

Professional Education in Expert Search: A Content Model

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This paper presents a descriptive model of the subject matter taught in courses on expert search in ALA-accredited programs, answering the question: What is taught in formal professional education on search expertise? The model emerged from a grounded content analysis of 44 course descriptions and 16 syllabi, and was validated via a review of literature on search instruction. The model provides a framework for further research on the pedagogy of professional search education, and its role in the development of search expertise.

Keywords: search expertise, professional search, online search, search education, qualitative content analysis

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Search expertise falls along a spectrum, with professional expert searchers at one end and novice searchers at the other. The learning process involved in gaining expertise has received limited research attention. One obvious and important source of search expertise is formal education in LIS programs, but few studies have investigated how professional education contributes to the development of expert knowledge in this area. Understanding how expertise is gained will aid in the development of new approaches for supporting the acquisition of expertise through instruction and system design. In a step toward that goal, the present study addresses the question: What is taught in formal professional education on search expertise? The last comprehensive study on this question was reported by Hsieh-Yee in 1997.

This paper presents a descriptive model of the subject matter taught in courses on expert search in graduate programs

accredited by the American Library Association (ALA). Specifically, the study focuses on general, *domain-independent* courses, in contrast with *domain-specific* courses in areas such as medicine, government documents, or legal information. The model was developed via grounded content analysis of course descriptions, thus it describes *what* is taught, but not *how* it is taught. Search is one subject area in programs of study in LIS, and the content of search education is but one component of the professional knowledge comprising that curriculum (Levander & Mikkola, 2009). A complete analysis of search education would cover this broader context, as well as learning goals, teaching methods, feedback, and assessment, but these are beyond the scope of this paper.

Lucas and Topi (2005) examined search education in the context of a *training* paradigm, but the present study adopts the framework of *professional education* (Eraut, 1994; Rubin & Rubin, 2012), where the learning objectives are *competence* and *understanding* in preparation for skilled professional practice (Kinchin

& Cabot, 2010; Shulman, 2005). In this view, professional expertise arises from two learning processes. In one process, students gain competence by practicing the procedures of the profession, with emphasis on performance. In the other process, students gain understanding by learning *why* practice is structured as it is, and *how* practice is adapted in differing circumstances; here the emphasis is on reasoning, judgment, and values. Expertise, or skilled professional practice, develops with increased fluency in the transitions between the two forms of knowledge. The present study provides context for future analyses of student learning, and offers a framework for broader discussion of the curricula and pedagogy of search education.

The remainder of the paper is organized as follows. First, a literature review provides background on the evolution and role of search education, and related prior studies. We then describe the research method. The next section presents the model, which we then validate by means of a second literature review. The paper concludes with a summary and discussion of future work.

Literature Review

Evolution and Role of Search Education

Before the advent of natural language queries and ranked retrieval, online search required an understanding of database structures and a command of the counter-intuitive Boolean query language. Expert searchers served as master “operators” of retrieval systems (Mignon, 1978; Tenopir, 1989). Through the 1990s, as information providers adopted new user-friendly approaches, it became possible to search without mastery of esoteric languages and difficult interfaces (Harman & Candela, 1990; Harman, 1992; Tenopir & Cahn, 1994; Turtle, 1994). End-users could search on their own behalf without the need of an intermediary (Drabenstott, 2004; Tenopir, 2001). With subsequent

growth in web-based sources, new issues such as source credibility and authentication emerged. As the information environment evolved, professional search education broadened to include new tools, methods, and resources (Nicholson, 2005) and a focus on search interaction (Xie & Cool, 1998).

While search has been greatly simplified for novices and experts alike, expert search remains essential in information-intensive domains such as medicine, the law, and industry. In medical librarianship, search expertise is essential to the professional specialization. Searching is discussed extensively in the literature (Golder & Loke, 2012; Tannery & Maggio, 2012) and the value of expert search has been demonstrated in clinical and research settings (Gardois *et al.*, 2011; Karimi *et al.*, 2010). Indeed, the Medical Library Association (2003) has a formal policy statement on the role of expert searching in health science libraries. Search expertise is also crucial in broader areas of research and analysis, such as legal research (American Association of Law Libraries, 2010; Gotchall, 2010; Wright, 2008), competitive intelligence, and intellectual property analysis (Brown-Syed, 2011; Falciola, 2009; Heinis, 2004). More generally, the Special Libraries Association (2003) includes the application of tools and technologies to improve information retrieval (IR) among its list of competencies for information professionals.

As pointed out by DiMattia (2007), expert search skills also remain important in public and academic libraries, where patrons with complex needs are likely to require assistance with resources such as periodical databases. Searching is one of five main areas of behavioral performance for reference and information service providers, as stipulated by the Reference and User Services Association, a division of the ALA (2004).

Today’s LIS students enter graduate programs already immersed in the information environment, well experienced in

finding information. They may even consider themselves to be expert searchers (Tenopir, 2001), although most are not (Aula & Nordhausen, 2006; Rowlands *et al.*, 2008.). For students planning a career in information services, understanding the role and practice of expert search remains important, particularly for those planning to work in search-intensive environments such as corporations, legal and governmental organizations, and the medical domain (Tang *et al.*, 2012). Typically, students pursuing these areas of specialization complete an elective general course in expert search before moving on to domain-specific training (Nicholson, 2005). Education in expert search continues to be a relevant component of professional education in LIS.

Generally, courses focused on expert search are not part of core curricula for graduate programs in LIS (Irwin, 2002; Markey, 2004; Nicholson, 2005), but the subject matter may be taught in several types of courses within a program. Courses in IR are a common point of overlap. Harter and Fenichel (1982) found courses with titles containing the term *information retrieval* offered various levels of instruction, with some covering no search-related content, and others presenting a full range. The literature discusses three approaches to the integration of IR content and search instruction. Content associated with IR may be included in courses focused on theories of information seeking behavior, with little attention to the practice of searching (Bawden, 2007). In a different approach, courses focused on IR systems use search instruction to demonstrate system functionality (Fernandez-Luna *et al.*, 2009; Johnson, 2008). In courses focused on the search process, IR-related content provides a conceptual foundation for the application of search knowledge to all types of systems (Johnson, 2008; Tenopir, 2001). In the present study, only courses with a primary focus on the search process were analyzed, while courses emphasizing theory or systems were excluded.

Related Prior Studies

The work most closely related to the present study is that of Fenichel and Harter (1981; Harter & Fenichel, 1982). Their comprehensive survey of ALA-accredited programs reflected a proposed curriculum standard for search education (Mignon, 1978), which included two levels of search-related coursework. The first level was termed *consciousness raising*, which was associated with introductory material. More advanced coursework, termed *operator training*, emphasized “skill mastery . . . characterized by individual practice and training.” (Mignon, 1978, p. 4). Fenichel and Harter found evidence that both levels of coursework had been adopted in professional programs, and characterized the advanced level of study as:

. . . an appreciation of the principles underlying online searching . . . [which is] . . . more than simply learning the command of a language. Effective searching demands a knowledge of system design, file loading practices and their effect on retrieval, the effects of specificity, exhaustivity, stoplists, and other indexing practices on retrieval, Boolean logic, ability to read, interpret, and use abstruse database documentation, ability to conduct a good reference interview, to select appropriate databases and fields for searching, to design a search strategy likely to produce relevant output, to evaluate intermediate output and modify the search strategy accordingly, and much more. (Harter & Fenichel, 1982, p. 20)

The search curriculum has been studied several times since 1982. Tenopir (1989) surveyed ALA-accredited programs, finding that introductory courses and electives in online searching were offered in 80% of programs, a large increase from the adoption rate found by Fenichel and Harter. Hsieh-Yee (1997) surveyed LIS faculty and found that subject matter on the then-emergent internet and web had been added to course content. More recently, Nich-

olson (2005) conducted a content analysis of course descriptions and 23 syllabi from eleven top-ranked ALA-accredited LIS programs, including both introductory courses and electives. In comparing course content to the Medical Library Association's (MLA) policy statement on the role of expert searching, he concluded that increased instructional focus on web searching had resulted in decreased coverage of database searching in library programs.

Research Method

This section of the paper describes the research method employed in the present study. After an overview, we detail processes used in constructing the model. These include the sampling method, unitizing and clustering procedures, iteration of modeling and refinement, and finally, validation of the model.

Overview of the Method. The study proceeds from the foundational assumption that the terminology in catalog descriptions accurately represents course content. Data about course content was collected from course descriptions found in the university catalogs of ALA-accredited programs. The model emerged from the verbatim language of the course descriptions, in an iterative series of qualitative, grounded, bottom-up content analysis procedures (White & Marsh, 2006); quantitative procedures were not used. Our objective was to characterize the breadth of subject matter as a conceptual whole. It was not our intent to classify the courses or to evaluate them. We had no initial theory of the content, nor did we use a pre-determined coding scheme or axial-coding process (Strauss & Corbin, 1998). Our approach is directly related to concept mapping (Davies, 2011), which has been applied in the analysis and development of course content in higher education (Amundsen, Weston, & McAlpine, 2008; Donald, 1983).

In LIS, content analysis has been applied to course titles, course descriptions,

and readings (Bailey, 2010; Irwin, 2002; Nicholson, 2005), but unlike the present study, these studies did not attempt to develop conceptual models of the content. Markey (2004) developed a visual model of the content areas of the core MLIS curriculum. In a validation method related to our own, Pomerantz *et al.* (2006) used a quantitative content analysis of journal articles and conference proceedings to validate a proposed curriculum in digital libraries.

Figure 1 summarizes our analytical process flow, which we describe below. After the initial sample was obtained, microanalysis of the texts consisted of two procedures: (1) extracting terminology from the course descriptions (unitizing), and (2) open-coding the terminology by term-clustering (Krippendorff, 2004). The model emerged as we arranged the clusters into content areas. We refined the model by analyzing a sample of course syllabi. The process iterated several times through sampling, microanalysis, modeling, and refining. The model was finalized after validation via a literature review (Pandit, 1996).

Sampling. We used purposive relevance sampling to collect the data (Krippendorff, 2004). The sampling units were the course descriptions, selected using the categorical distinctions described below. Initially, the websites and course catalogs of the 58 ALA-accredited graduate LIS programs were examined for course titles with terminology related to searching, such as *online*, *databases*, *information resources*, *information retrieval*, *information services*, and *information systems*. Courses from two non-English language programs were excluded from the final sample. Courses with ambiguous titles, particularly those relating to IR, were included. Courses with titles specific to an information domain (e.g. legal, medical, business, government) and introductory courses were excluded. Typical course titles selected were "Online Searching" and "Online Information Retrieval."

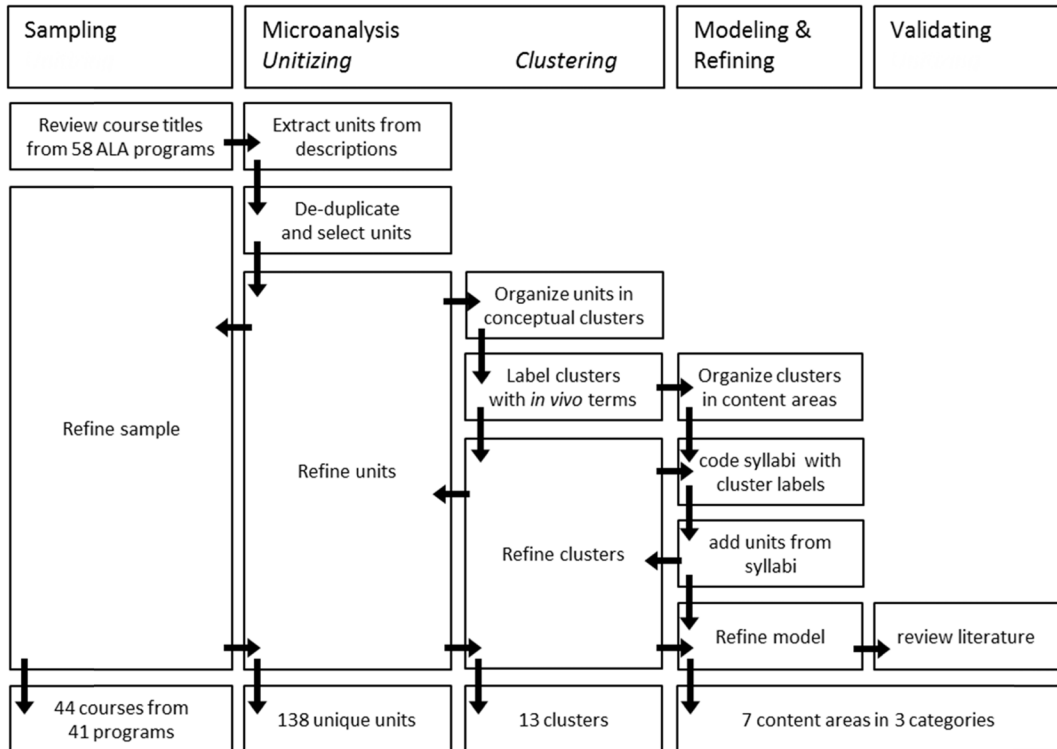


Figure 1. Analytical process flow.

The initial sample was collected in the fall of 2010, and represented 69 courses found in 46 programs. This set was further refined during analysis, as described below. The final model was derived from a set of 44 course descriptions from 41 programs. Fourteen of the 41 programs were part of the iSchool consortium (iSchools, 2013). Of the 17 programs where no applicable course was found, 4 were iSchools. Of the 44 courses in the final sample, 48% had no prerequisite course, 40% had one prerequisite course, and the remaining had two or more prerequisites. In the fall of 2012, the descriptions and titles for the 44 courses were collected once again and compared to the 2010 sample. One description had been rewritten, two had been edited, and three course titles had changed. We found no substantive changes to course content. We report here on the refined 2010 sample.

Microanalysis: Unitizing. The objective of the unitizing procedure was to

capture information about the breadth of subject matter by using the verbatim language of the texts. Much of the vocabulary in the course descriptions is quite similar. The nine terms with highest frequency, including variants, were *search, information, database, online, retrieval, strategy, system, service, and evaluation*. These key terms convey the general subject matter of the courses. Of the 44 descriptions in the final set, 30 contain five or more of the nine key terms. Beyond these terms, the specific language in each course description varies tremendously, hence, in order to best represent the range of course content, we elected to retain this diversity in the unitization procedure. Unitization was performed at three points in the iterative analysis, each time by a different analyst working independently. The first set of units was obtained from the initial sample. In the middle of the study, a second researcher, who participated in development of the initial model, completed the

second unitization; this was done to verify the units after several iterations of refinement to the sample. After the sample was finalized, a researcher unfamiliar with the model or details of the study conducted the third unitization, which was done to verify again that all content in the descriptions was included in the model.

In the first step of the unitization procedure, the analyst used a combination of simple categorical distinctions and natural syntactical distinctions (Krippendorff, 2004) to segment the text of each course description into words and phrases. Table 1 describes the criteria for inclusion. The segments were extracted verbatim from the text, or where a modifier applied to more than one object, the terms were arranged to form a complete expression of the content. Information about teaching methods, assignments, course registration, and so forth was excluded. Overly long phrases were avoided. In the second step, again working independently, the analyst reduced the recording units by removing exact duplicates and variations, so that the clearest version of each unit was selected to represent the content. In the remainder of the paper, we refer to the reduced text as *units*. The units comprised modified nouns (e.g., *search services*, *keyword commands*), unmodified nouns (e.g., *heuristics*, *directories*, *funding*), proper nouns (e.g., *Fac-*

tiva, *DIALOG*, *Google*), and noun phrases (e.g., *evaluation of information sources*, *selection of a search vocabulary*). The approach to unitization is justified by the researchers' familiarity with the grammar and knowledge domain of the texts (Krippendorff, 2004).

The procedure resulted in natural variation among the units produced by each analyst. Combined, the three sets contained 498 units, of which 120 were duplicated in all three sets, and an additional 238 were duplicated in two of the three sets. Duplicates were either exact verbatim duplicates (48% of the total 498 units) or variants (24% of the total); for example, *bibliographic databases*, *databases bibliographic*, and *bibliographic information* are variants of the same unit. The remaining 140 units not considered duplicates were either removed or subsumed during iterative refinement. Iteration and refinement resulted in a final set of 138 unique units, which remained in the model.

Microanalysis: Clustering. After the initial unitization, two analysts worked jointly to cluster the units, with the objective of reducing the data while expressing the content covered in the descriptions. This was done by physically sorting sticky-notes on which the units had been written. These were arranged on a work surface, and were later transcribed into lists. The

Table 1. Categorical Recording Criteria for Words and Phrases (examples in parentheses).

Inclusion criteria:

- names a content area or subject matter covered by the course (citation-based searching; formulation of search strategies; databases)
- defines or names a specific type of entity in a content area (electronic databases; commercially available databases; remote online databases; DIALOG)

Exclusion criteria:

- pertains to teaching or content delivery (will also be covered; hands-on)
 - course pre-requisites (LIBR 500)
 - course registration information (materials fee; charges)
 - defines or names assignments (discussions; readings and assignments; numerous laboratory assignments)
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researchers looked for units that expressed similar or related concepts; many of the units were moved multiple times until agreement was reached. The clusters were divided and combined as units were moved between existing and new clusters. *In vivo* terms were used to name the clusters. Analysis revealed that some courses did not fit well with the selection criteria and these, along with units thus derived, were removed from the analysis. In eight subsequent iterative rounds, the clusters were refined and renamed as learning progressed and the model emerged. A set of 13 clusters was retained in the final model.

Modeling and Refining. As analysis progressed, we used a concept diagram to organize related clusters into broader content areas. The model emerged from this nonhierarchical concept map (Daley, 2004; Davies, 2011). The third iteration of the diagram suggested four content areas and their associations: (1) the *environment* in which professional search occurs, (2) skills, which are *internal* to the searcher, (3) tools and resources, which are *external* to the searcher, and (4) *evaluation* and analysis, which connect skills with tools and resources. In subsequent iterations, the clusters were refined and merged, and the four content areas were divided into seven.

In order to increase understanding of the course descriptions and inform the modeling process, we analyzed 17 syllabi. These were obtained in a convenience sample, with 11 found on the Web, and an additional 6 received in response to email requests. The sample was obtained and analyzed in the spring of 2011. Seven syllabi were dated for the 2009–2010 academic year, eight for 2010–2011, and one was from 2005. One syllabus was found to be from a course no longer offered, and the course was subsequently removed from the sample. In the fall of 2012, thirteen of the syllabi were compared with then recent versions; no substantive changes to course content were found.

With the objective of identifying content not covered in the model, two researchers worked independently, coding each syllabus with the cluster labels from the third iteration of the diagram, identifying the subject matter of each class, week, or session, as indicated in course schedules. Where available, reading lists and other text were also coded. Relevant units not found in the course descriptions were added to the clusters, which were further refined.

Iterations of modeling and refinement continued in a recursive fashion. For purposes of brevity in exposition, we do not enumerate or detail the iterations here. After the ninth iteration, the final version of the concept diagram contained 138 units in 13 clusters, which comprised seven content areas in three general categories.

The model is presented in Figure 2. A summary of the final concept diagram (see Figure 3) shows the clusters underlying each content area. Figure 4 details the units contained in two example clusters, *Search Services* and *Client Analysis*. In the next section of the paper, a narrative of the model explicates the content areas and their relationships.

Our analysis involved continuous review of the source materials and discussion among the researchers, who articulated conceptual associations within the content based on their prior knowledge of the domain and their learning during



Figure 2. Content model for professional education in expert search.

Category	Content Area	Cluster Name
Environment	Professional Practice	Professional Context
		Search Services
	Conceptual Foundations	Information Retrieval
		Theory
		Online Environment
Analysis	Evaluation	Evaluation
	Client Analysis	Client Interaction
	Strategy	Strategy
Resources	Search Methods	Search Methods
	Sources & Tools	Tools
		Database Structure
		Databases
		World Wide Web

Figure 3. Summary of final content diagram, showing categories, content areas, and cluster names.

the analysis. The model expresses the researchers' understanding of the associations, however these are not necessarily pedagogical associations. Analysis of the syllabi revealed several possible patterns of content delivery, however we considered the sample too small, and too diverse in format, to draw conclusions, thus the model was developed without reference to

pedagogical structure. Different instructors may organize content differently, or may emphasize or omit content areas.

Validation. In the final step of the analysis, we validated the model by conducting a review of selected literature on search education. We discuss the validation after presenting the model in the next section of the paper.

<p>Search Services</p> <ul style="list-style-type: none"> • Competitive intelligence • Information services • Public access services • Reference services • Services for information users • User education 	<p>Client Interaction</p> <ul style="list-style-type: none"> • Analysis of information needs • Delivering search results • Interviewing process • Mediation • Pre-search interview • Presentation of search results • Question negotiation • User needs analysis
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Figure 4. Two cluster examples, showing units within clusters.

The Model

This section of the paper presents an overview of the model, followed by a narrative of the modeled content.

Overview of the Model

The model represents the structure of course content for a hypothetical, comprehensive course on domain-independent expert search. We found seven content areas: *conceptual foundations*, *professional practice*, *search methods*, *sources & tools*, *strategy*, *evaluation*, and *client analysis*. We organize these in three broad categories. (1) Conceptual foundations and professional practice cover the *environment* in which expert search occurs, providing context for the core content. In the visual model, environmental content frames the core. (2) Core content covers two types of *resources* used by expert searchers: (a) search methods are internal cognitive resources, and (b) sources & tools are external system and information resources. (3) *Analysis*, also at the core, connects internal resources with external resources. We found three types of analytical content: strategy, evaluation, and client analysis.

Using language derived from the course descriptions, the narrative below articulates the concepts underlying the visual model, and conveys course content in terms of the knowledge and skilled performance of expert searchers.

Model Narrative

The Environment. Expert search is conducted in the context of the online information environment and commercial information industry. Online search systems operate on the theories and principles of information retrieval, using special languages and user interfaces. The information industry can be understood in the context of its history, nevertheless, professionals must keep abreast of changes and trends. While underlying conceptual

foundations are important, equally significant are issues addressed in professional practice. These include management and administrative concerns related to vendors, contract negotiations, royalties, connect-time charges, and computer systems, for example. Expert searching is done in service to a client in areas such as library reference and competitive intelligence.

Resources. Expert searchers draw on two essential sets of resources: sources & tools and search methods. Sources contain information, and tools provide access to sources. An expert searcher's principal sources include general-purpose and specialized databases, and database services. Examples include DIALOG, FACTIVA, LexisNexis, OPACs, and PubMed. Databases are designed for various purposes, and contain information of various types (e.g. bibliographic, full-text, multimedia, citation, statistical, and patent). The web and search engines are also sources. Databases derive value from the structure of the information they contain. Expert searchers use structures such as thesauri, controlled vocabularies, and directories. They search using tools such as information visualization, search aids, front-ends, and query languages. Expert searchers use tools and sources by applying search methods such as Boolean searching, citation-based searching, similarity searching, free-text searching, and multi-database searching. These methods require skill with query logic and vocabulary.

Analysis. Search expertise also requires analysis. Client analysis involves interaction with the client, including the interviewing process, negotiating the client's question, and presenting search results. Strategy is the analytical process of planning the search. It guides the searcher's selection of the databases, tools, and search methods. Expert search requires skill in evaluation of database structures, search results, content, and system performance, as well as citation verification. It also involves the ethics of information evaluation.

Validation of the Model

Before finalizing the model, we reviewed literature on search education to determine how well the model fit with prior descriptions and discussion of course content. The review covers: the original curriculum proposal written in 1978; three surveys of course content; materials from a recent conference panel; two textbooks; and four commentaries written by search educators. Table 2 presents the content areas mentioned in each work, which we present below, followed by conclusions and discussion.

Curriculum Proposal, Surveys, and Conference Materials

The proposal (Mignon, 1978) set out

a curriculum standard for professional search education, including a list of skills and knowledge required in an advanced course. Proposed content areas included management, principles of searching, types of databases, and in the analysis area, types of information needs, database analysis, development of search strategies, evaluation of output, and reference interviews. Content on conceptual foundations was not included. Fenichel and Harter's (1981) survey of LIS programs covered the same content areas found in the proposal. The model covers all of the content included in both the proposal and the survey.

Hsieh-Yee (1997) surveyed faculty teaching reference services and information retrieval. While many of the topics listed by Fenichel and Harter were includ-

Table 2. Content Areas Mentioned in Reviewed Education Literature.

Category		Environment		Analysis			Resources	
		Conceptual Foundations	Professional Practice	Strategy	Client	Evaluation	Sources & Tools	Search Methods
Proposal	Mignon, 1978		✓	✓	✓	✓	✓	✓
	Harter & Fenichel, 1982		✓	✓	✓	✓	✓	✓
Surveys	Hsieh-Yee, 1997		✓	✓	✓	✓	✓	✓
	Nicholson, 2005	✓	✓	✓	✓	✓	✓	✓
	ALISE, 2012	✓	✓	✓	✓	✓	✓	✓
Textbooks	Walker & Janes, 1993	✓	✓	✓	✓	✓	✓	✓
	Bell, 2009	✓	✓	✓	✓	✓	✓	✓
	Tenopir, 2001	✓					✓	
Educator Commentary	Drabenstott, 2004		✓	✓	✓	✓	✓	✓
	DiMattia, 2007	✓	✓	✓	✓	✓	✓	✓
	Johnson, 2008	✓		✓	✓	✓	✓	✓

ed, they were organized differently. The model covers Hsieh-Yee's broad category titled searching, which includes strategy, search methods, and sources & tools. Two categories, one pertaining to management issues, and the other to the online industry, are covered under professional practice. One item on post-search evaluation, and two on client interaction, are covered by evaluation and client analysis. As above, content on conceptual foundations was not included. One content area, the "statistical analysis of numeric data" (Hsieh-Yee, 1997, p. 20), is not covered by the model; only 8% of respondents reported covering this content in their courses. We did not find this content in any of the other literature reviewed, therefore we did not modify the model.

As described above, Nicholson (2005) analyzed syllabi and assigned readings from ten LIS programs. His findings reflect the evolution of the information environment and resulting changes in course content. Content on conceptual foundations is evident in readings on IR and theories of information science. While databases remain primary, content on web searching is also found. The model covers all of the areas mentioned in Nicholson's results.

More recently, a panel of search educators at the 2012 ALISE Annual Conference (Tang *et al.*, 2012) addressed the role of the DIALOG service in search education. The panel covered the purpose of search courses, course objectives, and the content of courses offered at each of the five panelists' academic institutions. The presentation materials provide a current, although informal, record of course content. The model covers all of the content mentioned.

Textbooks

We also compared the model to the content of two textbooks on online searching. The Walker and Janes (1999) textbook is heavily focused on resources. Among its fourteen chapters, six are on methods, and

three are on sources & tools. There are two chapters on conceptual foundations, and one on evaluation. Client analysis is mentioned in one of two chapters on professional practice. Bell's (2009) textbook covers the same content, but it concludes with a chapter on teaching users about database resources, content which is not a major area of the model. In developing the model, we found the unit *user education* in one course description and included it under professional practice, but we found no additional terminology related to user education or bibliographic instruction. We did not modify the model. User education is discussed below. The model covers all of the other content of both textbooks.

Educator Commentaries

Finally, we reviewed four commentaries from educators writing on instruction in domain-independent search. Our goal was to look for content that was not included in the model. We selected these papers because they discuss course content in the three broad categories of resources, environment, and analysis; they are not intended as a comprehensive review of the literature on each content area. Collectively, these works address the seven content areas in the model.

Not surprisingly, all four commentaries (DiMattia's, 2007; Drabenstott, 2004; Johnson, 2008; Tenopir, 2001) discuss sources, tools, and search methods, with a focus on commercial databases, database types, and database structure. This reflects the longstanding core of the curriculum, which is well covered by the model.

Two commentaries discuss content on conceptual foundations. Tenopir (2001) argued that in learning to use DIALOG, students gain understanding of the underlying structure of retrieval systems. Much of Tenopir's discussion focuses on how concepts are revealed in content related to tools, sources, and methods, thus she also addresses pedagogical concerns. Johnson (2008) discussed content on system ar-

chitecture, retrieval models, and search behavior, and proposed an approach that bridges IR systems, theory, and the search process. The model covers the content discussed in both commentaries.

DiMattia (2007) described the importance of analytical skills in expert search, stating, "Assessing information needs via thorough reference interview, evaluating quality and applicability of answers, and matching search strategies with appropriate sources are among the higher-level educational attributes that we should strive to teach," (p. 38). Drabenstott (2004) focused on strategy and evaluation in a discussion of analytical approaches to searching. She described facet-analysis, a method that connects user needs with query and retrieval results. Drabenstott also described the process she used in developing methods for searching the web when it was new. In recounting her approach, she explicates the analytical skills deployed during strategy formulation and evaluation. The model covers this analysis-related content.

Conclusions and Discussion

In concluding the review, we found that the model's content areas fit well with the content described in the literature we reviewed, and that further refinement was not warranted. We propose that a comprehensive course in domain-independent search would cover all of the content in the model.

We also found that course content reflects the history of search systems and services. Over the period between the original proposal for curriculum standards in 1978 and the ALISE panel in 2012, the information environment changed radically. At a time when it was difficult to use search systems, many instructional objectives pertained to the mastery of operator methods, knowledge of tools and sources, and conduct in the intermediary role. This content remains the focus of the textbooks reviewed. As web access proliferated, di-

verse populations of end-users demanded and received more useful tools and sources, and expert searchers faced a deluge of new interactive systems (Markey, 2004; Tenopir, 2003; Xie & Cool, 1998). Knowledge of conceptual foundations and analytical skill became instrumental to the ability to learn and master each new generation of resources. These changes are reflected in the educators' commentaries. The model captures these aspects of search education.

Another effect of these historical changes was the diminished role of the search intermediary (Kennedy, 2011; Tenopir, 2003; Tyckoson, 2011). As the need for intermediaries waned, expert searchers assumed new relationships with their end-user populations. In domain-specific areas such as medicine and law, changing roles included a greater emphasis on end-user education (MLA, 2003; Wright, 2008). While Bell's (2009) textbook includes a final chapter on user education, and Tenopir (2005) argues that course content should include deeper coverage of user instruction, Tenopir also concedes that this is precluded by the already broad subject matter in search courses. Given the breadth of skills associated with proficiency in user instruction (ACRL, 2007) and the reported need for enhanced professional education in end-user instruction (Westbrock & Fabian, 2010), it is clear that this content area is outside the scope of the model.

Summary and Future Work

This paper presents a descriptive model of the subject matter taught in courses on domain-independent expert search in programs accredited by the ALA. The model was developed via a bottom-up grounded content analysis of the text of course descriptions, which were methodically selected, extracted, analyzed, and interpreted. The objective was to develop a conceptual representation of course content. In a review of related prior studies, relevant textbooks, and commentary from

search educators, the model has been found to represent content areas discussed in prior literature.

One of the motivations for this study was the need for a description of the pedagogy of expert search education, within the larger goal of understanding how professional instruction contributes to the development of search expertise. Having described *what* is taught in courses on search expertise, our next steps are descriptions of how this subject matter is taught and learned. With the transition to online course delivery affecting pedagogy, this goal is likely to be challenging in the near term. There is also the related question of how the subject matter is used by practicing experts. To this end, research is needed on how expert searchers view the role of coursework in their professional preparation, and on how course content matches the expert knowledge required in professional practice. The model provides a framework for undertaking these questions on professional search education. Beyond search education, the analysis method used in developing the model is applicable to courses across the discipline, and may be extended for the analysis of overlap between subject areas within the broader curriculum.

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References

- American Association of Law Libraries. (2010). *Competencies of law librarianship*. Retrieved from <http://www.aallnet.org/main-menu/Leadership-Governance/policies/PublicPolicies/competencies.html>.
- Amundsen, C., Weston, C., & McAlpine, L. (2008). Concept mapping to support university academics' analysis of course content. *Studies in Higher Education, 33*(6), 633–652. doi:10.1080/03075070802373180
- Association of College and Research Libraries. (2007). *Standards for Proficiencies for Instruction Librarians and Coordinators*. Retrieved from <http://www.ala.org/acrl/standards/profstandards>.
- Aula, A., & Nordhausen, K. (2006). Modeling successful performance in web searching. *Journal of the American Society for Information Science & Technology, 57*(12), 1678–1693. doi:10.1002/asi.20340
- Bailey, E. (2010). Educating future academic librarians: An analysis of courses in academic librarianship. *Journal of Education for Library and Information Science, 51*(1), 30–42.
- Bawden, D. (2007). Information seeking and information retrieval: The core of the information curriculum. *Journal of Education for Library and Information Science, 48*(2), 125–138.
- Bell, S. (2009). *Librarian's guide to online searching* (2nd ed.). Westport, CT.: Libraries Unlimited.
- Brown-Syed, C. (2011). Library and information studies and open-source intelligence. *Library and Archival Security, 24*(1), 1–8. doi:10.1080/01960075.2011.551935
- Daley, B. (2004). Using concept maps in qualitative research. *Proceedings of the 1st International Conference on Concept Mapping*, Pamplona, Spain. Retrieved from <http://cmc.ihmc.us/papers/cmc2004-060.pdf>.
- Davies, M. (2011). Concept mapping, mind mapping and argument mapping: What are the differences and do they matter. *Higher Education, 62*(3), 279–301. doi:10.1007/s10734-010-9387-6
- DiMattia, S. (2007). How we teach (or should teach) online searching. *Online, 31*(2), 34–38.
- Donald, J. (1983). Knowledge structures: Methods for exploring course content. *The Journal of Higher Education, 54*(1), 31–41.
- Drabenstott, K. (2001). Web search strategy development. *Online, 25*(4), 18.
- Drabenstott, K. (2004). Why I still teach online searching. *Journal of Education for Library and Information Science, 45*(1), 75–80.
- Eraut, M. (1994). *Developing professional knowledge and competence*. London, UK: Routledge.
- Falciola, L. (2009). Searching biotechnology information: A case study. *World Patent Information, 31*(1), 36–47. doi:10.1016/j.wpi.2008.05.006
- Fenichel, C., & Harter, S. (1981). *Research report prepared for OCLC on survey of online searching instruction in schools of library and information science*. Dublin, OH: OCLC, Development Division.

- Fernández-Luna, J., Huete, J., MacFarlane, A., & Efthimiadis, E. (2009). Teaching and learning in information retrieval. *Information Retrieval*, 12(2), 201–226. doi:10.1007/s10791-009-9089-9
- Gardois, P., Calabrese, R., Colombi, N., Deplano, A., Lingua, C., Longo, F., Villanacci, M., Miniéro, R., & Piga, A. (2011). Effectiveness of bibliographic searches performed by paediatric residents and interns assisted by librarians: A randomised controlled trial. *Health Information & Libraries Journal*, 28(4), 273–284. doi:10.1111/j.1471-1842.2011.00957.x
- Golder, S., & Loke, Y. (2012). Failure or success of electronic search strategies to identify adverse effects data. *Journal of the Medical Library Association*, 100(2), 130–134. doi:10.3163/1536-5050.100.2.012
- Gotschall, S. (2010). Teaching cost-effective research skills: Have we overemphasized its importance. *Legal Reference Services Quarterly*, 29(2), 149–163. doi:10.1080/02703191003757245
- Harman, D., & Candela, G. (1990). Bringing natural language information retrieval out of the closet. *ACM SIGCHI Bulletin*, 22(1), 42–48. doi:10.1145/101288.101297
- Harman, D. (1992). User-friendly systems instead of user-friendly front-ends. *Journal of the American Society for Information Science*, 43(2), 164–174.
- Harter, S., & Fenichel, C. (1982). Online searching in library education. *Journal of Education for Librarianship*, 23(1), 3–22.
- Heinis, J. (2004). Technical intelligence in a dot.com milieu: A Dialog/Dialog DataStar perspective. *Journal of Agricultural & Food Information*, 6(2), 109–143. doi:10.1300/J108v06n02_09
- Hsieh-Yee, I. (1997). Teaching online and CD-ROM resources. *Journal of Education for Library and Information Science*, 38(1), 14–34.
- Irwin, R. (2002). Characterizing the core: What catalog descriptions of mandatory course reveal about LIS schools and librarianship. *Journal of Education for Library and Information Science*, 43(2), 175–184.
- iSchools (2013). iSchools directory. Retrieved from <http://ischools.org/directory/>.
- Johnson, F. (2008, October). On the relation of search and engines. *Proceedings of TLLR 2008: the Second International Workshop on Teaching and Learning of Information Retrieval*, London, UK. Retrieved from http://www.bcs.org/upload/pdf/ewic_tl08_paper2.pdf.
- Kennedy, S. (2011). Farewell to the reference librarian. *Journal of Library Administration*, 51(4), 319–325. doi:10.1080/01930826.2011.556954
- Karimi, S., Pohl, S., Scholer, F., Cavedon, L., & Zobel, J. (2010). Boolean versus ranked querying for biomedical systematic reviews. *BMC Medical Informatics and Decision Making*, 10. doi:10.1186/1472-6947-10-58
- Kinchin, I., & Cabot, L. (2010). Reconsidering the dimensions of expertise: From linear stages towards dual processing. *London Review of Education*, 8(2), 153–166. doi:10.1080/14748460.2010.487334
- Krippendorff, K. (2004). *Content analysis: An introduction to its methodology*. Thousand Oaks, CA: Sage Publications.
- Lucas, W., & Topi, H. (2005). Learning and training to search. In A. Spink and C. Cole (Eds.), *New directions in cognitive information retrieval* (pp. 209–226). Netherlands: Springer.
- Markey, K. (2004). Current educational trends in the information and library science curriculum. *Journal of Education for Library and Information Science*, 45(4), 317–339.
- Medical Library Association. (2003). *Medical library association policy statement: Role of expert searching in health sciences libraries*. Retrieved from http://www.mlanet.org/resources/expert_search/policy_expert_search.html.
- Mignon, E. (1978). *Proposed standards for education in online searching in the professional librarianship curriculum: Position paper no. 1*. School of Librarianship: University of Washington.
- Nicholson, S. (2005). Understanding the foundation: The state of generalist search education in library schools as related to the needs of expert searchers in medical libraries. *Journal of the Medical Library Association*, 93(1), 61–68.
- Pandit, N. (1996). The creation of theory: A recent application of grounded theory method. *Qualitative Report*, 2(4). Retrieved from <http://www.nova.edu/ssss/QR/QR2-4/pandit.html/pandit.html>.
- Pomerantz, J., Oh, S., Yang, S., Fox, E., & Wildemuth, B. (2006). The core: Digital library education in library and information science programs. *D-Lib Magazine*, 12(11). Retrieved from <http://www.dlib.org/dlib/november06/pomerantz/11pomerantz.html>.
- Reference and User Services Association (2013). Guidelines for behavioral performance of reference and information service providers. Retrieved from <http://www.ala.org/rusa/resources/guidelines/guidelinesbehavioral>.
- Rowlands, I., Nicholas, D., Williams, P., Huntington, P., Fieldhouse, M., Gunter, & Tenopir, C. (2008). The Google generation: The information behaviour of the researcher of the future. *Aslib Proceedings*, 60(4), 290–310. doi:10.1108/00012530810887953

- Rubin, R., & Rubin, R. (2012). Justifying professional education in a self-service world. In Crowley, W. A. (2012), *Defending professionalism: A resource for librarians, information specialists, knowledge managers, and archivists* (pp. 21–30). ABC-CLIO: Santa Barbara, CA.
- Shulman, L. (2005). Pedagogies of uncertainty. *Liberal Education*, 91(2) 18–25.
- Special Libraries Association (2003). Statement of competencies for information professional in the 21st century. Retrieved from <http://www.sla.org/about-sla/competencies/>.
- Strauss, A., & Corbin, J. (1998). *Basics of qualitative research*. Thousand Oaks, CA: Sage Publications.
- Tang, R., Beheshti, J., Tenopir, C., Hanson, L., Applegate, R., & Ziemer, M. (2012). To Dialog or not to Dialog: ALISE online search panel. *Materials presented at the 2012 ALISE Annual Conference*, Dallas, TX.
- Tannery N., & Maggio L. (2012). The role of medical librarians in medical education review articles. *Journal of the Medical Library Association*, 100(2), 142–144. doi: 10.3163/1536-5050.100.2.015
- Tenopir, C. (1989). Education for database intermediaries: How library schools have changed (and how they haven't). *Online*, 13(6), 55.
- Tenopir, C. (2001). Why I still teach Dialog. *Library Journal*, 126(8), 35.
- Tenopir, C. (2003). Reflections on two decades. *Library Journal*, 128(2), 36.
- Tenopir, C. (2005). Teaching student searchers. *Library Journal*, 130(4), 33.
- Tenopir, C., & Cahn, P. (1994). DIALOG and Mead join the relevance ranks. *Online*, 18, 31–47.
- Turtle, H. (1994). Natural language vs. Boolean query evaluation: A comparison of retrieval performance. *Proceedings of the 17th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*, Dublin, Ireland, 212–220. doi:10.1145/125187.125188
- Tyckoson, D. (2011). Issues and trends in the management of reference services: A historical perspective. *Journal of Library Administration*, 51(3), 259–278. doi:10.1080/01930826.2011.556936
- Walker, G., & Janes J. (1999). *Online retrieval: A dialogue of theory and practice* (2nd ed.). Englewood, CO.: Libraries Unlimited.
- Westbrock, T., & Fabian, S. (2010). Proficiencies for instruction librarians: Is there still a disconnect between professional education and professional responsibilities? *College & Research Libraries*, 71(6), 569–590.
- White, M., & Marsh, E. (2006). Content analysis: A flexible methodology. *Library Trends*, 55(1), 22–45. doi:10.1353/lib.2006.0053
- Wright, N. (2008). Standing at the gates: A new law librarian wonders about the future role of the profession in legal research education. *Legal Reference Services Quarterly*, 27(4), 305–345. doi:10.1080/02703190802694815
- Xie, H., & Cool, C. (1998). Online searching in transition: The importance of teaching “interaction” in library and information science education. *Journal of Education for Library and Information Science*, 39(4), 323–331.