AC 2011-265: WHAT INFORMATION SOURCES DO ENGINEERING STUDENTS USE TO ADDRESS AUTHENTIC SOCIOTECHNICAL PROBLEMS?

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What information sources do engineering students use to address authentic socio-technical problems?

Abstract

In this study we investigate the information sources used by engineering students to address authentic socio-technical problems. Informed by discussions of information literacy in academic disciplines, we examine the information seeking behaviours of a class of engineering students engaged in problems that in their ambiguity and open-endedness mimic the problems faced by professional engineers. Our study has implications for librarians wondering about the allocation of library resources and the effectiveness of in-class presentations, and for instructors concerned that students garner relevant and authoritative information as they propose problem solutions. It also relates to the current interest in life-long learning. Both librarians and instructors would benefit from gaining insight into how best to prepare students for a global workplace with unknown constraints and limited information resources.

Introduction

Since the mid 1990s, information technologies have become ubiquitous in the workplace, in the home, and in academe, and the subject of information literacy has become central to discussions of pedagogy. How information literacy has been variously manifested among the academic disciplines has, in turn, become the focus of recent research. Kerins, Madden, and Fulton [1], for instance, compare information-seeking behaviours of Irish engineering students and Irish law students. Ercegovac [2] has gone on to posit that more work needs to be done on ascertaining information-seeking behaviours among the undergraduate engineering population. This literature forms the backdrop to our study.

Information-Seeking Behaviour of Students

Ercegovac [2] have confirmed findings by Kerins, Madden & Fulton [1] that students in general tend to "prefer quick, easy, and convenient" sources (e.g. Internet search engines, friends), making accessibility of information and ease of use key issues. Evidence also suggests that the issue of salience, "the perceived applicability of information to a problem that [the student] faces" [3], also becomes a key factor in information-seeking behaviour.

Several studies that looked at the information habits of undergraduates suggest that Google, Google Scholar (GS) and Wikipedia are the students' "discovery tools of choice", especially in science and engineering [4, 5] . 83% of students use GS – an additional 13% had not used it but want to [4] .

Some benefits for students of using GS are:

- GS searches citation metadata (and millions of fulltext books in Google Print)
- GS searches well into the fulltext of documents
- Though GS is not an index in the traditional sense due to the absence of a controlled
- vocabulary or thesaurus, it does point to scholarly and peer-reviewed information

We believe that introducing students to advanced Google searching techniques enhances their real-world searching experience not only for academic projects but also for their professional lives.

While the majority of science and engineering students favour GS, students are also initiated into information-seeking behaviour specific to their discipline through textbooks and lecture notes[6], which in turn reflect epistemological values. Because the study of engineering is directly influenced by industry standards, we look to Anderson et al's [3] work on the information sources used by engineering professionals, specifically those in the aerospace industry, as an example of the professional behaviour that both undergirds the information seeking of engineering students and may serve as a model for students when they are on coop work-terms or complete their education and enter the work force.

Information-Seeking Behaviour of Engineering Professionals

Anderson et al [3], building on the work by Pinelli and his colleagues [7-9], have chosen the aerospace industry to investigate the information-seeking behaviours of professional engineers because aerospace is characterized by technical complexity and market uncertainty. They note that aerospace engineers tend to prefer oral communication over written communication, especially when the technical task is ambiguous, difficult, and uncertain. While Zift's "principle of least effort" is at the basis of this information-seeking behaviour [10], Anderson et al also note that Ellis and Haugan [11] found that engineers tended to seek out contacts within their own personal social spheres and only later consulted librarians for information sources.

In our study, we examine the information-seeking behaviours of engineering students engaged in authentic socio-technical problems that due to their complexity and uncertainty mimic the kinds of problems students will encounter in their professional lives. We are interested in determining what information tools or sources students think or predict they will use and what they actually use. As Tella [6] posits, self-efficacy (what students think they can do) is strongly correlated with information-seeking behaviour (what they actually do).

Applied Science 263: Background and Objectives

Applied Science 263 (Technology and Development: The Global Engineer) at the University of British Columbia (UBC) uses Problem-Oriented Learning (POL) to explore engineering practice and appropriate technology in an international context. It aims to provide students with an opportunity to:

- Increase their understanding of global issues
- Gain an appreciation of the importance of social context in proposing technical solutions
- Expand existing research skills by working on authentic problems
- Enhance critical thinking skills through dealing with information that is not pre-determined or derived from a textbook
- Improve communication skills through awareness of intercultural contexts
- Develop leadership and teamwork skills through working in multidisciplinary groups

The backbone of the course is a set of real socio-technical problems identified by artisans in India and transmitted to us via a local social entrepreneur working in the craft sector. The problems are ambiguous and open-ended, and students are asked to address them through conducting a conceptual study. They begin with the engineering skills they have acquired in previous classes; however they are required to expand their view and to give heed to relevant factors relating to the physical and social contexts of the problems. These might include geographical and environmental, as well as social, cultural, economic, political, religious, and/or historical conditions.

Students are required to complete a progressive series of interrelated assignments related to one of the socio-technical problems. The assignments include a team proposal with a problem statement, an interview with an appropriate expert of their choice, a progress report (individual), a team presentation, a collaborative formal report, and an academic poster. Because specific information about the problems is sparse and transmitted to the class by the social entrepreneur only on an intermittent basis (when she is back from India or has access to email), students often flounder as they begin their research, and find themselves at a loss as they try to apply high-tech academic research skills and information to a low-tech applied context.

The course is currently in its third delivery with 32 students in two sections. For the last two deliveries, the instructors have invited an engineering librarian to offer information literacy sessions to help guide the students. While the librarians and instructors feel that it is important for students to become familiar with and know how to use specialized engineering research databases, e.g. Compendex, Web of Science, ASCE Digital Library and others, we wonder what information sources students actually use. And why? These questions have puzzled us and have motivated this study.

Methodology

In this study, we used three sets of questions to obtain predominantly qualitative data: first, we asked the students to identify in writing the information tools or sources they plan to use to conduct their research. Then an engineering librarian offered one 1-hour session introducing the students to several engineering and science databases, e.g. Compendex and Web of Science, and discussing Google and Google Scholar. The librarian spent some time focusing on advanced search commands in Google and Google Scholar, e.g. intitle:. Immediately following this session, we asked the students to again identify what information tools or sources they plan to use, and, if this response differed from the one provided prior to the librarian's session, to explain why. Finally, at the end of the course after the students submit their final reports, we will ask them to list and comment on the information tools or sources they actually used and why. The findings from this third round of questioning will be compared with the actual citations in the formal reports. Please refer to Appendix 1 for the worksheets containing the three sets of questions. The questions were designed to be readily comprehensible by students, and also to yield data that would be of interest to both librarians and instructors.

The ethical review application for this study is currently being processed as a "minimal risk" application by the Behavioural Research and Ethics Board at UBC. All students have been

assured that the study is voluntary. Participants cannot be identified and those who do not participate will not be penalized.

Signed consent forms and the first two sets of anonymous worksheets have been collected by a third party not involved in the course or the study; during these times the researchers exited the room to prevent visual identification of those students who did not participate in the study. Signed consent forms were separated from the worksheets by the third party. The consent forms have been stored in a locked filing cabinet inaccessible to the instructors. The worksheets will be reviewed and the resulting data will be evaluated by both instructors and librarians.

Expectations (Findings)

At the end of the first delivery of the course in 2009, students informally interviewed each other on camera about their learning experiences. They were asked to provide one piece of advice to future students. Many recommended taking advantage of their surroundings and any potentially useful personal connections, with one student suggesting to "become one with Google." As predicted by these peer interviews, we expect the students in our study to rely heavily on Google Scholar, Wikipedia, suggestions from friends, and interviews with experts in the field, but also expect that they will make use of library databases.

Our last collection of data is scheduled for March 22, 2011. We plan to analyze the data in both qualitative and quantitative terms, and present our findings at the ASEE conference in June 2011. We also plan to upload the most updated draft of the paper in May 2011 to the ELD division website - http://depts.washington.edu/englib/eld/

Conclusions

We expect our findings to suggest what Anderson et al [3] describe of aerospace engineers; namely, when engineering students are faced with complex and uncertain tasks, they tend to prefer oral communication over written communication, and to seek multiple sources of information that encompass both traditional academic databases (e.g. Compendex or Web of Science) as well as community-oriented popular databases (e.g. Wikipedia or Google Scholar), with some reliance on informal channels of communication (e.g. chatting face-to-face or electronically) in their personal social domain. By engaging in this kind of information-seeking behaviour, students simultaneously work towards fulfilling engineering accreditation criteria outlined by ABET and CEAB: collaborating in teams, learning about the broad social context and implications of engineering projects, and practicing habits of mind that lead to lifelong learning. As students critically reflect on their information-seeking behaviour, they are self-evaluating and re-directing their personal learning experience and expanding their awareness of what comprises a salient and valid information source.

References:

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Appendix: Three APSC 263 Worksheets

APSC 263: Technology and Development

8 February 2011

No Names Please

Conducting the Research for your Conceptual Design Project

Worksheet 1

In order to do the research for your conceptual design project, you will have to acquire information through various means. What information tools or sources do you expect to use (or have you already used) in conducting research for your project?

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APSC 263: Technology and Development

8 February 2011

No Names Please

Conducting the Research for your Conceptual Design Project

Worksheet 2

Having listened to the presentation by Eugene Barsky, Science and Engineering librarian, what information tools or sources do you now expect to use in conducting research for your conceptual design project?

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Are the information tools or sources you listed above different from those you listed at the beginning of the class (on the first questionnaire)? Please explain why or why not.

_____

_____

_____

APSC 263: Technology and Development

22 March 2011

No Names Please

Conducting the Research for your Conceptual Design Project

Worksheet 3

1. What information tools or sources did you use in conducting the research for your conceptual design project?

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_____

_____

_____

_____

_____

2. The following questions pertain specifically to your use of internet and library resources in conducting your research. Please circle the appropriate response.

a) Did you use Wikipedia?

yes no can’t remember

b) Did you use Google?

yes no can’t remember

c) If you used Google, did you use the advanced search commands demonstrated by Eugene Barsky, Science and Engineering librarian, at the in-class presentation on 8 February 2011?

yes no can’t remember

d) Did you use a database such as Compendex (Engineering Village) or Web of Science?

yes no can’t remember

e) Did you communicate with a UBC librarian, either by email, telephone, or in person?

yes no can’t remember

f) Did you use the resources of a non-UBC library?

yes no can't remember

If you did use a non-UBC library/libraries, please name it/them:

_____

3. In retrospect, was the presentation by Eugene Barsky, Science and Engineering librarian, on 8 February 2011, helpful? Please explain why or why not.

_____

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4. Do you feel that the means by which you acquired information for your collaborative research project were adequate?

_____

_____

_____

5. Do you think the library research skills you have gained in your UBC engineering classes will be useful in your future career? Why or why not?

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