

How Prepared Are We for ABET's New Outcome 7?

An Evaluation of Information Literacy of Students at The University of Tennessee at Chattanooga

Claire McCullough and Cecelia Wigal

The University of Tennessee at Chattanooga/ The University of Tennessee at Chattanooga

Abstract

ABET's new Outcome 7 requires that students have "an ability to acquire and apply new knowledge as needed, using appropriate learning strategies," substantially replacing the previous requirement of "a recognition of the need for, and an ability to engage in life-long learning." [1] While it can be argued that the new requirement better captures the essence of what "lifelong learning" was meant to capture, acquiring and applying new knowledge are not skills that engineering programs have been required to assess in the past, and are not explicitly taught in many engineering programs today. To evaluate the ability of engineering and computer science students at The University of Tennessee at Chattanooga to meet this criterion, the authors use a survey adapted from previous work [2] to assess various aspects of this skill set, including student preferences in searching for information, awareness of potential indicators of source reliability, ability to conduct effective and efficient searches of electronic data bases, proper citation of different types of references, and "fair use" and plagiarism issues. These questionnaires were administered to students at multiple class levels during fall semester 2018. Results are compared for students at various levels and are assessed to determine which elements of these skills need improvement to enable students to meet Outcome 7 successfully.

Keywords

Information Literacy, Engineering Education, ABET Assessment

Introduction

Information literacy may be defined as "the ability to determine the necessary information to perform a task, to select the most appropriate sources, to efficiently acquire data, to recognize potential biases and conflicts of interest in data sources, to utilize data correctly, and to properly reference all items." [2] This definition addresses multiple aspects of the new ABET EAC Criterion 7: acquiring information, determining validity of information (necessary before information is applied), and appropriate strategies for acquiring information. To judge the current state of readiness of students at The University of Tennessee at Chattanooga to meet this criterion, a survey was developed based on previous work, to determine ability of students to (1) obtain appropriate information sources efficiently, (2) assess the quality of the information acquired, and (3) cite information thus attained correctly, which is necessary for proper application. The questions assessed by the survey are

- Are our students proficient in finding appropriate information they need?
- Can our students properly judge whether information is reliable/credible?
- Are our students proficient in citing information properly?
- Are students' information literacy skills improving as they move through the engineering program?

The Survey

The survey, based on previous work [2], consisted of demographics questions, and questions concerning methods of searching for information, reliability of information sources, proper Boolean searches, keyword selection, and students' means of determining validity of sources.

The first questions on the survey were simple demographics: class level of the student and the student's major. No information regarding name, gender, age or other identifiers was collected. The remaining questions in the survey were divided into three major groups designed to assess multiple aspects of Information Literacy: finding information, evaluating information, and citing information.

The largest group of questions, fifteen in all, was dedicated to finding information. Some questions were related to student preferences; for example, the relative frequency of the student using library and electronic sources to search for information, and the student's view on the relative usefulness of sources, ranging from talking to a reference librarian, to Wikipedia. Students were also asked to rate their own skill in using both electronic and library sources to find information. The remaining queries in this section were questions with answers that could be judged as factually correct or incorrect. These items included questions on appropriate keywords for searches on engineering topics such as the reliability of nuclear plant operations in locations subject to earthquakes, and engineering design in light of environmental concerns and sustainable development. Another dimension of this section of the survey was choice of appropriate Boolean connectives to relate keywords in order to locate resources on topics such as datamining of social media or youtube viewing for targeted advertising, most efficiently. Students were also presented with examples of search statements and asked to determine whether they were too broad or too narrow for effective searches. In addition, students were given examples of keywords, and asked to select the search result most likely to be found using them. Finally, students were given examples of topics relevant to engineering fields, such as fundamental principles of tidal wetland restoration, and asked to select the most appropriate resources from a list of possibilities.

The second set of questions on the survey was related to the ability of students to judge whether or not information is reliable or credible. Although there were only four questions in this section, each had multiple parts—for example, for the question, “Which of the following would you regard as a reliable source to use to gather information for a technical paper in a senior engineering or computer science course?” students were asked to choose all appropriate sources from a list of eight possibilities, including newspapers, professional journals, and Wikipedia. Another asked students to choose, from a list of twelve possibilities, indicators that sources generated by an electronic search are reliable, including such information as website extension and author credentials. Students were also given a list of possible reasons to include information

in an engineering ethics assignment, from which they selected all that they regarded as valid reasons.

Lastly, students were asked to correctly identify what a “refereed source” means. The final set of ten questions in the survey related to proper citation of information. Students were asked to select different acceptable reference styles, identify the information represented in a journal citation, and tell what items are required in the proper citation of journals and books. Students had to determine which sources could be cited, from a list of nine possibilities, ranging from a journal article to something their professor said in class. Participants were also asked to choose which, from a set of examples, could constitute plagiarism. Finally, students identified appropriate uses of copyrighted materials, and were asked to rate, as true or false, the statement, “Documents in the public domain may be used by anyone, anywhere, anytime without permission, reference, license, or royalty payment.”

Results

The survey was administered electronically using Google Forms, and was conducted in a freshman level “Introduction to Engineering” class, a junior level “Computer Ethics” course and a computer engineering capstone course. Sixty-five students responded to the survey: 21 seniors, 21 juniors, 20 sophomores, and 3 freshman. Of these, 37 students are computer engineering majors, 24 are mechanical engineering majors, and the remaining four are industrial, civil, and electrical engineering majors. Responses have not been completely analyzed, and questions are far too numerous to discuss all here, but key results are discussed below.

Area 1: Can our students find information that they need?

Students appear confident in their ability to find information electronically; on a scale of 1 to 5, with 1 being poor and 5 being excellent, 80% rated themselves as 4 or 5 in skills at using electronic sources to find information, and no student rating him/herself lower than 3. However, when given a choice of keywords and Boolean connectives, only 43.1% were able to identify the most efficient search. In spite of this, students prefer to use electronic sources more than any other, as shown in Figure 1.

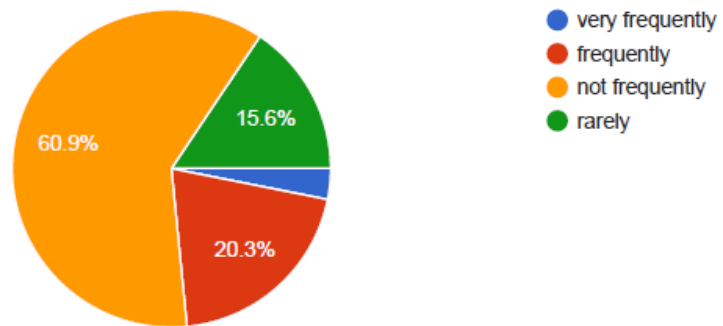


Figure 1: Student frequency of use of sources other than electronic sources

Students were much less confident in their ability to use library sources to find information, as shown in Figure 2.

Area 2: Can our students properly judge whether information is reliable/credible?

It appears that our students understand where to find reliable and credible sources. Students were asked to choose, from a list of possible sources, those most appropriate to support a technical paper. The two most cited as reliable sources were a professional journal (92.2% response) and a source from a result of a search using an engineering database (89.1% response). A source from a result of a Google Scholar search got a 71.9% response as a reliable source. The least cited as reliable sources were a source that includes advertisements, with a 3.1% response; and Wikipedia and a magazine with professional photographs, each at 7.8%.

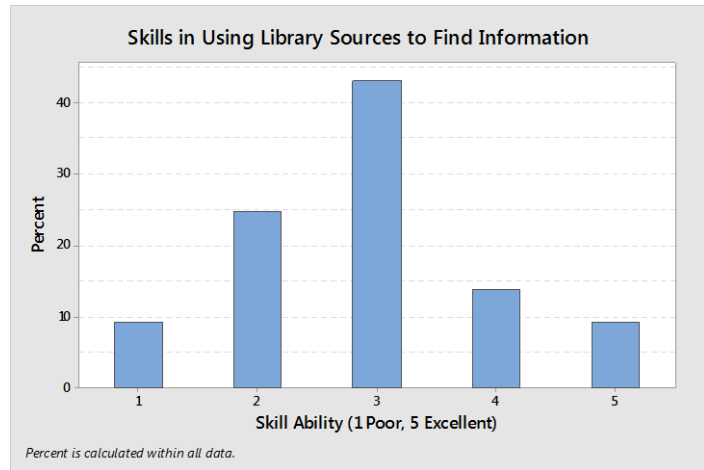


Figure 2: Student perception of ability to find library sources of information

Students appeared to recognize reliable electronic sources of information. When asked what indicates that a source generated by an electronic search is reliable, 87.5% of the students responded that a website with a .gov extension is reliable and 81.3% responded that a website associated with a professional journal is an appropriate source. Interestingly, however, 67.2% said that a source with a professor as an author indicates a reliable source. Also of concern is that, by a 71.9% response, the students believe a source with a .org extension indicates a reliable source, and that by a 42.2% response, that a source coming from a webpage with a professional presentation is reliable. The authors are encouraged that students do not believe sources from personal websites are reliable sources – this only received a response of 4.7%. It is interesting, however, that even though students recognize reliable sources, they did not indicate a clear understanding of what a refereed source is, as shown in Figure 3.

Finally, it appears that students want to use reliable sources and excellent references when writing a paper (85.9% and 81.3% response, respectively). However, they also desire to use a source that covers the topic well (76.6%), which may, at times, conflict with credibility.

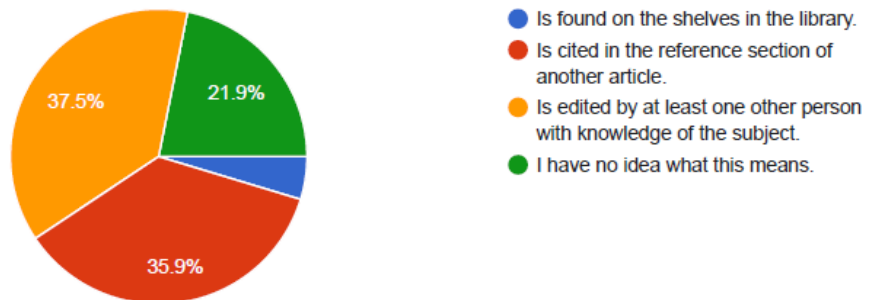


Figure 3: Student responses to "What is a refereed source"

Area 3: Proper Citations – Are our students proficient at citing information properly?

It appears that the understanding of citations, their structure and use, causes difficulty for the students. Of all 65 respondents, 30 agreed with a statement that documents in the public domain may be used by anyone, anywhere, anytime without permission, reference, license, or royalty payment, which is incorrect. This response did not vary significantly with academic year.

When asked to properly identify information from a journal citation, students had no difficulty in identifying the year of publication, but only 61.3% of the respondents correctly typed the complete title, and only 63.1% identified authors without error.

Another question asked which of the following could be considered plagiarism; students responded:

- Half a page or more, word for word, with a reference given. 60.9%
- Borrowing ideas from your roommate’s psychology paper for an ethics paper, given that he gave you permission to do it. 59.4%
- Using something the professor said in class, without a reference. 51.6%
- Re-using all or part of a paper you wrote for one class in another. 46.9%
- A small paragraph, word for word, with a reference given. 25.0%

Since the only answer that could not be considered plagiarism is the first, it appears that some additional coverage of this topic is necessary to the program.

Students were given a list of possibilities and asked which could be properly cited by giving a footnote or reference. Student responses were:

- A figure, graph, or picture. 68.8%
- A few words surrounded by quotes. 65.6%
- A paragraph surrounded by quotes. 51.6%
- A paragraph inset and single-spaced. 50.0%
- An idea put into your own words. 45.3%
- Something a professor said in class. 34.4%
- Something you heard on radio or television. 25.0%
- Something someone said to you in a conversation. 23.4%
- More than half a page surrounded by quotes. 21.9%

The answer with the lowest percentage, “more than half a page surrounded by quotes,” cannot be correctly cited, which most students got correct, but a paragraph surrounded by quotes is also not correctly cited, yet over 50% of students believed that it could be. In addition, students did not realize that items such as personal conversations can actually be cited, as can television or radio programs, and statements by professors.

When asked about what would *not* be allowable usage of copyrighted materials, students replied:

2019 ASEE Southeast Section Conference

- Making copies for sale in a college bookstore. 90.3%
- Making copies for free distribution to the public. 72.6%
- Reproducing the material for reporting in a news article. 48.4%
- Making copies of materials for a classroom assignment. 38.7%
- Reproducing the material for scholarly research. 35.5%

While students correctly identified the two most blatantly inappropriate uses (for sale and for free distribution), students seemed unclear about what other uses could be considered appropriate fair use, such as using copies in a classroom assignment.

Conclusions and Future Work

The purpose of the initial application of the survey was to evaluate the current state of abilities of students at The University of Tennessee at Chattanooga to meet the Information Literacy aspects of ABET's new Criterion 7. Although additional analysis needs to be done, for example, splitting results in each category by class level and evaluating all questions on the survey, the results presented make it clear that additional work is needed in all aspects of Information Literacy at The University of Tennessee at Chattanooga: finding information, evaluating information, and citing information. Discussions are on-going as to where in the curriculum this material could most reasonably be included.

The authors also plan to expand this survey to other universities in order to compare preparation in Information Literacy of students at The University of Tennessee at Chattanooga to those in other programs, as part of a search for best practices in education in the area of Information Literacy.

References

- 1 McCullough, C. L., "A Plan to Assess All the New ABET Outcomes Using Only Three Courses," presented at the American Society for Engineering Education Southeastern Section Conference, Daytona Beach, FL, March 2018.
- 2 McCullough, C. L., and Hoadley, P., "Information Literacy of Freshmen and Seniors at UTC and VMI," oral presentation, presented at the American Society of Engineering Education Southeastern Regional conference, Memphis, TN, April 2008.

Claire McCullough

Dr. McCullough received her bachelor's, master's, and Ph.D. degrees in electrical engineering from Vanderbilt, Georgia Institute of Technology and the University of Tennessee, respectively, and is a registered professional engineer in the state of Alabama. She is currently a Professor of Computer Science and Engineering at the University of Tennessee in Chattanooga, and teaches courses in such areas as Computer Ethics, Controls, and Engineering Design. Dr. McCullough has over 30 years' experience in engineering practice and education, including industrial experience at the Tennessee Valley Authority and the US Army Space and Missile Defense Command. Research interests include Data Fusion, Target Recognition, and Bioinformatics.

Cecelia Wigal

Dr. Wigal is a Professor in the College of Engineering and Computer Science at the University of Tennessee at Chattanooga. She received her Ph.D. from Northwestern University (1998), MSEE from Illinois Institute of Technology (1991), and BSEE from Ohio Northern University (1985). Dr. Wigal teaches freshmen and upper level interdisciplinary design courses and upper level industrial engineering courses. Her primary engagement activity is improving the lives of those with physical and mental disabilities. Her primary areas of research include complex system analysis and quality process analysis with respect to nontraditional applications such as service systems. Dr. Wigal is also interested in engineering education reform to address present and future student and national and international needs.