Cited as: Chiu, M.M.L., Chu, S.K.W., Ting, K.K.K., & Yau, G.Y.C. (2011). A novice-expert comparison in information search. Paper presented at *CITE Symposium 2011*, Hong Kong.

Abstract

In the age of Google, it is commonly believed that university students, especially those at postgraduate level, should have attained enough information searching skills to support their studies. However, recent researches have found that the information literacy level of quite a few postgraduate students is, in fact, far from satisfactory. One possible way for information search specialists to help students effectively search information is to use a novice-expert comparison to examine the differences between novices and experts in information search. The aim of this study is to uncover some of the major differences in the search query statements and information search strategies between eight doctoral students (novice searchers) and an expert information literacy professional. Preliminary findings show that conspicuous differences do exist in the complexity of the formulation of query statements, choice of keywords, use of operators between the novice and the expert searchers.

1. INTRODUCTION AND BACKGROUND

Consulting academic library's catalog, searching scholarly information online, and conducting rigorous database searches to support their studies have become an indispensable part of the research students' academic life. In such an age of Google, it is expected that university students at postgraduate level would not have problems in information literacy. On the contrary, several studies have found that the information literacy level of quite a few university students, including postgraduate students, is still far from satisfactory (Chu and Law, 2008; Graham and Metaxas, 2003; Laverty, Reed, and Lee, 2008). One study has pinpointed the initial inadequacy of information searching skills of students even at PhD level (Barry, 1997). These findings highlight the need to establish a suitable approach to examine the issue and subsequently improve the students' information searching skills.

One possible way for information search specialists to help students effectively search information is to apply a novice-expert study approach. It is believed that a good understanding of how people become experts can help shorten the novices' learning curve in becoming experts themselves (Larkin, McDermott, Simon, and Simon, 1980). Numerous studies have examined the differences between experts and novices in different domains, a research area known as expertise or novice-expert research. As a matter of fact, a substantial number of novice-expert comparative researches have already been conducted on the domain of information searching expertise (Chu and Law, 2007a, 2007b, 2008; Hölscher and Strube, 2000; Jenkins, Corritore, and Wiedenbeck, 2003; Sihvonen and Vakkari, 2004; Tabatabai and Shore, 2005).

This paper explores how novice searchers interpret an information search task, in terms of the search strategies they use, and the formulation and revision of a search statement over a two-year period. The novice searchers are initially at the first year of their doctoral study under the Education faculty of HKU, and towards the end of the research session they have just been a few months away from proceeding to their third year of their Ph.D. program. Comparisons are made with how an expert searcher would do with the same task, thus, identifying potential areas for improvement in the research students' searching skills.

2. LITERATURE REVIEW

2.1 Information Search Strategies and Query Formulations

According to Chu and Law (2007a), research-oriented sources include refereed journals, review articles, books, free web resources, bibliographies, conference papers, and theses. During the information searching process, what basically the research students do is to decide what databases they are going to use to look up for a particular type of research material. There are currently numerous databases for them to choose and their usefulness is highly dependent on whether the content of the database matches students' fields of interests. ERIC, ProQuest, and Academic Search Fulltext Elite are some of academic subscription databases considered useful to students studying in education field; while IEEE Xplore, ScienceDirect, Springer-LINK are some well-known databases for engineering students (Chu and Law, 2005). Meanwhile, some databases share equal importance among students of all disciplines such as the university library online catalogue and the highly popular Google, and Google Scholar. The databases that research students use may, in turn, fall into one of the three main Information Retrieval Systems (IRS) categories: 1) online public access catalog (OPAC), 2) free web search engines, or 3) online bibliographic or full-text databases subscribed by academic libraries that may be either multi-disciplinary or discipline-specific (Chowdhury, 2010). A series of actions and decision-making in the selection of databases and information retrieval systems for various types of information constitutes what we call information seeking strategy in this study. Chu and Law (2005, 2007a) have previously

investigated postgraduate research students' knowledge of academic databases and information source types in separate studies. However, their relationship has not yet been studied and established.

One common property shared by these databases and information retrieval systems is that they are all designed to support search by query formulation where "the query box is still the main channel for users to express their information needs" (Xie, 2007). The effectiveness of the information search depends not only on whether the correct database is being used, but also on how effective a search query formulated by students is. There have also been a few researches on query statement construction and various tactics have been formulated and developed accordingly in different time periods (Bates, 1979; Fidel, 1985; Hembrooke, Granka, Gay, and Liddy, 2005; Hölscher and Strube, 2000).

2.2 Novice-expert Studies on Information Search Behavior

Expertise or novice-expert researches are important because researchers on expertise research believe that a good understanding of how people become experts or how experts actually perform the required tasks can help shorten the novices' learning curve in becoming experts themselves (Larkin *et al.*, 1980). This was exactly what Brand-Gruwel, Wopereis, and Vermetten (2005) were striving to do in their research where, by attempting to decompose the information problem solving into different skills and sub-skills in order to design instructions, they hoped that it could foster the development of information problem solving skills and that their ""expert-novice analysis gave more insight in which skills need more attention and need to be further analyzed" (p. 502).

Novice-expert comparison studies have been indeed extensively conducted on a wide variety of aspects and issues related to information searching. Hölscher and Strube (2000) employed a 2 x 2 design resulting in 4 experimental groups of participants, namely double experts, experts in web expertise only, experts in domain knowledge only, and double novices, and compared their rates of solving information tasks, and query formatting behaviors. The findings indicated that double experts solved the most tasks while double novices reformulated query statements more than any other groups. In addition, web experts use query formatting tools more frequently than web novices. They also found that expert searchers made use of Boolean operators, modifiers, phrase searches and other IR system features more often than novice searchers did. Examining the interactive effects of both cognitive style and on-line database search experience on the search performance measured by both the time and the average number of nodes visited for an information task, Palmquiest and Kim (2000) found that cognitive style significantly affected the search performance of novice searchers only, but not the experienced searchers. Several studies tried to explore the effects of domain/subject knowledge on information seeking results and all findings confirmed a positive influence on it (Duggan and Payne, 2008; Hsieh-Yee, 1993; White, Dumais, and Teevan, 2009). In regard to the way the search terms were derived, Hsieh-Yee (1993) found that, when searching in an unfamiliar domain, expert searchers used the thesaurus more often for term suggestions, used more synonyms, and used more term combinations than they would when searching in a familiar domain, concluding that the users' search experience (information search expertise) affected their use of search strategies more than their domain knowledge did, and hence, played a more important role in information searching.

2.3 Research Gap

The research gap in regards to the relationships among information source types, databases and information retrieval systems is therefore twofold. The issue of how effective the students would be in terms of the usage of different databases when they attempt to look for a certain information type has not been studied before, let alone to be examined under expert-novice comparison approach. Regarding query formulation, despite the fact that there have been some previous researches that have been done on it using expertise study

approach, they seldom aim at studying or directly address to the academic searching behavior of doctoral students.

3. METHODOLOGY

Based on the research gaps identified in the previous literature review, this study adopts a novice-expert comparison approach to investigate the overall differences between the postgraduate students and an expert searcher in terms of 1) effectiveness when using different databases for various information source type search, and 2) formulation tactics of the search query statements.

3.1 Participants

Eight research postgraduate students in their 1st year study of their doctoral program under the Faculty of Education of the University of Hong Kong (HKU) were selected for the study by purposive stratified sampling.

3.2 Procedure

This study used surveys, interviews, direct observations of students' searching behaviors over a two-year period. The participants attended five research meetings during the period. During each meeting, each participant searched for information that was relevant to their research topic for 20 minutes. This was followed by 20 minutes of searching on the same topic by an information literacy expert. Participants also responded to a self-report questionnaire which assessed their search knowledge and skills at the end of three of the five meetings -- the first, third and fifth meetings. A final interview was conducted in the sixth meeting to probe students' perceptions of the development of their search strategies over time. Four kinds of data were analyzed: 1) search statements used by students when searching various databases, 2) transcriptions of students' think-aloud protocol as they verbalized their thoughts and actions when performing database searches, 3) responses to the questionnaires and 4) transcriptions of interviews.

3.3 Analysis Tool for Information Search Tactics

The measurement tool used to analyze the semantic structure of query statements is borrowed from Hembrooke et al.'s (2005) research whose initial attempt was to study the effects of domain expertise and feedback on the search term selection in constructing a search query. Nine distinct tactics were initially identified; among which the *Redundancy* tactic could be further sub-divided into 3 different tactics -- *Backtracking, Topic Terms, and Plural Making/Taking*. Definitions and examples of these tactics are provided as follows (Table 1):

TACTICS	DEFINITION
I) ELABORATION	The global level of detail and sophistication intrinsic to user search attempts.
Example:	*[History of Computers]: Microsoft, inventions, technological advance, personal computers, history of Microsoft, history of computers, inventions 20th century, technological advances 20th century, computers now and then, machine language development*
II) REDUNDANCY	An overall index of the extent to which search terms are used repeatedly on successive queries. Redundancy can be further divided to backtracking, topic terms, and plural making/taking.
Example:	*[18th century antiques]: 18th century antiques, 18th century, antiques, antiques 18th century*
a) BACKTRACKING	The frequency with which a searcher reuses prior search terms over successive trials.
Example:	*[Lakota Sundance Ceremony]: Indian ceremonies, Native American Ceremonies, Lakota Sundance ceremony, Lakota, Lakota ceremony, Native American Traditions, Native American ceremonies, ceremonial dances, dance ceremonies*
b) TOPIC TERMS	The extent to which the user incorporates the given query terms as their search terms.
Example:	*[Play strategies in basketball]: Basketball strategies, basketball plays, strategies in basketball playing, strategies for basketball, coaching basketball, learning basketball strategies, play strategies basketball, etc.....*
a) **PLURAL MAKING/TAKING**	Reflects instances when a user repeatedly incorporates similar nouns into their search attempt, with the slight modification of making the word plural or singular.
Example:	*[Common garden pests and how to get rid of them]: ant, ants, spider, spiders, pests, pest, etc....*
III) BROADENING	The extent to which a user begins with a specific query and expands the scope of the search phrase over successive trials.
Example:	*[Migration patterns of butterflies]: Monarch butterflies, butterfly migration, insect migration patterns, yellow swallowtail, painted lady, Mexico and monarchs, migration pattern and butterflies, migration routes butterflies*
IV) REFINING	The extent to which a subject begins broadly and narrows the search with increasing specificity.
Example:	*[History of Computers]: Computer history, Babbage, history of DARPA, history of IBM, mechanical computer, computer history, military computing history, eniac, uniac, early computer software*
V) KITCHEN SINK	The extent to which a searcher incorporates search terms related to the subject, but not specific to the query task
Example:	*[Asian Cooking/Dishes]: dumplings, kung pao chicken, rice, eating on the floor, wok, chopsticks, curry, haan, Korean dishes, French cooking*
VI) POKE-N-HOPE	The extent to which a searcher retains the same basic structure throughout all search queries, changing only a single word within each trial
Example:	*[Common garden pests and how to get rid of them]: garden pest elimination, garden pest kill, garden threats, garden pests, gardening tips, garden rid pests, garden pest wipe, garden pest eliminate, weed eliminate*

Table 1. Definitions of Nine information search tactics proposed by Hembrooke et al. (2005)

4. FINDINGS AND DISCUSSIONS

4.1 Comparison of Satisfaction Level of Search Results between Novice and Expert

As an indicator of search quality and success rate, the mean rating of satisfaction level in each of the 40 research meetings (8 participants x 5 sessions each) is calculated and presented in figure 1. The satisfaction levels towards the scaffold search sessions were unanimously higher than those of unaided search sessions for all 8 participants. Among those 40 meetings, improvement in satisfaction level between the unaided and scaffold sessions was found in majority of them. The overall average scores of the unaided sessions and scaffold sessions in all 40 research meetings were 3 and 4.35 respectively. The current study was based on the premise that it was the differences in the searching strategies (choices of databases used) and the tactics used for query formulation between novice and expert searchers that contributed to the improvement in the satisfaction level.

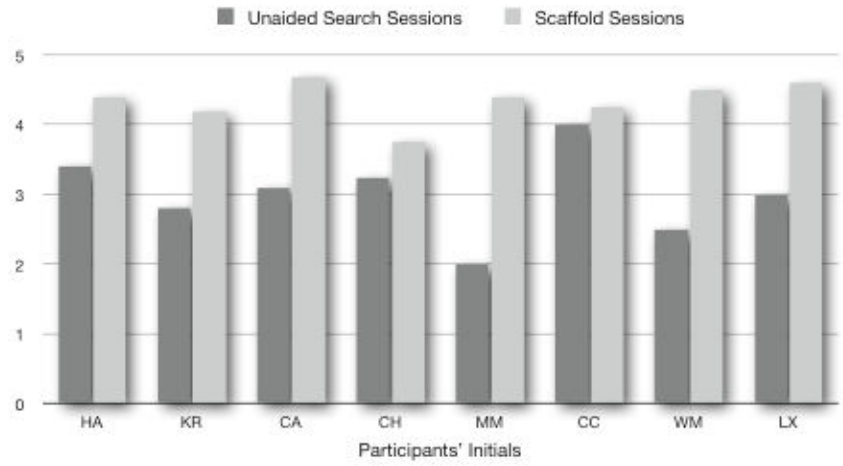

Figure 1. Comparison of satisfaction level between unaided and scaffold search Sessions.

4.2 Information Retrieval System Usage Comparison between Novice and Expert

Figure 2a and 2b show the distribution of the 3 main information retrieval system usages for seeking each of the four different types of research materials in the unaided search and scaffold search sessions respectively. In those 40 research sessions, the participants spent approximately 35% of those sessions searching for journal articles, 25% for theses, 23% for books and 17% free web resources. As the decisions on sources types for the information task in each research session were made solely at the participants' own preferences, this supports the previous findings by Chu and Law (2007a) that journal articles ranked highest in terms of perceived importance by doctoral students. This also supports the common perception that refereed journals usually have the more scholarly and respected researches (Morner, 1993), thus are better reference sources for academic research.

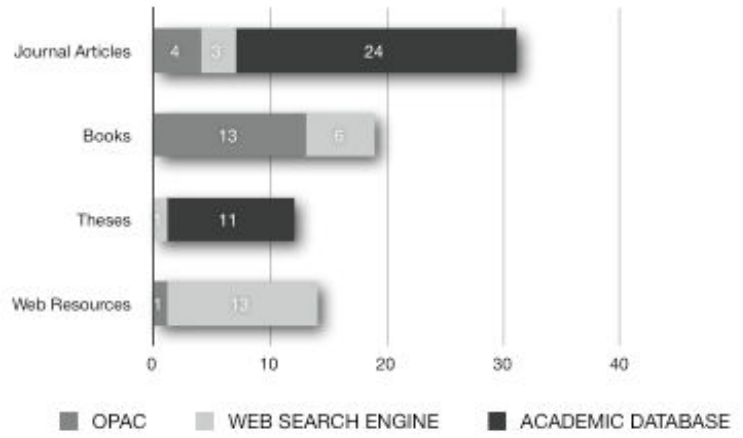

Figure 2a. IR usage frequency breakdown on four source types in 40 unaided search sessions

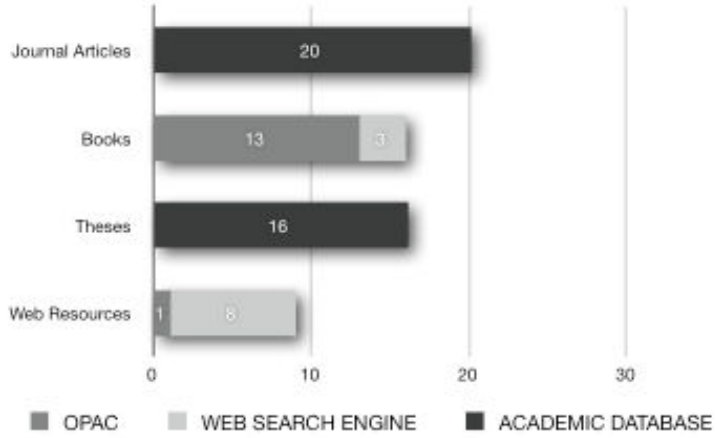

Figure 2b. IR usage frequency breakdown on four source types in 40 scaffold search sessions

Overall, the main information retrieval systems used for various source types in both novice and expert searchers shared a high degree of similarities -- online academic databases used mainly for searching journal articles and theses, OPACs mainly used for books, and web search engines for free web resources. All the main IRs adopted by both groups of searchers were logically sound choices with respect to each individual source type.

One notable findings is that the novice searchers would get the web search engines involved for searching all four source types while the expert searcher adopted a very clear cut approach and resorted to a single resource -- online academic databases, which, by definition, are those discipline-oriented or multidisciplinary databases or those databases that covers a specific type of publications other than books, such as theses and dissertations. One possible reason is that "using the internet to find information has become an integral part of everyday life" (Hembrooke et al., 2005, p. 861). As this piece of findings might suggest, even nowadays students at doctoral level who are looking for academic information are in no exception.

4.3 Database Usage Comparison between Novice and Expert

Table 2 displays all the databases used by both novice and expert searchers for searching different source types. At first glance, for each individual information source type, the databases used by novice searchers were more diversified than those used by expert searcher. The number of databases used by the expert searcher were limited to three and at most four while the number of databases used by the novice searcher could go up to as many as 10. All databases used by expert searcher were also used by novice searchers except WorldCat and Networked Digital Library of Theses and Dissertation (NDLTD).

SOURCE TYPES	DATABASES USED	NOVICES	EXPERT	TOTAL USAGE
Journal Articles	EBSCOhost	9	6	15
	ProQuest	6	6	12
	Web of Science	5	6	11
	HKUL Catalogue (Dragon)	2	1	3
	Scopus	1	-	1
	ScienceDirect	1	-	1
	Wiley Online Library	1	-	1
	HKALL	1	-	1
	HKIED Library Catalogue	1	-	1
	Google Scholar	1	-	1
	Google	1	-	1
Books	HKUL Catalogue (Dragon)	9	3	12
	WorldCat	-	7	7
	HKALL	3	3	6
	Google Book	3	3	6
	Google Scholar	2	-	2
	PolyU Library Catalogue	1	-	1
	Google	1	-	1
Theses	ProQuest	5	8	13
	WorldCat	-	6	6
	Digital Dissertation Consortium	4	1	5
	Emerald	1	-	1
	HKU Theses Online	1	-	1
	Networked Digital Library of Theses & Dissertation	-	1	1
	Google Scholar	1	-	1
Web Resources	Google	5	6	11
	Google Scholar	7	2	9
	HKUL Catalogue (Dragon)	1	1	2
	Google Scholar (Taiwan)	1	-	1

Table 2. Database usage frequency comparison between novice and expert searchers

4.3.1 Databases for Journal Articles

EBSCOhost, ProQuest, and Web of Science were the top three most frequently used databases for journal article search in the research sessions of both novice and expert searchers. This findings matches what had been found in several previous researches (Bar-Ilan *et al*., 2003; Talja and Maula, 2003; Chu and Law, 2005) that Academic Search Fulltext Elite (a subset of EBSCOhost), ERIC (a subset of EBSCOhost), and Web of Science, and ProQuest were all rated within the top ten databases by the doctoral students in Education field.

4.3.2 Databases for Books

Overall, the top three databases for searching books for both novice and expert searchers put together, in descending order of usage frequency, were: 1) HKUL Catalogue, Dragon, 2) WorldCat, and 3) HKALL and Google Books (both having the equal number of usage frequency). However, no participants had used the WorldCat for book search. Out of 8 participants, half of them had explicitly stated that either they did not know Worldcat at all or they just seldom used it. Participant AH showed another concern for using WorldCat:

> "WorldCat, I rarely go to that because I discovered many of the book I need can be accessed through the [local] library already, so I just wonder, even if I find the book that is not in the [local] library, then how long would it take for me to request that? It might not be as easy."

As inferred from the statement above, time factor is another concern for borrowing books overseas to novice searchers in the internet era where one of the major characteristics of both digital natives and digital immigrants is the need for instant gratification of the information needs (Agee, 2007; Prensky, 2001).

4.3.3 Databases for Theses

ProQuest proved to be the most popular database for dissertation and theses search for both novice and expert researchers. While the second most popular database for novice to search for dissertation and theses was Digital Dissertation Consortium, the expert's next favorite one after ProQuest was WorldCat. Similar to what has been discussed in the previous section, no single participant used WorldCat for theses search.

4.3.4 Databases for Free Web Resources

As indicated in table 2, an apparent contrast in the preferences of databases used for searching free web resources was observed. The novice searchers tended to favor Google Scholar more than Google. On the contrary, it was the opposite for the expert searcher, who tended to use Google most of the time. Such discrepancy was entirely attributed to their different interpretations of what free web resources actually meant to them. For novice searchers, most of the time when they searched for academic information on the web, they were actually looking for and paying attention to journal articles, theses, or dissertations that were accessible through the web. It was exactly what Google Scholar was intended to do when launched in late 2004 as a subset of Google. It provided a single interface for users to search scholarly works across different academic disciplines, sources, and across the world of scholarly research in the web. However, to the expert searcher CS, his interpretation of "free web resources" meant something entirely different in nature as he explained his search motive behind when attempting to search on the web:

> *"Beside Google Scholar, I think I'd like to suggest another way of searching for information. How about we will try to search by some either top scholars or top research centers in the area? How about let's try for some research centers for the area?"*

4.4 Query Formulation Comparison between Novice and Expert

The 8 students (novice searcher) conducted a total of 192 searches in the unaided search sessions of the five meetings while the principal investigator (search expert) 127 searches in the scaffold search sessions. The distributions of different query tactics used by both novice and expert searchers are calculated and listed in table 3. Since it is possible for a search query to contain more than one tactic, this explains why the percentages of all the tactics used did not add up to 100. The top three tactics used by novice searchers were *Topic Terms*, *Backtracking*, and *Elaboration* while expert searcher used, in the rank of descending *order, Topic Terms*, *Elaboration*, and *Backtracking* the most.

QUERY FORMULATION TACTICS		NOVICES	EXPERT
Semantic	1) Elaboration	99 (52%)	100 (79%)
	2) Backtracking (Redundancy)	104 (54%)	66 (52%)
	3) Topic Terms (Redundancy)	171 (89%)	110 (87%)
	4) Pural Making/Taking (Redundancy)	2 (1%)	1 (< 1%)
	5) Broadening	9 (< 5%)	2 (< 2%)
	6) Refining	5 (< 3%)	1 (< 1%)
	7) Kitchen Sink	3 (< 2%)	0 (0%)
	8) Poke-and-hope	12 (6%)	0 (0%)
Operational	I) System Modifier Usage	78 (41%)	89 (70%)
Total Queries for All 5 Sessions		192	127

Table 3. Query formulation tactics comparison between novice and expert searchers

4.4.1 Elaboration

The single largest difference between novice and expert searchers was the use of *Elaboration* in their construction of search query. The expert used it in 79% of his search statements and novices only 52%. Throughout the search processes in all the 40 scaffold search sessions, instead of using his own "existing knowledge store", the principal investigator drew upon two main resources to construct search statements -- 1) the students' articulation of their information needs, and 2) terms that the students found useful and relevant in the sources that the investigator or the students themselves managed to retrieve during the session.

Information needs at the doctoral level usually tends to be relatively specific even at the early stage of their study, and the search topic may contain more than one or two concepts. This might require a very demanding cognitive load when trying to manage and grapple with multiple search elements and concepts (Debowski, 2001). In one search session with KR, the principal investigator CS addressed this particular issue and provided an insight on how to deal with it:

> *".....then let's try to construct a search that would use all or most of these words.....first of all, put them into different concepts -- two or three concepts. Put the words that belong to the same concept together....."*

Listed below was one of the search statements the principal investigator CS formulated in regards to KR's information need on topic "well-being in school" versus another search statement by KR in the unaided session :

CS: ***(well-being or vitality or life satisfaction or positive affect or negative affect or "locus of control" or burnout or self-esteem) w/5 (goal or engagement) w/5 (school or student or pupil)***

KR: ***student* or school*** AND ***well-being*** AND ***goal****

As demonstrated, various search terms were grouped into a related concept and different concepts were, in turn, linked together by search operators or modifiers.

4.4.2 Topic Terms and Backtracking

Both novice and expert searchers shared similar percentages in the number of times they used *Topic Terms* and *Backtracking*. In about 90% of the search statements they used *Topic Terms* and about 50% of the time *Backtracking* was used. This findings appears to be contrary to the expectation that both *Topic Terms* and *Backtracking* (a subset of *Redundancy*) are considered the search tactics that usually only novice searchers resort to due to their inadequate resourcefulness in generating search terms. Furthermore, *Topic Terms* was found to be the top tactic used by both novice and expert searchers. What this implies is that formulating a clear topic and focus is a pivotal step before actually engaging in the searching action. The clarity of the topic would have much influence on the quality and relevance of the information retrieved.

4.4.3 Operational Tactics Comparison

The common system modifiers that help a searcher to build an effective search statement usually include parentheses ( ), quotation marks " ", question marks ?, asterisk *, and w/. The functions that these modifiers provide include setting a word phrase, using as a wildcard, truncation and proximity search. Novice and expert searchers demonstrated a significant discrepancy in the use of the various system modifiers, 41% of the search queries for the novices versus 70% for the expert. Even among those 41% of the search statements that the novices used system modifiers, what they usually used were only limited to parentheses, quotation marks, and asterisk most of the time. Such discrepancy can be best explained by what MM has once said:

> *".....I noticed the researcher knew how to use different symbols to find the results. But for me, I guess I learned it before, maybe in the library workshop, or somewhere else, but I did not remember. Actually I cannot remember the meaning of symbols and how to use them. So I did not use the symbols in my search."*

In some cases, the difference in the application of modifiers in various systems for the very same function could be quite substantial. When one of the students, CH, asked about the difference of modifier used for proximity search in different databases, the investigator answered:

> "F*or example, [in Web of Science], "same" will be restricting what is in the same sentence or if we search ProQuest, then we can use "w/" and add a number."*

5. CONCLUSION

There does exist a number of distinct differences in both search strategies and query formulation between novice and expert searchers. Regarding the differences in their search strategies in terms of information retrieval system and database usages, the expert searcher focuses on using academic databases only for journal articles, theses and dissertations while novices tend to use web search engines for all information source types. In regard to the familiarity of WorldCat, the world's largest library catalog, a large gap is present between the novice and expert searchers. Meanwhile, the expert demonstrates apparently better ability to generate more relevant search terms and use system modifiers not only more frequently but also more sophisticatedly and skillfully so as to formulate more complex and effective search query statements than novice searchers do. By spotting such differences during the information search process, the information specialists could help novice searchers, students at doctoral level in this case, raise awareness about the skills

that they lack and encourage them to pay more attention to in order to enhance their information searching skills for their academic researches.

References

Agee, J. (2007). *Acquisitions go global : an introduction to library collection management in the 21st century*. Oxford: Chandos.

Bar-Ilan, J., Peritz, B. C., and Wolman, Y. (2003). A survey on the use of electronic databases and electronic journals accessed through the web by the academic staff of Israeli universities. *The Journal of Academic Librarianship*, 29(6), pp. 346-361.

Barry, C. (1997). Information skills for an electronic world: Training doctoral research students. *Journal of Information Science*, 23, pp. 225-238.

Bates, M. J. (1979). Information search tactics. Journal of the American Society for Information Science, 30(4), pp. 205-214.

Brand-Gruwel, S., Wopereis, I., and Vermetten, Y. (2005). Information problem solving by experts and novices: analysis of a complex cognitive skill. *Computers in Human Behavior*, 21(3), pp. 487-508.

Chowdhury, G. G. (2010). *Introduction to modern information retrieval* (3rd. ed.). London: Facet.

Chu, S., and Law, N. (2005). Development of information search expertise: research students' knowledge of databases. *Online Information Review*, 29(6), pp. 621-642.

Chu, S., and Law, N. (2007a). Development of information search expertise: Research students' knowledge of source types. *Journal of Librarianship and Information Science*, 39(1), pp. 27-40.

Chu, S., and Law, N. (2007b). Development of information search expertise: Postgraduates' knowledge of searching skills. *Portal: Libraries and the Academy*, 7(3), pp. 295-316.

Chu, S., and Law, N. (2008). The development of information search expertise of research students. *Journal of Librarianship and Information Science*, 40(3), pp. 165-177.

Debowski, S. (2001). Wrong way: go back! An exploration of novice search behaviours while conducting an information search. *The Electronic Library*, 19(6), pp. 371-382.

Duggan, G.B. and S.J. Payne. (2008). Knowledge in the head and on the web: Using topic expertise to aid search. *Proc. CHI 2008*, ACM, pp. 39-48.

Fidel, R. (1985). Moves in online searching. *Online Review*, 9(1), pp. 61–74.

Graham, L., and Metaxas, P. (2003). "Of course it's true; I saw it on the internet!": critical thinking in the internet era. *Communications of the ACM*, 46, pp. 71-75.

Hembrooke, H. A., Granka, L. A., Gay, G. K., and Liddy, E. D. (2005)**.** The effects of expertise and feedback on search term selection and subsequent learning: Research Articles. *Journal of the American Society for Information Science and Technology,* 56(8), pp. 861-871.

Hölscher, C., and Strube, G. (2000). Web search behavior of Internet experts and newbies. *Computer Networks*, 33(1-6), pp. 337-346.

Hsieh-yee, I. (1993). Effects of search experience and subject knowledge on the search tactics of novice and experienced searchers. *Journal of the American Society for Information Science*, 44(3), pp. 161-174.

Jenkins, C., Corritore, C., and Wiedenbeck, S. (2003). Patterns of information seeking on the web: A qualitative study of domain expertise and web expertise. *IT & Society*, 1(3), pp. 64-89.

Larkin, K., McDermott, J., Simon, D., and Simon, H. (1980). Expert and novice performance in solving physics problems. *Science*, 208, pp. 1335-1342.

Laverty, C., Reed, B., and Lee, E. (2008). The "I'm feeling lucky syndrome": Teacher-candidates' knowledge of web searching strategies. *The Canadian Journal of Library and Information Practice and Research*, 3(1). Retrieved from http://journal.lib.uoguelph.ca/index.php/perj/article/view/329/892

Morner, C. J. (1993). *An instrument for measuring library skills of education graduate students* (PhD dissertation, Boston College, Boston).

Palmquist, R. A., and Kim, K.-S. (2000). Cognitive style and on-line database search experience as predictors of web search performance. *Journal of the American Society for Information Science*, 51(6), pp. 558-566.

Prensky, M. (2001). Digital natives, digital immigrants Part 1. *On the Horizon, 9*(5), 1-6. Retrieved from http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf

Sihvonen, A., and Vakkari, P. (2004)**.** Subject knowledge improves interactive query expansion assisted by a thesaurus. *Journal of Documentation*, 60(6), pp. 673-690.

Tabatabai, D., and Shore, B. M. (2005). How experts and novices search the Web. *Library & Information Science Research*, 27, pp. 222-248.

Talja, S., and Maula, H. (2003). Reasons for the use and non-use of electronic journals and databases. *Journal of Documentation*, 59(6), pp. 673-691.

Xie, H. (2007). "Shifts in information-seeking strategies in information retrieval in the digital age: Planned-situational model" *Information Research*, 12(4) paper colis22. [Available at http://InformationR.net/ir/12-4/colis/colis22.html]

White, R.W., S.T. Dumais, and J. Teevan. (2009). Characterizing the influence of domain expertise on web search behavior. *Proc. WSDM 2009*, ACM, pp. 132-141.