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Information literacy instruction for international graduate engineering students: A case study at University of Windsor

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Abstract

In recent years, the University of Windsor has seen a significant increase in international student enrolments, especially in the graduate engineering programs. Previous studies indicate that international students often have difficulties in developing information literacy skills. Furthermore, many engineering students lack library research skills essential for succeeding in academic study. However, there is a scarcity of studies focusing on information literacy instruction for international engineering students and existing research in this area seldom utilizes statistical analysis methods to determine the effectiveness of the instruction. This paper aims to fill in the literature gap by examining the impact of an information literacy session geared towards international graduate engineering students at the University of Windsor. Statistical analysis of the paired pre-post survey tests reveals that the session has significantly improved the students' understanding of certain aspects of information literacy, including searching and locating information, but not the areas of identifying and evaluating information. Further instructions and additional support integrated into graduate seminars or other classes as well as offered outside of classrooms will be beneficial to these students, particularly in the areas of identifying information, evaluating information, finding scholarly sources, and other more advanced information literacy topics.

Keywords: Information Literacy, International Students, Engineering Students, Graduate Students, Academic Libraries, Canada

Introduction

International Engineering Students in Canada

The international student population has been rapidly growing in Canada for the past decade, with prominence towards higher education enrolments. Post-secondary institutions saw the number of international students enrolled in formal programs more than triple from 2008/2009 to 2018/2019 (Statistics Canada, 2020b). China and India are the top two source countries which account for over half of the international student population (Statistics Canada, 2020c). International students not only contribute to the multiculturalism and diversity of Canadian higher education, but also have a significant financial impact on colleges and universities in Canada. In the academic year of 2018/2019, international students contributed about forty percent of all tuition fees to Canadian institutions (Statistics Canada, 2020a). Most universities in Canada have identified internationalization among their top strategic planning priorities. Internationalization "has become a pervasive force shaping higher education" in Canada and around the world in the recent decades (Association of Universities and Colleges of Canada, 2014, p. 5).

Architecture, engineering, and related technologies are the most popular fields of study for international students in Canada. More than fifty-five thousand international students were enrolled in these fields in 2018/2019, representing a nearly 250 percent increase compared to 2008/2009 (Statistics Canada, 2020b). According to Engineers Canada (2020), the general student enrolment in engineering programs in Canada has been steadily growing for the past five years. The total number of students enrolled in Canadian universities has reached 117,512 in 2019, which is over 112 percent of the number in 2015. Graduate student enrolments rose even more quickly with a 31.4 percent increase compared to 2015. International students contribute considerably to this trend. From 2015 to 2019, the total number of international engineering students increased by 38.5 percent to 34,045. Over the same period, international students enrolled in graduate engineering programs in Canadian universities soared by over fifty percent. In 2019, more than sixty percent of graduate engineering students were international in Canada.

International Engineering Students at University of Windsor

University of Windsor is a comprehensive university located in Windsor, Ontario, Canada. Currently twenty-three percent of its student body are international students from about 100 countries (University of Windsor, n. d.). The University is "often referred to as 'Canada's Automotive University' and the Faculty of Engineering [at the University] is a key contributor to [the] prominence" (Saif, n. d., 2nd para.).

The number of students attending the University with a student visa went up 158 percent, from 1,387 in 2011 to 3,582 in 2020; whereas the number of Canadian students slightly dropped over the same period. More and more international students are enrolling in graduate programs. In 2020, the University welcomed 2,881 international graduate students, with over sixty percent were enrolled in engineering programs. Student enrolments in the Faculty of Engineering at the University have more than doubled in the past decade. The growth mainly comes from international student population which reached near 2,000 in the year of 2020, almost four times of the number of ten years ago. Most of them have registered in graduate engineering programs. In fact, over ninety percent of graduate engineering students were international in 2020 (University of Windsor, 2019).

The quick expansion of international student population "has led the University to address several key issues of interest to international students", including academic integrity and writing support (Liu et al., 2020, p. 242). The Engineering Technical Communications course has been made mandatory to students enrolled in the Master of Engineering programs to prepare them "to communicate technical information clearly and concisely" (University of Windsor, 2021, p. 161).

Information literacy refers to "the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is produced and valued, and the use of information in creating new knowledge and participating ethically in communities of learning" (Association of College & Research Libraries [ACRL], 2015, para. 5). Although information literacy is not explicitly stated in the Canadian Engineering Accreditation Board (CEAB) graduate criteria, it is considered an essential element of the CEAB graduate attributes, particularly towards lifelong learning (Engineers Canada, 2019; Saleh, 2013). Many international

students have difficulties in developing information literacy skills compared to domestic students (Ishimura, Howard, & Moukdad, 2008; Zhao & Mawhinney, 2015). Librarians and faculty in some institutions in Canada and Australia have collaborated to integrate library training sessions into curriculum to help engineering students acquire information literacy skills (Palmer & Tucker, 2004; Wilkes, Godwin & Gurney, 2015; Zhang, Goodman & Xie, 2015). At the University of Windsor, there have been some efforts to develop information literacy workshops for international students, but very few instructions are specific to engineering students. In 2018, the Engineering Librarian at Leddy Library initiated the project "Embedded Information Literacy for Engineering Students" in collaboration with the Technical Communications Development and Support Coordinator at Faculty of Engineering. The project aims to enhance the information literacy skills of undergraduate and graduate students, particularly international engineering students enrolled in the University of Windsor. This paper reports some findings of the project.

Related Literature Review

Information Needs of Engineering Students

Engineering students heavily rely on online resources over other types of resources (Petr Balog, Badurina & Lisek, 2018), but they lack formal library training regarding searching and evaluating resources online (Wijetunge & Peiris, 2017). They tend to search for information sources on the Internet through search engines, Wikipedia, or taking advice from classmates rather than using relevant library databases (Vrkic & Pavlovski, 2014; Wijetunge & Peiris, 2017). Engineering students have difficulty in selecting appropriate sources of information (Wijetunge & Peiris, 2017). They often "overlook [the] library as a relevant information source but have [a] positive attitude toward librarians (knowledge, skill, courtesy)" (Balog et al., 2018, p. 13). Library instructions on the use of library and Internet resources as well as more engagement with library will be beneficial for engineering students to resolve specific research questions they have and to succeed in their academic studies (Vrkic & Pavlovski, 2014; Wijetunge & Peiris, 2017). Graduate engineering students also lack some essential library research skills for them to succeed in graduate studies. Library instructions on certain areas, including literature searches, citation management, data management, and finding funds for research will benefit these students (Lalwani, Niehof & Grochowski, 2018).

Information Literacy Instruction to Engineering Students

Previous research on information literacy instruction to engineering students focused on those enrolled in undergraduate programs, in particular the first-year engineering students (Bakermans & Plotke, 2018; Palmer & Tucker, 2004; Wilkes et al., 2015; Zhang et al., 2015). Palmer and Tucker (2004) developed a series of activities integrated into a first-year engineering and technology study unit for students to learn and practice information literacy skills. The assessment results showed that most students understood basic types of reference sources, such as books, journals, and web pages but not complex reference sources, such as book chapters, conference papers and other forms of monographs. Wilkes et al. (2015) described a collaboration of a librarian with a lecturer and a learning advisor in designing an assessment task for first-year engineering

students to develop information literacy and academic writing skills. They argued that the collaboration of librarian, faculty and learning advisor brought both opportunities and challenges. Zhang et al. (2015) embedded an online library instruction module with optional in-person tutorials in a first-year course for students to study independently. Pre- and post- tests along with survey questionnaire and focus groups were adopted to measure the success of this model. The authors claimed that the online module with optional in-person tutorials helped improve first-year engineering students' information literacy skills. Bakermans and Plotke (2018) assessed the first year Science, Technology, Engineering and Mathematics (STEM) students' perceptions of their information literacy competency. The results showed significant increase in students' perception of their familiarity with library resources, search strategies, citation use, and ability to evaluate source quality after they took the information literacy instruction. However, there was no change in their perception of their ability to evaluate the variety of source and source relevance and there was a decrease in their perception of the ethical use of information.

Many studies involved integrating information literacy into a course, for example, a writing or composition concentrated course (Palmer & Tucker, 2004; Stephens et al., 2018; Talikka, Soukka & Eskelinen, 2018; Wilkes et al., 2015; Zhang et al., 2015). Through examination on the effects of integrating information literacy sessions in a seminar course on the undergraduate engineering students' interdisciplinary research, Talikka et al. (2018) concluded that the information literacy sessions improved students' understanding of research problems and the formulation of information search questions. Stephens et al. (2018) conducted a case study on embedding information literacy instruction in an intense writing course to undergraduate engineering students. Librarians were embedded in student project teams of professional papers for the course to provide them customized information literacy as needed. The authors found that the usage of the class guide and the top engineering databases listed on the guide has risen, and the number of inter-library loan requests have also increased to some extent after students took the course. They argued that scalability of this model could be challenging because it demanded a lot of librarians and other library resources to carry on.

The effects of different information literacy delivery models, such as small group hands-on training, large class instruction, in-person instruction, and online tutorials have also been investigated in literature (Blicblau, Bruwer & Dini, 2016; Zhang et al., 2015). According to Blicblau et al. (2016), capstone engineering students "preferred small group hands-on training in comparison to large class training to improve their bibliographic referencing and citation research skills" using citation management software (p. 13). The hybrid model of online module with in-person tutorial option was effective to improve first-year engineering students' information literacy skills (Zhang et al., 2015).

To identify the most effective methods of teaching information literacy, Phillips et al. (2018) conducted a systematic literature review on the effectiveness of information literacy instruction to engineering undergraduate students. However, they found no clear answer to this question. Among the thirteen papers they selected, eleven studies reported effective results, but the remainders reported ineffective (no difference) or mixed results on information literacy instruction. Traditional, face-to-face instruction was still the most adopted delivery method in literature. First

year introductory course or engineering design class were the most frequent course types described in these studies, followed by senior engineering design and other engineering courses. Faculty-librarian collaboration contributed a lot to the effectiveness of information literacy instruction because most studies involved librarians' collaboration or consultation with faculty on the content of the instruction. Pre- and post- tests along with assignment examination were the most common assessment methods reported in the literature. (Phillips et al., 2018)

Not many studies focused on information literacy instruction to graduate engineering students in literature, although there is a need for information literacy instruction geared towards these students (Lalwani et al., 2018). Through a study on the impacts of an information literacy instruction program embedded in an introductory research method course, Koler-Povh and Turk (2020) concluded that the instruction had "a measurable positive impact" (p. 34) on the scientific work of the students. Students "felt they were able to use appropriate skills for finding information and [have] acquired knowledge for collecting, evaluating and using existing information in creating new knowledge and how to disseminate it" after they took the course (p. 34). The authors claimed that the instruction helped improve students' information literacy competence.

Research on International Engineering Students

International students often face the challenges of language barrier, cultural difference, and unfamiliarity with foreign library functions, resources, and services (Badke, 2002; Datig, 2014; Hughes, 2010; Liu & Winn, 2009). Many of them experience difficulties in developing information literacy skills, such as information retrieval, evaluation, and use (Chen & Van Ullen, 2011; Han, 2012; Ishimura, Howard, & Moukdad, 2008).

Some studies have been conducted on international engineering students but few of them focused on information literacy instruction to these students on campus. Chen and Brown (2012) claimed that Chinese engineering graduate students tended to overlook many valuable services, such as research consultation and document delivery services, although they were confident about their English language abilities and aware of American libraries' resources and services. Most of them relied on the Internet heavily to find information and strongly preferred acquiring library resources virtually. International STEM graduate students valued the role of academic libraries more than other students. However, they were "less dependent on the library as a place for storing resources or accessing information" than other students. They viewed "Google Scholar as an entity itself rather than a gateway to library resources" (Yu, Trei & Carlstone, 2018, p. 159). Through a comparison study on Canadian engineering students and international engineering students, Zhao and Mawhinney (2015) concluded that both groups had challenges with certain elements of information searching and writing; however, international engineering students faced unique challenges in searching, evaluating, reading, writing, and citing information.

At University of Windsor, a few research projects have been conducted on information literacy and international students on campus, but none of them focused on students enrolled in engineering programs. Liu and Winn (2009) explored the information seeking behavior of Chinese graduate students and found that these students did not take full advantage of library services and resources and were "often unaware of legal and ethical issues surrounding the access and use of

information" due to language limitations and cultural differences (p. 571). Liu et al. (2020) developed and delivered a series of plagiarism and information literacy workshops to international students at different education levels, including students enrolled in English language improvement programs and graduate programs, such as the Master of Management, Master of Education, and the Joint Ph.D. Educational Studies Program. Based on descriptive analysis on pre- and post- test results, the authors argued that the workshops enhanced the students' understanding on plagiarism and how to avoid it, but additional or specialized instruction on information evaluation and library resources and services as well as writing support will be helpful to these students in the future. It is indicated that "language limitation is still a barrier for international students to be more aware of plagiarism and become more information literate" (p. 257).

Methodology

Information Literacy Instruction Development and Delivery

The university enrollment data show that nearly ninety percent of international graduate engineering students were enrolled in the non-thesis master programs at the University during 2018-2020 (University of Windsor, 2019). The Engineering Technical Communications course, which is mandatory for course-based Master of Engineering students, is appropriate for the purposes of providing information literacy instruction to international graduate engineering students and collecting data for this study. The Engineering Librarian has developed an instruction session to the class based on her previous experiences and research on engineering and international students in consultation with the Technical Communications Development and Support Coordinator at the Faculty of Engineering. From this session, students are expected to improve the abilities of "reflective discovery of information" and "the understanding of how information is produced and valued" as defined by ACRL (2015, para. 5). More specifically, the learning outcomes are to improve students' knowledge and skills in the following aspects of information literacy:

1. Identifying information: understanding the basics of the Internet and the differences between scholarly and popular information
2. Searching information: comprehending the concept and coverage of databases, knowing how to search in a database and how to develop a search strategy in the engineering context
3. Locating information: understanding the purpose and structure of a citation, perceiving the library resources and services relevant to engineering
4. Evaluating information: knowing the criteria for evaluating information sources and how to evaluate a source critically.

The session is eighty minutes in length including an information literacy lecture, a pre-test in the beginning and a post-test at the end. The lecture provides an overview of basic information literacy topics aligned with the expected learning outcomes in the context of engineering study and research for students, especially those students from outside of North America who may not have had opportunities in their previous studies to be familiar with the areas. More advanced topics,

such as research data management, research impact, and publishing which is more interesting to other types of graduate students, including doctorate and thesis-based master students, have been excluded in this session. Due to the large number of the students enrolled in each section of the course, the class is mainly a lecture with an in-class exercise of search strategy for all students to practice together.

To measure the effectiveness of the lecture, survey tests have been developed and distributed to students in the form of pre- and post- tests. The questions and predefined answers in the survey test are included in the Appendix. The same test is put in an envelope labeled pre-test and post-test respectively. At the beginning of the class, students are informed about their rights to participate, not participate, or withdraw from the survey tests at any time before submitting their test sheets to the Librarian. Students are asked not to put their names on the test sheets, instead, only answer the questions on the pre-test sheets before the lecture and then on the post-test sheets after the lecture. In the end of the class, students are asked to put both pre-test and post-test sheets back to the envelope and hand both over to the Librarian or leave them on the desks for the Librarian to collect before leaving the classroom.

Data Collection and Measures

The Librarian taught the session to students enrolled in all four sections of the Winter 2018 class of Engineering Technical Communications for graduate students. There were 366 students in total registered in the course among which 359 were students with a visa (E. Mammarella, personal communication, May 28, 2021). There might be a few Canadian students (no more than seven) who have participated in the survey tests and included in the results, however the impact on the findings of this study is slight due to the small percentage of these students.

Survey test sheets from all four sections have been collected in pairs of pre-post tests and scored using the same multiple-choice grading rules. The questions are grouped by the topics in alignment with expected learning outcomes (see Table 1).

Table 1. Test Questions and Topics in Alignment with Learning Outcomes

Learning Outcomes	Topics	Questions
Learning outcome 1	Identifying information	1. What are often considered scholarly information sources?
		2. What are the pros of general websites?
		3. What are the cons of general websites?
Learning outcome 2	Searching information	4. What statements are correct about a search strategy?
		5. What statements are correct about a database?
		6. Where are you likely to find scholarly information?
Learning outcome 3	Locating information	7. A citation for a journal article often includes:
		9. What statements about services at our Library are correct?
Learning outcome 4	Evaluating information	8. How can you tell if you have a “good” source?

Average percentage scores are used for all topics. Table 2 shows the scores for the four topics on the pre- and post- tests and the overall scores for both tests. 301 valid pre-test sheets and 303 post-test sheets have been received in total. However, only 295 complete sets of pre- and post-tests are analyzed in this study. The participation rate of complete tests is 80.6 percent among all students registered in the course.

Table 2. Descriptive Statistics of Test Scores

Topics	Test	N	Minimum	Maximum	Mean	Std Deviation
Identifying information	Post	303	11	100	56.62	22.855
	Pre	301	0	100	54.27	22.629
Searching information	Post	303	0	100	44.71	20.615
	Pre	301	8	100	38.31	20.002
Locating information	Post	303	0	100	51.48	33.513
	Pre	301	0	100	44.86	32.978
Evaluating information	Post	303	25	100	52.56	22.829
	Pre	301	0	100	52.16	21.687
Overall	Post	303	17	94	51.04	16.091
	Pre	301	12	88	46.61	15.251
	Valid N (listwise)	295				

Results

Paired sample t-tests have been run in SPSS software to determine whether there are statistically significant differences in scores the students received on each topic and overall scores between the pre- and post- tests. Table 3 indicates that:

- All topics and Overall have greater scores in post-tests than pre-tests.
- Students received the highest scores in both post-tests and pre-tests for the topic Identifying information among all topics.
- Searching information seems to be the most difficult topic for students. Students received the lowest scores for this topic in both tests.
- None of the average scores for any topic surpasses 60 in both pre- and post- tests.

Table 3. Paired Samples Statistics

Topics	Test	Mean	N	Std. Deviation	Std. Error Mean
Identifying information	Post	56.25	295	22.805	1.328
	Pre	54.01	295	22.663	1.320
Searching information	Post	44.47	295	20.770	1.209
	Pre	38.18	295	19.853	1.156
Locating information	Post	51.80	295	33.544	1.953

	Pre	44.75	295	32.789	1.909
Evaluating information	Post	52.63	295	23.042	1.342
	Pre	51.95	295	21.783	1.268
Overall	Post	50.92	295	16.159	0.941
	Pre	46.43	295	15.047	0.876

Table 4 presents the paired samples t-test results. Table 3 and Table 4 reveal that on average:

- Students received higher scores in post-tests than pre-tests for all topics along with the overall scores. The *p*-values (Sig. (2-tailed)) are <0.05 for the topics of Identifying information and Searching information as well as the Overall scores, which means the students demonstrated significant improvements in these areas and in their overall information literacy competency.
- The scores of the topics of Locating information and Evaluating information are improved after the instruction. However, the *p*-values for these topics are >0.05, so the students' improvements in these areas are not statistically significant.

Table 4. Paired Samples T-Test Results

Topics	Paired Differences (Post-test Scores - Pre-test Scores)					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Identifying information	2.234	25.371	1.477	-.673	5.141	1.512	294	.132
Searching information	6.292	21.678	1.262	3.808	8.775	4.985	294	.000
Locating information	7.051	31.483	1.833	3.443	10.658	3.847	294	.000
Evaluating information	.678	24.213	1.410	-2.096	3.452	.481	294	.631
Overall	4.488	15.750	.917	2.683	6.293	4.894	294	.000

Searching information appears the most difficult topic to students in Table 3. This topic aligns with the following three questions (see Table 1): 4. Search strategy, 5. Database, and 6. Where to find scholarly information? To find out which specific questions related to information search may be challenging to students, the paired sample t-test analysis has been conducted on the questions 4-6 in the survey tests. Table 5 shows the results for the three questions. It reveals that Question 6. Where to find scholarly information is most challenging to students in both pre- and post- tests for this topic. In fact, students received the lowest scores for question 6 among all nine questions in pre- and post- tests in the survey tests. The average scores for this question is 19.79 in the pre-test and 32.44 in the post-test (see Table 5).

Further examination on the answers checked by students for Question 6 “Where are you likely to find scholarly information?” reveals that 37 students selected Google and 34 selected Wikipedia among all 301 students participated in pre-tests. The number drops to 21 selecting Google and 30 Wikipedia respectively in the post-tests after the lecture. Students demonstrated a much better understanding on the information retrieved by Google, but quite limited improvement with Wikipedia.

Table 5. Paired Samples Statistics for Question 4-6 (Topic: Searching Information)

Questions	Test	Mean	N	Std. Deviation	Std. Error Mean
4. Search strategy	Post	48.64	295	40.802	2.376
	Pre	45.76	295	40.478	2.357
5. Database	Post	52.37	295	22.744	1.324
	Pre	49.41	295	20.969	1.221
6. Where to find scholarly information?	Post	32.44	295	39.687	2.311
	Pre	19.79	295	33.112	1.928

In summary, students showed significant improvements in the areas of identifying and searching information which are aligned with the learning outcomes 2 and 3. Their overall information literacy understanding advanced significantly as well. Other areas as indicated in learning outcome 1 and 4, identifying and evaluating information improved but the improvements are not statistically significant. This study also reveals that finding scholarly information sources is the most difficult question to students in both pre- and post- tests. A sizeable number of students did not understand well that Google and Wikipedia are not good places to find reliable scholarly sources.

Since the post-test was conducted immediately after the lecture, the findings in this study might only reflect students’ short-term memory but not long-term retention that would translate into actual learning outcomes. Moreover, the students might not have had time to think carefully when writing the tests at the end of the class. Other assessment methods shall be explored to measure the effectiveness of the session and the level of information literacy of these students in the future.

The average scores that students received for all topics are relatively low, including tests after the lecture in this study. This may indicate that students had not developed very good information literacy skills in the areas covered in this study. However, students might be confused by some predefined options or English terms used in the tests with which they were unfamiliar. Furthermore, the multiple-choice questions might be challenging for students to complete within a short timeframe. Future study shall help reveal this.

Discussions and Conclusions

This study shows that the information literacy instruction enhanced the international graduate engineering students' information literacy skills significantly in the areas of searching and locating information. Students' overall understanding on all topics covered in this study was improved significantly as well. They demonstrated some improvement in identifying and evaluating information, but the improvement is not statistically significant. The results also indicate that these students did not have very good understanding of basic information literacy and finding scholarly information was most challenging to them. Further instruction and additional help with the information literacy topics covered in this study, particularly in the areas of identifying information, evaluating information, and finding scholarly information sources will be beneficial to these students.

The one-shot instruction embedded in the mandatory engineering technical communications course helped the Engineering Librarian reach out most students to address the needs for the large cohort of international students enrolled in the graduate engineering programs to develop basic information literacy skills essential for their academic and professional studies. It provided an overview of certain information literacy topics as well as an introduction to engineering related library resources and services for students, especially those students from outside of North America who might not have had opportunities in their previous studies to be familiar with these areas. However, the large amount of content covered in one session may cause cognitive overload for students. Furthermore, due to the large number of students in the class and the limited time allocated to the library instruction in the course, the one-shot lecture-style session was adopted. Such teaching method could affect the student learning outcomes. In the future, other teaching methods or delivery models discussed in related literature, such as small group hands on training (Blicblau et al., 2016), online modules plus in-person tutorial options (Zhang et al., 2015), and embedding librarians in student project teams (Stephens et al., 2018) shall be explored to have more interactivity to improve students' learning.

These methods can be applied in library instructions of specific topics integrated in graduate engineering seminars in a particular field, such as civil and environmental engineering which have smaller classes and more specific subject areas compared to the technical communications class. Capstone classes are another place to experiment with more interactive methods other than traditional lectures. Workshops focusing on a particular information literacy topic interested to some groups of engineering students, like boot camps described by Fong (2019) can be offered to students outside of classrooms in collaboration with the Graduate Student Society and the International Student Centre. In fact, an online module based on the session has been developed and made available on Blackboard, the course management system at the University, for students to study on their own as an attempt to further facilitate students developing information literacy skills. As indicated by ACRL (2015), "one-shot sessions that address a particular need at a particular time, systematically integrated into the curriculum, can play a significant role in an information literacy program (p.25)". These various approaches, along with the one-shot sessions embedded in the engineering technical communications course, will help establish a systematic approach enabling students to develop proficient information literacy skills essential to their success in academic studies and as engineers in the future.

This study has various limitations as well. Because most graduate engineering students were international students enrolled in non-thesis programs at the University, the session covered basic information literacy concepts in the context of engineering study and research rather than

advanced topics, such as research data management, research impact and publication. The findings indicate that the students need to improve their basic information literacy skills and the instruction delivered to the Engineering Technical Communications class is helpful to this end. Other methods or venues, such as instructions to graduate seminars, workshops outside of classrooms, and online modules shall be explored in the future to teach advanced topics.

In this study, the pre-post test method was used to collect data to assess the effectiveness of the information literacy instruction. However, the post-tests conducted immediately after the lecture might reflect just their short-term memory rather than what students comprehended and retained. Moreover, the students were rushing to other classes or commitments at the end of the sessions and might not have had time to think carefully when answering the questions. These might affect the accuracy of the test results and the findings in this study. Other assessment methods, such as examining the bibliographies or reports in students' assignments (Phillips et al., 2018), shall be adopted to further determine the effectiveness of the information literacy instruction in the future.

In addition, there might be a very small number of domestic student participants in this study which may slightly affect the results. The study did not collect participants' demographic information, rather, all students were treated as a homogeneous group regardless of their different language and cultural backgrounds as well as previous library or study experiences. Future studies applying both qualitative and quantitative research methods shall help address the limitations to further identify the international graduate engineering students' information needs and determine more effective ways to enhance their information literacy skills for their success in graduate studies and future careers.

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Appendix: The survey test questions

1. What are often considered scholarly information sources? (Check all answers that apply)
   a) Scholarly books
   b) TV shows
   c) Conference papers
   d) Research reports
   e) Popular magazines or newspapers
2. What are the pros of General Websites? (Check all answers that apply)
   a) Often up-to-the-minute information
   b) Almost infinite topic coverage
   c) Accurate and trusted information
3. What are the cons of General Websites? (Check all answers that apply)

a) Not always high quality
b) Authority and accuracy should be monitored
c) Information needs to be carefully scrutinized

4. What statements are correct about a search strategy? (Check all answers that apply)
   a) A search strategy is a structured organization of keywords used to search databases or search engines
   b) A specific search strategy can be applied in any databases
   c) A specific search strategy can be applied in any aspect of your research
   d) A good search strategy should include a research question, keywords and databases
5. What statements are correct about a database? (Check all answers that apply)
   a) A database is an electronic collection of records containing data
   b) Data in a database can be of all kinds: bibliographic, statistical, geographic, etc.
   c) A database usually contains articles
   d) A database is often subject specific
6. Where are you likely to find scholarly information? (Check all answers that apply)
   a) Google (www.google.com)
   b) Google Scholar (scholar.google.com)
   c) Wikipedia
   d) Library Catalogue/Library websites
   e) Databases
7. A citation for a journal article often includes: (Check the best answer that applies)
   a) Article title, author, journal title, year, volume, issue, page number
   b) Article title, author, journal title, publication place, year, volume, issue
   c) Article title, author, publication place, year, volume, issue, page number
   d) Title, author, year of publication, publication place, page number
8. How can you tell if you have a "good" source? (Check all answers that apply)
   a. You know the author is an expert on your topic
   b. The website is from a reputable publishing body
   c. The author is well versed on the topic
   d. The information is "current" and appropriate for your topic
9. What statements about services at our Library are correct? (Check all answers that apply)
   a) Academic Data Centre provides statistics and data help to students
   b) Students should pay for the interlibrary loan service if they want to borrow materials from another Ontarian university
   c) Students should pay for the service offered by the Writing Support Desk
   d) The Library provides reference help
   e) Students can book one-on-one research consultation with their subject librarian