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Doctoral students' development in information literacy

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Abstract

This paper aims to investigate how doctoral level students developed their information literacy in the beginning years of their doctoral research by focusing on the sources, databases and search engines they found relevant, the difficulties they encountered when engaging in information search with different databases, and the affordances offered by the databases which they found useful. This study adopts a one-year longitudinal approach which involved students' interactions with a search expert who showed them how to conduct searches more effectively. A combination of quantitative and qualitative data collection methods, such as surveys, interviews, think-aloud protocol, and direct observation were used. The goal is to identify students' initial searching abilities and their performance after receiving guidance from an expert. Vygotsky's social learning theory is used as the theoretical lens. Social learning theory argues that interactions with the more capable ones in the environment stimulate developmental processes and foster cognitive growth. For example, teachers and learners can work together on a difficult task with the teachers providing scaffolding to students. As such, students can complete tasks that they could not have completed on their own. The relationship between the teacher and the learner is essential in student learning as acquiring knowledge and skills from an experienced other is an important method for developing competence in a task. Social learning theory could also be applied into the information seeking situation where a master-apprentice relationship could be a possible solution to improve doctoral students' information literacy skills, where scaffolding support by information search experts could probably help them to improve their search techniques.

1. Introduction

In this age, the Internet bears lots of treasurable knowledge hidden in different media, like the Online Public Access Catalogs of libraries, popular search engines, and databases subscribed by academic libraries. In order to make use of the available information more effectively, information seekers need to possess the skills to distinguish higher quality information from those which is fallacious and less relevant. As such, searchers can access, analyze and utilize them afterwards in a more effective manner. As a result, information literacy skills become an important aspect for information seekers. It is commonly believed that university students, especially those at postgraduate level, will excel in information seeking as it is a core part of their research programme. However, Jacobson and Mark (2000) point out that many university students lack the critical thinking skills and the database searching proficiency necessary for fine-tuning their information searches. Past researches (Chu & Law, 2008; Graham & Metaxas, 2003; Weiler, 2001) show that the information literacy level of many undergraduates and even postgraduates is not up to standard for performing effective searches, so they often encounter difficulties in today's information-rich society.

Noticing the current problem that students encounter concerning information literacy, a number of researchers (Guun, 2005; Lauricella, 2009; Meyer et al., 2008) have been designing courses to prepare students for the challenges on information literacy. According to these researchers (Dadzie, 2009; De Jager, Nassimbeni, & Underwood, 2007), the majority of colleges and universities are making use of research results to offer library orientations and trainings to introduce different search tools, including trainings in OPAC, electronic databases, citations and referencing to their students. However, studies (Chu & Law, 2005, 2007; Hess, 1999) show that students' information literacy skills are still far from enough even though they are provided with training in searching.

To improve information literacy among doctoral level students, an apprenticeship model of learning can be used where students observe the teacher's demonstration, imitate it and hence internalize the knowledge of information search. By making use of Vygotsky's concept of Zone of Proximal Development (ZPD), teachers can observe how students search, identify their weaknesses and pinpoint their problems. They could also offer scaffolding support to students and demonstrate more effective ways of looking for information.

This study tracks the progresses of eight doctoral students, who are either in their 1st or 2nd year, in developing their information literacy with scaffolding support provided by an information search expert. In addition, this study also explores the potential outcomes of using scaffolding support to enhance the information literacy for doctoral students.

2. Literature Review

Information literates, according to Baro and Endouware (2011), are those who know how information is organized, located, and it could be used effectively. In the 1970s, the concept of information literacy was brought up in the states. Zurkowski argues that the “information literates” are those who are trained in the application of information resources and possess the techniques and skills for using a wide range of information tools as solutions to problems (1974). In 1983, Horton defines information literacy as the awareness of knowledge explosion (Bruce, 1997). In 1989, ALA defines information literates as those who learned how to learn because they know how knowledge is organized, how to look for information and how to use it in such a way that others can learn from them. (American Library Association Presidential Committee on Information Literacy, 1989).

In fact, many intellectuals have agreed among themselves the importance of information literacy. They point out that it is essential for higher education and institutions to provide training for their students (Candy, Crebert, & O'Leary, 1994). However, even though some institutions have done so, the outcomes of such initiatives were not impressive. Past studies (Higntte, Margavio, & Margavio, 2009; Tsai & Tsai, 2003) indicate that students' information search skills are initially inadequate and many students are having difficulties in finding and using information effectively. In the study of Higntte and others, 600 college students' information literacy skills were assessed and less than half (40%) of the participants achieved a passing grade. Similar situations were found even in doctoral levels (Chu & Law, 2007a, 2008; Hess, 1999). In the study of Chu and Law, education and engineering research students in M.Phil. and Ph.D. levels encountered hardships in locating effective information sources and constructing search terms that yield relevant results. Hess also finds that doctoral students in psychology often experience information overload when searching.

Noticing the above problems of information literacy among university students, investigations of students' learning process can possibly provide effective solutions in helping them to master such skills. As these researchers (Bransford, Brown, & Cocking, 1999; John-Steiner & Others, 1975; Rogoff, Mistry, Göncü, & Mosier, 1993) noticed, one way of learning is to observe and imitate others in completing tasks. What learners are doing is like being apprentices of the more experienced others: These apprentices first observe the acts of the master and listen to verbal explanations. They then simulate the acts themselves, and eventually they internalize the related knowledge and techniques.

According to Schunk (2009), interactions with the more capable ones in the environment stimulate developmental processes and foster cognitive growth as the interactions are transformed into learning experience. Evans, Kairam, and Pirolli (2010) share a similar view suggesting that interactions with

others during complex tasks lead to cognitive growth. Teachers of information literacy as the more capable others in the environment, can make use of Vygotsky's concept of ZPD. ZPD identifies students' ability in working alone and what students can achieve with the more advanced peers (Wood & Wood, 1996). Knowing the ZPD of students, teachers can design scaffold support. Such concept can be used in teaching information literacy as mastering information literacy skills is a difficult task that students would have difficulties in doing alone. Teachers can observe how students search, identify their weaknesses, and pinpoint their problems. They can also demonstrate effective ways of searching so that students can possibly learn from observations. This can foster new achievements that they may not be able to achieve on their own.

Since there are inadequate longitudinal researches done on the development of university students' information literacy, especially at doctoral level, the current study would try to 1.) investigate such relations between the developments in information literacy skills and the changes in familiarity on information sources and skills, 2.) assess the performance of scaffolding support in teaching information literacy among postgraduate students.

3. Methodology

This study aims at investigating the performance of master-apprentice relation in teaching information literacy for a longer period. As a result, a longitudinal design was adopted by using surveys, interviews, and direct observations of eight postgraduate students' searching behavior over a one-year or two-year period. Participants were eight beginning years (1st or 2nd) doctoral students of the University of Hong Kong. They attended five search sessions over a period of one to two years. Each session consisted of four sub-sessions, with two of them being unaided searching sessions and the other two with scaffold supports from a search expert. In the first unaided session, participants were asked to search alone for 15 to 20 minutes with the expert trying to identify students' weaknesses by observing their behavior. After that, in the scaffold support session, the expert searched the same topic for the same period of time and demonstrated to the student various information search techniques, information sources and databases. The above procedures were repeated for one more time. Mini interviews were conducted after each of the five sessions to inquire the participants' experience during the sessions.

In addition, participants were required to fill in questionnaires assessing their search knowledge and skills at the end of sessions 1, 3, and 5. An interview was conducted after the fifth session in an attempt to diagnose the causes of changes in search behaviors and skills, and to ask the participants about their irregular actions during search sessions. Four kinds of data were collected for the analysis: 1) search statements used by students when utilizing various databases, 2) transcriptions of students' think-aloud protocol as they verbalized their thoughts and actions when performing database searches, 3) data collected from questionnaires and 4) transcriptions of the interviews.

3.1 Instrument for Analysis

The criteria outlined in Chu and Law's study on information expertise (2008) are used to plot the development of students. Four levels (novice, advanced beginner, competent, and proficient) are proposed to classify the stages that the eight participants were in after each searching session.

Figure 1: Research Students' Growth and Development in Subject Knowledge Expertise and in Information Search Expertise

Stages of information search expertise	Research stage: changes of information needs due to the growth in students' subject knowledge	Expertise on sources/databases: knowledge of and ability to distinguish among sources /databases	Expertise on search skills: ability to construct appropriate search statements
<p>Proficient:</p> <ul style="list-style-type: none"> - Students are becoming efficient and effective in finding what they need 		<ul style="list-style-type: none"> - Familiar with peripheral sources/databases - Familiar with many databases in the core type 	<ul style="list-style-type: none"> - Familiar with a full range of keyword search operators and search features
<p>Competent:</p> <ul style="list-style-type: none"> - Students have become self-sufficient and are confident in information search - Get productive search outcomes on a consistent basis 		<ul style="list-style-type: none"> - Familiar with the core types of sources/databases in the area of their research 	<ul style="list-style-type: none"> - Familiar with the important operators for keyword search (mainly the Boolean operators AND and OR and the truncation operator)
<p>Advanced Beginner:</p> <ul style="list-style-type: none"> - Stage of understanding (begin to understand the different kinds of databases and searching skills) - Get productive search results occasionally 		<ul style="list-style-type: none"> - Start to understand that there are different databases available for different purposes - Use two or more types of databases 	<ul style="list-style-type: none"> - Start to use basic search operators to form search statements for keyword search (mainly the Boolean operators AND and OR)
<p>Novice:</p> <ul style="list-style-type: none"> - Stage of confusion (confused about sources/databases and search skills) - Mostly unproductive outcomes 		<ul style="list-style-type: none"> - Used mainly one type of source/database (mostly library catalogs or web search engines) 	<ul style="list-style-type: none"> - Don't understand how keyword and subject search operate though they are 'familiar' with these methods

(Chu and Law 2008)

4. Findings

This section is divided into four parts. The first part shows the progresses and ratings of participants' perceived familiarities of knowledge in information literacy of various kinds of databases and search engines over the five sessions. The second part exhibits the progresses and ratings of participants' perceived familiarities in knowledge in terms of information search skills and techniques over the five sessions. The third part tries to relate the progresses of the participants over the five sessions with the changes in the ratings of their perceived familiarity in search skills and in their knowledge in information sources. The fourth part discusses participants' magnitude of learning and investigates why some participants advanced more while others progressed less.

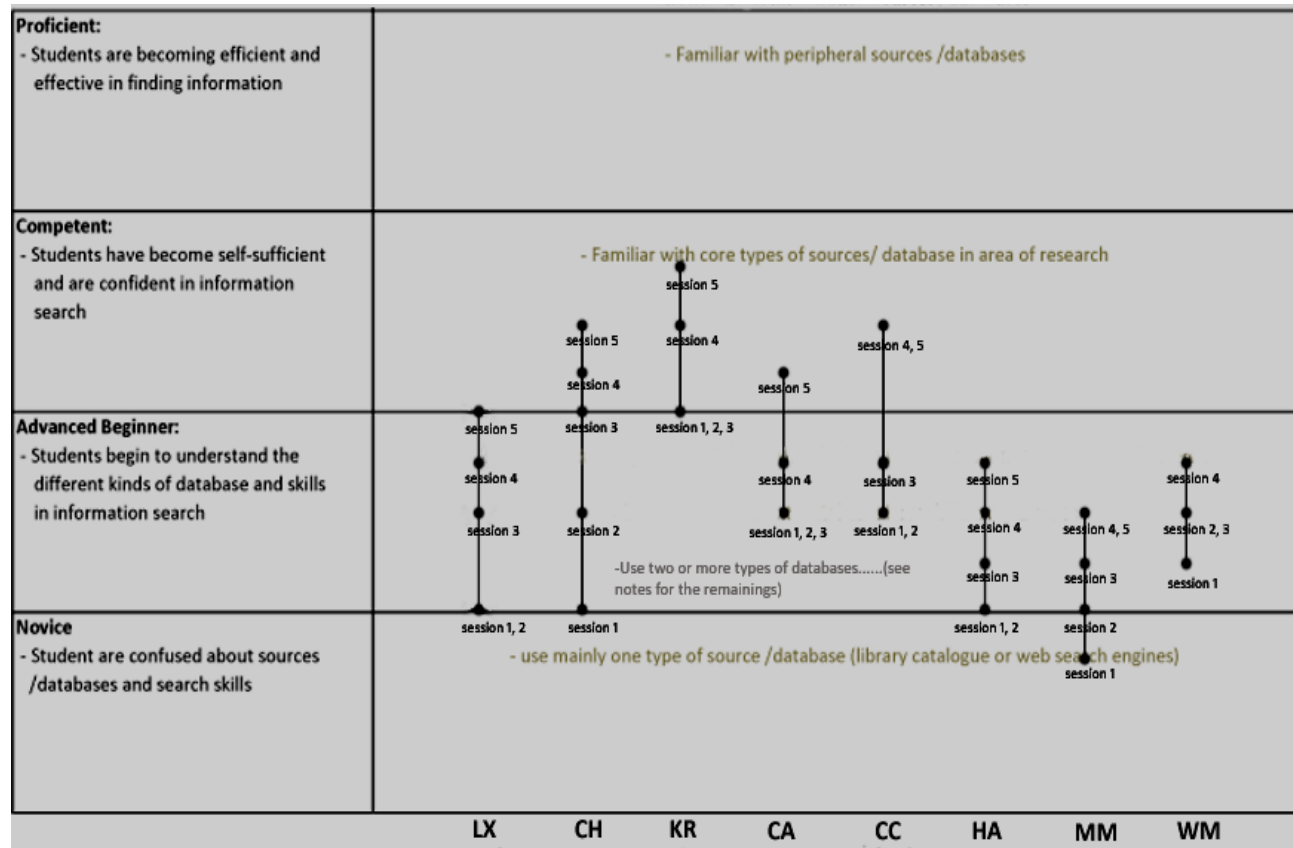
Initially all the eight participants began at the lower level in knowledge in information literacy skills (varied from novice level to in between advanced beginner and competent level). They failed to pinpoint resources that are highly relevant to their topic in a timely manner as they lacked the information search skills and knowledge in different information sources, which include the functions and purposes of those sources. As a result, they ended up getting insufficient amount of resources that are useful.

After the five sessions with scaffolding support, participants' search techniques in selecting information sources and database as well as their search skills increased (varied from advanced beginner level to close to proficient level). They learned about the strengths and limitations of different information sources and databases. Moreover, they used different types of search operators and applied various keywords when referring to the same topic.

4.1 Participants' developments in information sources and databases

Figure 2 shows the progresses of the eight participants in terms of knowledge in search engines and databases in the five sessions with the information search expert. Despite the differences in magnitude, progresses are observed among all eight participants from session 1 to session 5.

Figure 2. Participants' growth and development in knowledge of information sources and databases



Notes: Vertical lines from the bottom to top show the progress of participants from session 1 to session 5 in knowledge of information sources and databases. LX, CH, etc. are codes assigned to participants. For advanced beginner level: use two or more types of databases when looking for information and understand the purposes of different databases.

Participants broadened their knowledge on searching by realizing the subject coverage of different search engines and databases. In each session, participants were introduced to a variety of search engines and databases. During the demonstration session conducted by the search expert, participants picked up useful sources that yielded productive results. For example, prior to the sessions, none of the participants knew that the database WorldCat contains dissertations and theses. During scaffolding support, the expert selected the “manuscript” function in WorldCat to show that WorldCat holds not only books but also theses of institutions worldwide. After being introduced to this database in session 2, when asked about his opinions, KR replied:

“I have never used WorldCat... [and] WorldCat is also very useful... Before [this] I only used mostly ISI [Web of Knowledge] and EBSCOhost,”

In the follow up interview, KR said:

“I learnt more about database system I can access. Because before[,] I confined myself to maybe ISI [Web of Knowledge] or things like that, so after [the sessions] I learn more about databases that I can tap into.”

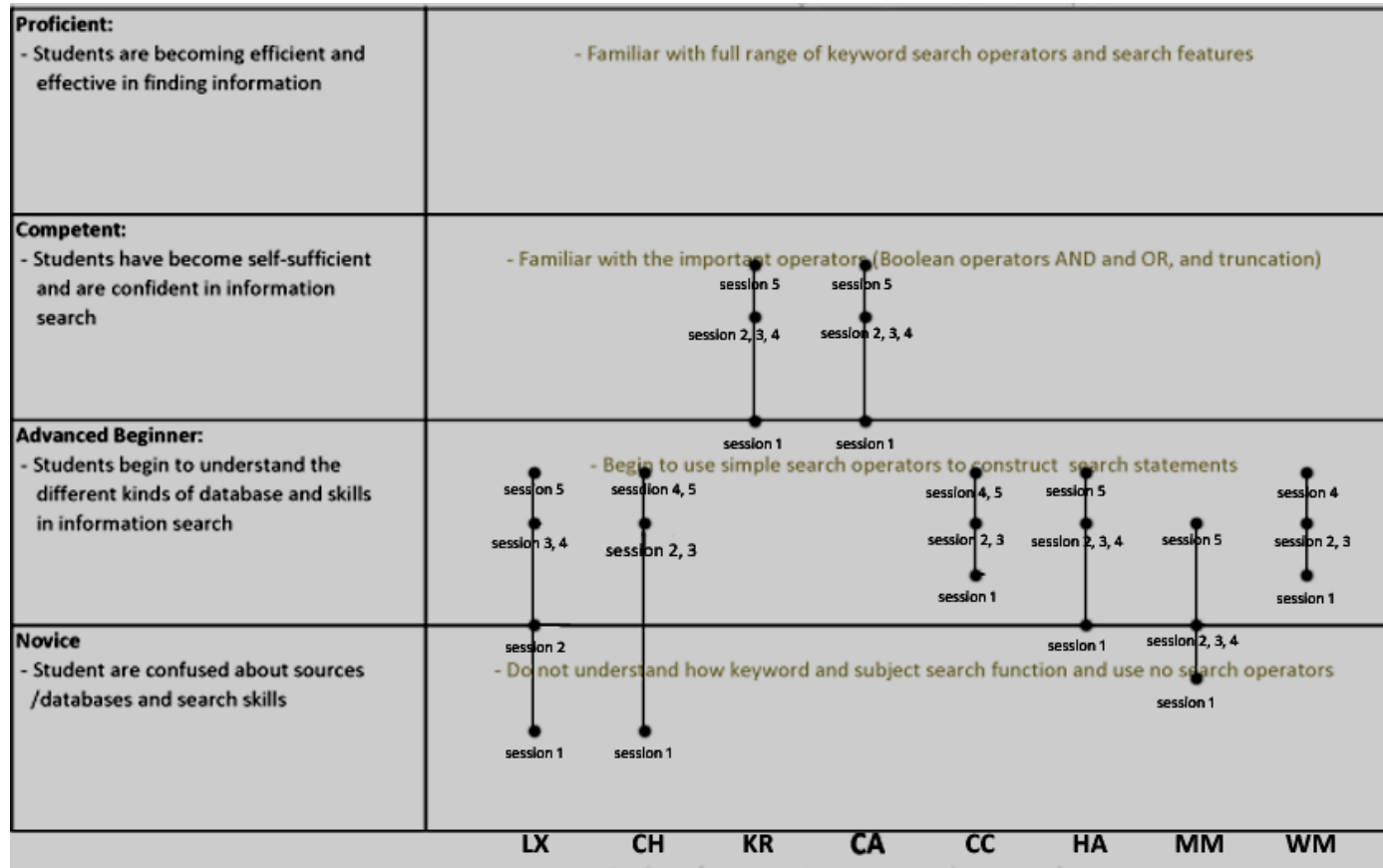
When the participants were exposed to different databases and search engines, they gained insight about the sources’ specific knowledge in terms of their abilities and constraints from the expert. Different information sources are programmed differently and hence different set of rules should be adopted when using them. Had the search novices not been instructed or had they not observed how the others used the sources before, they could encounter difficulties when jumping from one source to another. For example, in EBSCOhost, a participant got 0 results by typing [(teach* or educat*) and (profession* or staff) w/3 (development* or growth or learning) and (tools* or questionnaire*)] without noticing that EBSCOhost does not support the function of proximity.

In the scaffolding support sessions, the search expert acted as an example by showing the participants the “correct way” of entering search terms to get relevant results. The expert also introduced the functions of different databases. Very often, the expert made use of features like “times cited” and “related records” which help information seekers locate information in the ISI Web of Knowledge database that is valuable and relevant. By observation, participants remembered those features and applied them in later sessions.

4.2 Participants’ developments in information search skills and techniques

Figure 4 shows the progresses of the eight participants in terms of knowledge in information search skills and techniques in the five sessions with the information search expert. Similar to figure 2, despite the differences of magnitude, progresses are found among all eight participants from session 1 to session 5.

Figure 4. Participants' growth and development in knowledge of information search skills and techniques



Notes: Vertical lines from the bottom to top show the progress of participants from session 1 to session 5 in knowledge of information search skills and techniques.

LX, CH, etc. are codes assigned to participants.

In terms of information search skills and techniques, the role of the expert is to demonstrate his mastery. By observing the expert, participants could hopefully pick up some skills, and eventually master them. In order to locate information that is useful, we need a great deal of knowledge to distinguish the functions of different search fields. However, the functions, advantages and disadvantages of different search fields could appear to be confusing to novice information seekers. In the sessions, participants could learn about all these by observing the search expert directly. For example, in WM's earlier sessions, WM and the expert searched in the follow styles:

Information searcher	Search statement used in ProQuest	Results
WM	Wiki* AND collaborative writing AND primary school (limit to fulltext only)	0
WM	wiki* AND collaborate* AND writing (limit to fulltext only)	0
Expert	wiki* and collaborate* and writ* (in citation and abstract)	132
Expert	wiki* and collaborate* and writ* (in citation and abstract)	13

WM noticed the differences in search results and refined the search to be broader in later sessions. Participant HA said, "Perhaps I should not look for full text only ... don't skip those entries without full text," as he had difficulties locating useful items by limiting himself to full-text articles only.

In order to construct effective search statements, the skills to utilize different search operators and modifiers such as parentheses, quotations, truncation and proximity in an efficient manner is highly essential. Participants could discover different usages of operators in the scaffolding sessions and apply them in future searches, as KR mentioned in session 5 and the follow up interview:

"At first I didn't know how to use the proximity indicator. I just used basic search like I told you before. But now I know how to use it."

Participants observed the expert from behind and possibly picked up the knowledge; in session 1, during the scaffolding with CA, the expert searched with truncation in EBSCOhost to get relevant results. In later sessions, CA used truncation correctly and constructed effective search statements more often. Similar observations could also be found in other participants. For example, at the beginning of the study, LX searched with plain English phrases like "inquiry based mathematics teaching and learning" with no

search operators. In later sessions, LX began to combine search terms with search operators and selected the correct search fields, which yielded better results.

4.3 Magnitude of learning

In the five sessions, each participant progressed in terms of knowledge on information source, databases and search skills. However, not all participants showed the same progress. Some participants advanced more than the others.

For knowledge on information sources and databases, three participants could not reach the competent level in students' growth and development, in research and development, in research expertise and in information search expertise table proposed by Chu and Law (2008). For example, in the session without scaffold support, participant MM consulted the Digital Dissertation Consortium, EBSCOhost, Dragon, NDLTD, Google, Google Scholar, ISI Web of Knowledge, ScienceDirect, and the Hong Kong University Theses Online. However, during scaffolding periods, what had been introduced were ProQuest, WorldCat, and Google Book.

In theory, MM should have learned about and used these twelve sources after being exposed to them. However, in the follow-up interview, MM admitted that EBSCOhost, Science Direct, and HKU thesis online—which MM learned before joining the research—remained to be her top choices as they often gave her concrete results. The other databases she learned in the sessions were rarely chosen. During the sessions, MM got relevant results from EBSCOhost, whereas for the others, MM got irrelevant or no results. Therefore, the possible reason why MM retreated from exploring other information sources is that she failed to master the new sources while using old sources alone is sufficient to support her searches.

“The researcher just recommended to me the [ISI] Web of Science [Knowledge]. I think in my study, I also do not use this database very often. I only use EBSCO. I don't know why, maybe this is a kind of habit.” (MM session 5)

Moreover, in one interview with participant MM, she said “I'm just analyzing my data, so I seldom search online” (MM session 5). She focused more on the collected data rather than looking for new information which means a small amount of information sources could have already satisfied her needs.

In contrast, there were students who reached the competent level. In a follow-up interview with CA, CA provided some insights about his experience. CA said:

“Dr. Chu (the search expert) shared his opinion and experience in searching, I discovered more databases like WorldCat and others, so that I can search not only for articles but also theses, or some research reports”

CA had exhausted the information sources and databases. He read more and acquired more knowledge in his research area. He also wanted to extend his searches to the other databases as well. The drive for more specific information on his topic caused him to explore more resources and this improved his knowledge in information sources and databases.

For knowledge in information search skills and techniques, only two participants, KR and CA reached the competent level. According to participant KR, the development of his own skills contributed most to his advancement.

“I think maybe first should be independent skill developing... the more I knew about my research and the more I knew about what search terms to use, the jargon in the field ... I have more grasp of what the key terms are or who are the key authors to follow...”

By investigating into his research area, KR learned the terms used by others in his field and could formulate better search statements, and subsequently he could use the results to expand or narrow down his searches using different search operators.

“I know how to use more Boolean search function now... I tried to make it more specific like using advance term like the Boolean search like “AND” “OR” “NOT” and truncation.”

For those participants who were unable to reach the competent level, follow-up interviews provide possible reasons for why MM’s skill advancement was hampered, according to her claims. For example, she encountered difficulties in learning rules of different databases and various other search techniques, including the Boolean operators. She also lacked the opportunities to practise. MM said:

“I think I am not searching quite differently compared to the way before because after attending the five sessions, I still have very little knowledge on the symbols [truncation / proximity]. I don’t know how to organize the symbol to make my searches more accurate. So I think there is no big difference... And I think the reason for this is that I

don't have a lot of opportunities to practise... [database specific rules and command for] Different databases, yea. And I think the symbols are very complicated, not very convenient for us to remember.

Another reason for the little progress could be linked to the fact that participants did not need those advanced skillsets for their information search. Out of the five sessions, participant CC did find the scaffolding support helpful, but only in one session. For the other four sessions, CC was satisfied with the results she got on her own and found the scaffolding support not as productive as the others found to be.

5. Discussions

From the findings, we can conclude that participants showed improvements in information literacy skills after attending the scaffold support sessions provided by a search expert. However, such improvements were not solely due to the results of observations and imitations. Since the study lasted for more than a year, it is highly possible that participants enhanced their information literacy through other means. For example, improvements in subject area knowledge and more practices on searching information could have greatly contributed to the progress in information literacy skills.

6. Conclusion and Implications

After attending five sessions with scaffold support, all participants had some developments in their information literacy. As they progress, they became more familiar with various information literacy skills.

Participants' beginning level of competence in information literacy reinforced the findings of previous scholars that information search trainings are inadequate even for doctoral level students. Scaffolding support could possibly be an efficient way of teaching information literacy skills, and could probably shorten the learning curve of mastering information literacy skills, as suggested by participant CC. With better knowledge and skills, students could accelerate their information search process by performing more comprehensive and yielding searches. However, such method in teaching information literacy skills is not as cost effective as traditional trainings provided by libraries. As a compromise, libraries could continue to provide traditional trainings to all students while tailor-made scaffold supported style of training could be provided on request.

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