Integrating Information Literacy in the Engineering Curriculum: A Program Approach

Nasser Saleh
Queen's University
nasser.saleh@queensu.ca

Abstract – The paper summarizes a program-based model that has been developed at Queen's University to integrate an information literacy program into the undergraduate engineering program to meet CEAB graduate attributes in professional and design course. A program-level approach to information literacy is useful to define the purpose and goals of information literacy outcomes and also to capture evidence of student learning. It also informs instructional methods that can be developed in class or through the use of embedded learning modules at the course management system in addition to hands-on library workshops.

Keywords: Information literacy, lifelong learning, engineering libraries, learning outcomes.

1. INTRODUCTION

Information literacy is a set of abilities requiring individuals to “recognize when information is needed and have the ability to locate, evaluate, use effectively the needed information, and to engage in lifelong learning” [1]. Information literacy also is increasingly important in the contemporary environment of rapid technological change and proliferating information. Engineering librarians conventionally use the Association of College and Research Libraries (ACRL) Information Literacy Competency Standards for Higher Education as a framework for understanding, implementing and assessing information literacy in engineering programs as each standard can be envisaged as a set of capacities.

These skills have been always recognized to be essential for students to develop as a part of their learning experiences in undergraduate courses particularly in professional programs such as Engineering. Although CEAB graduate criteria [2] do not explicitly include information literacy as a graduate attribute, it is argued that information literacy is an important and essential element of the CEAB accreditation graduate attributes and outcomes particularly lifelong learning.

Information literacy forms the basis for lifelong learning. It enables learners to master content and extend

their investigations, become more self-directed, and assume greater control over their own learning.

In practice, engineering librarians have been looking for different approaches for what has been traditionally described as “library instruction” or “bibliographic search instruction” to new models that engage students more with information literacy skills rather than conceptualizing information literacy as a linear and discrete set of attributes, it is increasingly understood as critical thinking process which is iterative and profoundly linked to the acquisition and practice of discipline knowledge.

2. INFORMATION LITERACY PROGRAM FRAMEWORK

In order to develop a plan for information literacy within the engineering program, it was found essential to define the strategic priority area to engage instructors with the value of this approach that focuses on enabling students to develop information-related competencies that transcend specific finding tools, “to recognize the societal and disciplinary contacts of information, to think critically about the information they find and to let the information to transform their knowledge” [3].

Within the last years at Queen's University, there have been different approaches to develop such a program within the engineering curriculum that resulted in defining the following elements to develop an information literacy program based on the following dimensions:

1. Information literacy: information literacy skillsets are holistically a part of students' academic literacies that also include technological, visual, and numerical literacies and can be achieved in curricular contexts through clear and strategic collaboration between the library and the faculty in order to foster lifelong learning and developing students' critical skills.

2. Curriculum integration: the program is built on progress achieved in integrating information literacy competencies in inquiry-based courses particularly the design courses and to develop range of models that are relevant to different disciplinary contexts.

3. Assessment: the program needs to address possible assessment techniques to measure students' learning

experiences and how information literacy competencies are developed and transferred within the program. This includes the identification and implementation tools to gather evidence about the impact of developing information literacy skills on the academic literacies of students.

4- Continuous program improvement plan: The program components need to be reviewed on an ongoing basis by using evidence from assessment process and based on the available resources to improve the program further.

3. INFORMATION LITERACY PROGRAM OUTCOMES

It is found that a holistic approach of developing information literacy skills being a part of other academic competencies is essential to create partnership between librarians and faculty members by understanding that these skills are intertwined rather than separate sets of skills. These skills are parts of students' learning and should be approached and characterized as holistic, recursive, and non-linear.

Meanwhile, it is essential for librarians who contribute to this program to have clear learning outcomes expected to be achieved through the program and in different levels depending on the contextual characteristics of each course. At this stage, librarians have developed the following learning outcomes based on ACRL standards that at the end of the program that every student have the competencies to:

1. Define and articulate the need for information:
 - 1.1. Identify information need resulting from the assigned project.
 - 1.2. Construct key concepts and terms that describe the information need
 - 1.3. Explore general information sources to increase familiarity with current knowledge of the project topic.
 - 1.4. Identify a variety of types and formats of potential sources for information.
2. Develop a working knowledge of the literature of the *field* and how it is produced.
 - 2.1. Discuss information sources that are specific to the field, e.g. manuals, handbooks, patents, standards, material/equipment specifications, current rules and regulations, reference material routinely used in industry, manuals of industrial processes and practices, and product literature.
 - 2.2. Recognize that knowledge can be organized into disciplines and combinations of disciplines (multidisciplinary) that influence the way information is accessed and considers the possibility that the literature of other disciplines may be relevant to the information need.

3. Differentiate on how technical and related information is formally and informally produced, organized, and disseminated and develops skills in acquiring needed information effectively and efficiently
4. Demonstrate knowledge of the professional associations of the field and their literature and integrates applicable standards and codes.
5. Critique the found/selected information sources
 - 5.1. Evaluate information sources based on its originality, currency, and credibility
 - 5.2. Assess if the found information can be used for the learning task/project.
6. Demonstrate an understanding of intellectual property, copyright, and fair use of copyright materials and how to use the found information effectively and efficiently.
7. Practice these skills and understands that these skills are parts of an ongoing process and important components of lifelong learning.

These goals and outcomes were needed to be aligned with the goals and outcomes of individual academic programs and courses and the overall program outcomes based on applicable CEAB accreditation standards. It is also essential to differentiate the level of each learning outcome that is needed to develop a particular indicator within each year of the program as shown in Table 1 as an example of identification of information sources types.

Table 1: Types of information sources

Year	Learning Outcome
First Year	Identifies appropriate information sources to meet the information need using a prescribed methodology from prescribed sources (e.g. Library Catalogue and a multidisciplinary database)
Second Year	Differentiates types of publications from scholarly, popular, to professional periodicals through their content and audience, demonstrating skills in how to access them.
Third Year	Uses appropriate search methods to access a variety of information sources applicable to the discipline (standards, codes, regulations, patents, manuals, academic literature, technical reports, etc.)
Fourth Year	Identifies and accesses a variety of information sources applicable to the discipline using self-selected sources with self-structured guidelines

4. INFORMATION LITERACY CURRICULUM MAP

A curriculum map of information literacy has been needed to be developed in order to identify the key courses where information literacy teaching are essential and also to clarify that these skills are needed to be introduced, reinforced, then mastered by students as transferrable lifelong learning skills. The focus has been on faculty-wide courses in order to reach all of enrolled students in engineering programs. For example, the first year engineering course APSC100 is required course for all incoming engineering students at Queen's. The course is delivered through three modules in both of the fall and winter terms. In the second year, students have APSC200 as a faculty-wide course in the first six weeks and then as a departmental-based in the following weeks.

An information literacy map can be a detailed description of expected learning outcomes and indicators, methods of teaching, assessment methods, and evaluation tools. Information literacy maps help us in identification on when and how information literacy skills are developed so liaison librarians can build constructively on students' experiences in different courses.

A partial information literacy map as shown in Table 2 describes how some information learning outcomes were mapped into selected design and professional courses.

Table 2: Example of an information literacy map

Information Literacy Learning Outcomes I=Introduce R=Reinforce M=Master Students will be able to:	APSC100 Module 1	APSC100 Module 3	APSC200	Third Year	Senior Capstone
identify keywords that represent a topic	I	R	R	M	M
identify databases relevant to their discipline	I	I R	R	M	M
distinguish popular from scholarly sources	I	I	R	M	M
evaluate information sources based on originality, currency, and credibility	I	I R	R	M	M
cite resources according to standards citation styles	I	I R	R	M	M

A curriculum map is an essential tool in designing a program for integrating information literacy into a particular program and also to identify the most convenient and successful tools for instruction.

5. INFORMATION LITERACY LEARNING MODULES

It has been a major challenge to arrange library workshops for incoming first year course students and it was decided to provide information literacy instruction through embedded learning modules in the course management system. The context of each learning module is related to the course structure and what students need to learn at that particular stage of their course. The learning modules are part of the course assignment and students have to deliver at certain time.

The first learning module is introduced to students in Week 7 of the fall term and its main objective to familiarize students with the concept of evaluating web based resources and how to critique what can be found on the Internet. This module is extended to the following four modules in the winter term when students are assigned to their design projects. The learning modules are designed to meet particular learning objectives as described in Table 3.

Table 3: Information Literacy Online Modules in APSC100

Module #	Module Main Objectives
101	Understand how web-based search engines work and how to evaluate websites.
102	Define the problem of the design project to provide focus, identify key concepts for project. Identify the needed information types and the possible information sources.
103	Search for the information sources where to obtain these types of information. Revise search strategy, assess search results for quantity, quality and relevance
104	Understand citation styles and why appropriate referencing is needed. Manage and use information properly in IEEE citation style

The learning modules in first year course have been used as a foundation for the following years' modules. Currently, there are two learning modules designed for APSC200 that refer to these four modules and provide more details on the nature of engineering information sources and how to access them.

5. DISCUSSION

A program approach to information literacy was found useful for both librarians and faculty to target core courses within the program in order to map expected skills and how to develop them during the program of study.

The use of online modules was perceived to be a useful tool for students through their feedback and through the usage of these modules in the course management system. The number of access logs show that many students have accessed these modules more than one time during the course. It was important to analyze the necessary resources for this program because resources were limited at the library and there was a need to prioritize delivery options.

Assessment of the information literacy skills development remains a challenge for librarians as assessment remains the responsibility of the course instructor but librarians try to complement the development of grading rubrics to reflect the expected learning outcomes according to ACRL standards as a baseline assessment tool.

6. CONCLUSION

A program approach for information literacy is a successful result of librarians/faculty collaboration that sees librarians' involvement in students' learning experience important with a very real impact on the teaching and learning through the engineering program. The inclusion of the librarian as a member of the engineering curriculum review committee has been useful for the library to identify key components of the engineering programs to guide librarians to best practices and to demonstrate their impact as well.

Meanwhile, librarians will need to develop information literacy assessment plans designed for the program level and also outcome-level components that summarize the purpose of information literacy assessment, articulate specific goals and outcomes in order to capture evidence of student learning [4].

A program level approach can provide a model for future information literacy assessment plans. It can also enable librarians to demonstrate, document, and increase the impact of information literacy instruction on student learning and development.

Although the presented program approach seeks to integrate information literacy skills into the curriculum of the engineering program recommended a tiered approach to curriculum-integrated instruction; this tiered approaches suggest teaching basic skills to first and second year students and then advanced skills to third and fourth year students. This is mainly based on anecdote and common sense [5]. While both anecdote and common sense are useful as starting points, it is important to be aware that developing and improving an information literacy program should use evidence to make future decisions. The existing recommendation regarding a tiered approach will be investigated further and revised.

References

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