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Searching and sourcing online academic literature: Comparisons of doctoral students and junior faculty in education

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# Searching and sourcing online academic literature

Searching and sourcing online academic

## Comparisons of doctoral students and junior faculty in education

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### Abstract

**Purpose** – The purpose of this paper is to explore educational researchers' online literature searching and sourcing strategies.

**Design/methodology/approach** – Adopting a multiple-case study approach, the authors conducted interviews and compared strategies employed by three groups of researchers: less-experienced doctoral students, experienced doctoral students, and junior faculty.

**Findings** – The results showed that the three groups differed in four searching strategies and two sourcing strategies. The former included: using and modifying keywords, doing advanced searches to narrow down or expand results, chaining, and networking to retrieve literature, while the latter consisted of: evaluating and selecting multiple-source articles, and self-monitoring the multiple-source searching process. The findings also revealed that the experienced doctoral students and junior faculty were able to adopt searching and sourcing strategies flexibly and simultaneously for the purpose of determining more relevant and useful sources. The findings suggest that these researchers, especially the less-experienced students, need specialized training to acquire sourcing strategies in order to critically evaluate relevant information or scholarly work to fulfill their research purposes.

**Originality/value** – Information seeking, an essential part of scholars' work, has been widely examined across disciplines. However, few studies have explored scholars' searching and sourcing behaviors for online academic literature. This study fulfilled the research gap.

**Keywords** Information seeking, Information retrieval, Expert, Novice, Online academic literature, Sourcing

**Paper type** Research paper

### Introduction

Information seeking refers to the process by which web users read and select appropriate information resources to increase their knowledge or gain further understanding of certain topics (e.g. Brand-Gruwel and Stadtler, 2011; Bronstein, 2007). In the case of online academic literature seeking, researchers often need to find information by employing complicated strategies and skills (Ellis, 1993; Meho and



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Tibbo, 2003). On the one hand, they need to acquire searching strategies to define important research questions and to locate information for research purposes, for example, uses of search engines (e.g. Google or Google Scholar) or primary citation indexes as references (e.g. Science Citation Index, Social Sciences Citation Index, and Arts & Humanities Citation Index) (Levine-Clark and Gil, 2009; Jamali and Asadi, 2010; Meho and Yang, 2007). On the other hand, they need to develop higher-order sourcing strategies to comprehend multiple-source online information, avoid disorientation (e.g. where to go and what to do while searching for web information) or to evaluate the credibility of online sources (Tsai and Tsai, 2003). These strategies are particularly needed during scholars' interactions with multiple-source information and in the knowledge construction process (Lazonder and Rouet, 2008; Lu *et al.*, 2008).

Prior research has revealed that novice researchers tend to differ from experts in their usage of sourcing strategies (Brand-Gruwel *et al.*, 2005; Ismail and Kareem, 2011). For instance, comparing the information problem-solving processes of experts (PhD students) and novices (freshmen), Brand-Gruwel *et al.* (2005) found that experts spent more time defining the problem, and engaged more constantly than novices in employing their prior knowledge, elaborating on the content, and regulating their process. Similarly, Tsai (2004) found that experts (university professors) tended to employ an "elaboration and exploration" sourcing strategy (i.e. integrating web information of multiple sources to find best-fit results that fulfill their purposes) while novices (college students) were more likely to use a "match" approach to search for web information (i.e. considering best-fit results as retrieved by search engines). These studies identified key differences existing between novice and expert researchers' sourcing strategies, which advance our knowledge of the assistance that novice researchers may need. However, they did not investigate the differences between doctoral students and junior faculty's online academic literature searching and sourcing strategies.

Moreover, while most studies have focused on literature searching and sourcing behaviors in major disciplines (e.g. social sciences in Meho and Tibbo, 2003; humanities in Barrett, 2005) or across disciplines in general (Du and Evans, 2011; Ellis, 1993; Hemminger *et al.*, 2007), they do not examine behaviors of researchers in particular disciplines such as education. We argue that education is worth exploring for two reasons. First, it is one of the major disciplines in the social sciences and has a large number of journal volumes and articles based on the *Journal Citation Reports (JCR)* and bibliographical database services provided by the Institute of Scientific Information (ISI) or other database providers (e.g. Scopus or Google Scholar). The wide range and variety of literature in education indicates its broad and interdisciplinary nature. Thus, by focusing on a sophisticated discipline with rich academic literature such as education, this study hopes to fill the gaps in knowledge and simultaneously serve as a foundation for investigating scholars' searching and sourcing processes in other fields.

Second, we chose to study education in an effort to control the factor of disciplinary difference that might influence researchers' information searching and sourcing behaviors (Korobili *et al.*, 2011). Depending on disciplinary bibliographic resources, since there may be considerable differences in the strategies and amount of effort required to seek information for specific research purposes (Bates, 1996), we focused on education as the target discipline in the current research.

Our purpose was therefore to compare the similarities and differences in academic literature searching and sourcing strategies among three groups of educational researchers with different research experience: less-experienced doctoral students,

experienced doctoral students, and junior faculty. Through comparing these three groups, this qualitative study aimed to identify the searching and sourcing strategies used by educational researchers while conducting online literature seeking. It also discusses how researchers acquire these strategies and how technologies influence their use of these strategies. An overarching research question guided the present study:

*RQ1.* What are the similarities and differences among three groups of educational researchers' searching and sourcing strategies?

This study draws attention to the knowledge of online literature searching and sourcing which is often not taught in classrooms. It is hoped that the findings can shed light on developing training for graduate students and faculty to acquire literature seeking strategies in the rapidly changing web environments.

### Online searching and sourcing strategies

Research on web searching strategies can be divided into three general directions: searching strategies (e.g. George *et al.*, 2006), sourcing strategies (e.g. Biddix *et al.*, 2011), and a combination of the two (e.g. Tsai and Tsai, 2003; Lazonder and Rouet, 2008). Early research highlighted the importance of web users' searching strategies (e.g. browsing by Carmel *et al.*, 1992; chaining and accessing by Ellis, 1993). Recent studies have focused on the role of sourcing strategies, namely, the higher-order thinking skills when students evaluate sources for course assignments (Biddix *et al.*, 2011; Currie *et al.*, 2010; Head and Eisenberg, 2009). For example, Head and Eisenberg (2009) investigated how undergraduate students evaluated the credibility, authority, relevance, and currency of online resources used for their research papers. The authors found that the students failed to identify sufficient scholarly sources because they did not use as many of the criteria necessary for assessment.

Another strand of scholarship has called attention to the use of both strategies. Proposing a framework to analyze strategies used by freshmen while searching for related information and knowledge for a task concerning nuclear power, Tsai and Tsai (2003) divided both searching and sourcing strategies into three domains: behavioral, procedural, and metacognitive. The first two are considered as searching: the behavioral domain refers to basic manipulation and navigation on the internet that students might require (i.e. control of searching applications, and self-awareness of disorientation); the procedural domain is related to content-general web searching approaches (i.e. trial and error, and problem solving). By contrast, the metacognitive domain is related to sourcing strategies, considered higher ordered, and refers to how students self-control content-related reflective and metacognitive activities on the internet (i.e. purposeful thinking, selecting main ideas, and evaluating).

Inspired by Tsai and Tsai's (2003) framework for online searching, the present study focuses on both searching and sourcing strategies employed by educational researchers in Taiwan. We argue that these concepts can serve as insightful tools for analysis because they can provide in-depth knowledge of how scholars learn to search, evaluate, select, and regulate their actions and thoughts for research purposes.

### Literature searching and sourcing behaviors across disciplines

Over the past decades, a growing body of research has been conducted to investigate literature searching and sourcing strategies and behaviors of graduate students, postdoctoral researchers, and university professors from several disciplines: engineering

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(Ellis and Haugan, 1997), basic and medical sciences (Hemminger *et al.*, 2007), social sciences (Meho and Tibbo, 2003), and humanities (Barrett, 2005; Bronstein, 2007). Following is a review of qualitative studies relevant to the present study.

Adopting semi-structured interviews for data collection and grounded theory for analysis, Ellis (1993) compared the patterns of information seeking behaviors among three groups of researchers (social science, physical science, and engineering science). Six common features were identified: starting, chaining, browsing, differentiating, monitoring, and extracting. Starting refers to initial searching activities for relevant information including reading abstracts, consulting colleagues, or identifying relevant literature that could serve as starting points for the research cycle. Chaining involves searching for referential connections between the identified materials or sources. It consists of forward and backward chaining. Browsing is the activity of scanning information casually based on potential topics of interest. Differentiating refers to filtering the information obtained by using differences that are already known such as author, quality of information, or journal rankings. Monitoring includes following the developments in certain areas by regularly reading core journals or conference information. Extracting involves the activity of working through particular sources to locate materials of interest. Although Ellis's (1993) model has been influential, the search engines and searching techniques studied differ greatly from those examined in the current study.

Revising Ellis's model, Meho and Tibbo (2003) examined the information seeking process of 60 social science faculty through e-mail interviews (with five face-to-face interviews). In addition to the six features identified by Ellis (1993), Meho and Tibbo indicated four more features: accessing, networking, verifying, and information managing. Accessing refers to activities associated with gaining access to the materials or information already located. Networking involves contacting and communicating with people who work on similar topics or who are members of the academic community. Verifying is the activity of checking the accuracy of the information obtained. Information managing refers to filing, archiving, and organizing the information collected. These findings are useful for understanding educational researchers' searching and sourcing behaviors in this study.

Two important studies were conducted to explore graduate students' literature seeking behaviors. Investigating 11 doctoral students' searching patterns on their personal research topics across diverse disciplines, Du and Evans (2011) found that the participants adopted various strategies including interacting with multiple search systems (search engines, online databases, specific websites), relying on popular search engines such as Google or Google Scholar, modifying keywords or search queries (with Boolean (and, or, not) and other operators (\* "" +)), and looking for two or more topics simultaneously. Similarly, Barrett (2005) explored information retrieval patterns of graduate students in humanities and found that their patterns involved using Google to find general information on a topic, citation chasing, identifying primary sources to validate their theories and hypotheses, having interpersonal contact for feedback and guidance, and reading in a subject area.

For a more comprehensive understanding of how different educational levels of scholars employed searching and sourcing strategies for academic literature, Table I outlines these strategies based on the models or patterns identified in previous studies.

In conclusion, academic literature seeking strategies include searching and sourcing strategies. Researchers use searching strategies to locate information that fulfills their research purposes, and use sourcing strategies to evaluate information

Authors (year)	Fields	Participants	Searching strategies	Sourcing strategies
Meho and Tibbo (2003)	SS	Faculty	Starting, chaining, browsing, accessing, networking, information managing	Differentiating, monitoring, extracting, verifying
Tsai and Tsai (2003)	Unknown (computer course)	College students	Control, disorientation; trial and error, problem solving	Purposeful thinking, selecting main ideas, evaluating
Tsai (2004)	NS and SS	College students and faculty	Match (considering best-fit results as retrieved by search engines)	Elaboration and exploration (integrating information to find best-fit results)
Barrett (2005)	H	Master's and PhD students	Browsing, citation chasing, networking (with faculty, colleagues, and librarians)	Reading in a subject area constantly
George <i>et al.</i> (2006)	NS, SS and H	Master's and PhD students	Using both focused and general searches, citation chasing, networking (with faculty, librarians, and peers) internally and externally, using internet and library resources	Not mentioned
Head and Eisenberg (2009)	SS and H	College students	Using library resources and Wikipedia, consulting librarians to refine thesis statements or to locate hard-to-find sources	Not mentioned
Rempel (2010)	NS, SS, and H	Master's and PhD students	Using both focused and general searches, doing broad searches in Google Scholar, updating literature, organizing data	Targeted searching, navigating other disciplines to retrieve needed information
Du and Evans (2011)	NS and SS	PhD students	Using Google and Google Scholar as a starting point, using basic search functions (Boolean; "" *), modifying keywords, problem solving	Interacting with multiple search systems to find articles appropriate to their research topics, critically analyzing and evaluating gathered data
Biddix <i>et al.</i> (2011)	Unknown (a range of majors from communication classes)	College students	Accessing library resources for linked articles, using keywords from previous studies to look for additional related studies, relating sources found to suggested materials	Determining credibility and usefulness of internet information

**Notes:** NS, natural sciences; SS, social sciences; H, humanities

**Table I.** Studies on literature searching and sourcing strategies

and monitor the searching process when reading multiple-source information. It should be noted that although the strategies are categorized into two types, some of them overlap and are complementary.

## Methods

### *Participants*

A multiple-case study approach was used to design this study (Stake, 1995; Yin, 2003). We used convenience sampling (Gall *et al.*, 2007) and recruited 15 participants from the

field of education with varying research experience: less-experienced doctoral students, experienced doctoral students, and junior faculty who had received their PhD degrees within six years. Informed consent was obtained from all participants. To divide students based on their research experiences, we first used their years of study in the doctoral programs as a criterion. However, we found that a number of first-year doctoral students had published journal papers. Given that the research experiences of those doctoral students who had published journal papers differed from those who had not, we decided to use journal publication experience as a criterion to categorize research experience. Three groups of participants were formed: four less-experienced doctoral students, six experienced doctoral students, and five junior faculty. Students' research experience (including publishing journal articles) may affect their searching and sourcing performances. This relationship is discussed in the discussion section.

The less-experienced doctoral students were first to third year doctoral students. None of them had published a journal paper, but two had published conference papers based on their master's theses. Two mentioned in the interviews that their teachers invited a librarian to teach them how to search for academic literature. The experienced doctoral students were first to ninth year doctoral students. They had published at least one journal article and 3-17 conference papers. Three of the six experienced doctoral students were PhD candidates and had successfully defended their dissertation proposals.

The junior faculty had received their PhD degrees within the last two to six years. In this paper, we refer to the assistant professors as "junior faculty," as they were faculty who had received their doctoral degrees within the last six years. They had multiple publications of conference papers and journal articles.

The average age of the participants was 36 years old, ranging from 27 to 48 years old. All participants were recruited from five national universities in Northern Taiwan. They were in different departments related to education, including science education, English education, education, mathematics education, special education, learning and instruction, and early childhood education. See Table II for participants' backgrounds and publication experience.

### *Procedures*

The first author conducted an in-depth face-to-face interview with each participant for an average of 62 minutes (ranging from 34 to 96 minutes). To understand the

Groups	Number	Ave. age	Gender (Pseudonyms)	Years	Research experiences
Less-experienced doctoral students	4	38	2 males(Laitian, Laifu) 2 females (Lihui, Liyu)	Years 1-3 doctoral students	No journal paper 2 had conference papers
Experienced doctoral students	6	33	3 males (Dinhao, Dinkai, Dinye) 3 females (Dahui, Daping, Dayi)	Years 1-9 doctoral students; 3 PhD candidates	At least 1 journal paper All had conference papers ranging from 3 to 17 papers
Junior faculty	5	37	1 male (Dr Lai) 4 females (Drs. Chen, Chang, Li, Wang)	Received PhD degrees within the last 2 to 6 years	Multiple journal papers Multiple conference papers

**Table II.** Participants' backgrounds and research experiences

participants' searching and sourcing experiences, based on the literature on this topic we developed a semi-structured interview protocol to elicit four aspects of their experience: what is your purpose of conducting online literature searching? What are your searching and sourcing experiences? How does technology influence your online literature searching over time? and how do you use online and printed materials in your research? Interviews were conducted in the participants' native language, Mandarin Chinese, and were audio-taped and transcribed verbatim. The interview data were then selectively translated into English for inclusion in this paper. While interviews were the primary data source, to supplement them with more information, participants could use a computer to demonstrate their online searching and sourcing performances, which five did. Documents were also collected from the participants as supplementary data sources, including their publication lists, search results, and notes that they took when doing online literature searching. The limitation of interviews as the primary data source is discussed in the last section.

### *Data analysis*

Reflective journals were kept throughout the data collection and analysis to record the researchers' thoughts, questions, research decisions, and initial findings. They were used to create transparency in the research process and to help the development of the coding scheme and assertions. All the transcriptions, reflective journals, and document files were imported into a database and organized using the NVivo analysis software (QSR International, Doncaster, Victoria, Australia), which facilitated the development of the coding scheme. To analyze the data, a transcript or document was first segmented into units of meaning. Constant comparative methods (Charmaz, 2006) were used to develop the coding scheme. A unit of meaning is a consistent theme or idea in a passage (Wever *et al.*, 2006, p. 9). During constant comparisons, codes were added, deleted, merged, divided, and renamed throughout the analysis process. In the last stage of the coding, final thematic trends emerged as two aspects: searching and sourcing strategies that the researchers adopted for retrieving, evaluating, and managing literature of various sources. We then generated assertions about the possible connections between the participants' research experiences and their literature seeking practices.

To increase the trustworthiness (Lincoln and Guba, 1985) of the study, the first author used the member checking technique during interviews. This technique involves asking the participants to comment on the interviewer's interpretation and on other participants' opinions (Creswell, 2007). We triangulated our findings through multiple participants and multiple data sources (i.e. transcripts, documents, and demonstration video clips). The comparisons of similarities and differences in participants' behavior enabled us to identify key strategies. The use of primary and supplementary sources also helped us to investigate the behavior from different angles, increasing confidence in the findings (Creswell, 2007). In addition, we presented the findings of this study at two international conferences for peer debriefing. We maintained an audit trail that recorded the entire coding and made this analysis process explicit (Huberman and Miles, 1994).

### **Findings**

We found that the three groups of researchers differed in their online literature seeking strategies. We categorized these differences into four searching strategies and two sourcing strategies. The former included: using and modifying keywords, doing

advanced searches to narrow down or expand results, chaining, and networking to retrieve literature, while the latter consisted of: evaluating and selecting multiple-source articles, and self-monitoring the multiple-source searching process.

#### *Four searching aspects*

*Using and modifying keywords.* Lacking prior knowledge of their topics, the interviews of the doctoral students with less research experience revealed their difficulties using keywords. They indicated that they were often uncertain about the keywords for their searches, and tended to use keywords that were either too broad or too narrow, resulting in too much irrelevant information and difficulties evaluating the relevance of the results. For instance, Liyu stated, "I can't make a judgment on whether [the scope of a construct was] too broad or too narrow [...] I spent a lot of time on that part and the search results were a mess [...] that was because after [I] typed in the keywords, [I] ended up with many [unrelated] results." When asked about their solution, these students relied on their advisors to narrow down the scope of the literature or to select appropriate keywords.

In contrast, the doctoral students with more research experience adopted multiple techniques to confirm and modify their keywords. Three techniques were revealed: reading relevant articles to generate keywords, reading the listed keywords or descriptions of an article, and seeking help from their advisors. Some interview statements are presented as follows:

- (1) Reading relevant articles to generate keywords: the experienced doctoral students mentioned that they identified the target keywords through reading articles related to their research topics. Dinye said, "I read a paper [and found that] some words keep occurring. Yeah, they are keywords [...] [I] probably use these words for searching [...]."
- (2) Reading the listed keywords or descriptions of an article: some experienced doctoral students reported that they located appropriate keywords from reading the listed keywords or the article descriptions. Daping explained, "There are keywords listed under [the abstract of] a paper. I use those keywords for searching. [I pay attention to] how others choose keywords, and then [I] use their keywords as a starting point for searching."
- (3) Seeking help from an advisor: like the less-experienced doctoral students, the experienced doctoral students asked their advisors for appropriate keywords. Dinkai stated, "I discuss with my advisor [when I cannot locate relevant literature]. My advisor may suggest that I add a couple of keywords."

In comparison, the five junior faculty appeared to be more knowledgeable about the keywords relating to their topics of interest. They mentioned that they used and modified keywords more flexibly and strategically. Dr Li indicated that the ability to locate adequate keywords is related to one's growing research skills. She continued, "When you read more and more papers, you learn how they [authors] use keywords. Then you will know, if you want to do a search, you probably need to use certain keywords."

Moreover, some junior faculty revealed that reviewers' feedback could be an important indicator for modifying keywords in order to locate more relevant literature. Dr Chang noted, "When I wrote my paper and submitted it to a conference or a journal, people commented, 'the papers you cited are not directly related to your work.'" Such comments urged her to think about other keywords.

In addition to the above strategies, three of the five junior faculty and four of the six experienced doctoral students indicated that their skills of using and finding adequate keywords had improved over time. This implies that mastering the skill of using keywords appropriately requires time and experience and is one of the crucial skills that researchers need in order to conduct successful online literature searches.

*Doing advanced searches to narrow down or expand their results.* One less-experienced doctoral student, Lihui, mentioned that she did not conduct advanced searches to narrow down her results when encountering too many returns. When she entered keywords and had more than a thousand returns from multiple databases, she browsed the top five returns in each database. She then located only one article that she considered most relevant, and read the references of the article to identify more literature.

Some less-experienced and experienced doctoral students revealed in the interview that they did advanced searches to narrow down their results by using the following techniques:

- (1) Adding more keywords or modifying keywords: the experienced doctoral students reported that using the Boolean “AND” operator, they added or modified keywords to narrow down their search results. Dinye remarked, “If there are too many returns, I add more keywords. Take the keyword, ‘positioning theory,’ for example [...] If there are too many returns, I would probably add a few more keywords such as ‘science education’ to narrow it down.”
- (2) Purposefully establishing searching criteria: the doctoral students used two ways to establish searching criteria to narrow down their searches. One is limiting search results based on subject areas or years of publication. Daping demonstrated on the computer, when she encountered more than 2,900 search returns, she limited the search results to a specific subject, educational research. The other is displaying results that only contain keywords in a search field (e.g. title, abstract, keywords, and full text). Daping explained that when she found more than 1,000 results, she would choose those articles for which the target keywords appeared in the title.

In a similar vein, the five junior faculty used the two approaches described above to narrow down their searches. However, because they were more knowledgeable of the keywords in their fields, they were more capable of narrowing down their searches than the doctoral students.

In contrast to excessive returns, if their searches resulted in too few returns, the less-experienced doctoral students changed their keywords to expand their searches despite their immature experiences of using adequate keywords to locate relevant literature successfully. Some of them mentioned that they changed their topic of interest if they found too few articles. Laifu stated, “If I found a certain area of literature to be very limited and full texts to be unavailable, I would consider changing the topic.” Another commonly used approach was consulting their advisors for more articles.

On the other hand, the experienced doctoral students and junior faculty revealed in the interviews that they used the following four techniques when they obtained only a few articles:

- (1) Adding keywords: they added keywords in order to expand the search results. As Dr Chang indicated, “I could feel what words might lead to limited results [...] I felt that this word, ‘visualization,’ led to limited results. It was less

commonly used. So I added other keywords such as ‘simulation.’ All related [articles] would be included.” When adding keywords, they also adopted a Boolean search, using “OR” to specify multiple words in any related field to expand their search results.

- (2) Removing keywords: another strategy they used was removing keywords using the Boolean “AND” operator. For instance, Din hao explained, “I usually began my initial search by entering all related keywords at one time. If the results appeared, they might be close to what I expected. If not, I would remove some keywords, one after another.”
- (3) Using keywords with broader concepts: they changed keywords or used those words with broader concepts. Dr Chen described, “I wanted to find articles related to metalinguistics but only obtained two or three results [...] I then thought that I should step back and should not [use the ‘AND’ operator and] type in too many keywords. [Instead,] I should use those that had broader concepts such as ‘academic writing’ and ‘EFL’ [English as a Foreign Language].”
- (4) Finding less academic articles: the last strategy was finding articles from the references of less academic resources (e.g. magazines, books, and reports). A junior Faculty Member, Dr Lai, and an experienced Doctoral Student, Daping, mentioned that when their searches resulted in very few returns, they used Google Scholar for materials that are considered less academic. They explained that search engines like this include a wide range of literature such as technical reports, books, websites, and conferences papers, which allowed them to locate relevant journal articles from the references of these resources.

*Chaining.* Chaining, which involves tracking referential connections between identified sources, was one of the major strategies used by the participants. The less-experienced doctoral students indicated in the interviews that they tended to use the references of an article as resources to find additional articles related to their topic. Two less-experienced doctoral students responded that they used this strategy to look for the most relevant articles. Laifu explained his search process, “Two articles are good enough. Basically if I found two, I do other searches based on [the references of the] two articles.” A less-experienced Doctoral Student, Liyu, said that she had never heard of this strategy until she was admitted into the doctoral program, and had never used it herself.

All experienced doctoral students and junior faculty mentioned that in addition to checking articles references, they adopted other chaining techniques to find relevant articles, including: tracking article citations by other scholars, identifying important figures in their area of interest and following their publications, and referring to articles suggested by online databases based on the keywords they typed in.

*Networking to retrieve literature.* The doctoral students used librarians, peers, experts’ websites, and advisors as resources in their social networks to find literature. Two less-experienced doctoral students said that they sought help from librarians with online databases, while some experienced doctoral students used their social networks of senior peers or fellow students. They also established virtual online social networks and checked major experts’ websites to update their articles.

Doctoral students’ advisors played an important role. These students consulted their advisors about locating key articles, choosing appropriate keywords, and evaluating the quality of articles. Daping stated, “In the beginning, before I started to write my paper, my advisor gave me some papers to read.” In terms of selecting keywords,

Dinkai said, "I discussed with my advisor and he suggested that I add a few more keywords." Din hao also described the way he learned to evaluate the quality of a journal, "I noticed the papers that my advisor gave me were mainly from certain journals. That's how I learned [the quality of] these journals was OK."

In contrast to the doctoral students, the junior faculty rarely conducted comprehensive literature searches. Their research topics were mostly based on their previous research areas that were already familiar to them. Therefore, mostly all they had to do was update their literature. Compared to the doctoral students, they relied more heavily on their social networks. Four junior faculty mentioned that they attended conferences and asked the presenters in person or through e-mails for their papers. Dr Chen said that when she attended conferences, she took notes on studies that interested her. She would then search for these studies online. Two faculty members mentioned that when they conducted studies but were not familiar with the related literature, they asked senior peers or colleagues who were experts in the related topics for literature.

The development of social networking technologies facilitated the junior faculty's networking. They checked websites of former colleagues, peers, and research groups in order to update their literature. Dr Chang stated, "Sometimes I recall that someone conducts [research] and his work is related [to mine]. I check his recent publications. I usually go to his website because [his publication list] is more up-to-date. If his works are in press, they will show up."

Dr Chang also mentioned that she checked the websites of some research groups, indicating, "I know who is doing visualization projects, and I go to their websites to see if they have published new papers." Dr Chang further noted that she sent e-mails to particular researchers and asked for the full text of their articles. Moreover, she reported that she joined academic groups on Facebook for networking and those on ResearchGate for sharing full texts of research articles. In addition, an informal interview with a Professor, Dr Kao, revealed that she updated her literature using the Google Scholar function "My Updates." She also subscribed to publication updates of major journals in her field.

### *Two sourcing aspects*

*Evaluating and selecting multiple-source articles.* Regarding how to evaluate the literature from multiple sources, the doctoral students reported in the interviews that they used the following criteria: the article's relatedness to the topic, studies conducted by experts in a particular field, the quality of the journal in which the article was published, the year the article was published, the number of citations for the article, and the origin of concepts or theories included in the article. These students tended to use the aforementioned criteria strategically to evaluate and select suitable articles. Although they had gradually developed this skill, most mentioned that they still needed their teachers' or advisors' help to judge the appropriateness of articles.

The less-experience doctoral students mentioned that they employed another three criteria to evaluate articles that were not mentioned by the other two groups of researchers. First, they were concerned if there were full texts available for download. Four less-experienced doctoral students indicated that they tended to download articles that had full texts. Second, they were aware of the browsing and searching frequency rates listed. Lihui and Laitian indicated that they tended to regard most searched articles as relevant literature. They believed that the more frequently the articles were

searched, the more likely they would be to appear at the top of the search results. Finally, they looked at page length. Laitian mentioned that if an article exceeded 30 pages, he would not read it, saying, "To me, if I have to write something, I think reading a paper within 30 pages is easier to digest."

The experienced doctoral students indicated four criteria not mentioned by the other two groups. First, they would not refer to books as major sources of literature. Two of them noted that they usually referred to journal papers rather than books. Second, they avoided referring to papers from certain countries. Dinhaio remarked, "Those from certain countries [...] I definitely won't read them because they are too idiosyncratic [...]" Third, the experienced doctoral students indicated that they avoided reading papers based on particular methodologies, with Dinkai noting that papers based on qualitative studies were not his first priority because he was more familiar with those based on quantitative analysis and was able to grasp the contents much faster. Last, their criterion was to read articles published in those journals where they aimed to submit their papers for publication. As Dinhaio noted, "If I plan to submit my paper to a certain journal, I cite works published in this journal."

Of the six criteria listed above, the interviews of junior faculty revealed that they used the first five to select articles, and tended to regard an article's relatedness to their research topic as the most important indicator for selection. All of them tended to rely on the title and abstract to judge if an article is related to their research. As Dr Chang noted, "Relevance of topic matters. I analyze the title to understand what constructs are used and evaluate whether those constructs match my expected constructs [of the search topic]."

*Self-monitoring the multiple-source searching process.* All participants mentioned that they self-monitored their searching process and reminded themselves of their search goals when seeking literature. As such, they did not encounter disorientation. The four less-experienced doctoral students stated that they did not feel disoriented during searching. However, this does not mean that they were capable of identifying articles relevant to their searching topics. Rather, we found that they seemed to consider the best-fit results retrieved by search engines as relevant articles. They were unable to carefully identify the scope of related literature or explore the boundaries of topics. In other words, their searching remained at a surface level, and thus they did not struggle with disorientation.

The interviews of the less-experienced students revealed such surface, best-fit searches. Two of them stated that they selected only a handful of articles and then located more by consulting the references of the articles they had already found. Also, two students mentioned that they imitated the theoretical frameworks of previous studies when conducting their own research. Liyu indicated, "Similar research has been conducted overseas, which provides me with some clues to imitate. I incorporated its [theoretical] framework into my dissertation." Liyu and Laitian reported that they seldom felt disoriented while searching. Most of the time their major difficulty was locating relevant literature rather than feeling lost. The results indicated that the less-experienced students regarded searching literature as collecting a list of best-fit scholarly works rather than exploring the breadth and depth of the literature.

Similar to the less-experienced students, most of the experienced doctoral students stated that they did not feel disoriented. However, in contrast with the less-experienced students, the interviews of the experienced students revealed that they were engaged in in-depth literature searching and sourcing practices. They used some strategies to

monitor the searching process involving their comprehension and evaluation of various literature sources. Four of them mentioned that when they browsed the results, they cautiously evaluated the literature. They stopped searching when they found that the returns appeared to be irrelevant to their topic. At that time, they normally went back to the related sources they had already located. One Student, Daping, mentioned that she tended to open an article in a new window so that she could easily return to the original search output. Daping explained, "I usually open a new window so that I don't get lost. If I don't need it, I close it immediately or set it aside. If the search results seem unimportant, I go back to the original [search output]. If I find [something new], I cover over [the old one]." Two Students, Din hao and Dahui, indicated that the theoretical frameworks of their research were based on their advisors' suggestions which provided a clear direction for them to follow.

Like the experienced students, all junior faculty reported that they rarely felt disoriented. They always kept a topic in mind when doing online searches and selecting articles from various sources. Also, they had rich prior knowledge of the literature in their fields so they were able to evaluate and locate needed articles efficiently. Dr Chang noted:

I know what [literature] I need to insert in this page [of my paper]; so I am very sure about what I need and what I don't need. I go back and forth [in the results] evaluating what I need. [...] Nowadays I am more aware when evaluating the literature. When I browse [the search results], I ask myself: What articles do I need? Probably because of time limits, because [I] need to complete some tasks within time constraints, I have to use some strategies more often.

The participants mentioned three main searching purposes: composing the theoretical framework and the introduction of a study, having a better understanding of related studies' methodologies, and supporting and comparing findings. In total, 13 of 15 participants described that they searched for articles to establish the theoretical frameworks of their studies. One less-experienced doctoral student, Liyu, reported that she searched for articles in order to write the introduction. Three from each group mentioned that they looked for articles to better understand methodologies. Five of the six experienced doctoral students indicated that they needed to search for articles to support their claims in the findings or compare their findings with others' works. For example, Daping, indicated, "When I need some information to explain my findings, I do more searches." Din hao revealed that he conducted a literature review to ensure that no investigations on a certain topic had been conducted.

In summary, a number of differences were found among the three groups of researchers regarding their searching and sourcing strategies for retrieving, evaluating, and self-monitoring multiple-source information in the literature. We summarize these differences in Table III and provide comparisons of how these researchers developed these strategies.

In addition to the six strategies, the findings revealed two technical skills: locating full texts of articles, and managing data. Regarding locating the full texts, the less-experienced doctoral students reported that they tended to give up looking for articles for which they did not have immediate access to the full text. By contrast, the experienced doctoral students and junior faculty often used different resources (i.e. search engines, databases, library services, and social networks) to locate the full text of an article. Although there were times when some experienced doctoral students and junior faculty might give up searching for full texts, they only did so after conducting a careful evaluation based on the source origins and citation rates of the articles.

**Table III.**  
Participants'  
literature searching  
strategies

Strategies	Less-experienced doctoral students (4)	Experienced doctoral students (6)	Junior faculty (5)
<i>Searching strategies</i>			
1. Using and modifying keywords	Uncertain about keywords for search (4) <sup>a</sup> Narrow down results: Similar to experienced students (4)	Adopting multiple strategies to verify and modify keywords (5) Narrow down results: Adding more keywords or modifying keywords, limiting results based on areas or years of publications, purposefully establishing searching criteria (5) Expand results: Adding "or," removing keywords, using words with broader concepts, finding less academic articles (5)	Using and modifying keywords flexibly and strategically (5) Narrow down results: Similar to experienced students; more knowledgeable of keywords in certain areas and more capable of narrowing down their results (5) Expand results: Similar to experienced students (3)
2. Doing advanced searches to narrow down or expand their results	Expand results: Changing keywords, changing topics of interest, consulting advisors (3)	Expand results: Adding "or," removing keywords, using words with broader concepts, finding less academic articles (5)	Expand results: Similar to experienced students (3)
3. Chaining	Using references found to locate more articles related to topics (3)	Similar to junior faculty; using articles suggested by online databases (6)	Checking references of articles, tracking how an article had been cited, identifying important figures and following their works (5)
4. Networking for retrieving literature	Seeking help from advisors and librarians to obtain literature (4)	Seeking help from peers and advisors to obtain literature, checking major experts' websites to update literature (6)	Relying heavily on their social networks to update literature; seeking help from peers and colleagues, attending conferences, checking major experts' websites, joining online academic groups (5)

(continued)

Strategies	Less-experienced doctoral students (4)	Experienced doctoral students (6)	Junior faculty (5)
<i>Sourcing strategies</i>			
1. Evaluating and selecting multiple-source articles	Similar to junior faculty; additional criteria: downloading articles with full texts, using most cited articles, looking at page length, needing advisors' help to evaluate articles (4)	Similar to junior faculty; additional criteria: origin of concepts or theories, avoiding referring to books, avoiding referring to journal papers from certain countries, avoiding reading qualitative papers, reading articles published in certain journals where they planned to submit their papers for publications, needing advisors' help to evaluate articles (6)	Selecting articles based on: topic relatedness, studies conducted by major experts, quality of journal, year of publication, citation rates (4)
2. Self-monitoring the multiple-source searching process	Not feeling disoriented because of surface-level searches: locating more articles by consulting references, using previous studies as guidance (4)	Not feeling disoriented because of following advisors' suggestions and adopting these strategies: stopping searching when results were irrelevant to topics, opening articles in new windows to avoid disorientation (6)	Not feeling disoriented because of keeping topic in mind while searching, having rich prior knowledge, responding to time constraints (4)

**Note:** <sup>a</sup>The number in parentheses () refers to the number of participants who reported in the interviews the use of that technique

Furthermore, some faculty relied on their assistants to search for full texts because they thought their assistants were more capable of using databases and search engines. Regarding managing data, most of the experienced doctoral students, particularly the PhD candidates, used data management software (e.g. Endnote, Evernote, or Microsoft Excel) to manage the articles they had obtained. Some junior faculty either did not use such software/systems or asked their assistants for help. The need for junior faculty to learn these technical skills is discussed in the last section.

### Discussion and conclusion

This study reveals the complexity of how researchers use four searching strategies and two sourcing strategies. Particularly, it deepens our understanding of how web environments and multiple sources of online information influence researchers' searching behaviors.

We found that participants' research experience of publishing journal articles was related to the sophistication of their use of searching and sourcing strategies. Participants who had more experience of publishing journal articles might have accumulated more prior knowledge and motivation for literature searching. They consequently revealed in the interviews more complex strategies. In other words, the doctoral students with less research experience appeared to remain at the surface level during their literature seeking. By contrast, the experienced doctoral students and junior faculty were able to adopt searching and sourcing strategies flexibly and simultaneously, and determine more relevant and useful search outcomes. This result corroborates several previous studies regarding the differences in strategies used by novices and experts to assess web-based materials (Brand-Gruwel *et al.*, 2005; Ismail and Kareem, 2011; Tsai and Tsai, 2003; Tsai, 2004).

The finding of this study extends the strategy of matching identified by Tsai (2004) by elaborating two different matching approaches adopted by novice and expert researchers. Tsai found that novice researchers were more likely to use the matching strategy to search for relevant information (i.e. considering best-fit results as retrieved by search engines). In contrast, this study revealed that the matching strategy was used by not only the less-experienced students but also the experienced students and junior faculty. However, it is worth noting that the less-experienced researchers did surface searches according to the best-fit results retrieved by search engines, while the other two experienced groups of researchers did higher-order sourcing – in-depth explorations and evaluations of literature to find the most related articles.

According to Rempel (2010), graduate students might encounter difficulties defining appropriate boundaries for the coverage of their topics, and often regard the issue of scope as simply collecting works concerning their research topic. Similar to Rempel's viewpoint, this study found that the less-experienced group seemed to be engaged in surface-level searching, which prevented them from experiencing disorientation. In contrast, the other two groups explored multiple sources to identify related literature and self-monitored the searching process to avoid disorientation.

Previous work conducted by Meho and Tibbo (2003) revealed that networking is one of the key strategies social science researchers use to seek information. Our findings extend their viewpoint by revealing that the development of social network technologies facilitates junior faculty's networking for updating literature. Also, we found that, unlike the junior faculty who requested literature from their peers and colleagues, the doctoral students relied heavily on their advisors for selecting

keywords, evaluating the appropriateness of articles, and recommending articles. Although Wijnia *et al.* (2015) argued that student-selected literature resources can increase learning motivation and competence for independent study more than instructor-selected literature resources, this study reveals that novice researchers still need their advisors' scaffolds and guidance in the process of mastering skills for retrieving relevant academic literature.

This study found that the participants limit their searches by years of publication and subject areas. Other limits, such as full-text article, peer review articles, and language, were not mentioned. Additionally, they failed to mention methods that can be used to improve the number of search results such as using more synonyms with the "OR" operator, wildcards, and avoiding field searches. The absence of more detailed search skills might be because they were not asked about the usage of these specific skills during the interviews. Thus, it is suggested that future researchers probe into how participants use these skills and find out whether there are differences between different groups of scholars.

While the interviews revealed the participants' knowledge and perceptions of their online searching behavior, they did not tell what they actually do in an online searching task. Online academic literature searching tasks can be added into the design of future research to deepen the understanding of the searching and sourcing behavior. In addition to searching tasks, the information literacy measurements can be adopted in future studies for a better understanding of participants' prior searching experience and competence.

This study only examined educational researchers' searching and sourcing behaviors. To what extent the strategies discovered in this study are used by scholars in other sub-fields in the social sciences and other major disciplines such as the natural sciences and humanities requires further investigation. Adopting mixed methods including surveys and interviews could perhaps gain a broader picture of users' perceptions and behaviors of searching and sourcing.

The findings of this study strongly suggest that additional training is needed for educational researchers. Less-experienced doctoral researchers may need to develop sourcing strategy knowledge in order to critically assess the accuracy and usefulness of online literature. Regarding junior faculty, it is suggested that they develop better technical skills to search for full texts and manage their data. Also, the findings of this study can be used to modify the existing information literacy measurements, which can then be used to test whether researchers improve their searching strategies after training.

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