

The “I’m Feeling Lucky Syndrome”: Teacher-Candidates’ Knowledge of Web Searching Strategies

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Abstract

The need for web literacy has become increasingly important with the exponential growth of learning materials on the web that are freely accessible to educators. Teachers need the skills to locate these tools and also the ability to teach their students web search strategies and evaluation of websites so they can effectively explore the web by themselves. This study examined the web searching strategies of 253 teachers-in-training using both a survey (247 participants) and live screen capture with think-aloud audio recording (6 participants). The results present a picture of the strategic, syntactic, and evaluative search abilities of these students that librarians and faculty can use to plan how instruction can target information skill deficits in university student populations.

Project Background

The need for teacher web literacy has become increasingly important with the exponential growth of freely accessible learning materials on the web. Practical web search tips are readily available in professional development journals for teachers such as the frequently cited article by Holly Gunn, *Become a Google power user*. Associations and organizations provide a wealth of interesting online resources including access to text and/or visual primary sources; video and audio files; interactive tutorials, games, and puzzles; webquests; and digital learning object repositories. Teachers need the skills to locate these tools on the web and also the ability to teach their students web search and evaluation strategies so that students can effectively explore the web by themselves. Conversely, Google’s “I’m Feeling Lucky” button suggests that a single query can be answered by a single website and epitomizes the notion that web searching is easy. The physical design of a single box on a blank page

reinforces the idea that a few words can retrieve specific information. This is actually the converse of what happens in practice. Satisfactory results may be found quickly when topics are straightforward. For complex ideas, however, the single search box masks the depth and abundance of information that is potentially accessible. It creates the illusion that deep thinking is not necessary to penetrate the expression of sophisticated ideas. The reality of web searching is that far more skill is needed for narrowly focused returns.

This study examined specific web search strategies of pre-service teachers and was prompted by research results from local, national, and international studies on information finding techniques. A previous survey of Queen's University teacher-candidates' information literacy knowledge by Lee, Reed, and Laverty (2) revealed their heavy reliance on the web for both professional development and teaching resources. Furthermore, these students prefer to search Google for learning materials rather than pursue the professional resources indexed in academic databases. The pre-service teachers who participated in this study are required to have an undergraduate degree for acceptance into the Bachelor of Education program (B. Ed.) and are granted a teaching certificate upon completion of the program.

Users of all ages prefer Google because searching the library is an emotionally frustrating experience that is very difficult when you are looking for something you do not know about (Markey 3-5). Reliance on the Internet for school and university assignments is confirmed in a range of studies that have looked at the information-seeking habits of school students through to pre-service teachers (Colaric, Fine, and Hofmann; Environics Research Group; Graham & Metaxas; Levin and Arafeh; Lorenzen; OCLC). In a study of undergraduate web search behavior, students preferred Internet sources for their schoolwork, rated themselves as confident users of search engines, yet had considerable difficulty recognizing trustworthy information and distinguishing between advertising and fact (Graham and Metaxas 72-75). In a study of pre-service teachers, 36% of students did not have the necessary factual knowledge to use search engines, 77% did not understand the principles of web technology, and most used a limited selection of operators to restrict search results (Colaric, Fine, and Hofmann 196).

An Environics Research report surveyed 5,200 Canadian students in grades 4-11. It found that 62% of grade 4 students prefer the Internet for information finding, while 38% choose the library. At the grade 11 level, 91% of students prefer the Internet, with only 9% choosing the library. Although many students reported doing schoolwork online on a "daily or almost daily" (Environics Research Group 7) basis and were confident about their search capabilities, they wanted to learn more about how to verify the accuracy of web sources, find information, and identify how web technology works. An Australian study of student teachers' confidence and competence for finding web information (Albion 1248) confirmed that new teachers over-rate their web finding abilities and are not the "digital natives" that we expect them to be. This data emphasizes the need for newly trained teachers to be knowledgeable information seekers themselves so that they can confidently develop the information literacy skills of their own students.

Research Method

A group of 247 teacher candidates from both the primary-junior and intermediate-senior streams completed a survey of seventeen questions that called for self-assessment of their web searching capabilities as well as a measurement of their strategic, syntactic, and evaluative search abilities. Open-ended questions calling for search strings on specific topics captured their web search strategy and their use of search engine syntax. All survey questions were related to familiar teacher-related tasks such as how to manage a class that included students with various learning disabilities and how to find an overview on the Canadian government for a grade five class. The responses were scored against five possible levels of ability depending upon the number and type of keywords and operators that were used. A further picture of strategic knowledge was gathered through participant responses to a checklist of types of web resources (e.g. textbooks, lesson plans) where students were asked to assess the likelihood that a Google search would find the full text of that type of resource free on the web. Descriptions of the evaluative criteria students used to assess a list of web search results and an individual website were also collected.

To complement the survey data, the search behaviors of six teacher candidates were observed in depth using Macromedia Captivate software to capture their online movements. Three students represented the primary-junior stream and the other three were from the intermediate-senior stream. As such, they are representatives of the larger survey group and the data they provided offer insight into the thinking processes at work during web searching. The software captured a visual record of browser activities as they took place and the students used a headset with microphone to record a think-aloud description of their strategies. These students were given three real-time search tasks that progressed from easy to difficult:

Question 1: Find activities that you could use at the start of the school year with your class.

Question 2: Find information that could help you address bullying in your classroom.

Question 3: Find information on how to develop good research questions for student projects.

A think-aloud while searching (concurrent) method of data collection was chosen because these verbal data reflect what is in short-term memory. This methodology allows access to the active cognitive processes of the participant and has been documented in the numerous studies reviewed by Ericsson and Simon. Retrospective questioning in which the participant is cued to report after completing part or all of a task elicits reporting of what is stored in long-term memory. As search behaviour involves multiple decisions, we were interested in the reporting of what was current in consciousness as the participant searched. Afflerbach describes a range of studies

where the data collected from think-aloud (verbal protocol) methodology are a fair representation of a participant's cognitive and affective processes (Afflerbach 163-173).

The survey data were coded and percentages were calculated. The think-aloud data were transcribed and coded into categories that emerged from the data.

Key Findings of the Study

Self-Assessment of Web Searching Abilities

Data from the general survey of 247 participants provides a picture of the web searching skills of the teacher candidate group. The survey population identified themselves as being good to excellent web searchers and evaluators of website information (Table 1). They were not, however, as confident of their abilities to teach these skills to their future students.

Table 1 - Responses of primary-junior and intermediate-senior candidates to the statement: Rank your web searching abilities

Ability	Poor	Satisfactory	Good	Very Good	Excellent
Find information on the web	1.6%	8.5%	36.0%	35.6%	17.4%
Ability to evaluate websites	0.8%	13.8%	39.3%	33.6%	12.1%
Ability to teach information finding on the web to future students	2.4%	19.0%	41.7%	28.7%	7.7%
Ability to teach website evaluation to future students	4.5%	20.6%	43.7%	24.3%	6.9%

Strategic and Syntactic Web Searching Abilities

While confidence levels in searching were high overall, actual scores in practice questions revealed that students tend to employ relatively unsophisticated search methods. Two searches that were completed by the 247 survey participants were scored against a five-point scale to determine relative levels of searching ability. Each level of the scale represents a filter that the librarian researchers of the study might apply to focus a result set. As each filter is applied, the result set should become more focused. The most relevant filters for the questions in the study were:

- Selection of relevant keywords that address the concept/topic of the query.
- Use of operators to express the relationship of the keywords where possible (e.g. identifying phrases and critical words).
- Identification of the desired format or type of information (e.g. curriculum, lessons, strategy, guide)

- Identification of the target audience or level of reading (e.g. high school teachers, elementary teachers)
- Addition or replacement of focus words during the search to improve relevancy.

The order of the levels in each table is based on the frequency with which they were used by the participants. The achievement of each subsequent level from 1-5 demonstrates use of more sophisticated search techniques. Level 0 indicates that a participant did not respond to the question.

Table 2 presents the survey data of 247 students and demonstrates that the most common search method used one or two keywords with search operators applied by about one-third of the students. Google was the preferred starting point. Sixty percent of the survey participants achieved Level 1, indicating use of one or two topical keywords in their searches while an additional twenty-seven percent achieved Level 2, reflecting use of topical keywords with at least one operator. No participants identified the type of information desired or the target audience for the desired information. No participants added more detailed focus such as naming a specific disability or linking it to specific learning tasks such as reading or mathematics. Keywords expressed only the general concepts in the question even though these were so broad that it would make the selection of useful information difficult.

Table 2 - Levels of ability in response to the statement: Find tips of how to manage a class with various learning disabilities

5 Point Evaluation Criteria	Level	Percentage
No Points (left blank)	0	12.0
Keywords: one or two general keywords that express concept (e.g. classroom management, teaching, teaching strategies, behavior management, learning disabilities, special needs)	1	60.3
Operators: use of quotation marks for phrases and other operators	2	27.1
Format Identified: use of words that express format (e.g. tips, strategy, lesson, curriculum, introduction, overview, description, guide, etc.)	3	0.8
Level Identified: use of words that identify level or target audience (e.g. teachers, secondary, elementary, high school, etc.)	4	0
Additional Focus Words: use of more words to narrow topic (e.g. specific disability identified or subject area such as mathematics etc.)	5	0

Other survey results revealed a lack of clarity about the range and types of resources available freely on the web (Table 3). The shaded boxes in Table 3 indicate the predicted likelihood of finding these resources on the Web. Students were confused about the availability of most types of resources if the “don’t know” option is taken to reflect uncertainty.

Table 3 - Estimates of likelihood that the free full text of each resource type can be found by Google

Resource	Not Likely	Likely	Don't Know
Canadian statistics	7.3%	77.3%	10.9%
Journal articles from the Canadian Education database	47.0%	32.4%	15.8%
Primary-junior or intermediate-senior math textbook	60.7%	15.8%	19.0%
Articles from most scholarly journals	52.2%	32.4%	10.1%
Lesson plans	4.0%	86.2%	5.3%
Teaching materials from teacher association websites	11.3%	65.2%	18.2%
Encyclopedia Britannica	25.1%	47.8%	22.3%
Books in the Queen's Library catalogue	41.7%	38.5%	15.0%
Globe and Mail newspaper articles from one year ago	28.3%	44.5%	21.5%
Video clips from CBC news	12.6%	63.2%	19.0%
Best-selling fiction	46.2%	32.0%	17.0%

Website Evaluation

Educators at all levels of schooling are concerned that students be able to evaluate websites critically. Student inability to comply with this expectation can lead to assignments where students are asked not to use any web resources. Since many library materials are now web-based, this restriction just adds to the confusion. Study participants were asked to list the criteria by which they evaluate a website and their responses are listed in Table 4. The most frequently used criteria is authority which was expressed in numerous ways such as author, author credentials, organization, or URL.

Table 4 - Frequency of criteria that survey participants state they use to evaluate websites

Criteria Frequency	Percentage
Authority	40.1
Coverage	17.4
Currency	15.0
Accuracy	7.3
Objectivity	5.3

Table 5 reveals that students determine website credibility primarily by authorship and a match of keywords in the website title or abstract. They did not articulate considerations about coverage, currency, or objectivity. A match on search words was used as a measure of assessing accurate and relevant content.

Table 5 - Frequency of criteria used by survey participants to select a website from a web search results list

Evaluation Criteria in Results list	Percentage
Blank	10.5
Authority: as identified by URL, name of relevant organization, educational institution (edu) etc.	68.0
Match of search words in title of site.	19.0
Relevance of Description: appears to be on topic judging from short description of site, audience, level, fewer ads, etc.	2.4

Web Searching Models

An examination of live web searches with think-aloud narration by six teacher candidates provided an in-depth snapshot of web searching patterns. Although no single model was used by all six think-aloud candidates, common trends were identified and these are reported below.

Selection of keywords

Search words are frequently derived from the initial question to form the basis of the query. The number of words generally reflects two to three key ideas. Candidate 3 preferred to formulate searches as a natural language question (e.g. how to stop bullying in the classroom). Table 6 shows the range of first search strings in response to each of three questions.

Table 6 - First search string responses to three questions by think-aloud candidates

Question 1: Find activities that you could use at the start of the school year with your class.			
Candidate 1	rules first day of school	Candidate 4	grade 1 first day activities
Candidate 2	positive +classroom +space	Candidate 5	classroom setup
Candidate 3	First day of school activities	Candidate 6	First days school
Question 2: Find information that could help you address bullying in your classroom.			
Candidate 1	bullies in school	Candidate 4	teaching strategies for bullying in the classroom
Candidate 2	bullying in the classroom	Candidate 5	bullying
Candidate 3	how to stop bullying in your classroom	Candidate 6	bullying classroom
Question 3: Find information on how to develop good research questions for student projects.			
Candidate 1	high school research questions	Candidate 4	designing effective research questions for grade 6-8
Candidate 2	research + questioning	Candidate 5	research in elementary school
Candidate 3	how to come up with good research design questions	Candidate 6	independent project defining research questions

Table 7 reveals a common method of revising a search string. The addition of words to the existing search string to focus search results was preferred over re-stating the search completely.

Table 7 - Complete set of search strings in response to the Question 2: Find information that could help you address bullying in your classroom.

C1	bullies in school bullies in high school bullies in high school dealing with bullies in high school dealing with teacher	C3	how to stop bullying in your classroom strategies to stop bullying in your classroom classroom strategies to stop bullying	C5	bullying bullying and schools bullying and elementary schools
C2	bullying in the classroom bullying prevention bullies + "classroom management"	C4	teaching strategies for bullying in the classroom bullying strategies for teachers organization Child and Family Canada Child and Family Canada Bullying Child and Family bullying teacher resources	C6	bullying classroom
Potential Improvements to Search	intitle:bullying +classroom elementary strategies +teachers -site:.com				

Use of operators

When a candidate is aware of operators and how they work, those operators tend to be applied to every search as appropriate. For example, Candidate 2 used both the plus sign and quotation marks for phrases across three search questions, while the other five candidates did not apply any operators throughout the process.

Searches using operators by Candidate 2:

Question 1: positive +classroom +space

Question 2: bullies + "classroom management"

Question 3: research + questioning "student +project"

Limited exploration of results lists

The number of pages browsed by each candidate generally increased with the complexity of the question. The number of search strings also increased as the difficulty of the question increased. However, the number of pages explored was low given the many results returned. Table 8 documents the number of pages browsed and the matching number of search strings used per question. In ten out of the total eighteen searches (55%), candidates viewed from 1-4 pages of search results.

Table 8 - Number of results pages browsed and search strings used for each of three questions

Questions:	Find activities that you could use at the start of the school year with your class.	Find information that could help you address bullying in your classroom.	Find information on how to develop good research questions for student projects.
Candidate 1	4 (3 search strings)	4 (4 search strings)	9 (5 search strings)
Candidate 2	3 (3 search strings)	3 (3 search strings)	9 (5 search strings)
Candidate 3	14 (9 search strings)	8 (3 search strings)	11 (7 search strings)
Candidate 4	1 (1 search string)	6 (5 search strings)	10 (8 search strings)
Candidate 5	2 (3 search strings)	3 (3 search strings)	4 (5 search strings)
Candidate 6	2 (1 search string)	3 (1 search string)	10 (7 search strings)

Lack of application of evaluation criteria

Determination of which site to open within a set of search results was based most often on a match of search words in the titles and descriptions followed by authority of site based on URL. Sites that suggested they were written for teachers (e.g. Scholastic; Education World; word “teaching” present) were accepted even though the content on them was often not comprehensive or necessarily useful, given the question. Table 9 maps the criteria that the six think-aloud candidates used to evaluate websites as stated on their written surveys. Authorship and ease of site navigation are key features. During the think-aloud searches, however, they all applied from 3-5 criteria consistently on every search perhaps because they were prompted to declare their thinking as they selected websites.

Table 9 - Evaluation criteria used by six think-aloud candidates as recorded in survey data

Evaluation criteria	Presentation (organization, level of language)	Authorship (credentials, reputable, official, contact info.)	Currency (time of pub., up-to-date)	Site features (search option, extra links)	Content (meets needs)	Ease of navigation
Candidate 1	X			x	x	
Candidate 2		x	x			
Candidate 3		x				
Candidate 4		x				x
Candidate 5		x	x			x
Candidate 6	X					x

The confidence that the teacher candidates have in their search behaviour can be attributed to their having success in locating information. This model of searching behaviour poses search strings as questions. Although websites more often present information as answers to questions, there will be sufficient matches on words in any order to provide useful information. The approach of adding to search terms to help narrow search results can help, although the relevance of the results depends upon the initial terms used. If the initial search terms do not capture the key concepts of the topic question, results may not improve with additional words.

Discussion

One of the most obvious shortcomings of this model is the lack of question analysis before execution of a search. Students did not explicitly state what they hoped to find and consequently did not prompt themselves to articulate a range of words that could lead to useful results. The selection of keywords was usually taken directly from the question itself but the research questions were purposely written to require some degree of interpretation to reflect the real world tasks faced by teachers. As a search progressed and websites were browsed, it was also apparent that there was little identification of relevant terminology and vocabulary to trigger a re-formulation of the search as a whole. Instead, more web pages were explored and the topic focus was sometimes even changed to match what appeared in search results. Evaluation criteria were not applied consistently or even critically. Less relevant sites were selected when others could not be found. There was a marked preference for sites that provided point-form or brief information. Sites that met critical website criteria but did not provide immediate full text, such as a link to a scholarly or professional journal article that could have been checked in the library catalog, were not pursued.

This model of search behaviour resulted in teacher candidates frequently missing high quality information that was available on their topics. However, the search behaviour is successful enough in locating large amounts of somewhat related information to encourage them in the belief that they are skilled at web searching. In the real world of the classroom, this model will not enable teachers to effectively instruct their own pupils because they do not appear to hold a mental model of resources on the web, an understanding of how Google operates, and an awareness of the limitations of the online resources that Google is able to access.

Response to the Study

The Queen's University Education Library responded to the study in several ways. First, we revised the content of both our generic and our course-integrated library instruction classes with a new appreciation for the pre-eminence of Google as the university students' starting search tool of choice. It no longer makes sense to separate instruction on best practices for searching Google from instruction on finding journal articles. Second, a new workshop that showcases a suite of Google tools was developed, with the goal of extending the teacher candidates' understanding of how Google can be used in classrooms. The survey data revealed that the confidence levels that pre-service teachers have about finding information for their own use is much higher than their confidence level for teaching information skills to their students. The data suggest that when teacher candidates perceive themselves as teachers of research skills they see the value of acquiring expert skills and of learning to articulate best practices in information seeking. And finally, we shifted our library's teaching philosophy somewhat, in response especially to the work of the six searchers who shared with us their "think-aloud" narratives of why they do what they do when they search Google. From our analysis of the search skills these searchers possessed we

learned that searchers who know of a search technique will tend to use it in every search. This suggests that once a searcher understands the value of a particular best practice, they will then formulate search strings that integrate the use of that best practice.

Apart from teaching Google search tips, teachers can demonstrate to their students that starting points for searching depend on the type of information needed. Do you need newspaper articles, government documents, magazine articles, research articles, encyclopedias, dictionaries, books, or multimedia, community organizations, primary sources, or professional associations? What form of information will best answer a question? The best retrieval method depends on the type of information being sought and it is not always a search engine. Teachers should be able to guide students in the best ways to locate precise content for inquiry projects, knowing that students often turn to the web as their first, and their last, information stop.

During the year we conducted the study, 2005/06, we had designed and taught a five part teaching program called the INSPIRED Teaching Series (**IN**ovative **S**tudent **P**articipation **I**n Research and **ED**ucation). In this series, we offered optional lunchtime sessions that each focused on a single topic: in “Best Classroom Resources” we highlighted the range of interesting resources available in our ten library collections; in “Assignments Already?” we introduced the teacher candidates to key professional and scholarly journals in education and taught best practices for using the education journal databases; in “Be a Subject Expert” we focused on content by discipline, alerting teacher candidates to notable and popular resources in each content area covered in the Ontario K-12 curriculum; in “When YOU Teach Research” we worked with teacher candidates to develop their instructional strategies for teaching the research process to K-12 students; and in “Out-Google Your Students” we presented tips for searching Google effectively by discussing Google in the context of the Internet and especially the ‘invisible web’ of databases. In this Google workshop that ended our 5-part program we reminded students, too, that there are other tools for searching information on the Internet, from subject directories, to known educational web sites of excellence, to other search engines. Our approach to teaching web searching before learning the results of this study, in other words, was to teach Google tips in a stand-alone workshop that placed Google in the context of the entire Internet. We presented Google as one information-finding tool among many that are useful for finding information on the web.

In the academic year following this study, 2006/07, we now understood that Google is the starting point for teacher candidate research, so we integrated Google and Google Scholar search strategy instruction into our former “Assignments Already” workshop. In the past, our “Assignments Already” workshop had focused on finding journal articles by using academic journal index databases only, but in acknowledgement that Google is the starting point for research that includes finding professional and scholarly journal articles, we now fused the two workshops and renamed the new version “Google and Beyond: How to Find Inspiring Journal Articles”. In this new workshop, we began where the teacher candidates begin their journal searches: with a Google search. However, we still wanted to illustrate for the teacher candidates the continuing value of

using academic journal databases that index and often supply relevant and expert articles on the topics they were searching, even as we acknowledged the potential use of Google as an irresistible starting point. To this end, we used a comparison chart of search tools that provided a means of comparing search results for the same search -- from Google, Google Scholar, ERIC, and EBSCOhost's Professional Development Collection. The teacher candidates participated in the development of this chart by performing a search on a current topic in education. The topic would vary depending on the group being taught, but a typical topic might be "I need to know more about how to modify a lesson for students with learning disabilities". For each search tool tried, the teacher candidates would record 1) the search string used, 2) any revised search strings, and 3) any tips that they already knew for searching with that particular tool. Once they had tried their search in each of the search tools, they were asked to consider the results they found in each source, and to rank the tools according to their value for finding professional or scholarly articles on their topic. Given the type of resources that teacher candidates are seeking for use in their university assignments, the value of a teacher-friendly database like the Professional Development Collection or ERIC emerged from the completion of this comparison chart.

The use of a comparison chart to illustrate the relative value of a Google result list to an academic journal result list served to help us achieve one of our objectives in our 2006/07 workshops, which was to encourage teacher candidates to evaluate their Google result lists from a critical perspective. A second objective of these classes was to provide the teacher candidates with a more extensive array of Google search strategies than they may already have been aware of. To this end, we focused on the six Google tips that we consider most useful for classroom teachers; we included these in our class handout and we demonstrated them in class. A table listing the Pros and Cons of Google Scholar as a search tool was also included in the class handout, including the critical information that the library's journal holdings are linked to Google Scholar IF the teacher candidate is either on campus or using the Queen's proxy service. The findings in our study alerted us to the confusion that exists around what is and is not freely available on the Internet, as was evidenced in the many "Don't Know" responses to the survey question on the availability of full text educational resources on the Internet. The responses to this question suggest that librarians at the school and university level need to be explicit when identifying the web information that is free and the online information that institutions pay for either by subscription or purchase.

In addition to merging our stand-alone journal article class and our stand-alone Google searching class, in response to the study results, a librarian at the Education Library also developed a new two-hour workshop called Become a Google Power Teacher. This workshop grew out of the original "Out-Google Your Students" session, but expanded to include an exploration of multiple Google search tools (Google Earth/Maps, Google Books, and Google Scholar) as well as web searching strategies. From the study results, it was clear that teacher candidates perceived Google as a simple search tool that responds well to simple search queries. In the Google Power Teacher workshop the librarian instructor demonstrates the power of the Google product to provide answers and to provoke questions that go beyond the "I'm Feeling

Lucky” level of investigation. The goal in this workshop is to lead teacher candidates to view Google as a powerful learning tool that requires thoughtful curriculum linking and that offers much more for classroom learning than the Google search tool that is the most commonly known of the Google suite of services.

Teachers do not need to approach web searching with the expertise of a librarian. They do need to gauge the range of tools and techniques that will help them identify professional development materials for themselves and learning resources for their students. A number of studies have identified the characteristics of novice versus expert web searchers (Griffiths and Brophy; Tabatabai and Shore; Jansen and Pooch; Tabatabai and Luconi; Lazonder, Biemans, and Wopereis). Skill levels can be characterized in different ways, such as by the amount of time someone is engaged in web searching each week or even the duration of time taken to find specific information during a single search session. Martzoukou argues that web searching is best understood when authentic searches are observed taking into account variables that express physical, mental, and behavioral approaches (6). Table 10 presents a hypothetical continuum of tactical, cognitive, and affective web searching strategies. The levels of searching that are represented might all be used by one searcher depending on the information content being sought. Surface web searching does not apply many narrowing techniques whereas deeper searching, often needed for research purposes, exploits several methods of narrowing search results. These are contrasted with the additional techniques that librarians often draw on to focus content. Teachers who are instructing their students should be able to examine this table and consider the skill level that is appropriate for them and their students.

Table 10 - Hypothetical Continuum of Web Searching Strategies

Surface Web Search	Deep Web Search	Further Mining
Tactical Strategies		
Typically use two search terms to begin search.	Use two or more terms to start and continue to add more, sometimes replacing a term that has been found on a useful website.	Add words that express the type of material sought such as research, analysis, critique, introduction, lessons, statistics, etc. Add words that express the audience - that the work is written for such as children, teachers, university, graduates, students, etc.
Tend not to use search engine operators such as quotations, plus, Boolean.	Use several operators consistently such as quotations for phrases and plus signs to include specific words	Draw on range of operators in combination including Google features such as intitle: -site:.com
Cognitive Strategies		
Search Google as preferred research method. Goal is to	Start with search engine but aware that library has full	Consider types of resources that will help to

find free full-text information on web without using library subscriptions to online resources.	online text of many items not available in a web search.	answer the question and then the tools that access them. Starting point may be an online encyclopedia, an article database, Google Scholar, or even a specific website.
Apply limited or unclear evaluation criteria.	Apply clear and comprehensive evaluation criteria.	Compare findings to other types of resources that offer more authoritative or comprehensive content, such as scholarly databases not accessible via a search engine.
Navigate excessively by clicking links in hopes of finding better information.	Read results list carefully to judge if titles and descriptions are on track.	If first search brings up irrelevant hits, search quickly reformulated.
Type first words that come to mind without thinking about type and format of information needed (website – research article – news – government doc.)	Use “found” words on websites to reformulate search.	Think about search words carefully before typing. Consider different ways of expressing concepts in query. Consciously selecting set of key words.
Affective Strategies		
Search with hit and miss attitude. Do not ask for help from experts but continue to click without analyzing how search can be improved. Approach with confidence as level of skills usually over-rated and results usually appear, even if they are not especially useful or closely related to the topic.	Aware that search success depends on search formulation in terms of operators applied and selection of terms. Critical of results and may be skeptical of results.	Aware of range of potential resources other than those on the web so approach task with caution but also with confidence.

In summary, the research findings prompted us to rethink the methods we use to teach web searching and to stress the need to articulate why one search is better than another. Searchers who can explain how to improve a query when results look futile are more likely to be able to model those skills for others. We decided to give further context to the web as an information tool by including these additional components in our workshops:

- Consider when Google is an appropriate starting point for information gathering depending on the nature of the information being sought. Discuss other more direct methods of finding web information such as using an online encyclopedia,

government website, database, or institution or association specializing in the type of information needed.

- Mapping the information landscape of the web and the types of resources it houses.
- Comparison of search engine functionality and how they access web materials.
- Concept of web search strategy where the starting tool depends upon the type of information needed.
- Development of website evaluation criteria.
- Modeling of how web searching skills can be taught to elementary and secondary school students.
- Relationship of web resources to library holdings.
- Comparison of Google and Google Scholar results with results in education-focused journal indexes.
- Principles of online searching.

In all our library workshops we approach our work with the teacher candidates as professional development with colleagues rather than as instructional classes for students. An emphasis is placed on the role of teachers as inquiry educators who need to acknowledge their role as model searchers when information seeking. We encourage our teacher candidates to access all our learning materials on web searching, all aspects of information literacy, and a selection of learning objects on website evaluation by making them accessible on the library website.

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