

Engineering Graduate Students' Literature Searching Behaviors

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Abstract: In this paper, we drew on Kuiper, Volman and Terwel's (2008) three aspects of web literacy skills (searching, reading, and evaluating) and investigated engineering graduate students' literature searching strategies. Through in-depth interviews and think-aloud protocols, we compared strategies employed by twenty-two engineering graduate students in Taiwan. The findings showed that the students' literature searching behaviors included searching, reading, and evaluating sources for their research purposes. Implications for enhancing information literacy of engineering students are suggested.

Keywords: Engineering, graduate students, literature searching

1. Introduction

During the past decades, studies have been conducted to examine graduate students' literature searching behaviors in several disciplines: education (Moselen, 2011), humanities (Bronstein, 2007), physics and astronomy (Jamali & Nicholas, 2010), and basic and medical sciences (Hemminger, Lu, Vaughan, & Adams, 2007). However, few have examined engineering graduate students' seeking behaviors. How engineering students actually search literature and use information for research purposes has been little studied. Thus, this study aims to explore Taiwanese engineering graduate students' literature searching behaviors in three aspects: (1) how do they seek and obtain online information for research? (2) how do they read and interpret sources? and (3) how do they assess and evaluate those sources for their research tasks?

2. Literature Review

2.1 Graduate Students' Literature Searching Behaviors

During the past decades, studies have been conducted to understand graduate students' literature searching behaviors. Some have conducted large-scale studies with the purpose to categorize students' search behaviors across diverse disciplines (Du & Evans, 2011; Rempel, 2010). However, such approach has been criticized by those who value a discipline-based approach (Grafstein, 2002; Jamali & Nicolas, 2010). These researchers argue that it is equally important to examine skills required for acquiring knowledge or conducting research in a specific subject area (Talja, Vakkari, Fry, & Wouters, 2007). For instance, Barrett (2005) explored humanities graduate students' seeking practices and found that they used *Google* to find general information on a topic, and other techniques such as citation chasing, identifying primary sources to validate their theories and hypotheses, having interpersonal contact for guidance, and constantly reading in a subject area.

Thus far, to the best of our knowledge, only one study conducted by Ismail and Kareem (2011) is related. Studying information seeking by Malaysian master's students in a computer science and information technology program, Ismail and Kareem found that these students had difficulties obtaining relevant information for their research. Unfamiliar with specific scholarly tools, the students relied on *Google* or *Google Scholar* for searching but were overloaded with massive information.

Ismail and Kareem's research demonstrates struggle and strategies novice engineering researchers are likely to encounter when obtaining the required information and it indicates the importance of facilitating them to enhance their searches for academic literature.

2.2 Searching, Reading, and Evaluating Online Information

Several frameworks have been proposed to explore students' searching practices. Related to this study, Kuiper, Volman and Terwel's (2008) three aspects of skills: searching, reading, and evaluating, are considered. *Searching skills* refer to the ability to define appropriate keywords and use search engines or library databases. *Reading skills* include the ability to sort through massive information and decide what to use and what to neglect. *Evaluating skills* consist of the ability to assess the authority, relevance, and reliability of Web information. According to Kuiper et al. (2008), these three skills are mutually connected. Considering this study, we adopted Kuipert et al.'s framework and aimed to investigate how graduate students search, read, and evaluate information sources for their research purposes.

3. Methods

3.1 Participants

For the purpose of the study, fifteen master's students and seven doctoral students from two national universities in Taiwan were recruited. The students' research-related searching experiences ranged from one to seven years. Their specialized areas varied from material science and engineering, automation and control, to applied science and technology. They conducted academic literature searching for a variety of writing purposes (course assignments, grant projects, conference papers, journal articles, and theses/dissertations) and sometimes for experimental purposes (details of methodology in other studies).

3.2 Data Collection

Data sets included two parts: a semi-structured retrospective interview (30-40 minutes) and a concurrent think-aloud protocol (30-40 minutes). Audio recordings were collected from the interview and screen recordings were gathered from the think-aloud protocol.

3.3 Data Analysis

To answer the three research questions, the analyses were guided by Kuiper et al.'s (2008) three skills. We focused on how the engineering graduate students were engaged in searching, reading, and evaluating research-related information.

4. Findings and Discussion

The findings correspond with the three aspects of web literacy skills raised by Kuiper et al. (2008): searching, reading, and evaluating. In the following, we offer responses to the research questions and discussions of the findings in relation to the literature.

4.1 Searching

The participants reported four strategies they used for seeking and obtaining online information. These strategies included: using search engines and library databases, and networking for retrieving articles or materials.

In this study, seven students reported that they turned to *Google* or *Google Scholar* before the library databases because they included major science databases and thus provided sufficient sources related to their research. Frequent use of *Google* or *Google Scholar* by graduate students has been reported in the literature. Purposes indicated include conducting broad searches (Rempel, 2010) and using them as a starting point (Du & Evans, 2011) or to acquire new knowledge (Vibert, Rouet, Ros, Ramond, & Deshoullieres, 2007). The finding implies that it is beneficial to begin research by using search engines to browse and construct background knowledge and then use library databases for specific search purposes.

Moreover, networking for retrieving articles or materials was frequently reported by the engineering graduate students in this study. Aligned with previous studies, the finding revealed that engineering literature searching behaviors involve dynamic source-seeker connections for retrieving information efficiently (Xu, Tan, & Yang, 2006). It is suggested that graduate students initiate contacts with colleagues, librarians, or experts inside or outside their programs to request information.

4.2 Reading

The participants reported that they selected main ideas for reading, including browsing the title first and then the abstract, and referring to specific sections in the article (e.g., methods or conclusion). These involve quick decisions to read online or to download an article for in-depth reading. Such practice corresponds with M. J. Tsai and C. C. Tsai's (2003) finding of selecting main idea strategy regarding how students grasp or summarize the main information provided in each Web page. The engineering students' practices for online and printed resources are more intertwined and interactive than those observed in Ellis, Cox, & Hall's study (1993).

The current study also observed that the engineering graduate students assessed the usefulness or relevance of information based on the graphs or images in the methods section. This is similar to Aurisicchio, Bracewell, & Wallace's (2010) finding regarding aerospace designers' use of drawings.

Moreover, it was found that to develop a comprehensive understanding of a research topic, the participants were aware that they had to read broadly in a subject area. Such finding is similar to humanities graduate students' practices (Barrett, 2005) and it indicates the process of building domain knowledge through constant searching and reading.

4.3 Evaluating

Four evaluation criteria were discussed by the participants regarding the usefulness of online sources. These included: *relevance*, *recency*, *credibility*, and *authority*. Different from the processes of searching and reading, these criteria are considered higher-order thinking skills, facilitating the users to differentiate and sort out online information critically. Without this process, literature searching would not be successful and thus it plays a crucial role in information seeking (Biddix, Chung, & Park, 2011; Currie, Devlin, Emde, & Graves, 2010; Head & Eisenberg, 2009).

5. Limitations and Implications

This study has some limitations and thus draws some implications for future research. In this study, a sample of Taiwanese engineering graduate students enrolled in the master's and doctoral programs was recruited. It is suggested that the theoretical frameworks and the conclusions of the study can be further explored in other student populations.

Interviews with those (e.g., librarians, peers, colleagues, or advisors) who facilitate the participants to conduct their literature searching may be needed in order to triangulate varied perspectives of their searching processes.

Finally, it is suggested that adopting mixed methods including surveys and interviews could perhaps gather a broad picture of users' searching perceptions and behaviors.

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