

## **An Integrated Approach to Information Literacy Instruction in Civil Engineering**

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It is critical to graduate students that are information literate. Possessing the suite of skills associated with information literacy will enable our students to embark upon the path of life-long learning. To ensure that information literacy skills were adequately imparted to students in the Civil and Environmental Engineering department and to quantify the extent to which the students attain these skills, information literacy modules were introduced into the civil and environmental engineering curriculum at Villanova University. These modules, which were first introduced in 2005 and are integrated throughout the curriculum, were developed by faculty in the Civil and Environmental Engineering Department with librarians from Falvey Library at Villanova University. Prior research has shown that information literacy instruction is most successful when it is associated with an assignment within a course as opposed to a stand-alone subject. Since the initial development of these modules, there have been several changes to the curriculum and the faculty teaching the courses. The attainment of the educational outcomes, which were based on Association of College and Research Libraries (ACRL) outcomes, has been well assessed in the first course in the sequence; now this assessment will be extended to all five courses in which information literacy instruction occurs. The information literacy program was the subject of a paper presented at the 2005 Annual ASEE conference. This paper will provide an update on the educational modules and outcomes and the assessment tools.

### Introduction

The amount of information available to our students is overwhelming to them and is increasing every day. Consequently, the challenge of research is no longer finding information; it is knowing how to find, organize, and evaluate the vast array of information that is the challenge. The Association of College and Research Libraries (ACRL)<sup>1</sup> defines an information literate person as someone who can:

- Determine the extent of information needed
- Access the needed information effectively and efficiently
- Evaluate information and its sources critically
- Incorporate selected information into one's knowledge base
- Use information effectively to accomplish a specific purpose
- Understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally

These outcomes, in essence, describe someone that has learned how to learn<sup>2</sup>. The successful attainment of these skills enables a student to excel at their course work and throughout their lives. Because these skills are fundamentally important to our students' development, a several course information literacy sequence was developed and implemented within the civil engineering curriculum at Villanova University. Faculty from the Civil and Environmental

Engineering Department developed these modules in a cooperative effort with librarians from Falvey Library.

### Relationship to ABET Criterion 3 and ASCE Body of Knowledge

Information literacy is related to two of the outcomes in ABET criterion 3<sup>3</sup> as well as two of the outcomes described in American Society of Civil Engineers' (ASCE) Body of Knowledge<sup>4</sup>:

- an ability to communicate effectively (ABET g, BOK 16) and
- a recognition of the need for, and an ability to engage in life-long learning (ABET i, BOK 23).

### Outcomes by year

To guide our instruction, 26 outcomes, which were based on those developed by ACRL<sup>1</sup>, were created for each year of study within our curriculum.

By the end of the sophomore year, the students should be able to:

1. explore general information sources to increase familiarity with a topic
2. identify key concepts and terms that describe the information need
3. define a realistic overall plan and timeline to acquire the needed information
4. read text, select main ideas, and restate textual concepts in their own words
5. identify verbatim material that can then be appropriately quoted
6. evaluate a website for authority, reliability, credibility, purpose, viewpoint, and suitability
7. reflect on past successes, failures, and alternative strategies by maintaining a log of information seeking and evaluating activities
8. communicate clearly and with a style that supports the purposes of the intended audience
9. demonstrate an understanding of intellectual property, copyright, and fair use of copyrighted material
10. select an appropriate documentation style and use it consistently to cite sources
11. confer with instructors and participate in class discussions to identify a research topic, or other information needed
12. define or modify the information need to achieve a manageable focus
13. know how information is formally and informally produced, organized, and disseminated
14. determine the availability of needed information and make decisions on broadening the information seeking process beyond local resources
15. select controlled vocabulary specific to the discipline or information retrieval source
16. construct and implement a search strategy using appropriate commands for the various information retrieval system selected
17. integrate new and prior information in a manner that supports the purposes of the product
18. develop a thesis statement and formulate questions based on the information needed

By the end of the junior year, the students should be able to:

19. select efficient and effective approaches for accessing the information needed
20. assess the quantity, quality, and relevance of the search results to determine if additional information is required or if the search strategy should be revised
21. create a system for organizing the information

By the end of the senior year, the students should be able to:

22. recognize that existing information can be combined with original thought, experimentation, and/or analysis to produce new information
23. identify the purpose, audience, value, and differences of potential resources in a variety of formats
24. examine and compare information from various sources to evaluate reliability, validity, accuracy, authority, timeliness, and point-of-view bias
25. extend initial synthesis, when possible, at a higher level of abstraction to construct new hypotheses that may require additional information
26. draw conclusions based upon information gathered

#### Placement within the curriculum

Students are most receptive to information literacy instruction when it is needed for an existing assignment.<sup>1,5-9</sup> Consequently, we have placed information literacy modules into classes with relevant assignments throughout the three years the students are within our department (Villanova has a common freshman year in engineering).

Information literacy modules were developed for five courses that span sophomore to senior year (Table 1) and there is at least one information literacy related assignment each year. The sophomore and junior classes are required of all civil engineers while the senior-level classes are electives. The most intensive information literacy component is in Geology for Engineers (GLY 2805).<sup>9,10</sup> This is reflected in the outcomes (i.e. 18 of the 26 outcomes should be satisfied by the end of sophomore year).

**Table 1.** Courses with Information Literacy Modules

Year	Course	Assignment	Semester
Sophomore	Geology for Engineers (GLY 2805)	Term paper on issue or issues dealing with geology, environmental geology, or engineering geology	Fall
Junior	Soil Mechanics Laboratory (CEE 3901)	Case study of a civil engineering failure	Spring
Senior	Foundation Design (CEE 4801)	Evaluation of the resources available on a geotechnical engineering project	Fall
	Solid and Hazardous Waste (CEE 4331)	Term paper on a contemporary solid/hazardous waste issue	Fall
	Advanced Transportation Engineering (also open to juniors) (CEE 3235)	Design solution for a highway focusing on highway safety	Fall

#### Activities and outcomes for each course

The instruction and assignments for each course are directly related to the outcomes. In-class information literacy instruction by the science and engineering librarian is provided in three of the five courses. Tables 2 through 6 summarize the activities, assessed outcomes, and deliverables associated with the modules.

**Table 2. Summary of GLY 2805 Activities and Outcomes**

<b>Week</b>	<b>Where</b>	<b>Activities</b>	<b>Outcome Assessed</b>	<b>Deliverable</b>
1	In class	The student will receive the term paper assignment with an explanation of the assignment from the instructor. The instructor describes the documentation style used by ASCE and provides an example page. The instructor will also tell them that they need to document their research activities using RefWorks.	10, 11	Student selects topic
2	In/out of class	The student is provided with evaluation criteria for websites (approximately 10 minutes of class, presented by library personnel). Each student explores sources that are available to the general public (i.e. Web sources). Student records search progress using RefWorks.	1, 2, 3, 6, 7, 18	Student completes worksheet evaluating a website, develops preliminary list of key words used to describe the topic, and submits a plan/timeline to perform the required research
3	In library	Student creates Boolean search statement. Student uses appropriate databases. Student obtains sources from the library and inter-library loan. Student records search progress using RefWorks.	4, 10, 12, 13, 14, 15, 16	Student records proper citation of selected articles. Student evaluates and summarizes a selected article. Student describes differences between Google and subject-specific database.
5	Out of class	Student continues performing research on selected topic and recording progress in RefWorks	10, 17	Student submits outline, reference list, and introduction
12	Out of class	Student continues performing research on selected topic and recording progress in RefWorks	4, 5, 8, 9, 10, 17	Student submits term paper
13	Out of class	Student summarizes how they performed their research, what was successful and unsuccessful and what they would do differently next time	7	Student submits search journal with summary sheet
14	Out of class	Student reads and critiques another student's term paper following a set of evaluation criteria	4, 5, 8, 10, 17	Student submits critique
15	In/out of class	Student answers quiz questions on WebCT	6, 12, 13, 14, 15, 16	Student submits information literacy assessment

**Table 3. Summary of CEE 3901 Activities and Outcomes**

Week	Where	Activities	Outcome Assessed	Deliverable
4	In class	The student will receive the case study assignment with an explanation of the assignment from the instructor. The instructor describes the documentation style used by ASCE and provides an example page. The instructor will also tell them that they need to maintain a journal of their research activities.		Student selects topic
9	In/out of class	Student continues performing research on selected topic and making entries in journal	9, 10, 19, 20, 21	Student submits case study

**Table 4. Summary of CEE 4801 Activities and Outcomes**

Week	Where	Activities	Outcome Assessed	Deliverable
4	In class	The student will receive the evaluation of resources assignment with an explanation of the assignment from the instructor. The instructor describes the documentation style used by ASCE and provides an example page.		
7	Out of class	Student continues performing research on selected topic	9, 10, 13, 23, 24	Student submits assignment

**Table 5. Summary of CEE 4331 Activities and Outcomes**

Week	Where	Activities	Outcome Assessed	Deliverable
2-3	In class	Project is introduced. Students are instructed on how to use RefWorks and relevant databases		Student selects preliminary topic
4	Out of class	Student continues performing research on selected topic and continues to documents their research using RefWorks		Student selects final topic
6	Out of class	Student continues performing research on selected topic and continues to documents their research using RefWorks	4, 8, 9, 10, 17, 22, 25, 26	Student submits final research paper

**Table 6. Summary of CEE 3235 Activities and Outcomes**

Week	Where	Activities	Outcome Assessed	Deliverable
2	In class	Project is introduced. Students are instructed on how to use RefWorks		Student selects topic
3	In/out of class	Students are introduced to TRIS/TRB/catalog	13, 19	Student submits information literacy pre-assessment
4	In/out of class	Students are introduced to various resources: CRCnetBASE/FHWA/state specifications		
8	Out of class	Student continues performing research on selected topic and continues to documents their research using RefWorks	16, 19, 21	Student submits draft list of sources using RefWorks
9	In class	Students are (re)introduced to Compendex and provided with specialized help on their topics		
11	Out of class	Student continues performing research on selected topic and continues to documents their research using RefWorks	14, 19	Student completes resource evaluation survey
13	Out of class	Student continues performing research on selected topic and continues to documents their research using RefWorks	4, 8, 9, 10, 17, 22, 25, 26	Student submits design report
13	Out of class	Student continues performing research on selected topic and continues to documents their research using RefWorks	19, 20, 21	Student submits RefWorks bibliography with annotations
14	Out of class	Student answers quiz questions on WebCT	13, 14, 16, 22, 19	Student submits information literacy assessment

### Assessment

The achievement of the outcomes is assessed several ways: analysis of student assignments, quizzes, and to a much lesser extent, surveys. The analysis of student assignments is the most commonly used assessment tool that we use. Rubrics have been developed to assess the final papers that are required in the five classes. One example, from the assignment in Foundation Design (CEE 4801) is provided in Table 7. This rubric is used to grade the assignment and to assess outcomes 9, 10, 13, 23, and 24.

The information literacy modules were designed to reinforce previous topics while introducing more complex topics. This methodology is reflected in our assessment process: foundational outcomes are assessed repeatedly while the higher level outcomes may only be assessed in one course. For example, outcomes 9 and 10 are assessed in each of the five classes while outcomes 23 and 24 are only assessed in one class.

The information literacy modules in the five classes were developed at different times and have been assessed to varying degrees over the past few years. As the process matures it is hoped that the students achieve more success on the foundational outcomes with repeated exposure to the topics. Determining if this is the case is one of the goals of the assessment process. The information literacy module in Geology for Engineers (GLY 2805) is the oldest and most rigorously assessed<sup>9, 10</sup>. The next modules developed were for Foundation Design (CEE 4801), Soil Mechanics Laboratory (CEE 3901), and Solid and Hazardous Waste (CEE 4331). The

module for Advanced Transportation Engineering (CEE 3525) is the most recently developed. Although the information literacy modules for Foundation Design, Soil Mechanics Laboratory, and Solid and Hazardous Waste have been in existence for several years, to date they have not been rigorously assessed. Rubrics to assess the students' attainment of the outcomes associated with those classes were just recently developed and will be implemented this coming semester.

**Table 7.** Assessment and Grading Rubric for CEE 4801 assignment

Item assessed/points allocated	Outcome assessed			
ASCE documentation style followed consistently and correctly for in-text citations  3	ASCE documentation style followed consistently and correctly for in-text citations with few errors  2	ASCE documentation style not followed consistently or applied incorrectly for in-text citations; many errors  1	No apparent documentation style followed for in-text citations  0	10
ASCE documentation style followed consistently and correctly in bibliography  4	ASCE documentation style followed consistently and correctly in bibliography with few errors 3 2	ASCE documentation style not followed consistently or applied incorrectly in bibliography 1	No apparent documentation style followed in bibliography  0	10
Student found all required sources: 1. available to the general public 2. web site 3. peer-reviewed article 4. conference or trade publication 5	Student did not find all required sources – but has a peer-reviewed article  3	Student did not find all required sources - missing a peer-reviewed article  0	13	
Concepts found in sources restated in student's own words; direct quotations used effectively and integrated into text where appropriate  5	Adequate restating of concepts in student's own words; adequate use – without overuse--of direct quotations  4 3 2	Quotations often too lengthy or inadequately integrated into text of paper 1	9	
Student effectively compares the four sources considering: 1. Intended audience 2. Contradictions amongst sources 3. Communication style 4. Quality of information 5. Trustworthiness/reliability/accuracy 6. Any biases of the authors 6	Adequate comparison, but student does not consider all required aspects  5 4 3 2	Student does not compare sources  0	23, 24	
Student thoughtfully considers the larger, societal impacts of the project  2	Student provides a cursory description of the larger, societal impacts of the project  1	Student does not discuss the larger, societal impacts of the project 0	N/A	

## Conclusions

A five-class information literacy program was developed and implemented within the Civil and Environmental Engineering Department of Villanova University. The information literacy modules were developed such that the students received at least one assignment each year, the instruction was relevant to their coursework, and the assignments were progressive in nature. A rigorous assessment plan has been developed to determine if the students are achieving the 26 outcomes associated with information literacy. It is expected that the assessment process will reveal that reinforcement of previous topics, while introducing new, more complex topics, improves the attainment of those topics.

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