words and alternate key words together using **AND OR** connectors. Here is how you do it:



This diagram shows you how your search would look for only those articles that contain information about both **Main Idea 1**(frogs **OR** toads) **AND Main Idea 2** (warts **OR** growths). Would articles containing only information about **Frogs OR Toads** be found by your search? The answer is no. The articles would also have to contain information about **Warts OR Growths** to be found because you connected the two different **Main Ideas** using **AND**.

Now that you understand how to design a search statement using **AND OR** statements the last thing you need to know is how to write them out for entry into the computer. The only trick you need to remember, is to use brackets around the **OR** search statements eg. (**Key Word OR Alternate word**) to keep them as separate units joined by **AND**. The example below will show you this.

(Toads	OR	Frogs)	AND	(Warts	OR	Growths)
Main word 1	Connector	Alternate word 1	Connector	Main word 1	Connector	Alternate word 1

When typed into the computer the search statement will look like this:

(Toads OR Frogs) AND (Warts OR Growths)

If you are uncertain on any ideas presented please raise your hand or review the instructions before proceeding.

If you are confident you understand how to: **Identify main and alternate key words and connect them in a search statement using AND / OR** then you may proceed to the worksheet on the next page (Section 2).

Section 2

Please fill-in all of the blanks of this search worksheet.

Your search question is: **Do volcanoes cause hurricanes?**

1. Main Key words
What are the main key words in this search question?
Write the main words in the spaces below.

Main word 1:_____ Main Word 2:_____

2. Alternate Key words
What would be a good alternate word for each of the main words listed above?
Write the alternate words in the spaces below.

Alternate for Main word 1:_____ Alternate for Main word 2:_____

3. Expanding or Broadening the search
If you want to expand and broaden your search, what connector would you use to link your main key words with the alternate key words?
Write the connector in the space below.

Connector to link Main word with Alternate word: _____

4. Reducing and Limiting the Search
If you want to reduce and limit your search, what connector would you use to link your main words? Write the connector in the space below.

Connector to link 2 main statements:_____

5. Writing the Search statement.
Now you want to combine your main words with alternate words using connectors in a search statement by filling in the spaces below.

(_____ ____ _____) ____ (_____ ____ _____)

Main word 1	Connector	Alternate word 1	Connector	Main word 2	Connector	Alternate word 2

Your search question is: **What is the main export of the world?**

6. Main Key words
What are the main key words in this search question?
Write the main words in the spaces below.

Main word 1:_____ Main Word 2:_____

7. Alternate Key words
What would be a good alternate word for each of the main words listed above?
Write the alternate words in the spaces below.

Alternate for Main word 1:_____ Alternate for Main word 2:_____

8. Writing the Search statement.
Now you want to combine your main words with alternate words using connectors in a search statement by filling in the spaces below.

(_____ ____ _____) ____ (_____ ____ _____)

Main word 1 | Connector | Alternate word 1 | Connector | Main word 2 | Connector | Alternate word 2

When finished, please raise your hand to get the answer sheet

Appendix C

Copy of: Survey of Previous Computer Experience
adapted from Evans, 1995.

Survey of Previous Computer Experience

Name:_____

Please answer all questions honestly and accurately.
All information will be kept confidential.

1. Circle the answer that best reflects your experience.

D= DAILY W= WEEKLY M= MONTHLY S= ONCE A SEMESTER N= NEVER

1. I use library CD-ROM databases...	D	W	M	S	N
2. I use CD-ROM encyclopedias...	D	W	M	S	N
3. I use library card catalogues...	D	W	M	S	N
4. I use the Internet...	D	W	M	S	N
5. I use an Internet search engine...	D	W	M	S	N
6. I use a microcomputer...	D	W	M	S	N

Thank you for taking the time to answer this questionnaire.

Appendix D

Copy of: Keyword/Boolean knowledge posttest, and answer key

Gender

Stick ident. label here.

Section 3

Quiz on Searching.

Follow the instructions below. Please answer each part of every question.

Don't worry if many of these questions seem unrelated to the worksheet you just completed, each worksheet covered different topics and only some of the topics are represented on this quiz.

Multiple choice: Circle the 1 best answer for each question

Use the following search topic to answer questions 1-4.
Why do teenagers smoke less as they grow older?

1. The main key word for this search topic is
a) Why b) teenagers c) grow d) cigarettes

2. A good alternate key word for either main word in the above search topic is
a) cancer b) teenagers c) smoke d) cigarettes

3. To broaden your search to find many articles on your search topic, the main key words could be connected using
a) INCREASE b)EITHER c) OR d) BROADEN

4. To Narrow or restrict your search to find only a few articles on your search topic, the main key words could be connected using
a) DECREASE b) AND c)PLUS d) WITHOUT

5. The search topic is: **Why is good health and fitness important?**
Which search statement connects a main key word and an alternate key word correctly?
a) fitness OR shape b) health AND conditioning
c) health PLUS physique d) shape NOT exercise

6. The search topic is : **Is fast food good or bad for your health?** Which search statement correctly connects two main key words?

a) fast OR food
b) fast food AND health
c) fast PLUS food
d) food EITHER good

For questions 7 and 8 the search topic is:
What types of jobs do teenagers hold while in high school?

7. Which search statement will give you **more** articles?
a) jobs OR teenagers OR high school
b) jobs PLUS teenagers PLUS high school
c) jobs EITHER teenagers EITHER high school
d) jobs AND teenagers AND high school

8. Which search statement will give you the **fewest articles**?
a) jobs OR teenagers OR high school
b) jobs PLUS teenagers PLUS high school
c) jobs EITHER teenagers EITHER high school
d) jobs AND teenagers AND high school

Short Answer

9. Write the main key words from the search topic: **Why do teenagers join gangs?**

_____ Main Key word 1 _____ Main Key word 2

10. Write the best alternate key words for the two main key words in the search topic: **Why do teenagers join gangs?**

_____ Alternate Key word 1 _____ Alternate Key word 2

11. Write the main key words from the search topic: **How does advertising influence spending?**

_____ Main Key word 1 _____ Main Key word 2

12. Write the best alternate key words for the two main key words in the search topic: **How does advertising influence spending?**

_____ _____
Alternate Key word 1 Alternate Key word 2

13. The search topic is: **What is the best way to search the Internet?** Write the two main key words and two alternate key words to use in your search statement.

_____ _____
Main Key word 1 Main Key word 2

_____ _____
Alternate Key word 1 Alternate Key word 2

14. The search topic is: **Why do waterfowl migrate?** Write the two main key words and two alternate key words to use in your search statement.

_____ _____
Main Key word 1 Main Key word 2

_____ _____
Alternate Key word 1 Alternate Key word 2

15 & 16. The search topic is: **How many white tigers exist in the world today?** Using connectors write the best search statement for this topic in the space below.

_____

17 & 18. The search topic is: **What is being done to improve the air quality on commercial airplanes?** Write the best search statement for this topic in the spaces below.

_____

19 & 20. The search topic is: **How do the types of dreams and daydreams we have affect how well we sleep?** Write the best search statement for this topic in the space below.

_____

Keyword/Boolean knowledge posttest answer key

1. b 2. d 3. c 4. b 5. a 6. b
7. a
8. d

9. Main Key word 1 = teenagers Main Key word 2 = gangs

10. Alternate Key word 1 = kids, youth adolescents, etc.
Alternate Key word 2 = group, club, etc.

11. Main Key word 1 = advertising Main Key word 2 = spending

12. Alternate Key word 1 = commercials, campaigns, etc.
Alternate Key word 2 = buying, purchasing, etc.

13. Main Key word 1 = search Main Key word 2 = internet
Alternate Key word 1 = find, locate, etc.
Alternate Key word 2 = WWW, etc.

14. Main Key word 1 = waterfowl Main Key word 2 = migrate
Alternate Key word 1 = ducks, geese, etc.
Alternate Key word 2 = travel, journey, move, etc.

15. (_____OR_____) AND (_____ OR_____)

16. white tigers cats, etc. world planet, etc.

17. (_____OR_____) AND (_____ OR_____)

18. air quality air purity, etc. commercial airplanes planes, etc.

19. (_____OR_____) AND (_____ OR_____)

20. dreams daydreams, etc. sleep rest, etc.

Appendix E

Copy of: Statement Construction Posttest Answer Key for the Three Excite Database Searches.

All search statements for each of the three topic searches were analyzed to determine if any 1 correct search statement was used which combined at least 2 keywords using 1 Boolean operator. Search statements were marked incorrect if an unrelated keyword or incorrect Boolean operator was used.

What are the main causes of dropout among high school students?

Use of acceptable keywords: dropout, causes, high school students
1mark related keywords - quit, senior high school, etc..
Proper use of Boolean operators:Correct use of AND/OR statements with parentheses 1 mark to broaden or narrow their search.

How do viruses cause colds and get spread to others?

Use of acceptable keywords: virus, cold
1mark related keywords - sneezing, microorganism, etc..
Proper use of Boolean operators:Correct use of AND/OR statements with parentheses 1 mark to broaden or narrow their search.

What kinds of animals live in a rain forest?

Use of acceptable keywords: animals, rain forest.
1mark related keywords - creatures, tropical, etc..
Proper use of Boolean operators:Correct use of AND/OR statements with parentheses 1 mark to broaden or narrow their search.

Appendix F

Search Topics, URL and Search Statement Recording Sheets, and the Predetermined Best Sites for Each Topic.

Search Topic Instructions

You will be conducting 3 separate searches of the Excite database to find what you feel are the 5 best sources of information for those topics.

As you search you will need to do 2 things:

1. Record Excite rankings, the URL's, and the title for any good sites you come across.
2. Write down the search statement you used each time you enter a new search statement into Excite's search window. You can do this while you wait for Excite to bring you your search results.

When you are satisfied that you have adequately searched the database and found all of the good sources of information on each topic, place a check mark beside the 5 best sites (use the title of the site to help you remember the quality and topic of each site).

An example of a completed worksheet is provided below.

√ if in top 5	Excite Ranking	URL address	Search statements entered in Excite's search window.
[ ]	___%	http://www_____	
title of site_____			
[ ]	___%	http://www_____	.....
title of site_____			

- There is no limit to the number of search statements you can use.
- There is also no limit to the number of sites you may record for any 1 search statement.
- You may have extra search statement boxes or extra spaces for recording URL's and titles.
- Remember to check mark the 5 best sites after trying all of the search statements you feel will work.

Search Topic 1

Conduct a search of the Excite database to find what you feel are the 5 best sources of information about the following topic:

What are the main causes of dropout among high school students?

If you are not sure how to use this sheet ask for help or check back to the instructions page.

√ if in top 5	Excite Ranking	URL address	Search statements entered in Excite's search window.
[ ]	____%	http://www_____	
	title of site_____		
[ ]	____%	http://www_____	
	title of site_____		
[ ]	____%	http://www_____	
	title of site_____		
[ ]	____%	http://www_____	
	title of site_____		
[ ]	____%	http://www_____	
	title of site_____		
[ ]	____%	http://www_____	
	title of site_____		
[ ]	____%	http://www_____	
	title of site_____		
[ ]	____%	http://www_____	
	title of site_____		
[ ]	____%	http://www_____	
	title of site_____		

After completing your search be sure to <u>check mark the top five sites</u>.
Once you have done this you may proceed to the next search topic.

Search Topic 2

Conduct a search of the Excite database to find what you feel are the 5 best sources of information about the following topic:

How do viruses cause colds and get spread to others?

Search Topic 3

Conduct a search of the Excite database to find what you feel are the 5 best sources of information about the following topic:

What kinds of animals live in a rain forest?

Search Topic 1 - Predetermined "Best" URL's

What are the main causes of dropout among high school students?

1994-95 Report on Public School Dropouts
http://www.tea.state.tx.us:70/0/research/dropout95/dropout.toc.html

Characteristics of Dropouts
http://www.tea.state.tx.us:70/0/research/dropout95/characteristics

Dropout Prevention

Educators' Notepbook - Dropouts
http://www.mbnet.mb.ca/~map/eddrop.htm

Examining Factors of Dropouts, Education...
http://boserup.qal.berkeley.edu/~martin14/assign6.htm

Facts in Brief Excerpts
http://www.acenet.edu/prpoducts/Publications/FIB/FIB13.html

Headline: School Dropout Rates: Going Do.
http://www.igc.apc.org/handsnet2/Articles/art.854987176.html

High School Dropout Rate is Declining
http://www.acenet.edu/products/Publicatios/FIB/FIB13.html

KIDS COUNT 1996: Annual High School Dr...
http://oseda.missouri.edu/kidscount/96/dropout.html

MONBUSYO/MONBUSYO news
http://www.monbu.go.jp/news-en/e960405.html

News Release - Oregon Department of Education
http://www.ode.state.or.us/new/nr/7.html

Oregon dropout rate increases
http://www/pantless.com/~pdxnorml/Oregon_dropout_rate.html

Rural Students at Risk: Dropout Rates - ...
http://www.sedl.org/rural/atrisk/rates.html

Sisters dropout rate lower than state's
http://www.nuggetnews.com/archives/970129/front5.shtml

State Dropout Rate
http://www.tea.state.tx.us:70/0/research/dropout95/Table2.html

Staying in School
http://www.royalbank.com/english/news/letter/school.html

Student Dropouts
http://www.tea.state.tx.us:70/0/reports/1996cmprpt/02drpout.html

Students Staying in School, Studying Mor
http://www.ed.gov/bulletin/fall1994/coedout.html

Trends in State Dropout Rates
http://www.tea.state.tx.us:70/0/research/dropout95/Figure2.html

Untitled
http://www.temple.edu/LSS/108.html

Untitled
http://inet.ed.gov/pubs/OR/ConsumerGuides/dropout.html

Youth and High School
http://pilot.msu.edu/user/lvacalc/youth.html

Search Topic 2 - Predetermined "Best" URL's

How do viruses cause colds and flu's?

475 Madison Avenue
http://475madison.msn.com/archive/ep30/whitehall/robinf2.html

AAA ANGELO BERTONI CHEMIST
http://www.harpbbt.com.au/comm/bertoni/PRODUCTS/ColdsFlu-ColdsFlu.html

AAFP: Health Notes: Colds and Flus
http://www.aafp.org/patientinfo/

AHCN: KnowledgeBase: colds
http://www.housecall.com/databases/ami/convert/000678.html

Beware: cold and flu season has arrived
http://www.bethelks.edu/collegian/archives/96.11.15/cold_and_flu.html

Childhood Infections - Common Cold
http://kidshealth.org/parent/common/cold.html

Colds
http://www.stayhealthy.com/hrd/DICOPr_CHRECO_Cods.htm

Cold_Facts
http://cavern.uark.edu/depts/healinfo/coldfact.htm

Colds and the Flu - The Ontario Lung Association
http://www.on.lung.ca/health/colds.html

Colds & Flus
http://www.bionu.com/coldsflus1.html

Colds, how to keep them from spreading
http://family.starwave.com/experts/leach/archive/le082296.html

Colds
http://www.familyinternet.com/peds/top/000678.htm

Colds
http://www.ctw.org/0196/019611t1.htm

Colds and Flus
http://www.uhs.berkeley.edu:80/students/HealthPromotion/coldflu.html

Cough, Cold, & Flu/FAQ
http://www.chsra.wisc.edu/chsra/chen-fu/qa0.htm

Cough, Cold, & Flu/INSTANT LIBRARY/Cold
http://www.chsra.wisc.edu/chsra/chen-fu/il1.htm

Fleeing the flu
http://www.paweekly.com/PAW/morgue/monthly/1995_Nov_22.FLUS

Health Source - Cold/Flu/Sinus Informati...
http://www.healthsource.com/store/cold.htm

Healthy.Net - Colds and Flu (See Influen...
http://205.180.229.2/clinic/dandc/colds/index.html

Managing Colds
http://www.enl.umassd.edu/InteractiveCourse/DLewis/ManagingColds.htm

MediaCity - Information Centre - Health ...
http://www.mediacity.com.sg/ic/health/hmflu.htm

MSU Student Health Center Web Pages
http://www.montana.edu/wwwhs/genhealth/comcold.html

New York University Health Services
http://www.nyu.edu/pages/health/html/NYUcold.html

THE COMMON COLD
http://www.netdoor.com/com/entinfo/coldcom.html

The Flu
http://www.netdoor.com/entinfo/flu.html

thrive@health
http://bubblemouth.pathfinder.com/thrive/health/bill.10-09-96.html

Untitled
http://www.nutrimed.com/COLDSFLU.HTM

Upper Respiratory Infections (Colds) and...
http://www.njc.org/MFhtml/URI_MF.html

Untitled
http://www.medhelp.org/general/cold.txt

Weekly Alibi.Feature. January 22
http://desert.net/disk$ebony/tw/www/alibi/01-22-97/feat-b.htm

When are colds contagious
http://www.cc.columbia.edu./cu/healthwise/0533.html

You First
http://www.youfirst.com/tips/atip2.htm

Search Topic 3 - Predetermined "Best" URL's

What kinds of animals live in a rainforest?

An Introduction to Understanding the Tro...
http://www.stevensonpress.com/intro.html

Biosphere 2 Rainforest
http://www.cc.columbia.edu/cu/biosphere2/josh/vir_tour/r_forest/index.htm

Endangered Tropical RainForest
http://www.csusm.edu/public/22crazy/ENDANGER.html

Explain the Amazon Rainforest Habitat
http://cord.iupui.edu/~tethais/learn.html

Get Real!: Biodiversity--Costa Rica [More Like This]
http://www.wpt.org/GetReal!/400/413/CR_BI/CR_BI.HTM

Kids' Action: Rainforest Animals
http://www.ran.org/ran/kids_action/animals.html

M.RYDER: TROPICAL RAINFOREST
http://dc.smu.edu/personal/pscholle/StudRepts/Rainforests/WEBSITE%20TEXT/index.html

Rainforest
http://lerc.nasa.gov/Other_Groups/K-12/bosau/Rainforest.html

Rainforest
http://www.mindsurf.com/

Rainforest Animals
http://mh.osd.wednet.edu:80/Homepage

Rainforest DB 1.4 index
http://www.gn.apc.org/LivingEarth/RainforestDB/Ecology/1.4/index.html

Rainforest Walk
http://www-ed.fnal.gov/linc/spring96/projects_linc2/rainforest/rainforestwalk.html

Science in the Rainforest: Take a Walk I...
http://www.pbs.org/tal/costa_rica/rainwalk.html

The Rainforest at Night
http://www.pbs.org/tal/costa_rica/night.html

The Rainforest Page
http://www.rusd.k12.ca.us/Kids_Stuff/rainfore.htm

The Virtual Rainforest: Animals
http://www.shs.org/rainforest/animals.html

Tropical Animals and Peoples
http://www.stevensonpress.com/animals.html

Tropical Rainforest in Suriname
http://www.euronet.nl/users/mbleeker/suri_eng.html

Untitled
http://ecology.kyoto-u.ac.jp/yumoto.html

WRI Article: "Tropical Forest Species Ri...
http://www.wri.org/biodiv/b01-koa.html

Appendix G

Searcher Satisfaction Posttest
Adapted from Ankeny (1991).

Stick ident. label here

Opinions of Your Searches Using the Excite Database

About this survey: There are no right or wrong answers. Please read each statement carefully, then circle the opinion you feel best represents your feelings about the statement. All information is collected anonymously, please be honest and accurate.

	Strongly Agree	Agree	not sure	Disagree	Strongly Disagree
1. The Excite database is a quick way to find information about a topic.	SA	A	N	D	SD
2. I produced effective statements when searching with Excite.	SA	A	N	D	SD
3. The Excite database retrieved good information, closely related to the topics	SA	A	N	D	SD
4. I experienced a lot of difficulties creating good search statements.	SA	A	N	D	SD
5. I experienced technical problems using the Excite database.	SA	A	N	D	SD
6. The Excite database retrieved a lot of information that was unrelated to my topic.	SA	A	N	D	SD
7. I was satisfied with the Excite database as a tool for locating information.	SA	A	N	D	SD
8. My search statements were not effective in finding documents related to the topic.	SA	A	N	D	SD
9. I would not use the Excite database to search for information in the future.	SA	A	N	D	SD

	Strongly Agree	Agree	not sure	Disagree	Strongly Disagree
10. I retrieved too many irrelevant documents for each of my search requests.	SA	A	N	D	SD
11. Most of the documents I found were closely related to the search topics.	SA	A	N	D	SD
12. My search statements produced a lot of good hits or URL's for the search topics.	SA	A	N	D	SD
13. Searching the World Wide Web for information is a frustrating experience.	SA	A	N	D	SD
14. I am an effective searcher when using the Excite database.	SA	A	N	D	SD
15. The Excite database was difficult for me to use.	SA	A	N	D	SD
16. I obtained good results with my search statements.	SA	A	N	D	SD
17. I did not know how to write good search statements for these topics.	SA	A	N	D	SD
18. I need more help writing good search statements to locate relevant documents.	SA	A	N	D	SD
19. I need more instructions or help on how to search using Excite.	SA	A	N	D	SD
20. I am not sure if search terms or search strategy used was good.	SA	A	N	D	SD

Thank you for taking the time to answer this survey honestly and accurately.