

A Content Analysis of Strategies and Tactics Observed Among MLIS Students in an Online Searching Course

Anita L. Ondrusek

*Department of Library and Information Studies, Valdosta State University, Valdosta, GA 31698.
Email: alondrus@valdosta.edu*

Xiaoai Ren

*Department of Library and Information Studies, Valdosta State University, Valdosta, GA 31698.
Email: xren@valdosta.edu*

Changwoo Yang

*Department of Library and Information Studies, Valdosta State University, Valdosta, GA 31698.
Email: cyang@valdosta.edu*

Online searching is a skill that all professional programs educating librarians consider an essential part of their curricula. However, investigations of online searching behavior have centered almost exclusively on end users, and there have been no recent formal studies that explore the online searching behaviors of MLIS students. In this study, the researchers conducted a qualitative content analysis by coding documents collected from assignments in an MLIS online searching course. The analysis used typologies derived from previous research that identified specific strategies and tactics employed in information retrieval. Taken as a whole, the results suggested that there are signposts instructors can expect to encounter when evaluating strategies and tactics in online searching assignments. The typologies provided the vocabulary needed to classify those strategies and tactics—a key ingredient for future studies of online searching performance.

Keywords: Database searching; Electronic information resource searching; Online information resource searching; Library and Information Science Education; Content analysis; Qualitative research

Introduction

As far back as the 1980s, many programs offering a master's degree in library science (MLS) recognized that the move to computerized information retrieval would affect how librarians provided materials to their patrons, and the faculties in those schools began adding online searching as a skill to their curricula (Fenichel & Harter, 1981). This development partly served as the impetus for MLS programs to broaden their scope to a master of library and information science (MLIS).

Today, typing a name, a phrase, or a few keywords into a search box provides lists of results that impress the untrained online searcher, but often do not provide the explicit information being sought. In this cyber-driven and hyper-connected world, more than ever, librarians still function as experts schooled to extract and evaluate information from the myriad choices of electronic collections available in the contemporary marketplace. Their online searching learning curve begins in their master's coursework as library and information science students.

This study categorizes the strategies

and tactics observed in searches conducted by a group of graduate library and information science students. In doing so, it elucidates the searching patterns observed in terms of the "signposts" that LIS educators can expect to encounter in the searches that they ask their students to perform.

Literature Review

The research on MLIS students and their searching habits has been sparse. Fenichel (1981) conducted a study on 72 searchers of ERIC, using 24 MLIS students enrolled in the Fundamentals of Library Information Science course to represent novice searchers. As part of her review on the research of online searching behavior, Ondrusek (2004) identified 20 studies using experimental designs. Three of those studies, described next, used MLIS students as subjects. The first example was a comparison study by Sullivan, Borgman, and Wipern (1989) that assigned 40 library school students into two experimental treatment groups and used search intermediaries as the control group. In another study cited in the Ondrusek review, Hsieh-Yee (1993) examined search experience and subject knowledge using 30 newly-trained library school students and 32 professional searchers. Vaughn (1993), the third study cited, recruited 61 students mostly from library science curricula to examine searching techniques crossed with prior search experience and gender.

Two other studies from Finland used students in library and information studies programs. Iivonen and Sonnenwald (1998) developed a model of search term selection as observed in searchers before their subjects went online. The authors characterized the process as one in which "searchers step into various discourses" and must navigate "many ways of thinking about a topic" (p. 313). Their study included 24 professional searchers and eight undergraduate information studies students who had received instruction in online searching. Vakkari (2000) showed

how information science students progressed through problem stages while preparing a research proposal connected to their choice of search terms and tactics.

Nicholson (2005) reported on the state of generalist search education in library schools and identified skills and knowledge areas for expert searching in medical libraries that apply broadly to strategies and tactics that should be nurtured in MLIS programs. Namely, he discussed identifying and clarifying an information need; understanding databases; developing a reflective, iterative, and heuristic search strategy; and evaluating and preparing results to meet the user's need (p. 63).

To date, researchers of online searching have accumulated a broad corpus of findings from past investigations that inform new research, and a significant proportion of their findings have been classified into typologies that identify distinctive strategies and tactics. For this study, strategies were defined as "a plan for the whole search" (Bates, 1979, p. 207). Tactics were differentiated from strategies as the "low-level individual actions" (Marchionini, 1995, p. 76) that generate shifts in search strategies to improve results, including search choices and actions that users apply to advance their searches (Fidel, 1991). The authors of this study consider it a follow-up examination of those strategies and tactics as documented on typologies from previous research but, in this case, analyzed through the lens of online searching performances of MLIS students.

Purpose and Research Questions

Unlike most search study participants who received minimum or no training in information retrieval prior to observations of their searching, MLIS students in an online searching course receive a repertoire of techniques on which to base searching decisions. Yet, no study has ever documented the searching habits and preferences of these students. The availability of

documents generated through assignments submitted by MLIS students for an online searching course created an opportunity to analyze student work products based on two assignments completed in the 2013 and 2014 courses.

This study poses the following research questions that may guide LIS educators:

RQ1: What search strategies do MLIS students use in online searching assignments?

RQ2: What search tactics do MLIS students use in online searching assignments?

Course Design

In the Master of Library and Information Science (MLIS) program at the Valdosta State University, an accredited American institution, a course in online searching is an elective course—one that builds upon the fundamentals of online searching that students receive in their core reference course. This course covers both the mechanics and the strategic thinking involved in the advanced searching of proprietary databases and the Internet. It is taught each spring semester. The materials for the assignments are instructor-developed handouts complemented by links to online tutorials and assigned readings from the literature on online searching. The students learn in an online, distance learning setting, using commercial courseware.

The first assignment introduced students to the search tactics developed by Bates (1979) in an example using gun violence in schools as the original query with term selections, formulations/reformulations including truncation (*) codes, and monitoring tactics explained as they occurred in the sample search (<https://www.slideshare.net/secret/51MmOx1rd8fSn>). Students then received search problems that tested their abilities to apply those tactics.

The search problem assigned in 2013 asked students to identify the *causes of school avoidance*. An article in Wikipedia

provided related terms for school avoidance and listed causes of this phenomena. The 2014 search problem asked students to identify *risks of in vitro fertilization* and introduced students to the wildcard (?) code. Again, a Wikipedia entry provided related terms for that topic. In both cases, students had shown their opening searches, select their “best” search, describe at least three tactics they used as defined by Bates, and cite five scholarly articles that either supported or disputed the conclusions presented in the Wikipedia entries.

The final course assessment was a client report in which students were paired and searched for articles that addressed topics presented to each other. They interviewed their partners, following recommendations on client interviews from Schwarzwaldner (1997), and formatted their final reports using guidelines recommended by Kangiser (2003). Altogether, they were assessed on the criteria as shown in the rubric in the Appendix.

Research Methods

For the project presented in this paper, the researchers conducted a qualitative content analysis to identify the strategies and tactics present in the online search assignments of the 35 MLIS students enrolled in the online searching course. Characteristics of students in the sample included 27 females and 8 males; 22 students with library work experience and 13 with no on-the-job library background. The final grade distributions were 25 As, 9 Bs, and 1 C.

The procedures for “data unitization” followed the recommendations made by White and Marsh (2006, p. 29). First, the sampling units were defined as the documents produced from the two assignments completed by the students during the 2013 and 2014 spring semesters. Next, the documents were broken into two units representing the previously described assignment types: the practice exercise assigned during the first quarter of the semester and

the client report created at the end of the semester. Finally, the search statements and accompanying narratives within both the practice exercises and the client reports served as the units of analysis—the basis for reporting search performances. All documents were coded manually on hard-copy printouts.

The Coding Schemes

Two separate coding schemes served as the data collection units—one for search strategies and one for search tactics. These schemes were mainly derived from previous studies on online searching behavior with a few codes added based upon observations made by the instructor who taught the course from 2004–2014. The research team reviewed each coding scheme item by item. For the strategy codes, they located examples of how codes were applied in previous studies (Ondrusek, 1999; Xie and Joo, 2010, 2012), streamlined definitions, and refined the coding nomenclature. For the tactic codes, they reviewed the articles by Bates (1979, 1987, 1992) to clarify definitions and, again, developed examples for each code.

Search Strategy Codes

The coding scheme for strategies consisted of 22 types of search strategies grouped into four categories: CONCEIVE (the conceptualization of where to start a search and what terms and moves to use initially); COMBINE (term combination); DESIGN (the architectural structure and re-design); and EVALUATE (assessment of results). This coding scheme will be described within the framework described by Xie and Joo (2012) which divided a search into beginning, middle, and ending phases. This framework accounts for planning, query formulation, moves, and evaluation of results.

At the beginning phase of the search process, searchers select databases suited to the search query. Iivonen and Sonnen-

wald (1998) identified the database as one of the six discourses that influenced selection of terms stating that “the database represents perspectives on a topic [and] what should be included in the topic area” (p. 378). Many studies on strategies target a specific database or a prototype collection of documents for searching by their search participants and omit database selection as part of the planning stage. A code for *Database selection* was added to this study’s coding scheme.

Extracting concepts from the search query and exploring and selecting terms to represent the concepts properly also occurs in the beginning phase of a search. Chen (1993) and Nahl and Harada (1996) discussed the importance of a searcher’s skill in topic analysis, or breaking queries into concepts and terms to be combined. Therefore, two strategic codes, *Term selection* and *Term exploration*, were added to this study’s coding scheme. Under *Term exploration*, three specific strategies observed in undergraduate students trained in searching by Ondrusek (1999) were incorporated into the codes: *Brainstorming*; *Systematic exploration*; and *Trial and error*. Finally, the code *Initial search strategy* was included to indicate decisions about term qualification made at the very start of the search.

Search term formulation takes center stage during the middle phase of a search. Here searchers decide how to combine the identified terms logically. Four codes represent actions at this phase: *Grouping* (terms together), *Decisions* (e.g., whether to search for exact phrases or split the phrases into words); *Boolean operators*, and/or *Proximity operators*. The final middle phase action is coded as a *Search reformulation* which occurs whenever a searcher makes changes to the search terms derived from the originally stated information request (Dalrymple, 1990). This includes rephrasing search terms by modifying either the order or the form of terms from the original search statement (Chen, 1993; Hsieh-Yee, 1993; Nahl, 1993).

The *Design* component of this phase refers to what may be thought of as the architecture of a search. Three different *Design* codes denoted the use of typical search structure strategies taught to the MLIS students: *Entering all terms into a search form at once*, *Building a search using sets* (block building), and *Building a search successively* (successive fractions). Chen (1993) observed that students in her study were re-qualifying some searches (e.g., switching from author to title searching)—a strategy switch that she felt was a reformulation even though it did not involve new search terms. To cover this action, a *Re-design* code was introduced as a search strategy. It reflects switching from a non-qualified search to a qualified search, or vice versa, classified under one of these four sub-codes: *Keyword to Sub-*

ject, Subject to Keyword, Keyword and other field(s) combination, and Field limits replacing keyword qualifications.

The final phase in strategic thinking during a search is evaluating results. Two codes were adopted from the study by Xie and Joo (2010) who divided those actions into Evaluating individual items and *Evaluating search results*. They found these two categories to be distinctive—the former focusing on one item at a time (which could be a document or a website), the latter consisting of a scan of results as a whole for relevance.

Table 1 presents the coding scheme in which each strategy is represented by a code, followed by its definition and an example of its application. The CONCEIVE category contained two codes with sub-divisions: *Term exploration and Ini-*

Table 1. Strategy Typology with Codes and Examples.

| Code | Search Strategy | Definition | Example |
|-----------------|------------------------|---|--|
| CONCEIVE | | Strategies used in initial planning | |
| C1 | Database selection | To match the query to an appropriate database | "I decided to search in ERIC since it is an education database." |
| C2 | Term selection | To extract terms from the search query | All initial terms come from the request. |
| C3 | Term exploration | Term collection from multiple sources | |
| C3.1 | Brainstorming | To explore self-generated terms | "After reading the articles provided, I got a general idea of some key terms." |
| C3.2 | Systematic exploration | To check the thesaurus or grow a pearl | "An exploration of both the thesaurus and the descriptors of several relevant citations yielded new terms . . ." |
| C3.3 | Trial and error | To insert various terms randomly | Term exploration shows no monitoring tactics (see Table 2) such as WEIGH or PATTERN. |
| C4 | Initial field settings | Those settings used in the first search | |
| C4.1 | Keyword | To use the default keyword setting | First search is all in keyword. |
| C4.2 | Qualified | To invoke field qualifier(s) | First search uses at least one qualifier. |
| C4.3 | Hybrid | To combine keyword(s) and qualifier(s) | First search qualifies one set of terms by keyword and another set of terms by another field. |

(continued)

Table 1 (continued). Strategy Typology with Codes and Examples.

| Code | Search Strategy | Definition | Example |
|-----------------|------------------------|--|--|
| COMBINE | | Development of term combinations | |
| TC1 | Grouping | To position terms in search form | Terms are grouped. |
| TC2 | Decisions | To decide on term combinations | Phrases are split or kept together. |
| TC3 | Boolean operators | To combine terms with Booleans operators | AND, OR, or NOT operators are used. |
| TC4 | Proximity | To use proximity operator(s) | The proximity operators w(ith), n(ear), pre/#, and w/# were introduced to students. |
| TC5 | Reformulation | To change the original term combination | Introduction of tactics (see Table 2) such as SPECIFY, REDUCE, PARALLEL, PINPOINT, BLOCK, VARY, or FIX, or any Re-design strategy (below in D4). |
| DESIGN | | | |
| D1 | All-term combination | To enter all terms at once | Use of the default advanced search form to enter all terms. |
| D2 | Block building | To build a search using sets | Use of the History search form to group terms and combine them using set notation. |
| D3 | Successive fractions | To build a search successively | Use of either the default or History search forms to enter grouped terms sequentially. |
| D4 | Re-design | Decisions to change qualifiers | |
| D4.1 | SU switch | To switch from keyword to subject | Search histories reveal this. |
| D4.2 | KW switch | To switch from subject to keyword | Search histories reveal this. |
| D4.3 | KW + field(s) | To combine keyword and other fields | Search histories reveal this. |
| D4.4 | Exclusive field-limits | To replace Keyword with other fields (author, title) or limits (peer review) | Search histories reveal this. |
| EVALUATE | | | |
| E1 | Individual items | To assess results item-by-item | Narratives in the assignments reveal this. |
| E2 | Search results | To assess the entire results list | Narratives in the assignments reveal this. |

tial field settings. The DESIGN category contained one sub-divided code labeled as *Re-design*.

Search Tactics Codes

The coding scheme of search tactics that has stood the test of time and been

widely referenced by researchers and educators in online searching research is that developed by Bates (1979) who defined a search tactic as “a move made to further a search” (p. 207). Bates classified 29 tactics under these four categories: Search Formulation, Term, File Structure, and Monitoring. The Bates typology was used

for this study and has been reprinted in its entirety with permission from John Wiley & Sons (Table 2). The examples (in the right column) were added using content from the practice exercises that served as target documents for this study.

The tactics of *Survey* and *Weigh* generated much discussion among the researchers. Bates (1979) categorized *Survey* as a File Structure Tactic. Since the MLIS students employed a sequence of actions that fit the definition of *Survey* at multiple decisions points throughout their searches, namely, they deliberated upon the databases to search, checked the thesauri or

subject headings displayed in citations, reviewed results, identified tactical options available for the next step, and based their subsequent tactics on the viable option(s), the *Survey* tactic was, therefore, used as a code to indicate that sequence of moves. The *Weigh* code was assigned whenever students expressed a search goal, designed or re-designed search queries to achieve that goal, and reflected upon the effectiveness of the search afterwards. These moves were assumed to be indicators of reducing time spent on searches and increasing searcher efficacy which resulted in "cost benefits."

Table 2. Bates Tactic Typology with Codes and Examples.

| Code | Search Tactic | Definition | Example |
|-----------------------------------|---------------|--|---|
| SEARCH FORMULATION TACTICS | | Tactics to aid in the process of designing or redesigning the search formulation. | A search on causes of school avoidance. |
| S1 | Specify | To search on terms that are as specific as the information desired | Keeping phrases together in quotes, e.g., "school avoidance" rather than school AND avoidance |
| S2 | Exhaust | To include most or all elements of the query in the initial search formulation; to add one or more of the query elements to an already prepared search formulation | "school avoidance" AND causes |
| S3 | Reduce | To minimize the number of elements of the query in the initial search formulation; to subtract one or more of the query elements from an already-prepared search formulation | Eliminating causes and all its equivalent terms from the search |
| S4 | Parallel | To make the search formulation broad (or broader) by including synonyms or otherwise conceptually parallel terms | ("school avoidance" OR "school refusal") AND (causes OR reasons) |
| S5 | Pinpoint | To make the search formulation precise by minimizing (or reducing) the number of parallel terms, retaining the more perfectly descriptive terms. | ("school avoidance" OR "school refusal") AND causes |
| S6 | Block | To reject, in the search formulation, items containing or indexed by certain term(s), even if it means losing some document sections of relevance | ("school avoidance" OR "school refusal") AND causes NOT truancy |

(continued)

Table 2 (continued). Bates Tactic Typology with Codes and Examples.

| Code | Search Tactic | Definition | Example |
|-------------------------------|---------------|---|---|
| TERM TACTICS | | Tactics to aid in the selection and revision of specific terms within the search formulation. | A search on risks of <i>in vitro</i> fertilization |
| T1 | Super | To move upward hierarchically to a broader (superordinate) term | <i>in vitro</i> fertilization OR assisted reproductive therapy |
| T2 | Sub | To move downward hierarchically to a more specific (subordinate) term | <i>in vitro</i> fertilization AND ("birth defects" OR "congenital malformations" OR "premature births") |
| T3 | Relate | To move sideways hierarchically to a coordinate term | N/A ¹ |
| T4 | Neighbor | To seek additional search terms by looking at neighboring terms, whether proximate alphabetically, by subject similarity, or otherwise | N/A ¹ |
| T5 | Trace | To examine information already found in the search in order to find additional terms to be used in furthering the search | "I picked up the terms <i>perinatal outcomes</i> and <i>consequences</i> that were used a lot in the results." |
| T6 | Vary | To alter or substitute one's search terms in any of several ways | Modifying <i>risk*</i> OR <i>complicat*</i> to <i>risk*</i> OR <i>complicat*</i> OR <i>consequence*</i> |
| T7 | Fix/ | To try alternate affixes, whether prefixes, suffixes, or infixes. Includes truncation or wild cards in any form. | Modifying <i>in vitro</i> fertilization AND risks to <i>in vitro</i> fertilization AND <i>risk*</i> |
| T8 | Truncation | To reverse or rearrange the words in search terms in any or all reasonable orders | <i>in vitro</i> fertilization OR fertilization <i>in vitro</i> |
| T9 | Rearrange | To search for the term logically opposite from that describing the desired information | <i>in vitro</i> fertilization AND positive outcomes |
| T10 | Contrary | To search under a different spelling | <i>in vitro</i> fertilization OR <i>in vitro</i> fertilisation |
| T11 | Respell | To try spacing variants | N/A ¹ |
| FILE STRUCTURE TACTICS | | Tactics for threading one's way through the file structure of the information facility to desired file, source, or information within source. | Continuing the search on (<i>in vitro</i> fertilization OR assisted reproductive therapy) AND (<i>risk*</i> OR <i>complicat*</i> OR <i>consequence*</i>) |
| F1 | Bibble | To look for a bibliography already prepared, before launching oneself into the effect of preparing one; more generally, to check to see if the search work one plans has already been done in a usable form by someone else | N/A ¹ |
| F2 | Select | To break complex search queries down into sub-problems and work on one problem at a time | "I searched <i>assisted reproductive therapy</i> AND (<i>risk*</i> OR <i>complicat*</i> OR <i>consequence*</i>) to see how often <i>in vitro</i> fertilization was in the results." |

(continued)

Table 2 (continued). Bates Tactic Typology with Codes and Examples.

| Code | Search Tactic | Definition | Example |
|---|---------------|---|--|
| FILE STRUCTURE TACTICS (continued) | | | |
| F3 | Survey | To review, at each decision point of the search, the available options before selecting | "After removing the acronyms IVF and ART, results narrowed significantly in both Academic Search Complete and Research Library. However, within a few pages of results, only a few sources were relevant. More strategies are needed." |
| F4 | Cut | When selecting among several ways to search a given query, to choose the option that cuts out, eliminates, the largest part of the search domain at once. | N/A ¹ |
| F5 | Stretch | To use a source for other than its intended purposes | N/A ¹ |
| F6 | Scaffold | To design an auxiliary, indirect route through the information files and resources to reach the desired information | N/A ¹ |
| F7 | Cleave | To employ binary searching in locating an item in an ordered file | N/A ¹ |
| MONITORING TACTICS | | Tactics to keep the search on track and efficient. | Continuing search on causes of school avoidance. |
| M1 | Check | To review the original request and compare it to the current search topic to see that it is the same | "When adding the more general term <i>school attendance</i> . . . results were less relevant, so I removed it from the search." |
| M2 | Weigh | To make a cost-benefit an assessment at one or more points of the search, of current or anticipated actions | "I found that when separating the word <i>school</i> from <i>avoidance</i> and <i>refusal</i> , many of the search results were off-topic. By making sure to search the words as a phrase, I got much more relevant articles than I was otherwise discovering." |
| M3 | Pattern | To make oneself aware of a search pattern, examine it, and redesign it if not maximally efficient or if out of date | "I originally included the terms <i>phobia*</i> and <i>anxiet*</i> in the search, but got too many articles related to social causes other than school." |
| M4 | Correct | To watch for and correct spelling and factual errors in one's search topic | "[The terms] <i>trigger*</i> , <i>explanation*</i> , and <i>diagnos*</i> . . . were pulled out [because they] bring a different connotation to school phobia." |
| M5 | Record | To keep track of trails one has followed and of desirable trails not followed up or not completed | "The search formulation tactic SPECIFY was used by searching for either of the three variants (<i>school avoidance</i> OR <i>school refusal</i> OR <i>school phobia</i>) and then adding [one by one] <i>bully*</i> (yielded 150 results), <i>anxiety*</i> (yielded 172 results), and <i>depress*</i> (yielded 150 results)." P.S. Also an example of the F2 tactic above. |

¹N/A—Codes not applied in the practice exercises.

Data Analysis

Several rounds of coding were conducted by two researchers who previously taught the online searching class and a third researcher who ultimately assumed responsibility for data visualization. The coding process began with a pilot study in which the three researchers coded 16 practice searches completed by students from the spring 2010 semester. This pilot coding session was done as a group so that the team could review their applications of the codes, discuss discrepancies in their interpretations of the coding rules, and reach consensus for each code.

Once a satisfactory level of consistency in coding was achieved through the practice trial, the coding of the spring 2013 and spring 2014 assignments began. The names of students were removed from each document. All three researchers received copies of all assignments—35 practice exercises and 35 client reports. Each practice exercise was coded independently by two researchers; each client report was coded independently by all three researchers. They analyzed all text in the documents including: narrative passages; lists of terms, citations, or sources (for example, databases or websites used); and the facsimiles of search histories that students were required to include as an appendix to each Client Report.

Using the alphanumeric codes from the coding schemes, the researchers coded strategies and tactics where they occurred in the hard copies of the students' assignments. Each coded type was marked as many times as it appeared in each document. The researchers also made margin notes to document their thinking processes.

Inter-coder reliability, based on percentages calculated from 1007 cases derived from the coding reached 81% agreement. This percentage did not include the re-scans of the *Survey* and *Weigh* tactics that were conducted singularly by two of the coders and are described in the Results

and Discussion section. When the results from the third coder who did not teach the online searching course were removed, the agreement rose to 85%—"a minimal benchmark to those most concerned with an evidentiary statistic" (White & Marsh, 2006, p. 39). Since this study was qualitative, the numerical reliability rating was less important than reaching consensus "with each point of difference being debated and clarified until the [team] agreed on appropriate usage of the set of codes" (Harry, Sturges, and Klingner, 2005, p. 6).

In the client reports, students were required to explain their strategies and tactics in language that a client not trained in expert searching would understand. Narratives from the "Sources Consulted," "Search Strategies," and "Key Findings" sections of the client reports provided a wealth of data that revealed the thought processes behind searching decisions. An excerpt from a student search who experimented successfully with many complex strategic and tactical techniques and showed no errors in her searches has been parsed out to align statements from the report with the codes assigned (Table 3). The sentences listed together in a cell on the table were organized into paragraphs in the original document. To analyze statements such as those in the sample required latent coding on the part of each coder, for instance, the coders used their judgment to interpret the meaning of phrases or passages.

Students had to supply a screen capture of their search histories in their client reports. An example from the same student's work represented in Table 3 has been reformatted in Table 4 in order to show strategy and tactic progression from top to bottom and to include the codes. In the original document, the student entered her searches into a search form, and the search platform in use, not the student, generated the parenthetical statements replicated in this table. The details included on the search history table produced by many commercial search platforms allow

Table 3. Samples of Coded Segments from the Narrative of a Client Report.

| Search request: Research on sexual violence against Native American women from academic/scholarly sources or government reports within the last 10 years. | Codes |
|---|------------|
| "Because you requested that the results returned have an academic /scholarly perspective, I researched your topic in several reputable research databases." | C1 |
| "[Database name redacted] is known as a leading source of articles in the social sciences and humanities field, which suits your topic well." | F3 |
| "Because the provision of full-text results was not a requirement of your search request, I searched several subject-specific abstracting and indexing databases." | M1 |
| "To begin the search, I broke your search request into four concepts: factors, sexual violence, North American, and women." | C2 |
| "However, these words alone tended to yield a small amount of results." | M2 |
| "In an attempt to retrieve more results, I reviewed the results . . . to look for synonyms to your search terms that might also be used in other articles . . . I also checked the list of preferred terms used in each database." | F3 C3.2 |
| " . . . it appeared initially that including the term "factors" and its equivalents actually limited the number of results and eliminated relevant ones." | M2 |
| "To verify this, I started with one search concept and gradually added each additional concept in order to [find] . . . the search concept that was limiting results." | F2 D3 |
| "It turned out that [the problem was these terms] . . . used in combination with the search concept "women" . . ." | M3 |
| "Research indicates that while sexual violence against Native American women is not a new issue, it is one that is just recently emerging into public knowledge. As an example, a 2007 study by Amnesty International . . . was called 'groundbreaking" and a 2013 article detailing studies to be undertaken by the US government described the studies as "baseline." | E1 |
| "While you indicated that you were not interested in domestic violence as much as sexual violence, the search results revealed that these two subjects are sometimes addressed together." | E2 |

for content analysts to make use of manifest coding, i.e., the output makes explicit what strategies and tactics were employed.

After coding all practice exercises and client reports, two spreadsheets were created to transfer the relevant data into Excel. The letters (O, R, and Y) in the cells

are the initials of each coder's last name. The horizontal rows of codes indicated the extent to which students were applying each code and indicated the agreement between coders. For example, Figure 1 clearly shows how the CONCEIVE strategies of C1 Database selection and C2 Term

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | |
|----|------------------------|--------------|-----|-----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1 | CODES | Assignment # | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 |
| 2 | STRATEGIES CODE BOOK | | | | | | | | | | | | | | | | |
| 3 | CONCEIVE | | | | | | | | | | | | | | | | |
| 5 | C1. DATABASE SELECTION | OYR | OYR | OYR | OYR | OR | OYR |
| 6 | C2. TERM SELECTION | OYR | OYR | OYR | OYR | OR | OYR |
| 7 | C3. TERM EXPLORATION | | | | | | | | | | | | | | | | |
| 8 | - C3.1 | OYR | YR | OYR | OYR | OR | OYR | ORY | RY | OYR | RY | RY | OYR | OYR | OYR | OYR | OYR |
| 9 | - C3.2 | OYR | OYR | OYR | OYR | O | OYR |
| 10 | - C3.3 | | | | | OR | | | | | | | | | | | |

Figure 1. Interpreting data rows in the coded spreadsheets. This highlighted excerpt shows how codes in rows were used to notate the use of each application by its code and coder agreement.

| | | | | | | | | | | | | | | | | | |
|----|---------------|-----|-----|-----|-----|----|-----|----|-----|----|-----|-----|-----|-----|-----|-----|--|
| 21 | DESIGN | | | | | | | | | | | | | | | | |
| 22 | D1 | OY | OY | OYR | OYR | OR | OYR | OR | RY | RY | OY | OYR | RY | OYR | OYR | O | |
| 23 | D2 | OYR | OYR | | | OR | OYR | | OY | OR | OYR | | OYR | | OYR | | |
| 24 | D3 | | | OR | | | | | OYR | | OY | | O | | | OYR | |
| 25 | D4. RE-DESIGN | | | | | | | | | | | | | | | | |

Figure 2. Interpreting data columns in the coded spreadsheets. This highlighted excerpt shows how codes in columns were used to notate applications by student and coder agreement.

selection were applied by all students (21-35) and inter-coder agreement was almost unanimous. The vertical columns of the spreadsheet also proved to be instrumental in isolating searching patterns as can be seen in Figure 2 which highlights a small group of students who progressed from the D1 *All-term entry of terms* to the D2 *Block building* and D3 *Successive fraction* strategies. Recurring codes within individual documents were counted once per document on the spreadsheet even though many documents revealed the repetitive

observations of strategies and tactics. In effect, the spreadsheets and the frequency counts reflect overall search patterns rather than grand totals for observations.

Results and Discussion

Overwhelmingly, the results of the searches created by MLIS students in this study showed a preference for reformulating terms rather than redesigning the overall structure of a search. This can be detected in a multitude of reformulation

Table 4. Samples of Coded Segments from the Search History of a Client Report.

| Set #s | Search Statements | Codes |
|--------|--|-------------------------------|
| Set1 | factor* AND "sexual* violen*" AND "native* america* AND wom?n | C2 C4.1 D1 S2 TC3 |
| Set2 | (factor* or contribut* or cause*) AND ("sexual* violen*" or "sexual* assault*" or rape* or "sexual* abuse*" or "sex crime*") AND ("native* america* or America* n2 indian*) AND (wom?n or female*) | S2 S4 TC4 |
| Set3 | "native* america* or America* n2 indian* | |
| Set4 | ("native* america* or America* n2 indian*) AND ("sexual* violen*" or "sexual* assault*" or rape* or "sexual* abuse*" or "sex crime*") | |
| Set5 | ("native* america* or America* n2 indian*) AND ("sexual* violen*" or "sexual* assault*" or rape* or "sexual* abuse*" or "sex crime*") AND (wom?n or female*) | D3 |
| Set6 | ("native* america* or America* n2 indian*) AND ("sexual* violen*" or "sexual* assault*" or rape* or "sexual* abuse*" or "sex crime*") AND (wom?n or female*) AND (factor* or contribut* or cause*) | |
| Set7 | ("native* america* or America* n2 indian*) AND ("sexual* violen*" or "sexual* assault*" or rape* or "sexual* abuse*" or "sex crime*") AND (factor* or contribut* or cause*) | S5 S3 |
| Set8 | s5 or s7 | D2 |
| Set9 | Limiters – Date of Publication 20040101-20141231 | D2 S6 |

efforts coded as TC5 *Vary*, a term combination tactic that, *in toto*, encompassed any changes that occurred after the initial search formulation coded as S1-S6 SEARCH FORMULATION TACTICS and T5-T7 TERM TACTICS. The D1-D3 DESIGN strategies and the D4.1-D4.4 RE-DESIGN strategies were mostly applied to fulfill requirements for the Client Report.

The diagram in Figure 3 shows that students were using many strategies and tactics in the early practice exercises and sustained the use of those techniques throughout their searches for the client reports. It also shows at what points in the search process strategies and tactics were most likely to occur. Details will be discussed in the sections that follow.

Use of Search Strategies

Because the practice exercises were assigned near the start of the course, students understandably had fewer options for varying search strategies. Even in this

early highly-structured exercise where students were told what databases to use and directed to the Bates tactics and a Wikipedia article as guides, strategic decision making was evident in many of the searches. Below are illustrations of two approaches used to answer the same request for articles on the risks of in vitro fertilization.

One student identified this as her “best” search (parentheses added for clarity):

(“in vitro fertilization” OR IVF OR “assisted reproductive technology”) AND (risk* OR complication* OR defect*) AND (birth* OR pregnan*)

Her reasons were: “I ended up adding a third line to the search related specifically to the concept of birth/pregnancy, as many of the risks/complications listed on the Mayo Clinic and MedlinePlus webpages were related to that topic.”

This narrative shows evidence of what Iiovnen and Sonnenwald (1998) referred to as a “document” tactic--navigating to a

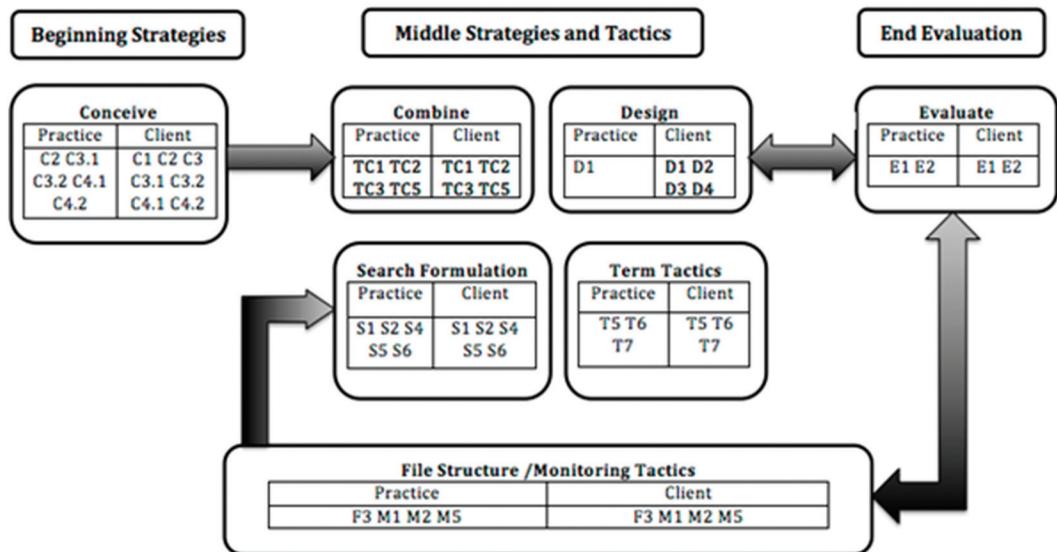


Figure 3. Most-observed strategies, tactics, and errors. The codes are grouped under the place in the search process where they most occurred (beginning, middle, or end), by sub-classifications (e.g., Combine and Design are sub-classifications of mid-search strategies), and by the assignment type (practice exercise or client reports). *Note:* Conceive, Combine, Design, and Evaluate are defined in the Strategies section on Table 1. Search Formulation, Term Tactics, File Structure/Monitoring Tactics are defined in Table 2.

source to make term selection decisions. Using Bates's classifications, this tactic was coded as a *Trace*. Adding the third line to narrow to birth or pregnancy is a *Specify* tactic of a higher order. In addition, the student kept only the most productive terms for the risks factor—an example of the *Pinpoint* tactic. An overall strategic plan emerges—the student sought risks as yet unknown to test the validity of the risk claims in Wikipedia.

In contrast, another student entered a string of terms listed as risks in the Wikipedia article. This search string was coded as a *Sub* tactic, a hierarchical move down-

ward to more specific terms, even though the searcher never dropped the broader terms. This student's strategy was to use presumed known risks to confirm the validity of the Wikipedia claims.

risk* OR depression OR stress OR complication* OR birth defect* OR ectopic pregnancy OR ovarian hyperstimulation syndrome OR infection* OR neurodevelopment delay OR cancer* OR miscarriage.

However, it was in the analysis of the client reports submitted at the conclusion of the semester that the authors found the

Table 5. Most-Observed Strategies Comparison Chart.

| STRATEGY CODES AND DESCRIPTORS | Number of students who used the strategies based on a total of 35 documents analyzed. | |
|--|---|----------------|
| | Practice Exercises | Client Reports |
| CONCEIVE | | |
| C1. Database Selection | N/A ¹ | 35 (100%) |
| C2. Term Selection (from original request) | 35 (100%) | 34 (97.14%) |
| C3.1. Brainstorming | 35 (100%) | 35 (100%) |
| C3.2 Systematic Exploration | 28 (80%) | 35 (100%) |
| C4.1. Default Keyword Used | 34 (97.14%) | 35 (100%) |
| C4.2. Field Qualifiers Invoked | 34 (97.14%) | 33 (94.3%) |
| COMBINE | | |
| TC1. Grouping | 35 (100%) | 35 (100%) |
| TC2. Decisions | 35 (100%) | 35 (100%) |
| TC3. Boolean Operations | 35 (100%) | 35 (100%) |
| TC4. Proximity | N/A ¹ | 25 (71.42%) |
| TC5. Reformulation | 34 (97.14%) | 35 (100%) |
| DESIGN | | |
| D1. All Term Combination | 35 (100%) | 34 (97.14%) |
| D2. Block Building | N/A ¹ | 12 (34%) |
| D3. Successive Fractions | N/A ¹ | 21 (60%) |
| D4.1. Keyword switch to Subject | N/A ¹ | 9 (25.71%) |
| D4.3. Keyword + Subject | N/A ¹ | 18 (51.42%) |
| EVALUATE | | |
| E1. Individual Items | 35 (100%) | 35 (100%) |
| E2. Search Results | 26 (74.3%) | 32 (91.40%) |

¹N/A—Codes not applied in the practice exercises.

most compelling evidence of preferences for strategies. The table in Appendix B reveals the “signposts” of preferred strategies that LIS educators can expect to encounter in the searches that they ask their students to perform.

All but one student began *Term Selection* by culling relevant terms from the original query. *Brainstorming* came next. *Decisions*, *Grouping* and selecting *Boolean* operators on the search form using the *All term combination*, and accepting *Default keyword* as the setting followed. All students used a *Reformulate* strategy at some point in subsequent search iterations, mostly making use of *Parallel*, *Block*, *Vary*, or *Fix* tactics. All students executed the E1 *Evaluate Individual Items* strategy. For a comparison of strategy use between the practice exercises and the client reports, see Table 5. Note that there increases in two strategies: *Systematic exploration* and E2 *Evaluation of search results*. Students selectively applied proximity operators and the alternative search architectures of block building and successive fractions. In general, less than half the students re-designed their searches by applying or experimenting with field limits and just about half experimented with combined keyword-subject terms.

Use of Search Tactics

The MLIS students in this study drew heavily upon search tactics to formulate and reformulate searches for both the practice exercises and their client reports. This might be explained by the fact that they were exposed early on to the Bates typology of search tactics, and that many tactics classified on that typology are rather intuitive, particularly in the sub-divisions of SEARCH FORMULATION and TERM tactics.

Using 33 of 35 students (94.3% or higher) as a baseline, the analysis of search tactics revealed consistent reliance on a small number of tactics throughout both the practice exercise and the culminating

client searches: Table 6 shows that these tactics were observed most: *Check*, *Record*, *Parallel*, *Vary*, and *Fix/Truncate*. In contrast, using the same baseline, *Weigh* and *Survey*, progressed from low use in the practice exercise to high use in the culminating searches. *Block* and *Trace* tactics also increased in usage. The *Specify* and *Pinpoint* tactics dropped in use in the client report assignment.

Xie and Joo (2012) reported that monitoring tactics, which they defined as examining the search process or checking [its] current status, took place more in the ending phase of a search where their study participants were evaluating the results for relevance (p. 266). Since their findings were based on sophisticated quantitative analytics, it is difficult to make comparisons to qualitative observations. However, using the client reports from the MLIS student, monitoring techniques were in evidence starting in the early stage of the search when most students applied the *Check* tactic to make sure the database selections and/or the initial term selections fit the client request, continuing throughout the middle phase where most students used *Weigh* and *Record* to judge the effects of their search reformulations, and culminating in strategies to Evaluate relevance of results. In fact, in a final re-scan of the client reports, there were 13 documents (37% rounded) in which students used the *Survey* tactic combined with recurring use of other monitoring tactics *Check*, *Weigh*, *Pattern*, and *Record* throughout the search process.

Deciding to search databases one at a time with terms specific to each database is one way of reformulating searches based on term changes, and it was a tactic used by many students. In their study using untrained searchers, Xie and Joo (2012) reported that “participants unfamiliar with the topic were likely to use multiple IR systems and create queries for each system” (p. 263). However, the MLIS students who used this tactic often justified it, stating that they customized their

Table 6. Most-Observed Bates Tactics Comparison Chart.

| TACTIC CODES AND DESCRIPTORS | Number of students who used the strategies based on a total of 35 documents analyzed. | |
|-----------------------------------|---|----------------|
| | Practice Exercises | Client Reports |
| MONITORING TACTICS | | |
| M1. Check | 33 (94.3%) | 35 (100%) |
| M2. Weigh * | 24 (68.5%) | 34 (97.14%) |
| M5. Record | 35 (100%) | 35 (100%) |
| FILE STRUCTURE TACTICS | | |
| F3. Survey * | 30 (85.7%) | 35 (100%) |
| SEARCH FORMULATION TACTICS | | |
| S1. Specify | 33 (94.3%) | 29 (75.86%) |
| S2. Exhaust | 31 (88.6%) | 34 (97.14%) |
| S4. Parallel | 33 (94.3%) | 33 (94.3%) |
| S5. Pinpoint | 32 (91.40%) | 12 (34%) |
| S6. Block | 29 (82.9%) | 32 (91.40%) |
| TERM TACTICS | | |
| T5. Trace | 21 (60%) | 29 (75.86%) |
| T6. Vary | 34 (97.14%) | 35 (100%) |
| T7. Fix/Truncation | 33 (94.3%) | 35 (100%) |

*One researcher assumed responsibility for the second round of coding for this tactic.

terms to fit controlled vocabularies of disparate databases to retrieve the most relevant results. The other approach used by the remaining MLIS students was to enter the same set of terms and term combinations repetitively from one database to the next. In these cases, most students started with the tactics of *Exhaust* (at least one term representing each facet) and *Parallel* (lots of equivalent terms for each facet) and then moved to tactics such as *Pinpoint* (winnowing terms down to the most productive ones) and *Block* (mostly in the form of applying limits for date, peer review, and full-text).

Benefits and Limitations of the Study

The primary benefits of conducting a content analysis based on target documents such as the ones used in this study are the collection of data from simulations of real

world search queries and the reduction of researcher bias. This study also has a number of limitations. It examined the performances of 35 students who were trained to search using a particular pedagogy—starting with the application of Bates's tactics and ending with an assignment that placed certain inherent restrictions on searching related to database availability and the nature of the topics assigned to each student. Although students received instruction and examination items on searching the Web and discovery systems, this analysis concentrated solely upon what MLIS students do when confronted with searches in indexed databases primarily because previous research used to develop the typologies concentrated on those sources.

Conclusion

This study brings to light a confluence of online searching strategies and tactics

as they apply to MLIS education. The analysis provides a record of information retrieval techniques that may serve as baseline data for MLIS educators and future researchers in need of a set of formal variables that occur in online searching behavior. The typologies provide a framework for those variables. The results of the analysis also identified specific strategies and tactics that MLIS students prefer and those that they neglect. The overall results support the validity of the typologies in that the classifications were a good fit to the techniques applied in the search assignments. Therefore, the findings on strategy and tactic applications could be used to develop course content, practice exercises, and assessments.

Having a classified set of strategies and tactics as a baseline for searching behavior opens avenues to other types of research. For example, an investigation of alignment of observed search strategies and tactics with the phases or stages in accepted information seeking models would require a set of standard strategies and tactics. The techniques classified on the typologies provide that standard. Another potential area for research, an examination of the variability in student effort, relies upon a standard set of variables. Again, a typology codifies these variables. Therefore, a secondary outcome from this study was the validation of the vocabulary used in the typologies. For future analyses of online searching performance, standard terminology is a key ingredient.

Endnote: Approval for this study was obtained from the Valdosta State University.

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Appendix

Grading Criteria for the Client Report

| Points | Score | REQUIRED ELEMENTS |
|---|-------|---|
| | | <p>Format is professional in design and easy to follow. All sections are labeled and paginated—starting with your cover page and ending with your appended section(s)</p> <p>No points for formatting. If it is lacking, your report will be returned to you for editing.</p> |
| 2 pts. | | <p>Your consultation with your client is well developed in Section I.</p> <ul style="list-style-type: none"> <input type="checkbox"/> You describe how contact with the client was initiated and maintained <input type="checkbox"/> What questions you asked in the initial interview <input type="checkbox"/> How you checked back with the client |
| 3 pts. | | <p>You included at least five databases in Section II.</p> <p>These databases represented:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Both multi-subject and special subject collections <input type="checkbox"/> Both EBSCO and ProQuest platforms <input type="checkbox"/> Content appropriate to the client's topic |
| 1 pt. | | You recommend a Web search engine or directory somewhere in your report |
| 2 pts. | | <p>Your search strategies discussion in Section III shows that you explored search terms:</p> <ul style="list-style-type: none"> <input type="checkbox"/> From the client's request <input type="checkbox"/> Derived from the thesaurus <input type="checkbox"/> Grown from a pearl <input type="checkbox"/> Ascertained through other legitimate sources |
| 6 pts. | | The content of Sections IV and V reflects maximum effort in filling the client's request and communicating results to that client. |
| 5 pts. | | <p>Your bibliography entries in Section VI are:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Relevant to the topic <input type="checkbox"/> From acceptable sources <input type="checkbox"/> Formatted in a suitable style |
| 5 pts. | | <p>Your search histories in Section VII show that at some point (not necessarily in every search) you used these search strategies, including, but not limited to:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Exploration of equivalent terms <input type="checkbox"/> Correct truncation <input type="checkbox"/> At least one effective proximity operation <input type="checkbox"/> Application of field limits IF appropriate to the request <input type="checkbox"/> ONE of these techniques successfully applied: <ul style="list-style-type: none"> • Block building (combining sets from the search history) OR • Searching by successive fractions (entering terms in succession) |
| 24 pts. | | |
| <p>Grades: 24-23-22 pts. = A 21-20-19 pts. = B 18-17 pts. = C 16 pts. and below = sub-standard effort</p> | | |