Identifying Challenges Faced by Chinese Undergraduate Engineering Students in Acquiring Information Literacy Skills – A Report on Survey Findings

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Abstract

This study investigates challenges related to information literacy that Chinese undergraduate engineering students face in comparison with their native English speaking peers in completing a research paper. Steps of a typical research process are examined including: selecting a topic, finding information sources, planning search strategies, and gathering, evaluating, managing and presenting information. Both survey and interview methods were used to gather data. The SCONUL Seven Pillars of Information Literacy framework was adopted to develop the survey and interview questions, and the ACRL Information Literacy Standards for Science and Engineering/Technology were used to examine the findings. Only survey findings are reported in the current paper. Although there are some areas where both groups reported challenges such as finding enough relevant information and incorporating ideas from their readings into their paper, other areas such as evaluating sources and knowing when and how to cite, were especially challenging for Chinese students.

I. Introduction

Growing Chinese enrollment in North American institutions of higher education

International students, and specifically Chinese students, comprise a large and growing percentage of students enrolled in engineering programs in North America. In the US, Chinese students account for 29% of all international students, the largest cohort from any given country. Engineering is the second most popular field of study for international students with 19% choosing engineering after business and management chosen by 22%. Similarly in Canada over the past decade, the largest percentage of international students have come from China and engineering is the second most popular field of study with approximately 15% of international students selecting this field after business and management. Moreover, international students enroll in engineering twice as often as Canadian students. A recent Government of Canada report on International Education advises doubling the number of international students in Canada from 239,131 in 2011 to more than 450,000 by 2022 and creating mechanisms to assure a high quality experience for international students.

McGill University’s enrollment statistics mirror trends throughout North America. For the past ten years, Chinese students have been the largest student group that speaks neither English nor French as their first language, and enrollment has rapidly increased by 142% from 432 students in 2003 to 1045 in 2013. Within the context of increased Chinese student enrollment (specifically in engineering), understanding the information needs of this user group is important to ensure that they have a positive learning experience outside their country of origin.
Increasing information literacy competency requirements

The recently revised Canadian Engineering Accreditation Board’s accreditation criteria\(^6\) have higher expectations of information research skills for undergraduate engineering graduates than ever before. Among the 12 graduate attributes, *problem analysis, investigation, communication skills, ethics and equity, and life-long learning* are closely associated with information literacy (IL) competencies and can be addressed by academic librarians themselves or in collaboration with different units on campus. IL training may help this group of students become better empowered to use information effectively, which has the potential to contribute to their overall academic and career success.

Role of undergraduate research

Along with the importance of promoting IL to meet accreditation requirements in engineering, there are additional reasons why developing critical thinking and research skills at the undergraduate level is becoming increasingly important. McGill University’s strategic plan, ASAP 2012,\(^7\) places a growing emphasis on undergraduate research as being one of its priorities in the years ahead. The strategic plan has as one of its goals to: “Mandate all faculties to increase or initia[te] undergraduate research opportunities, including summer research opportunities, and to monitor and report on them regularly” (p. 33). Teaching IL skills is important for all students in the context of the increasing role that research is playing even at the undergraduate level at McGill and elsewhere. Within our context at McGill University, providing support for undergraduate research is an increasingly important role for the library.

Purpose of this study

The first step in better serving this user group is to understand their challenges. This study investigates challenges related to information literacy that Chinese undergraduate engineering students face in comparison with their native English speaking peers in completing a research paper. Next, we hope to apply this knowledge to create increasingly relevant information literacy skills training for Chinese students and international students in general. The current paper reports on preliminary findings from initial face-to-face interviews and an online questionnaire. The results of the online questionnaire should be considered as a case study given that there were a small number of participants and that they were from only one academic institution. Nevertheless, it is hoped that the results will inspire other librarians to further investigate the needs of undergraduate international students in engineering. Qualitative findings from the second face-to-face interviews with participants will be reported in a future research publication.

II. Literature review

Little research has been conducted into the information literacy skills of Chinese (or international) students in engineering programs, although, as mentioned earlier, engineering is the second most popular choice of international students throughout North America. Only two articles discuss the information needs of international engineering students specifically and both consider graduate students rather than undergraduate students. The most relevant study related
Information literacy needs in a research context

Among research studies that examine Chinese students in other disciplines, most existing studies focus on the use of library services and resources by international students, rather than their information literacy needs within the context of a given research assignment. Students’ use of library services and resources are largely driven by the information research needs generated from their coursework and research. Although previous studies uncover certain information literacy needs among student participants, there is little research on students’ IL needs throughout the entire research process. As Han\textsuperscript{10} notes in her article entitled “Information literacy challenges for Chinese PhD students in Australia,” “The literature has highlighted international… students’ language and cultural issues as the main factor that caused problems in the use of the library and searching e-resources. However, there is little research exploring the IL needs of international… students within their specific research context or discipline” (emphasis added) (p. 5). Most previous research focuses on awareness and use of library resources rather than considering students’ underlying information needs within a specific research context. For example, Shao and Scherlen’s study\textsuperscript{11} employed an online survey with 83 Chinese student respondents from various disciplines to determine their level of satisfaction with library services and resources. Liu and Winn’s article\textsuperscript{12} entitled “Chinese graduate students and the Canadian academic library” reports on the results of a qualitative study of 12 Chinese graduate students. It aims to uncover “the issues and challenges these students encountered in seeking information needed and the reasons and explanations for these issues” (p. 566). However, given that the investigators do not examine the context of participants’ research needs (e.g. difficulties with certain aspects of the research process such as topic selection, evaluating sources, etc.), little information is gathered beyond suggestions for improving awareness of library resources and of the librarian’s role, increasing library use and reducing use of library specific terminology.

Han’s research\textsuperscript{10} does address information literacy needs within a research context. The researcher used a biographical narrative approach and examined journal accounts from three Chinese PhD students in their first 15 months studying Education at an Australian university. She concluded that Chinese students in graduate programs have a need for “interdisciplinary knowledge (such as knowledge in statistics and information science)” (p. 15)
to succeed in their research which requires a variety of skills to handle their intensive information related tasks.

Another paper that considers information literacy needs within a specific research context is Morrissey and Given’s pilot study\textsuperscript{13} at the University of Alberta (UofA) where the investigators interviewed nine Chinese graduate students and discovered that they tended to start with their supervisors’ general instruction on the research process, i.e. “go to the library to obtain ‘a lot of papers’” to determine their information needs. They highly valued key papers and books recommended by their supervisors and actively followed the references cited in those papers for their topic. They also relied heavily on the Internet for sources relevant to their research topics.

The current study examines Chinese undergraduate engineering students in comparison with their native English speaking peers in order to compare the challenges each group encounters when completing a research assignment. Investigators chose this specific user group because undergraduate research is becoming more common at McGill University and thus a focus for the library’s instructional efforts, and because Chinese students make up a large percentage of undergraduates in engineering. The current study also differentiates itself from previous ones because it examines information literacy skills acquisition within the context of a research assignment rather than focusing on awareness and use of library resources and services.

III. Methodology

This study uses a mixed method of gathering data from an online survey and two face-to-face interviews to understand the information literacy needs of Chinese engineering undergraduate students in comparison to their native English speaking peers. However, the current paper reports on findings from the first face-to-face interview and the online questionnaire only. Qualitative data gathered in the second face-to-face interview will be reported in a future publication. By providing students with two different methods for reporting their research experiences (e.g. by survey and in person), it is hoped that the data will reveal a full picture of challenges students face throughout the research process.

CCOM 206 - Communication in Engineering

This study takes Fitzgibbons’ approach\textsuperscript{14} of comparing two groups of students: first, the Chinese students group and second, the native English speaking students group. Investigators recruited students from the CCOM 206 - Communication in Engineering course, which is a required undergraduate course for most engineering programs and teaches undergraduate engineering students written and oral communication skills. The course was chosen because there is a large cohort of students (approximately 350 students) who take this course each semester, which potentially provided enough native English speaking and Chinese students to participate in this study. Because all participants in this study were recruited from the Communication in Engineering course in the Fall semester of 2013, the expectations were the same for all participants in terms of the quality of their research papers. This created a controlled environment for the study. It was hoped that the similarities and differences between the IL needs of these two student groups could be identified most accurately in this controlled context.
Students are required to complete a research paper where they must find an engineering problem, conduct a literature review, and write up their arguments in favor of a specific solution. The experience touches upon nearly every facet of information literacy, and is therefore an ideal setting to identify the difficulties and challenges that the students may encounter throughout the research process.

The authors and their colleagues at the Schulich Library of Science and Engineering have been teaching library instruction sessions that are embedded in the class for a number of years and in Fall 2013, there were two library instruction sessions delivered to each section of the course. The first library session taught students how to create a search strategy, search effectively in an engineering database, and use EndNote citation software to manage references and cite them in the paper. The second library session taught students how to identify the typical structure of an engineering article and read an engineering article efficiently.

Eligibility criteria

In the Fall semester of 2013, authors of this paper began the research study after obtaining Research Ethics Board approval (certificate #: 137-0813). A recruitment letter was sent out to all students enrolled in the CCOM 206 class and one of the investigators made an announcement in each of the second library sessions to seek participants. Students were eligible to participate if they were either: (1) A Chinese student who had received his or her education in China (including Mainland China, Hong Kong and Taiwan) and had received 8 years or less of his or her education in North America, or (2) a native English speaking student who had received most of his or her primary and secondary education in North America. By having two relatively homogenous groups, the investigators sought to determine what differences there were in the challenges faced by these two user groups. A total of eight Chinese students and nine native English speaking students completed the study. The demographic information of these participants will be documented in the Findings section of this paper.

Methods for gathering data

This study takes a mixed methods approach to gather data about students’ experiences completing the research paper. Both a survey questionnaire and in-depth interviews were used in this study. The study design is based on Seidman’s best interview practice, involving three interview sessions: the first interview is to familiarize participants with the purpose and steps of a study and to gather demographic data; the second interview is to identify participants’ experience; and the third interview is to examine the factors contributing to individual experiences. It is believed that this model provides participants with enough time and opportunity to become acquainted with the study and the investigators, and to understand the research questions and the research context. However, in the current study, the second step differed from Seidman’s model in that an online survey questionnaire replaced the second face-to-face interview. It was hoped that the participants would find it more convenient to reflect on their research experience by completing an online survey questionnaire instead of coming to a face-to-face interview while continuing to derive the benefits of the Seidman model (i.e. allowing students the opportunity to become familiar with the study and the investigators, and to accurately reflect on their experiences at several different moments).
First, participants were invited to the initial interview, lasting from 15 to 25 minutes, to sign the consent form and answer questions about their biographical and educational backgrounds, as well as their previous research experience. Second, after completing the first draft of their research paper, participants were sent a link to the online survey questionnaire with multiple choice and open-ended questions about their information related challenges (the online questionnaire is included in Appendix B). The third step of the study was the second face-to-face interview, ranging from 45 to 60 minutes, which was conducted after participants completed the online questionnaire. Interview questions were based on individual participants’ survey responses. The second interview was to gather further qualitative data about the challenges these two user groups experienced when researching and writing their papers and to enrich incomplete data generated by the survey method.

The theoretical framework adopted in composing the online survey questions was The SCONUL Seven Pillars of Information Literacy: A Research Lens for Higher Education from the SCONUL Working Group on Information Literacy. This framework follows the steps of the research process from identifying one’s topic to presenting information and applying knowledge. The pillars are constructed in such a way that they were well suited for developing the online questionnaire in the current study because they allowed the investigators to design questions in the order of how the research process actually takes place. It was believed that designing the questions using this sequence would allow students to best reflect on their research experience.

Questions were grouped into the seven categories presented in the SCONUL document and described below:

1. Identify: Able to identify a personal need for information.
2. Scope: Can assess current knowledge and identify gaps.
3. Plan: Can construct strategies for locating information and data.
4. Gather: Can locate and access the information and data they need.
5. Evaluate: Can review the research process and compare and evaluate information and data.
6. Manage: Can organise information professionally and ethically.
7. Present: Can apply the knowledge gained: presenting the results of their research, synthesising new and old information and data to create new knowledge and disseminating it in a variety of ways.

Method for analyzing data

Although the theoretical framework adopted in composing the questions for the online questionnaire was The SCONUL Seven Pillars of Information Literacy, the framework used to analyze the findings is the Information Literacy Standards for Science and Engineering/Technology by The ALA/ACRL/STS Task Force on Information Literacy for Science and Technology. The ACRL Sci-Tech Standards are widely used as a basis for science and engineering librarians to design their teaching practices and assess their effectiveness. Please see Table 1 for a detailed comparison of the two sets of standards. The table also
provides a list of the sections from the online questionnaire that relate to each standard and maps the questions from the survey to the relevant standards.

### TABLE 1: COMPARISON OF ACRL SCI-TECH STANDARDS AND SCONUL SEVEN PILLARS

<table>
<thead>
<tr>
<th>ACRL SCI-TECH STANDARD #</th>
<th>DESCRIPTION</th>
<th>CORRESPONDING SCONUL</th>
<th>SURVEY SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard One</td>
<td>Articulates information need and identifies sources</td>
<td>1. Identify and 2. Scope</td>
<td>2 (Identify), 3 (Scope) and 9 (General)</td>
</tr>
<tr>
<td>Standard Two</td>
<td>Designs effective search strategies and retrieves relevant information</td>
<td>3. Plan and 4. Gather</td>
<td>4 (Plan), 5 (Gather) and 9 (General)</td>
</tr>
<tr>
<td>Standard Three</td>
<td>Summarizes, evaluates and incorporates information</td>
<td>5. Evaluate and 7. Present</td>
<td>6 (Evaluate), 8 (Present) and 9 (General)</td>
</tr>
<tr>
<td>Standard Four</td>
<td>Acknowledges information sources and uses information ethically</td>
<td>6. Manage</td>
<td>7 (Manage) and 9 (General)</td>
</tr>
<tr>
<td>Standard Five</td>
<td>Recognizes importance of preserving information and keeping current in the field</td>
<td>2. Scope, 3. Plan and 6. Manage</td>
<td>3 (Scope), 4 (Plan) and 7 (Manage)</td>
</tr>
</tbody>
</table>

Means to improve trustworthiness of methodology

In this study, the investigators asked several individuals, who were relevant “stakeholders” in information literacy for engineering students, for feedback in finalizing the survey questions. In order to increase the face validity of the online questionnaire, the following people reviewed, tested and commented on the questions: two librarian colleagues who also taught the two library sessions in the CCOM 206 course in the Fall of 2013, a native English speaking student enrolled in CCOM 206 in the 2013 Fall semester, and a native Chinese speaking graduate student at McGill University. Comments were carefully considered in producing the final version of the survey. The idea was to let these stakeholders test the language and organization of the survey questions so that they could be understood by participants in the same way as they were understood by the investigators of the study. Therefore, errors due to misunderstanding of survey questions could be minimized.

Another method to improve the reliability of the findings was to give Chinese speaking students the option of completing the survey and interviews in either English or Chinese. Five Chinese students chose to conduct the study in Chinese and three students chose English. By
allowing students to answer questions in the face-to-face interviews and the long questions in the survey in their first language, errors caused by low proficiency in English could be minimized. Also, by doing this, both of the investigators of the study (one who is a native English speaker and one who is a native Chinese speaker) were able to interview students of both groups with almost equal numbers and to analyze data they gathered accordingly. Having two investigators conduct the data analysis helps reduce bias and increases the reliability of the findings.

Conversations during both interviews were audio-recorded with limited note-taking. This allowed the investigators more time and attention to focus on conversing with participants. All the audio recordings will be transcribed into written form and Chinese recordings will be translated into English by the native Chinese speaking investigator in the future. A thematic analysis will be used to code and interpret the data. Only data from the online survey were analyzed and documented in the current paper.

Limitations of the study

The results reported in this paper are only a portion of the results from a larger study that will provide findings based on all three components of this study. The results reported in this paper primarily draw on the findings from the online questionnaire and the first demographic interview. Given that there are limitations in drawing quantitative findings from a group of only 17 students, the survey findings that are documented in this paper should be considered as results of a case study. The findings are preliminary in nature, and it is recommended that they be used along with qualitative findings from the interviews which will appear in a future publication.

Subjects participating in this study were only recruited from one general communications course for engineering students at McGill University, and participants are all in their early years of their undergraduate engineering programs (i.e. the first or second years). The majority of Chinese students recruited in this study have been in Canada for three to five years. Most have not just arrived from China. Their English language proficiency, understanding of cultural and social differences and knowledge of support and services at the university, are likely to be very different from those who have only recently arrived in North America. Therefore, the challenges and difficulties identified in this study may differ from those who have newly arrived. However, we could not determine if the demographic profile of Chinese students in this study represents the typical Chinese undergraduate student in Canada or North America. As a result, the findings of this study may not be easily generalized to other educational institutions in North America where the context is different.

IV. Findings

Participants’ demographic information

There were 17 students who participated in this study, nine native English speaking students and eight Chinese students. They were all approximately 20 years old and most started their undergraduate engineering programs at McGill University right after high school (if they were from another province in Canada or from another country) or CEGEP (the Quebec college system that is the equivalent of grade 12 and first year university). Students were from the
following departments: Mining and materials (8), Mechanical Engineering (5), Electrical and Computer Engineering (3), and Civil Engineering (1). Chinese students and native English speaking students were almost evenly distributed among these disciplines. All students were in their first or second year of their programs. 14 participants were males, and one participant in the English speaking student group and two participants in the Chinese student group were female (a total of 17%), which resembles the gender profile of engineering students at large within Canada (20% are female).18

Chinese students

None of the participating Chinese students had recently arrived from China. Two students had been in Canada for two years or less, four students had been here between three to five years, and two students for more than five years. Seven of them came from mainland China and only one student came from Taiwan.

All Chinese students in the study acquired their High School or CEGEP Diplomas from a country outside of China, most from Canada and one from the United Kingdom. Most of them conducted research for essays or papers in high school or CEGEP for various classes: Geography, English, History, Biology, etc. 63% of them reported that they had received instruction on using a library or database from their high school teachers or school/CEGEP librarians. Most reported that they could not read as fast as local students because they had problems with new words and understanding the meaning of lengthy text. As a result, they felt that gathering information on their topics took them a long time. One student even used a Chinese search engine to search for background information in Chinese to help her understand the topic. All students had difficulty in writing their papers. Although their writing had no apparent grammatical mistakes, the choice of words and structure of sentences often caused confusion to readers and proofreading by a native English speaker was always preferred. Most students were able to follow a guide given by their instructors showing how to compose a reference list, but did not always have a clear understanding of when and how to cite. They also found it difficult to summarize ideas from materials.

Native English speaking students

Six out of the nine native English speaking students were from Canada and the remaining three were from the U.S. Most of them had research experience in their high school, and in general, they were confident in their abilities to conduct research. 89% reported receiving previous library training. They all agreed that in their previous research tasks, gathering information took a great amount of time, and they often received recommendations of materials to start with from their instructors, families or friends. Once they were finished reading relevant materials, they could write up their papers quickly.

Another interesting finding relates to attendance at McGill Library Orientation sessions. Although the Library offered orientation sessions at the beginning of each semester to familiarize students with library spaces, services, and resources, only two out of the 17 participants attended a session.
Survey results

Please see Appendix A for the description of each section of the online questionnaire and Appendix B for the complete questionnaire.

In general, students reported several challenges in researching and writing their papers. The writing assignment is challenging especially given that most students had not completed a research paper at the university level before this course. They are expected to consider an engineering problem and come up with evidence to support a specific solution. Both student groups had difficulty carrying out many aspects of the research process. The top challenges are identified in Table 2 below (responses to Question 9.1):

**TABLE 2: TOP CHALLENGES FOR EACH PARTICIPANT GROUP**

<table>
<thead>
<tr>
<th>TOP CHALLENGES</th>
<th>NATIVE ENGLISH SPEAKING STUDENTS</th>
<th>CHINESE STUDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Finding enough relevant information</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2. Incorporating ideas from my readings into my paper</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>3. Identifying a research topic</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>4. Evaluating sources</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

The challenges will be discussed in further detail below as arranged using the ACRL Sci-Tech Standards.

ACRL Sci-Tech Standard One: Articulates information need and identifies sources

The questions in the online questionnaire that relate to Standard One are ones on topic selection and awareness of possible information resources and services (Sections 2 - “Identify” and 3 - “Scope” of the online questionnaire). Please see Table 3 below for a detailed comparison of survey responses by user group related to Standard One.

**TABLE 3: SELECTED SURVEY RESPONSES BY USER GROUP RELATED TO STANDARD ONE**

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>RELEVANT QUESTION NUMBER</th>
<th>NATIVE ENGLISH SPEAKING STUDENTS</th>
<th>CHINESE STUDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying research topic was challenging</td>
<td>9.1</td>
<td>56%</td>
<td>38%</td>
</tr>
</tbody>
</table>
Native English speaking students found topic selection to be especially difficult with 56% (5 out of 9 participants) having difficulty with this area, making it one of the top challenges faced in researching and writing the assignment, tied with Finding enough information and Incorporating ideas (Question 9.1). By comparison, 38% Chinese students had difficulty with topic selection (please see Table 3 for a detailed comparison of survey responses by user group).

Both participant groups scored equally well in awareness of services and resources such as the library, the Writing Center, etc. (Questions 3.5, 3.6 and 3.7). However, native English speaking students reported using a wider variety of information resources such as the library catalogue, article databases, Google, etc. than Chinese students. The average number of different types of sources used by native English students was 3.1 and 2.4 for Chinese students (Question 3.1). Similarly, native English students used a higher number of article databases such as Compendex, IEEE Xplore, Scopus, etc. than Chinese students with an average of 2.6 and 2.1 article databases respectively (Question 3.3). There was also less use of books/ebooks by Chinese students than by native English students (33% compared to 13% respectively). The first library workshop only demonstrated use of Compendex and did not cover searching the library catalogue for books. It is possible that Chinese students had greater difficulty than native English speaking students using resources that were not discussed in class. However, given the small number of students that completed the online questionnaire, the differences between the native English speaking students and the Chinese students in the number of article databases and ebooks they used is not substantial. Differences may possibly be attributed to lack of awareness of these sources or lack of ability to read additional lengthy materials beyond what was required by the instructors. Further qualitative data from the second face-to-face interviews may help explain if and/or why there were differences in use.

ACRL Sci-Tech Standard Two: Designs effective search strategies and retrieves relevant information

Questions related to Standard Two include those from the following sections of the online questionnaire: Section 4 - “Plan” (e.g. creating your search strategy, methods for finding synonyms, revising your search strategy, etc.) and Section 5 - “Gather” (e.g. locating relevant material). Please see Table 4 below for a detailed comparison of survey responses by user group related to Standard Two.
The learning objectives from the “Plan” aspect of Standard Two were well covered in the library’s workshop and both native English and Chinese speaking students generally had fewer problems in this area than in others. Only 12% of participants overall reported that “Determining what methods to use to form a search strategy” was a challenge (Question 9.1).

One difference in the survey results between the two participant groups with regard to creating a search strategy was how students came up with their search terms. Chinese students were much less likely to use synonyms in their search strategy. 63% of Chinese speakers reported that they did not use synonyms because they felt they had enough terms without using them. No native English speakers said so. Given the linguistic challenges faced by Chinese students...
The “Gather” aspect of Standard Two created challenges for many students. The top challenge reported in this study by all participants was finding enough relevant information on their topic (please consult Table 2 for more details). Both native English speaking and Chinese students reported this as their top challenge, with 56% and 63% of students reporting this difficulty respectively (Question 9.1). There could be many reasons for students having difficulty finding enough relevant information including selecting an appropriate database, searching effectively in databases, finding full-text of articles, etc. Further qualitative research will investigate the specific difficulties participants encountered in searching for relevant information.

In particular, native English students reported having difficulty in determining the relevance of their search results. Native English students found this challenging with 67% responding that they found it either difficult or somewhat difficult to determine the relevance of information sources that they found (Question 6.1). Only 25% of Chinese students reported having difficulty determining the relevance of information sources. This is one question that will be further investigated in the qualitative data from the second face-to-face interviews.

While Chinese students did not find it difficult to determine the relevance of information sources, 63% found it challenging to actually locate the full text of articles. 44% of native English speakers also reported this difficulty (Question 5.2). Interestingly, when asked what students did when a book or article was not available at McGill, giving up trying to locate it and finding something else instead was the top response by Chinese speakers (88%). 22% of native English speaking students chose this response. In comparison, 44% English speakers reported that they did not encounter this problem, which was the most common response among this group. It is possible that due to linguistic challenges, Chinese students were more pragmatic in their approach to locating materials. If a specific article was not available, they looked for something else that was.

ACRL Sci-Tech Standard Three: Summarizes, evaluates and incorporates information

Questions related to Standard Three include primarily those in Section 6 - “Evaluate” and Section 8 - “Present” of the online questionnaire. Table 5 below provides a detailed comparison of survey responses by user group related to Standard Three.
TABLE 5: SELECTED SURVEY RESPONSES BY USER GROUP RELATED TO STANDARD THREE

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>RELEVANT QUESTION NUMBER</th>
<th>NATIVE ENGLISH SPEAKING STUDENTS</th>
<th>CHINESE STUDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluating sources was challenging</td>
<td>9.1</td>
<td>22%</td>
<td>63%</td>
</tr>
<tr>
<td>Incorporating ideas from readings into paper was challenging</td>
<td>9.1</td>
<td>56%</td>
<td>50%</td>
</tr>
<tr>
<td>Recognized bias in articles they read</td>
<td>6.4</td>
<td>22%</td>
<td>25%</td>
</tr>
<tr>
<td>Used the checklist distributed in class</td>
<td>7.10</td>
<td>11%</td>
<td>13%</td>
</tr>
<tr>
<td>Had enough time to complete the assignment</td>
<td>9.3</td>
<td>89%</td>
<td>25%</td>
</tr>
</tbody>
</table>

Many students, both native English speakers and Chinese speakers reported problems with carrying out activities related to Standard Three. Although the second library workshop covered how to identify the typical structure of an engineering article and how to read an engineering article efficiently, the class did not include much information on how to evaluate information sources. Difficulty evaluating information sources (e.g. books, journal articles, etc.) before including them in their papers was tied with finding enough relevant information as the top challenge encountered by Chinese students in completing the assignment (in Question 9.1, 63% reported this difficulty). In comparison only 22% of native English students reported this challenge. Further research will be conducted using the qualitative data gathered in the second face-to-face interview to determine the nature of the challenges faced by Chinese students when evaluating information sources.

In terms of evaluation criteria for determining which journal articles to use for their papers (Question 6.3), participants from both groups relied almost exclusively on judging the articles based on how relevant they were to their topic. Few used any other criteria (such as choosing peer-reviewed articles or recently published articles, looking for articles from credible sources, etc.). On average, native English students chose 2.1 methods and Chinese students chose 1.8 methods to evaluate their sources. When asked if they recognized bias or conflict of interest in any of the articles they found, only 24% of participants noted any bias (Question 6.4). Further qualitative research with the second face-to-face interviews will be used to determine how important it is for participants to consider bias in articles.

Overall, “incorporating ideas from their readings into their paper” was the second largest challenge reported by students in the study (with 53% of participants reporting this challenge).
after “finding enough relevant information.” This was a challenge in equal numbers for both native English and Chinese students alike (please see Table 2). The second library workshop included information on how to read an engineering article efficiently in order to extract information as quickly as possible and ways to read it in order to answer the question: “What does this article tell you that is important for your research?” However, many students had difficulty not only locating information that was relevant to their topic but also determining how to incorporate these ideas into their argument. Although in the second library instruction workshop, librarians gave out a checklist for students to work through to help them think about how the research papers they were reading helped them to answer their own research question, few students made use of the checklist on their own outside of the class (only 12% answered that they used the checklist - Question 7.10). Completing this assignment was the first experience that all participants had in writing an engineering research paper at the university level, with 41% of participants being in their first semester at university and the remaining students being in their second year. It is possible that this lack of experience translated into uncertainty as to how to incorporate ideas from engineering articles into their own papers.

In terms of writing the paper, several Chinese students in particular found it difficult to complete the assignment on time. While 89% of native English speaking students reported having enough time to complete the assignment, only 25% of Chinese students said the same. 38% of Chinese students reported that they needed more time (Question 9.3). Also, Chinese students read fewer lengthy materials such as books than native English speaking students with 13% of Chinese students consulting books compared to 33% of native English speaking students (Question 7.12). Given that Chinese students face additional challenges with not only reading material that is not in their native language but also writing in English, it is not surprising that they would feel that they needed more time to complete the assignment.

ACRL Sci-Tech Standard Four: Acknowledges information sources and uses information ethically

Questions related to Standard Four include primarily those in Section 7 - “Manage” of the online questionnaire. Please see Table 6 below for a detailed comparison of survey responses by user group related to Standard Four.

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>RELEVANT QUESTION NUMBER</th>
<th>NATIVE ENGLISH SPEAKING STUDENTS</th>
<th>CHINESE STUDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizing and keeping track of references was challenging</td>
<td>9.1</td>
<td>22%</td>
<td>50%</td>
</tr>
<tr>
<td>Citing references was challenging</td>
<td>9.1</td>
<td>22%</td>
<td>25%</td>
</tr>
<tr>
<td>Did not know when to cite</td>
<td>7.3</td>
<td>33%</td>
<td>50%</td>
</tr>
</tbody>
</table>
Many students, but especially Chinese students, reported problems with carrying out activities related to Standard Four. 50% of Chinese students and 22% of native English speaking students found it challenging to organize and keep track of their references (Question 9.1). Also, 50% of Chinese students and 33% of native English speaking students responded that they did not know when they should cite (Question 7.3). Many students, especially Chinese students, felt that they could have benefited from more guidance in determining when and how to cite. Chinese students would have liked an average of 2.3 additional services (such as an individual consultation with a librarian or a print or online guide) in comparison to native English speaking students who would have liked an average of 1.3 additional services to help them better understand when and how to cite (Question 7.6).

ACRL Sci-Tech Standard Five: Recognizes importance of preserving information and keeping current in the field

Although performance indicators in Standard Five, namely those related to lifelong learning, are very important information literacy skills, they were not addressed directly in the online questionnaire. The SCONUL Seven Pillars of Information Literacy do not address lifelong learning as explicitly as the ACRL Sci-Tech Standards, and thus, they were not included as an individual section in the online questionnaire, and they were not learning objectives that were emphasized in the two library instruction workshops. However, some of the survey questions relate to these skills. Some of the outcomes for Standard Five include that an information literate student “recognizes emerging forms and methods of scholarly publishing in the field. Recent examples are: the use of blogs, RSS feeds, open access journals, and freely available online research data,” “follows citation and cited references for pertinent articles” and “manages files of citations of articles read or accessed (such as through use of bibliographic management software).” Although the study did not emphasize these skills, nonetheless, many of the student participants showed an awareness and the ability to use some of these technologies. In Sections 3 - “Scope”, 4 - “Plan” and 7 - “Manage” of the survey, students were asked questions about various types of information resources that they used for their paper, techniques they used to find relevant information and tools they used to manage their references. Please see Table 7 below for a detailed comparison of survey responses by user group related to Standard Five.
TABLE 7: SELECTED SURVEY RESPONSES BY USER GROUP RELATED TO STANDARD FIVE

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>RELEVANT QUESTION NUMBER</th>
<th>NATIVE ENGLISH SPEAKING STUDENTS</th>
<th>CHINESE STUDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used web sources like blogs</td>
<td>3.4</td>
<td>56%</td>
<td>25%</td>
</tr>
<tr>
<td>Found related articles through citation analysis</td>
<td>4.1</td>
<td>33%</td>
<td>63%</td>
</tr>
<tr>
<td>Found related articles by using the reference list</td>
<td>4.1</td>
<td>44%</td>
<td>38%</td>
</tr>
<tr>
<td>Used EndNote citation software</td>
<td>7.1</td>
<td>78%</td>
<td>100%</td>
</tr>
<tr>
<td>Using EndNote was challenging</td>
<td>7.2</td>
<td>44%</td>
<td>38%</td>
</tr>
</tbody>
</table>

When asked about use of freely available internet sources including blogs, native English speakers replied that they used these more often than Chinese students with 56% and 25% using these types of sources respectively (Question 3.4). With regard to following citation and cited references, native English speakers and Chinese students used these techniques in approximately equal numbers with 47% of students seeing what articles have cited a key journal article to find related ones and 41% using the reference list at the end of a key article to find other articles (Question 4.1). Many students used the types of sources and techniques involving emerging technologies even though they were not taught explicitly in the library workshops.

As for managing references using bibliographic management software, this was a major emphasis in the first library workshop, and 100% of Chinese students and 78% of native English speaking students used EndNote to manage their references (Question 7.1). Some students did have difficulty in using EndNote with 45% of English speaking students and 38% of Chinese students reporting various problems (Question 7.2).

In general, students had the greatest difficulty with information literacy skills related to Standards 3 (Summarizes, evaluates and incorporates information) and 4 (Acknowledges information sources and uses information ethically). Many students, both native English speaking and Chinese, had difficulty incorporating ideas from the readings into their papers. Students, especially Chinese students, had difficulty knowing when and how to cite. Chinese students also found it challenging to organize and keep track of their references. Possible suggestions for helping students develop these skills will be provided in the following section.
V. Discussion/Conclusion

This study identifies that finding enough relevant information is one of the top challenges faced by both native English and Chinese students. Given that this challenge was identified among the students who had received instruction on this topic in the library workshop, how challenging would it have been to them if there were no such library instruction? As reported in this paper, very few students had attended Library Orientation sessions perhaps because of their unawareness of these events and because of inflexibility in their schedules. Therefore, promoting in-class IL instruction remains essential in equipping students with needed skills for finding and locating academic sources.

However, in order to build on information literacy competencies that are expected of students by the Canadian Engineering Accreditation Board, simply providing the existing IL training to the class is not enough. The study shows that identifying a research topic and incorporating ideas into papers are two other top challenges faced by lower level undergraduate engineering students. Unfortunately, these two topics are not normally included in instruction offered by McGill Library. However, both of them are written into the two core information literacy guidance documents - the ACRL Sci-Tech Standards and the SCONUL Pillars - as competencies expected of students. This may call on collaboration among different units on campus to address them together. It is necessary to look into the curriculum of undergraduate engineering students and make sure these needs are met.

Other than the challenges above shared with their native English speaking peers, this study identified that Chinese students in particular need more instruction on evaluating information and determining when and how to cite, beyond the basics of using citation management software. Although factors contributing to these two challenges will be investigated in the further qualitative interview data and reported in a future publication, it is time for librarians to consider providing library workshops covering these topics and targeted to Chinese and other international students. This is of significance especially in the current information world where a great deal of information is generated by many different creators and for many different purposes. Future CCOM 206 library workshops will include not only the mechanics of using EndNote but more general information on citing since this improvement will benefit both native and non-native English speaking students alike.

As for other challenges that were specifically identified among Chinese students in this study, such as finding synonyms, gathering information from readings, using a range of search tools and materials including books, and requiring more time to write up their assignments, Chinese students’ linguistic disadvantage is most likely a contributing factor. However, this could be mitigated by well-organized services and support provided by multiple units on campus, such as specialized instruction offered by librarians to non-native English speaking students on how to find synonyms, instruction and tools on reading efficiently, as well as helpful proofreading organized by the Writing Center or the Library.

More flexible instruction practices from librarians to non-native English speaking students would help them gain IL competencies in order to achieve academic success. For example, the library could offer and encourage attendance at repeat library instruction sessions.
and dedicated librarians with the linguistic and cultural background could provide targeted instruction and services to these students (as recommended by Shao and Scherlen). The next step of this study is to interpret the data collected in the second interview. Investigators will examine contributing factors to many challenges faced by native English speaking and Chinese students, such as difficulty evaluating information, less use of information sources and types, tendency to quit when an article is not available, etc. Some confusion in individual students’ survey responses will be clarified and reported. Further recommendations on implementing information literacy training to non-native English speaking students, such as Chinese students, will also be provided. It is hoped that the current and future findings will help to improve information literacy skills instruction and support services both to this specific user group and to undergraduate engineering students in general.

References


## APPENDIX A: DESCRIPTION OF SECTIONS IN ONLINE QUESTIONNAIRE

<table>
<thead>
<tr>
<th>Section 1 Personal identification</th>
<th>In this section, you will be asked questions about identifying your research topic.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 2 Identify</td>
<td>In this section, you will be asked questions about identifying your research topic.</td>
</tr>
<tr>
<td>Section 3 Scope</td>
<td>In this section, you will be asked questions about search tools, article databases, types of information resources, support services, etc.</td>
</tr>
<tr>
<td>Section 4 Plan</td>
<td>In this section, you will be asked questions about planning your search strategy.</td>
</tr>
<tr>
<td>Section 5 Gather</td>
<td>In this section, you will be asked questions about locating information for your research paper.</td>
</tr>
<tr>
<td>Section 6 Evaluate</td>
<td>In this section, you will be asked questions about evaluating the information you found.</td>
</tr>
<tr>
<td>Section 7 Manage</td>
<td>In this section, you will be asked questions about managing references and organizing information.</td>
</tr>
<tr>
<td>Section 8 Present</td>
<td>In this section, you will be asked questions about creating an outline of your paper.</td>
</tr>
<tr>
<td>Section 9 General</td>
<td>In this section, you will be asked questions on the entire research process.</td>
</tr>
</tbody>
</table>
APPENDIX B: COMPLETE ONLINE QUESTIONNAIRE
Data entry: CCOM-206 Students Information Research Skills Survey

Data entry

Completed: Yes

Response ID: 30

Date submitted: 

Start language: en

Token: 

1.1 Please provide your name.

1.2 Please provide your email.

2.1 Why did you select the topic you chose for your research paper?

- a. The topic seemed manageable within the given timeline
- b. I have already done some course work on this topic
- c. I knew I could find research material on this topic
- d. I know someone who has expertise in this field
- e. I received suggestions for potential topics from the instructor or friends
- g. The topic was interesting to me
- h. I was curious to explore an unknown topic

2.2 Did you change your research topic at any point?

- a. Yes
- b. No
- c. Don’t remember

2.3 If you changed your topic, why?

- a. I couldn’t find enough research material on my original topic
- b. My instructor suggested I change the topic
- c. My original topic was too general
- d. My original topic was too specific
- e. My original topic was too complicated

3.1 Which of the following search tools did you use for your research?

- a. Library catalogue
- b. Article databases
- c. Google Scholar
- d. Google
- e. Library subject/course guides (e.g. CCOM 206 library course guide)

3.2 Please list any of the above search
3.3 If you used an article database for your research, which one(s) did you use?
- a. Compendex
- b. Scopus
- c. IEEE Xplore
- d. INSPEC
- e. Google Scholar
- f. Web of Science

3.4 What types of information resources did you use for your paper?
- a. Books/E-books
- b. Journal articles
- c. Conference papers
- d. Newspaper or magazine articles
- e. Freely available sources on the internet such as blogs, government websites, Wikipedia, etc.

3.5 Were you aware that support was available for the following tasks?
- a. Choosing a topic
- b. Formulating a search strategy
- c. Evaluating information sources
- d. Knowing how to cite
- e. I was not aware that support was available for any of these tasks

3.6 Were you aware that support was available from the following people or services?
- a. Course instructors
- b. Librarians
- c. McGill Writing Center
- d. McGill Tutorial Service
- e. I was not aware that support was available from any of these people or services

3.7 Which of the following support people or services did you use?
- a. Course instructors
- b. Librarians
- c. McGill Writing Center
- d. McGill Tutorial Service

4.1 Which of the following methods did you use to form your search strategy?
- a. Extracting the main concepts from my research question
- b. Finding synonyms for my search terms in order to increase the number of search results
- c. Combining my search terms using AND/OR
- d. Using an asterisk (*) to find words with various endings
- e. Using quotations (" ") around words to search them as a phrase
- f. Using terms provided by an article database (e.g. controlled terms) to limit my search results
- g. Seeing what articles have cited a key journal article in order to
find related ones
☐ h. Using the references listed in a key journal article to find other related ones

4.2 If you did use synonyms, was it difficult for you to find them?
☐ a. Yes
☐ b. No
☐ c. Somewhat difficult
☐ d. Don’t remember

4.3 If you did not use synonyms, why not?
☐ a. I had enough search results without using them
☐ b. I could not think of any
☐ c. I did not know how to find them
☐ d. I did not realize that I needed search for any
☐ e. I did not think this would be helpful

4.4 If you found synonyms for your search terms, how did you find them?
☐ a. Brainstorming
☐ b. Using a dictionary or thesaurus
☐ c. I googled my search terms
☐ d. I found them among the results of a search in an article database

4.5 If you revised your search strategy based on the results you found (e.g. if you didn’t get the results you expected), why?
☐ a. I did not retrieve enough results in my initial search
☐ b. My initial search strategy generated too many results
☐ c. My initial search strategy generated irrelevant results
☐ d. I discovered new keywords that I had not thought of initially
☐ e. My instructor or a librarian suggested that I make changes to my search strategy
☐ f. I did not revise my search strategy

5.1 Were you able to identify each element in a reference (e.g. journal article title, author, etc.)?
☐ a. Yes
☐ b. No
☐ c. Don’t remember

5.2 Was it difficult to locate the full text of articles found in database searches?
☐ a. Yes
☐ b. No
☐ c. Somewhat difficult
☐ d. Don’t remember

5.3 If you found it difficult to locate the full text of articles, please explain.

5.4 Was it difficult
☐ a. Yes
to locate and use print books or e-books?

b. No

c. Somewhat difficult
d. Don’t remember

5.5 If you found it difficult to locate and use print books or e-books, please explain.

5.6 What did you do if a book or the full text of a journal article was not available at McGill University?

a. I gave up trying to locate it and selected another book or article which I could find

b. I ordered the item through Interlibrary Loan

c. I found a free version online

d. I found the book or article from a colleague or the instructor

e. I asked a library staff member for assistance

f. I didn’t encounter this problem

6.1 Was it difficult for you to determine the relevance of information sources that you found?

a. Yes

b. No
c. Somewhat difficult
d. Don’t remember

6.2 If you found it difficult to determine the relevance of information sources, what did you find difficult?

a. I could not understand the terminology or the language was too difficult

b. I could not determine if the information source was relevant because there was no abstract

c. The information given in the abstract was not enough to determine if the article was relevant

6.3 How did you select which journal articles to use for your paper?

a. I judged the articles based on how relevant they were to my topic

b. I looked for articles that were peer-reviewed or scholarly (e.g. no advertisement included at all, they used academic language and technical terms, they included a list of references, etc.)

c. I determined that the authors were authoritative researchers on my topic

d. I critiqued the methods and/or discussion sections of an article and agreed with the logic

e. I selected only recently published articles

f. I looked at the journal that the articles were published in to see if it seemed to be a credible source

g. I used the Checklist given out by a librarian in the second workshop

6.4 Did you recognize any bias or conflict of truth?

a. Yes

b. No
c. Don’t remember
interest in the articles that you found?

6.5 If you recognized any bias or conflict of interest, how did you recognize this?

7.1 How did you manage your references for your paper?

7.2 If you used EndNote and had difficulties, please explain.

7.3 Which of the following difficulties did you encounter in citing references for your paper?

7.4 If you encountered difficulties in citing your references, please elaborate.

7.5 How did you select what citation style to use?

7.6 What assistance would have been beneficial to improve your knowledge about when and how to cite?

7.7 Approximately how many journal articles did you read (either in part or in full)?

7.8 Approximately how much time did you spend reading
<table>
<thead>
<tr>
<th>Question</th>
<th>Response Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.9 How many journal articles did you cite in your paper?</td>
<td>☐ a. I used the Checklist given out by a librarian in the second workshop</td>
</tr>
<tr>
<td></td>
<td>☐ b. I took notes or highlighted the article while reading</td>
</tr>
<tr>
<td></td>
<td>☐ c. I skimmed through the article for useful information without reading it comprehensively</td>
</tr>
<tr>
<td>7.10 How did you gather information from journal articles?</td>
<td>☐ a. I used the Checklist given out by a librarian in the second workshop</td>
</tr>
<tr>
<td></td>
<td>☐ b. I took notes or highlighted the article while reading</td>
</tr>
<tr>
<td></td>
<td>☐ c. I skimmed through the article for useful information without reading it comprehensively</td>
</tr>
<tr>
<td>7.11 Did you read books or e-books for completing the paper?</td>
<td>☐ a. Yes</td>
</tr>
<tr>
<td></td>
<td>☐ b. No</td>
</tr>
<tr>
<td></td>
<td>☐ c. Don’t remember</td>
</tr>
<tr>
<td>7.12 Approximately how many books/e-books did you read or consult?</td>
<td>☐ a. I used the Checklist given out by a librarian in the second workshop</td>
</tr>
<tr>
<td></td>
<td>☐ b. I made a mind map (or a visual display of the main ideas)</td>
</tr>
<tr>
<td></td>
<td>☐ c. I figured out the main headings of my research paper and filled in the headings with relevant information</td>
</tr>
<tr>
<td></td>
<td>☐ d. I didn’t make an outline</td>
</tr>
<tr>
<td>7.13 Approximately how much time did you spend reading each book/e-book?</td>
<td>☐ a. I used the Checklist given out by a librarian in the second workshop</td>
</tr>
<tr>
<td></td>
<td>☐ b. I made a mind map (or a visual display of the main ideas)</td>
</tr>
<tr>
<td></td>
<td>☐ c. I figured out the main headings of my research paper and filled in the headings with relevant information</td>
</tr>
<tr>
<td></td>
<td>☐ d. I didn’t make an outline</td>
</tr>
<tr>
<td>7.14 How many books/e-books did you cite in your paper?</td>
<td>☐ a. I used the Checklist given out by a librarian in the second workshop</td>
</tr>
<tr>
<td></td>
<td>☐ b. I made a mind map (or a visual display of the main ideas)</td>
</tr>
<tr>
<td></td>
<td>☐ c. I figured out the main headings of my research paper and filled in the headings with relevant information</td>
</tr>
<tr>
<td></td>
<td>☐ d. I didn’t make an outline</td>
</tr>
<tr>
<td>8.1 Which of the following methods did you use to draft the outline of your paper?</td>
<td>☐ a. I brainstormed by writing out the main ideas</td>
</tr>
<tr>
<td></td>
<td>☐ b. I made a mind map (or a visual display of the main ideas)</td>
</tr>
<tr>
<td></td>
<td>☐ c. I figured out the main headings of my research paper and filled in the headings with relevant information</td>
</tr>
<tr>
<td></td>
<td>☐ d. I didn’t make an outline</td>
</tr>
</tbody>
</table>
| 8.2 If you created
an outline, please explain if and how it was helpful.

8.3 If you created an outline, when did you do so?
☐ a. Before I started searching for articles and books
☐ b. After I finished gathering articles and books
☐ c. After I finished reading articles and books

9.1 Which of the following did you find challenging in researching and writing your paper?
☐ a. Identifying my research topic
☐ b. Selecting search tools such as an article database or the library catalogue
☐ c. Determining what methods to use to form my search strategy (e.g. keyword searching, finding synonyms for my search terms, using quotations around words to search them as a phrase, etc.)
☐ d. Finding enough relevant information sources on my topic
☐ e. Locating the full text of books/ebooks, journal articles, conference papers, etc.
☐ f. Evaluating sources (e.g. books, journal articles, etc.) before including them in my paper
☐ g. Organizing and keeping track of my references
☐ h. Citing my references and creating a bibliography in my paper
☐ i. Incorporating ideas from my readings into my paper
☐ j. None of the above

9.2 For the above selected challenges, please explain.

9.3 Was the time you allotted for each step sufficient to complete the paper on time?
☐ a. Needed more time
☐ b. Had enough time
☐ c. I didn’t plan ahead

9.4 Which of the following did you find helpful in completing the paper?
☐ a. Clear and easy-to-follow instructions on the research process from the instructor
☐ b. Peer support
☐ c. Enough information resources provided by the library, such as article databases, and availability of full text
☐ d. Having relevant library workshops included in the class
☐ e. Having the chance to consult a librarian for finding information and citing references